Klohn Crippen Berger

Yukon Government

Faro Mine Complex

2013 Annual Geotechnical Review

August 2014
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CANADA'S BEST MANAGED COMPANIES

Klohn Crippen Berger

August 20, 2014

Yukon Government
Faro Mine Remediation Project
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Karen Furlong, EIT
Project Manager

Dear Ms. Furlong:

Faro Mine Complex
2013 Annual Geotechnical Review

We are pleased to submit the report on Faro Mine Complex - 2013 Annual Geotechnical Review, including Appendix I on 2013 Site Visit Photos, Appendix II on reviewed site monitoring data and Appendix III on instrumentation status and monitoring schedule. The current review covers the geotechnical and hydrotechnical aspects of the water management and waste storage facilities at the Faro Mine Complex, including those at both the Faro and Vangorda Plateau sites. The review is based on site observations by Robert Lo on June 4 to 6, 2013 and by Arvind Dalpatram and Robert Lo on September 10 to 12, 2013 and ongoing review of monitoring data collected by Tlicho Engineering and Environmental Services (TEES).

The critical issues at Faro in 2013 include: suspension of water treatment at the Faro site due to safety concern in the treatment plant, rise of pit lake level approaching or above the overburden/bedrock contact at the Faro and Grum Pits, development of slope slumps on the hillside of Rose Creek Diversion Channel, ongoing pit wall deformation in the East Instability Zone at the Grum Pit and excess spring runoff at the Grum Waste Dump. Measures taken in 2013 to deal with these issues are discussed in the report. These issues will be followed closely in 2014 in order to reduce their impact on the normal site care and maintenance activities.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Robert C. Lo

Robert C. Lo, P.Eng.
Project Manager

RCL:dl

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CANADA'S BEST MANAGED COMPANIES

Yukon Government

Faro Mine Complex

2013 Annual Geotechnical Review

EXECUTIVE SUMMARY

Notice: The Executive Summary is provided solely for purposes of overview. Any party who relies on this report must read the full report. The Executive Summary omits a number of details, any one of which could be crucial to the proper application of this report.

This report assesses the geotechnical and hydrotechnical performance of the water management and waste storage facilities at the Faro Mine Complex, including those at both the Faro and Vangorda Plateau sites. The review is based on our site observations by Robert Lo on June 4 to 6, 2013 and by Arvind Dalpatram and Robert Lo on September 10 to 12, 2013, and ongoing review of monitoring data collected by Tlicho Engineering and Environmental Services (TEES).

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 TEES 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. More detailed recommendations are summarized in Table 4.1. These recommendations deal with ongoing maintenance issues. They could be implemented by the Government of Yukon according to its priority and operational budget, as guided by its long-term closure objectives.

Representative 2013 site visit photographs are included in Appendix I, and the reviewed TEES monitoring data are organized in Appendix II. Appendix III summarizes the status of site instrumentation and reviews the current geotechnical/hydrotechnical monitoring schedule established by BGC (2010) and proposes some adjustment based on our interpretation of instrumentation data collected to date.

The following highlights some of the current and general issues for the site facilities at Faro Mine Complex:

Dam Safety Aspect

- According to the Canadian Dam Safety Guidelines (CDA 2007), both the Intermediate Dam and Cross Valley Dam will be due for their third dam safety review in 2014 because of their classification as “high” consequence dams. Moreover, a dam breach and inundation study completed by KCB (2014a) confirmed the “high” consequence classification of the Intermediate Dam and Cross Valley Dam, and raised the Little Creek Dam classification from “low” to “significant” or “high” pending on a more refined future inundation study.
- The Operations, Maintenance and Surveillance (OMS) Manual and Emergency Response Plan (ERP) for the Intermediate, Cross Valley and Little Creek Dams were updated as a joint effort by the Government of Yukon (YG), Tlicho Engineering and Environmental Services (TEES) and Klohn Crippen Berger (KCB), and issued in 2014 (KCB 2014b and 2014c). The ERP documents also include three diversion channels: Faro Creek Diversion Channel, Rose Creek Diversion Channel and Vangorda Creek Diversion Flume.

- We understand that a dam safety review will be arranged by Yukon Government in 2014 covering the Intermediate, Cross Valley and Little Creek Dams. Maintenance issues covered in Table 4.1 should be adequately addressed prior to the dam-safety site visit, and all relevant documents should be ready for the safety review.

Water Treatment Aspect

- In 2013, water treatment operation at the Faro site was suspended due to safety issue in the water treatment plant. To cope with this temporary situation, a rental filtration plant was set up at the north abutment of the Cross Valley Dam in the summer to treat and release water from the Polishing Pond via North Valley Interceptor Ditch, when water quality is in compliance with discharge criteria. In addition, excess water in the Intermediate Pond was pumped back to the Faro Pit.
- A pump barge has been set up at the Grum Pit starting in 2013 to transfer water from the Grum Pit Lake to Vangorda Pit Lake, and, in turn, water was transferred to the Vangorda Water Treatment Plant for treatment.
- In 2013 the pit lake level has risen approaching the overburden/bedrock contact at the Faro Pit and above the contact at Grum Pit with potential increase of seepage out of the pit lakes. The ongoing rise of pit lake level in the overburden zone could undermine local pit wall stability as well as increase groundwater degradation in the pit rim region.

Spring Freshet Aspect

- Excess inflow into Moose Pond occurred during 2013 spring freshet due to release of surface runoff from the Grum Waste Rock Dump. Measures were taken to drain some of this runoff directly to Vangorda Pit Lake by gravity and to improve retention dykes around surface water storage areas on the berms of the waste rock dump.

Pit Wall Stability Aspect

- Golder (2013) conducted a pit wall slope stability inspection and review at the Faro, Grum and Vangorda Pits on September 12 to 14, 2012, following similar periodical inspections since 2002: for Faro Pit from 2002 to 2010 and for Grum Pit in 2009. These reviews provided an in-depth assessment of pit-wall stability and gave recommendations for care and maintenance of infrastructure near these pits.
- Following Golder's recommendation, CH2MHILL (2013a) established 14 locations of survey prisms for ongoing monitoring of Grum Pit wall and rim movement. YES (2013b) installed and surveyed the initial 4 prisms, MP005 to MP008, in September 2013 and provided installation details for additional prisms for TEES to complete the installation work in 2014 (see Figure 11). We note that 7 of these potential prisms are located below the pit brim with associated risk to installation personnel. YG may wish to avoid this risk by adopting an alternative technique.
- The 2013 pit-wall rim movement monitoring programs at the Faro and Grum Pits indicate that the measured distance changes are within the measurement accuracy. At the Grum Pit, cracks that developed in the summer of 2012 at Reference Rod GP-N2 in the north array continued

to grow in width and depth in 2013. Safety precautions related to site personnel working in the area were highlighted to prevent accidents.

Facility Maintenance Aspect

- The hillside channel slope of the Rose Creek Diversion Channel experienced longitudinal cracks and slumps for a distance of about 30 m above and near mid-height (see Photos 21 to 24). Permit and/or means to access and check these slopes closely during ice/snow free season need to be confirmed so that these slopes can be examined and assessed adequately in 2014 in order to determine what appropriate measures may be required to preserve the ongoing function of this important diversion channel. In addition, thermistors and inclinometers reading along the Back Slope of the diversion channel should resume starting from 2014.
- A small washout of the Rose Creek Canal Dyke south shoulder near the Cross Valley Dam south abutment was observed during our fall inspection (see Photo 27).
- At the North Valley Wall Interceptor Ditch, sediments have been accumulated at the inlet and outlet of culverts and inside the culverts under the well-access road (see Photos 12 and 13). These sediments need to be removed to prevent blockage of culverts prior to the next spring freshet. The channel bottom at the culvert inlet and outlet could be slightly over-excavated to create a sediment trap and to minimize sediment deposition inside the culverts.
- The existing maximum recommended lake level has been exceeded at both the Faro and Grum Pit in 2013 (see Appendix II-A.1 and II-J.1). In the current period of high lake levels, an interim targeted maximum lake level appears to be set at the contact level of overburden and bedrock at the two pits (in a range of El. 1150 to El. 1160 m at the Faro Pit and at El. 1216 m at the Grum pit). The rationale appears to be for limiting outward seepage from the respective pit, as the permeability of overburden material is significantly higher than that of the bedrock.

  At the end of December 2013, pit lake levels at Faro and Grum Pits were either approaching or above the contact level between overburden and bedrock: 1.9 m below the lowest contact for Faro and 0.1 m above the contact for Grum. Potential increase of seepage from these two pit lakes and their ramifications in terms of local pit wall instability at the toe and increasing groundwater degradation in the pit rim needs close attention, as the pit lake levels continue to rise in 2014.
- The exfiltration function of the Moose Pond bottom in 2013 has probably been further impeded by silt sedimentation during 2013 spring freshet due to excess inflow from Grum Waste Dump. Exfiltration through the pond bank slope likely plays a more important role. Ongoing monitoring of the exfiltration groundwater flow regime and downstream slope of the esker ridge around the pond are needed to follow the natural recovery process in the area. Careful removal of excess silt sediment using a small backhoe from the pond bottom could be attempted to recover its exfiltration capacity, if the pond becomes dry during late summer.

- Flash floods in 2004 and 2012 overflowed the Vangorda Flume (i.e., CSP half pipe). The flood flow was barely contained by the channel slopes above the flume without spilling into the Vangorda Pit. The CSP lining has holes or is torn at several locations, and many of the cross braces are bent. We understand that the installation of a replacement flume and/or channel along a different route is being studied. The replacement structure should be installed as early as practical.

In general, the key water and waste management facilities at both the Faro and Vangorda Plateau sites have functioned satisfactorily in 2013 as in the past. The care and maintenance activities, including instrument monitoring and survey measurement, also followed the planned schedules.

CLARIFICATIONS REGARDING THIS 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.

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1 INTRODUCTION

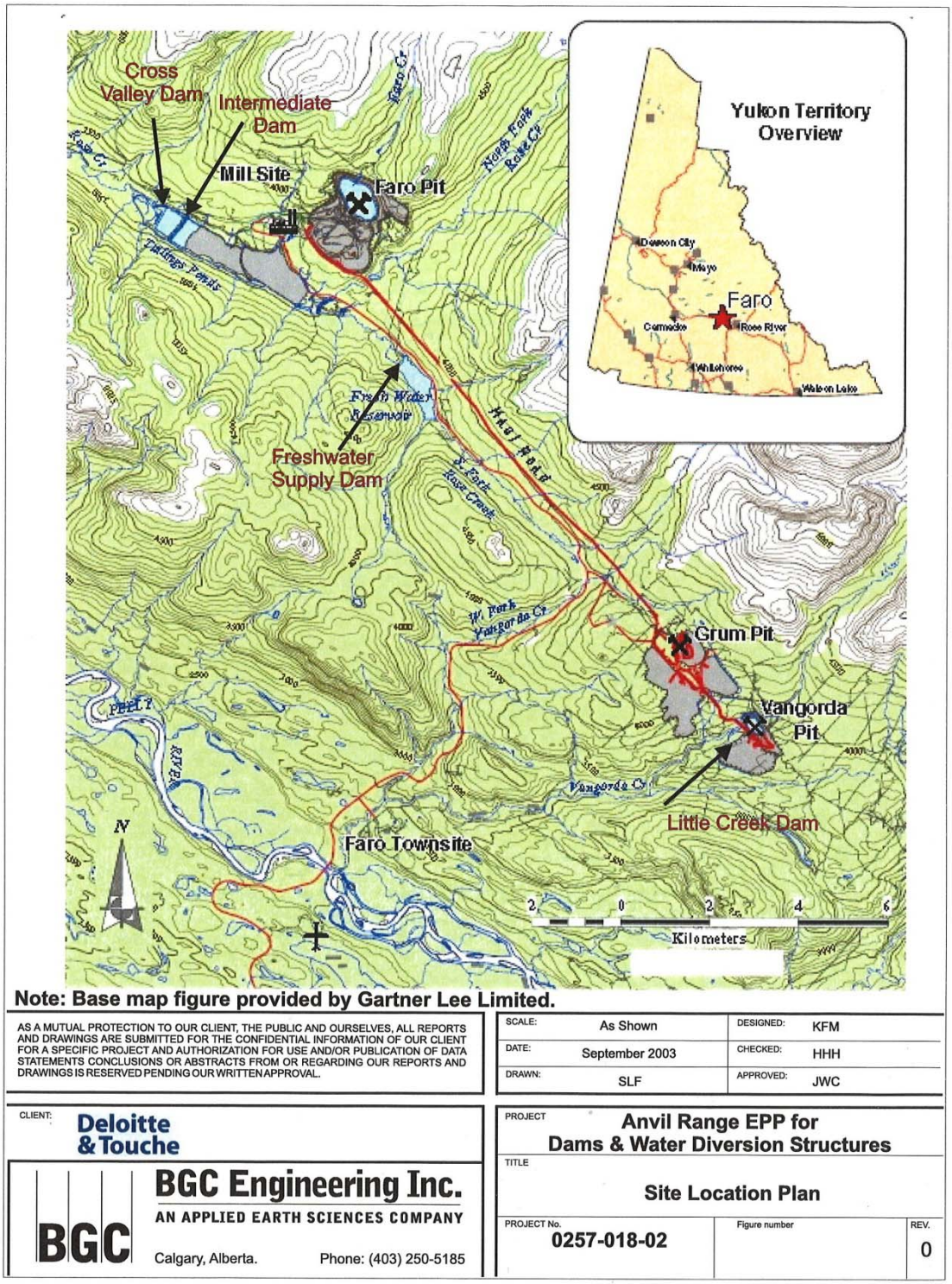
1.1 Project Background

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 was under the management of Deloitte & Touche, who were the court-appointed interim receiver. From 2009 to date, the Yukon Government has actively managed the mine complex. Ongoing care, maintenance, and environmental protection activities have been carried out by Denison Environmental Services (DES) between 2009 and 2011, centered on a seasonal pumping and water treatment program for the Faro and Vangorda open pits, and inspection and maintenance of water and waste retention and water diversion structures. Tlicho Engineering and Environmental Services (TEES) replaced Denison in 2012.

There are three main waste and water retention dams, Intermediate, Cross Valley and Little Creek Dams, in the Faro Mine Complex covered in the Operations, Maintenance and Surveillance (OMS) Manual (KCB 2014b), while in addition to these three dams, three water diversion structures, Faro Creek and Rose Creek Diversion Channels and Vangorda Creek Diversion Flume, are included in the Emergency Response Plan (ERP) (KCB 2014c). The Intermediate and Cross Valley dams are located in the Rose Creek Valley and were constructed between 1981 and 1991 to form the Down Valley tailings area (Golder 1980, 1981, 1982, 1983, 1990a, 1990b and 1992). The Little Creek Dam, constructed in 1991 with a spillway added in 1998, is located adjacent to Vangorda Creek to capture water discharging from the Vangorda Waste Rock Dump (SRK 1990 and 1998).

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) (1999), BGC Engineering (2000 to 2009), and SRK Consulting Engineers (1996 to 2011). The annual reviews for 2011-2012 were completed by Klohn Crippen Berger (KCB 2012-2013).

According to the Canadian Dam Safety Guidelines (CDA 2007), both the Intermediate Dam and Cross Valley Dam will be due for their third dam safety review in 2014 because of their classification as “high” consequence dams. Moreover, a dam breach and inundation study for the Intermediate, Cross Valley and Little Creek Dams was prepared by KCB (2014a). The study confirmed the “high” consequence classification of the Intermediate Dam and Cross Valley Dam, and raised the Little Creek Dam classification from “low” to “significant” or “high” pending on a more refined future inundation study of the dam. We understand that Yukon Government is arranging a dam safety review for the Intermediate, Cross Valley and Little Creek Dams in 2014.



Site Location Plan of Faro Mine Complex

1.2 Project Scope

This report documents the 2013 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 follow the 2012 annual review report format by grouping these facilities into two sites: Faro and Vangorda Plateau sites. Although some of the following facilities are not within the scope of our 2013 task, such as Vangorda Pit, Grum Dump, we have included our observations here for future reference.

Faro Site (see Figures 1 and 2):

- Faro Pit and 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
- Cross Valley Dam

Vangorda Plateau Site (see Figures 3 to 5):

- Grum Pit
- Vangorda Pit
- Grum Dump
- Vangorda Waste Rock Dump
- Grum Interceptor Ditch
- Vangorda Northeast Interceptor Ditch
- Vangorda Creek Diversion Flume
- Little Creek Dam
- Sheep Pad Sediment Ponds
- Grum Settling Pond
- V-15 Seepage Ditch and Moose Pond
- Sludge Pond Embankment at Vangorda Water Treatment Plant

The review is based on our site observations by Robert Lo on June 4 to 6, 2013 and by Arvind Dalpatram and Robert Lo on September 10 to 12, 2013 and ongoing review of monitoring data collected by Tlicho Engineering and Environmental Services (TEES).

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 TEES site instrumentation monitoring data, and comments and recommendations. Section 4 summarizes our review making use of summary tables, and Section 5 outlines the key conclusions and recommendations. More detailed recommendations are summarized in Table 4.1. These

recommendations deal with ongoing maintenance issues. They could be implemented by the Government of Yukon according to its priority and operational budget, as guided by its long-term closure objectives.

Representative 2013 site visit photographs are included in Appendix I, and the reviewed TEES monitoring data are organized in Appendix II. Appendix III contains three summary tables outlining the status of instrumentation, the current geotechnical/hydrotechnical monitoring schedule established by BGC (2010) and our proposed schedule adjustment in 2014.

2 FARO SITE FACILITIES

2.1 Faro Pit and Faro Creek Diversion Channel

Faro Pit (see Photos 1 and 2 and Figure 2) and Faro Creek Diversion Channel (FCDC) (see Photos 3 to 10 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

Our 2013 observations of the Faro Pit are as follows:

- The lowest contact between overburden and bedrock along the pit rim is El. 1150 m. By the end of December 2013, pit lake level had risen to within 1.9 m of this level at El. 1148.1 m.
- No obvious changes on the east pit wall North and South Instability Zones, except minor erosion by runoff, were observed.

Faro Creek Diversion Channel (FCDC)

Our 2013 observations of the Faro Creek Diversion Channel are as follows:

- The channel and side slopes appeared to be stable along most of its length.
- During spring freshet season, side slope slumps occurred at some locations, where TEES had repaired and strengthened the riprap protection zone along the access road during freshet. However, no repair was done on the hillside slope of the diversion channel due to safety concern.

2.1.2 Instrumentation

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 2009b and Golder 2011a).

Data provided by TEES on Faro Pit for the year of 2013 and survey data on Faro Pit reference bars and prisms by YES (2013a) are presented in Appendix II, and discussed below:

- Pond level (Section II-A.1) – The maximum pit lake level in 2013 was El. 1148.1 m on December 30, and the minimum level in 2013 was El. 1141.6 m on January 2. These levels are compared with historical values in Table 2.1. In general, the pit lake level has been operated in a lowered range varying from 1140.7 m to 1142.1 m from August 2010 to December 2012, as compared with the range of 1141.0 m to 1142.8 m from August 2005 to July 2010. However, the pit lake level continued to rise in 2013 due to suspension of normal water treatment at the Faro site.
- Pit wall regression (Section II-A.2) – The ID tag for Reference bar #15353 was destroyed in September 2010. In 2011 Yukon Engineering Services re-tag the Reference bar with ID tag #13908. The measured relative distances between reference bars and the pit wall have been similar for four bars (#15352, #15354 to #15356) from 2008 to 2013, and for four newly installed bars (#13908, #15717, #15737 and #15742) from August 2011 to September 2013. Locations of the four new reference bars have been added on Figure 6 to facilitate interpretation. The apparent difference in readings of about 2 m for #15351 from July 2010 to October 2011 and from September to October 2012 was attributed to potential error in the bearing of distance measurement (Golder 2011a). In general, with the exception of bar #15351, all measured distances are practically the same within measurement accuracy. In 2013 the bearing issue of distance measurement for bar #15351 had been reduced. This improvement should continue in the future.
- Pit wall prism monitoring (Section II-A.3) – The ordinates of change in northing and easting for the prism monitoring plots have been corrected to “cm”. The scatter of the nine data points for the change in northing and easting plots seems to increase from 2 cm in 2006 to 3 cm in 2009. The scatter in the northing-change plot increases further to 5 cm in 2010 and 2011, 8 cm in 2012 then decreases to 6 cm in 2013. The corresponding scatter in the easting-change plot remains within 3 cm from 2009 to 2010, and increases to 4 cm in 2011 and 6 cm in 2012 to 2013. It is uncertain whether these changes in scatter are related to prism position/survey accuracy or pit wall movement. In general, these “apparent movements” are in the northwest direction except those for Points #13875 and #13876, which are in the southwest direction. 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 for Point #13875 and within 2 cm for Point #13877 from 2006 to 2013. 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 for flow measurements in the diversion channel. Data provided by TEES on the diversion channel is discussed below:

- Staff gauge flow measurements (see Appendix II-B) - Historical and 2013 flows in the Faro Creek Diversion Channel are shown in Table 2.1. Since the values shown in the table are based on spot measurements, they might not show the lowest or the highest flows the channel experienced during the reporting period.
- Discharge rating curves for the staff gauges are shown in Section II-B.1 of Appendix II. Two rating curves are shown for FD-3 and FD-4: one for the period 2008 to 2010; and the other for the period 2011 to 2013. Different staff gauge calibration equipment was used during these two periods, and it is believed that the equipment used after 2010 is more accurate.
- Plots of channel discharges estimated from the rating curves shown in Section II-B.1 are presented in Section II-B.2 (Appendix II). Since the discharges shown are based on spot measurements, they might not show the lowest or the highest flows the channel experienced during the reporting period. Furthermore, the high flows shown in the plots are based on the extrapolation of the rating curves beyond their calibrated range therefore they are likely not reliable. These flows should be re-calculated when additional data for the extension of the rating curves is collected.

Table 2.1 Faro Pit Lake Level and Faro Creek Diversion Channel Flow

Structure	Monitor Location	Historical[1]		2013	
		Max	Min	Max	Min
Faro Pit - Pond El.	FP	[2]1143.1 m	1140.7 m	[2]1148.1 m	1141.6 m
Faro Creek Diversion Channel - Flow	FCD-1	[3]2213 L/s	69 L/s	[3]4070 L/s	80 L/s
	FCD-2	6178 L/s	7 L/s	1340 L/s	100 L/s
	FCD-3	[3]1366 L/s	47 L/s	[3]1800 L/s	98 L/s
	FCD-4	[3]6018 L/s	47 L/s	[3]10550 L/s	110 L/s

Notes: 1. Historical data was taken from 2011 Annual Geotechnical Review (KCB, 2012). However, it is not known how the high staff gauge reading was calibrated.
2. The maximum pit lake level was increased by 5 m from 1143. 1 m to 1148.1 m due to high lake level measured on December 30, 2013.
3. Due to the uncertainty of flow calibration for high flows, no changes were made for historical maximum flow value.

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 (see Photos 1 and 2).
- Continue monitoring distances between the pit wall 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.

- Reference-bar distance measurements for bar #15351 improved in 2013. Ensure the improved field technique is followed in future years.
- Continue visual monitoring of diversion channel and any seepage from the channel to the Faro Pit wall north and south instability zones with photos taken at strategic locations.
- Repair slumps on the hillside slope of the channel under safe conditions, if practical.
- Purchase and install equipment to allow flow measurement across the diversion channel for staff gauge calibration under high flow conditions.
- Continue flow calibration measurements for the diversion channel in order to improve the stage/discharge rating curves.
- Continue to have pit slope stability reviewed periodically, especially in case of development of new sizable slumps.

2.2 North Valley Wall Interceptor Ditch

North Valley Wall Interceptor Ditch (NVWID) (see Photos 11 to 18 and Figures 1 and 2)

The North Valley Wall Interceptor Ditch diverts creek flow from the north valley wall around the tailings impoundment area. It is approximately 3 km long and includes 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

Our 2013 observations of the North Valley Wall Interceptor Ditch are as follows:

- The channel and side slopes appeared to be stable.
- Sedimentation accumulated both up and down gradient from the potable-water-well access road culverts became excessive (see Photos 12 and 13).
- There was moderate to heavy vegetation growth in upper and middle constructed channel reaches. Vegetation clearance started from the upstream end of the upper reach in the fall of 2012, but was halted in 2013 due to more urgent maintenance issues on site.
- Potential locations and construction detail for a weir in the ditch near the beginning of the upper constructed reach were established by Arvind Dalpatram and Tracy Parkin during 2013 fall site visit.

2.2.2 Instrumentation

Instrumentation at the North Valley Wall Interceptor Ditch includes one flow monitoring location, NWID, within the diversion channel. Flow data for the NWID is shown in Section II-C.1 of Appendix II. Historical and 2013 flow data for this ditch is shown in Table 2.2.

Table 2.2 North Valley Wall Interceptor Ditch - Flow

Structure	Monitoring Location	Historical[1]		2013	
		Max (L/s)	Min (L/s)	Max (L/s)	Min (L/s)
North Valley Wall Interceptor Ditch	NWID	32[2]	1[3]	554[2] (Measured)	0.1[3] (Estimated)

1. Historical flow data is from the Geotechnical 2011 Data Review (Golder, 2011c).
2. The maximum historical flow was increased by 522 L/s from 32 L/s to 554 L/s due to the high flow measured on May 30, 2013 during spring freshet.
3. The minimum historical flow was decreased by 0.9 L/s from 1 L/s to 0.1 L/s due to the low flow estimated on February 21, 2013 in icy conditions.

2.2.3 Comments and Recommendations

- Remove sediments from channel at the inlet and outlet of culverts and from inside the culverts under well-access road. The channel bottom at the culvert inlet and outlet could be slightly over-excavated to create a sediment trap and to minimize sediment deposition inside the culverts.
- Repair the well-access road embankment at the above culverts.
- Continue vegetation clearance 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 and Canal Dyke

Rose Creek Diversion Channel (RCDC) and Canal Dyke (CD) (see Photos 19 to 28 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 Pond, Intermediate Dam, Polishing Pond and Cross Valley Dam, 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.
- Back Slope: The Back Slope is the upper portion of the south excavation slope for the diversion channel above the flowing water.

2.3.1 Observations

Our 2013 observations of the Rose Creek Diversion Channel are as follows:

- The channel and side slopes appeared to be in general stable condition with satisfactory rock armour protection.
- The hillside channel slope of the Rose Creek Diversion Channel experienced longitudinal cracks and slumps during 2013 spring freshet for a distance of about 30 m above and near mid-height (see Photos 21 to 24). The condition of this slope appeared to remain the same during our fall inspection.
- A small washout of the Rose Creek Canal Dyke south shoulder near the Cross Valley Dam south abutment was observed during our fall inspection (see Photo 27).
- Moderate vegetation growth in lower channel reaches.
- Obvious seepage was observed from RCDC into the tailings impoundment in the spring but not during the fall visit.
- We understand that TEES is exploring purchase of equipment to allow flow measurement across the diversion channel for staff gauge calibration under high flow conditions.
- Minor seepage from the RCDC at base of spoil piles into the Polishing Pond was reported previously, but could not be located during the 2013 inspections.

2.3.2 Instrumentation

Rose Creek Diversion Channel (see Figures 7 and 8)

Instrumentation in the diversion channel consists of one in-stream flow monitoring location (RCDC4). There are three other monitoring locations along the North Fork Rose Creek (NFRD-23, NF2 and X2), and two monitoring locations (X10 and X14) in Rose Creek downstream of the Rose Creek Diversion Channel.

- Historical and 2013 data of maximum and minimum flows for the stream flow stations are shown in Table 2.3. Since the values shown in the table are based on spot measurements, they might not show the lowest or the highest flows the channel experienced during the reporting period.
- Discharge rating curves for the staff gauges are shown in Section II-D.1 of Appendix II-D.
- Plots of channel discharges estimated from the rating curves shown in Section II-D.1 (Appendix II) are presented in Section II-D.2. Since the discharges shown are based on spot measurements, they might not show the lowest or the highest flows the channel experienced during the reporting period. Furthermore, the high flows shown in the plots are based on the extrapolation of the discharge rating curves beyond their calibrated range therefore they are likely not reliable. For example, the discharge plot for RCDC4 in Appendix II indicates a maximum recorded flow of 120,000 L/s (120 m^3/s) in 2013, but the hydraulic capacity analysis for the RCDC (NHC 2006) indicates that the RCDC fuse plug would be overtopped at a flow of

113 m^3/s. It is our understanding that the RCDC fuse plug was not overtopped in 2013. The high flows at the staff gauges should be re-calculated when additional data for the extension of the rating curves is collected.

- For RCDC4, there were 15 occasions in 2012 and 2013 when the water level was higher than the 2 m gauge height and the true water level could not be recorded.
- For NFRD-23, there were four occasions in 2013 when the water level was higher than the 2 m gauge height and the true water level could not be recorded.

Table 2.3 Flow in North Fork Rose Creek and Rose Creek Diversion Channel

Location	Name	Historical[1]		2013	
		Max (L/s)	Min (L/s)	Max (L/s)	Min (L/s)
North Fork Rose Creek	NFRD-23	8000	0	>16 000[3,6]	640
	NF2	2713	613	-	-
	X2	1538	207	-	-
Rose Creek Diversion Channel[2]	RCSG4/ RCDC4	38,000	1858	>151 000[4,6]	540
Rose Creek	X14	-	-	>99 000[5,6]	210

Notes:
1. Historical data taken from Geotechnical 2011 Data Review (Golder, 2011c). However, it is not known how the high flow data was measured.
2. RCDC4 is a replacement of RCSG4 in 2012.
3. Maximum water level at NFRD-23 was higher than the staff gauge in May 2013.
4. Maximum water level at RCDC4 was higher than the staff gauge in May and June, 2013.
5. Maximum water level at X14 was higher than the staff gauge in May 2013.
6. Maximum flows shown for 2013 are based readings which were higher than the calibration range of the staff gauges, therefore they are probably not reliable.

Canal Dyke (see Figures 7 and 8)

A summary of existing instrumentation on the Canal Dyke, Spoil Piles and Back Slope of the diversion channel is shown in Table 2.4. Plots and recorded data, provided by TEES, for these instruments are given in Appendix II: Section II-E (Piezometers in Section II-E.1, Thermistors in Section II-E.2 and Inclinometers in Section II-E.3). Many of inclinometer readings taken in 2013 are erroneous probably due to insufficient training for some personnel. To confirm correct readings are taken in the field, the site personnel should perform the “checksum” as indicated in the instrument manual. Deformation profiles are presented in Section II-E.3 for five inclinometers with correct 2013 readings: BGC05-08, BH91-CD-1, CD-10, CD-19 and SP-2. In addition, deformation profiles are also presented for three other inclinometers: BGC05-05, CD-15 and CD-21 by making reasonable corrections of some raw readings as noted in Section II-E.3.

Table 2.4 Instrumentation for Canal Dyke, Spoil Piles and Diversion Channel Back Slope

Structure	Instrumentation (See Figures 6 and 7)
Canal Dyke	Pneumatic Piezometers - 5 single piezometers[1] (BS-5, BS-9, 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[4], BGC05-08[4], CD-10[4], CD-15[4], CD-19[4], CD-21[4], BH91-CD-1[4] and BH94-CD-1)
Spoil Piles	Thermistors - 3 (SP-2[3], SP-3 and SP-5[5])
	Inclinometers - 2 (SP-2[4] and SP-5)
Back Slope of Rose Creek Diversion Channel	Pneumatic Piezometers - 2 (BS-5 and BS-9)
	Thermistors - 4 (BS-5[5], BS-9[5], BS-10[5] and BS-12[5])
	Inclinometers - 3 (BS-5, BS-9 and BS-10)

Notes:
1. Piezometers: BS-5 and BS-9 not monitored since 2011 and CD-7, CD-9 and CD-10 not monitored since 2009. However, one reading was taken for CD-10 in 2013.
2. Piezometers: BH88-7, BH88-11 and CD-19 destroyed in 2004, and CD-21 deep piez. destroyed in 2005.
3. Thermistor SP-2 not monitored since 2009.
4. Deformation profiles for BGC05-08, BH91-CD-1, CD-10, CD-19 and SP-2 as well as for BGC05-05, CD-15 and CD-21 (with some reasonable correction of raw readings) are presented in Section II-E.3.
5. Thermistors SP-5, BS-5, BS-9, BS-10 and BS-12 not monitored since 2011.

2.3.3 Comments and Recommendations

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

- Monitor condition of longitudinal cracks and slope slump scarps at the back slope of Diversion Channel.
- Explore permit requirements regarding investigation and repair of the above slope slumps, starting with obtaining a permit to allow personnel access to the back slope to assess the condition closely under ice-snow free condition and to determine appropriate remedial measures that may be required. RCDC is the main diversion channel at the Faro site, and prevention of a major slump and blockage is a high priority.
- Repair the small washout of the Rose Creek Canal Dyke south shoulder with a proper filter zone adjacent to the upstream riprap near the Cross Valley Dam south abutment.
- Continue to monitor the staff gauge and extend staff gauge, if required, such that it can be read during high flows.
- Continue to document seepage locations from RCDC into tailings impoundment area after fresh snow fall.
- Clear vegetation along lower channel reaches as required.
- Continue to monitor instrumentation on a regular basis.

- Conduct geotechnical inspection of the diversion channel during spring peak flow condition.
- Continue to monitor the staff gauges. Take readings during high flows such that the discharge rating curves can be extended beyond the current calibrated limits.
- Purchase and install equipment to allow flow measurement across the diversion channel for staff gauge calibration at RCDC4 under high flow condition.
- Extend the staff gauge at RCDC4 such that readings above 2.0 m can be recorded.
- Extend the staff gauge at NFRD-23 such that readings above 2.0 m can be recorded.
- 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.
- Thermistors and inclinometers were installed to track the geothermal and deformational development of the discontinuous permafrost present in the original foundation of the structures related to the diversion channel (Golder 1981). Current geothermal profiles seemed to indicate that the foundation at depth at many locations of these structures remains frozen. Thus readings for these thermistors should be taken in June, each year including those at Back Slope.
- Many inclinometer readings taken in 2013 were erroneous. The field personnel need to check the instrument manual for proper procedures, and to perform “checksum” during monitoring in the field to confirm correct readings have been taken. The situation will be reviewed after correct inclinometer readings are obtained in 2014 for all functional inclinometers including those located along the Back Slope to see whether the frequency of reading should be adjusted.

2.4 North Fork Rock Drain

North Fork Rock Drain (NFRD) (see Photos 29 and 30 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 the North Fork Rose Creek flow to cross the haul road, see Figures 1 and 2. The haul road at stream crossing is approximately 55 m high with a 25 m crest width. Downstream of the haul road, the North Fork Creek crosses the Main Access Road to the mine via a culvert which is supplemented by an auxiliary culvert at a slightly higher elevation.

2.4.1 Observations

Our 2013 observations of the North Fork Rock Drain are as follows:

- Stable crest and side slopes of mine haul road in general.
- Washouts occurred on the upstream and downstream slopes starting from the road shoulder during 2013 spring freshet, and the condition remained the same during our fall inspection.

- 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 upstream pond and downstream discharge elevation at the mine haul road. A summary of the historical maximum and minimum values including the most current data (2013) is shown in Table 2.5. Recorded water level plots provided by TEES, are given in Section II-F.1 of Appendix II.

Table 2.5 North Fork Rock Drain - Water Level

Name	Historical[1]		2013		Comments
	Max (m)	Min (m)	Max (m)	Min (m)	
NF-1	1094.35	1088.83	1093.19	1089.55	Upstream of haul road
NF-2	1089.11	1085.02	1088.4	1085.2	Downstream of haul road

Notes:
1. Historical data was taken from 2011 Annual Geotechnical Review (KCB, 2012).

2.4.3 Comments and Recommendations

- The crest and side slopes of the mine haul road appeared to be stable.
- Repair the downstream slope washout prior to 2014 spring freshet to prevent the base rockfill drain being blocked by fine material derived from the upper washout debris.
- Continue to monitor head pond level and downstream flow discharge level and flow condition, especially during spring freshet season.

2.5 K8 Creek Rock Drain

K8 Creek Rock Drain (K8CRD) (see Photos 31 to 32)

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

Our 2013 observations of the K8 Creek Rock Drain are as follows:

- The crest and side slopes of the mine haul road appeared to be stable in general.
- Washouts occurred on the upstream and downstream slopes starting from the road shoulder during spring freshet, and the condition remained the same during our fall inspection.

2.5.1 Comments and Recommendations

- Repair the downstream slope washout prior to 2014 spring freshet to prevent the base rockfill drain being blocked by fine material derived from the upper washout debris.

- Continue to monitor the head pond level and downstream flow condition from the haul road, especially during the spring freshet season.

2.6 Secondary Tailings Impoundment

Secondary Tailings Impoundment (STI) (see Photos 33 to 36 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 (see Photos 37 and 38). 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

Our 2013 observations of the Second Tailings Impoundment are as follows:

- The crest, upstream and downstream slopes appeared to be stable.
- No evidence of seepage along the downstream slope.
- The condition of the Lower Road, which also serves as the Rose Creek Canal Dyke, was satisfactory.
- A row of tailings piles was located along the upstream shoulder of the crest in the southwest portion of the dam. Tailings deposits covering the dam crest in the area appeared to have been derived from these upstream tailings piles.
- The annual appearance of longitudinal cracks along the downstream berm road surface in the spring and their subsequent disappearance seemed to be related to seasonal freezing and thawing effect. This phenomenon repeated in 2013.

2.6.2 Instrumentation

Instrumentation at the Secondary Tailings Impoundment (see Figure 8) 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 2.6. Individual plots of piezometric levels at these piezometers as provided by TEES, are included in Section II-G.1 of Appendix II. Piezometers P81-6 to P81-8 have been dry, while P03-1 to P03-3 show a variation less than 1 to 2 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 2.6 Secondary Tailings Impoundment – Pond and Piezometer Levels

Location	Piezometer	Historical[1]		2013	
		Max (m)	Min (m)	Max (m)	Min (m)
Dam Crest	P81-06	Dry	Dry	Dry	Dry
	P81-07	Dry	Dry	Dry	Dry
	P81-08	Dry	Dry	Dry	Dry
Tailings Pond	P03-01	1055.25	1054.29	1054.9	1054.78
	P03-02	1058.35[2]	1053.72	1055.08	1054.26
	P03-03	1060.27[2]	1052.28	1054.78	1054.68

Notes:
1. Historical data was taken from 2011 Annual Geotechnical Review (KCB, 2012).
2. Maximum historical 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 surface adjacent to the upstream end of the Rose Creek Diversion Channel, where cracks were usually observed in the spring. The cracks, when discovered, should be sealed by grading to minimize ingress of runoff into the embankment.
- Check vegetation growth on the downstream dam slope periodically and clear vegetation, as required.

2.7 Intermediate Dam

Intermediate Dam (ID) (see Photos 39 to 48 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. It has a downstream berm about 7 m wide, with the berm surface at approximate 1031.7 m. The Starter Dam has a vertical core, which was modified to an upstream sloping core during subsequent dam raises. The rest of dam zones consist of gravel shells and filters.

In 2012, the Government of Yukon experimented with increasing the maximum rate of drawdown of the Intermediate Pond from the historical rate of 25 mm/day to 40 mm/day, and monitors the dam performance in response to this change. No noticeable effect of this increased drawdown rate has been observed to date.

2.7.1 Observations

Our 2013 observations of the Intermediate Dam are as follows:

- Pond level was relatively high.
- Stable crest, upstream slope and spillway channel, in general.
- Near south abutment, a minor upstream remnant construction feature was noted (see Photo 42).
- The status of downstream slope rill erosion is similar to that observed in 2012.
- Minor rill erosions on downstream berm shoulder (see Photo 47).
- Eroded fill material from the downstream slope often pushed the above-ground portion of existing instruments to lean toward downstream (see Photo 48).

2.7.2 Instrumentation

Instrumentation at the Intermediate Dam (see Figures 7 and 9) 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 piezometers 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 2.7. Plots of pond and piezometric levels are included in Sections II-H.1 and II-H.2 of Appendix II. The upper range of pond level in 2013 was about 1 m higher than that in 2012, while the lower range was about the same in both years. The monitored piezometric levels were in a range consistent with historical variations.

Table 2.7 Intermediate Dam - Pond and Piezometer Levels

Location	Name	Historical[1]		2013		Comments
		Max (m)	Min (m)	Max (m)	Min (m)	
Water Elevation Readings						
Int. Pond	IP	1047.58	1043.47	1046.92	1044.31	Target El. 1043 m
Standpipe Piezometers (Nested piezometers at P01-4, BH96-3 and BH96-4)						
Dam Crest	BH96-1	1031.65	1027.37	1029.25	1028.49	-Tip El. At 1027.35 m
	BH96-2	1031.94	1028.87	1029.66	1028.97	-Tip El. At 1028.87 m
	BH94-IDC-1	Dry	Dry	Blocked	Blocked	-
	BKS04-06	Dry	Dry	Dry	Dry	-
	BKS04-07	Dry	Dry	Dry	Dry	-
Dam Toe	P01-3	1030.63	1027.48	1029.33	1028.60	-
	P01-4A	1032.24	1029.27	1031.13	1030.81	Shallow
	P01-4B	1032.17	1029.06	1030.28	1030.17	Deep
	BH96-3A	1031.38	1026.62	1029.19	1028.35	Shallow
	BH96-3B	1031.45	1027.48	1029.22	1028.42	Deep
	BH96-4A[3]	1032.04	1027.61	-	-	No readings for 2012
	BH96-4B[3]	1032.28	1028.39	-	-	No readings for 2012
	BH96-4C[3]	1031.64	1027.74	-	-	No readings for 2012
	BH96-4D[3]	1031.75	1027.62	1029.39	1028.76	-
Pneumatic Piezometers (BH91-ID3 to ID6 are nested piezometers with one tip deep and one shallow)						
South Abutment	BH91-ID3	1039.23	1036.82	1036.96	1036.89	Shallow
		1038.04	1029.95	1033.66	1032.12	Deep
Dam Toe	BH91-ID4	1035.91	1028.28	1030.45	1029.47	Shallow
		1031.85	1026.74	1028.91	1028.14	Deep
	BH91-ID6[2]	1040.9	1026.62	1028.58	1024.80	Shallow
		1034.96	1020.82	1029.57	1016.9	Deep
	BH91-ID7	1035.2	1028.82	1029.94-	1028.82-	-Destroyed in winter 2011/2012

Notes:
1. Historical data taken from 2011 Annual Geotechnical Review (KCB, 2012).
2. BH91-ID6 Shallow and Deep: Readings taken in June, September and October show no piezometric head above tip.
3. 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.
- Continue to monitor ongoing development of rill erosions on the downstream slope and related longitudinal cracks and slope slumps.

- Site staff indicated that re-sloping of the downstream slope has been successfully implemented in 2000s using site dozer equipment working on existing slope material. We recommend that this successful practice be implemented as early as practical to prevent further degradation of the downstream slope by rill erosion.
- Repair shoulder erosion of the downstream berm.
- Tilted above-ground portion of existing instrumentation on the berm surface to be restored after completion of downstream slope re-grading work.
- Review and update, if required, geotechnical stability analyses based on the current planned pond operation range.
- The pond level should be drawn down to the targeted drawdown level by pumping, once normal water treatment operation resumes at the Faro Site.

2.8 Cross Valley Dam

Cross Valley Dam (CVD) (see Photos 49 to 56 and Figures 1 and 2)

The Cross Valley Dam impounds 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. The dam has a central silty till core with gravel shells and filters.

2.8.1 Observations

Our 2013 observations of the Cross Valley Dam are as follows:

- The crest, upstream and downstream slopes and spillway channel appeared to be stable.
- The annual appearance of longitudinal cracks along the dam crest in the spring and their subsequent disappearance seemed to be related to seasonal freezing and thawing effect. This phenomenon repeated in 2013.
- Water stored in the Polishing Pond was being treated through a rental filtration plant at the time of the fall site visit. Compliance water is then released from the filtration plant to the North Valley Wall Interceptor Ditch (see Photo 56).

2.8.2 Instrumentation

Instrumentation at the Cross Valley Dam (see Figures 7 and 10) consists of a pond level measurement, 12 standpipe piezometers, four pneumatic piezometers and two thermistors. Except for 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.

Plots of Polishing Pond and piezometric levels, ground temperature profiles, and downstream weir flows are included, respectively, in Sections II-I.1 to II-I.4 of Appendix II. A summary of historical and current pond and piezometer levels are shown in Table 2.8. A summary of historical and current maximum and minimum flow weir readings are shown in Table 2.9.

Since 2009, the Polishing Pond level varies in a similar range from about 1027 m to 1029 m. In 2013, the minimum pond level was slightly higher than that in 2012. The 2013 monitored piezometric levels were 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, no monitoring of thermistors is required for the Cross Valley Dam, and existing instrumentation should be preserved for potential future use.

Table 2.8 Cross Valley Dam – Pond and Piezometer Levels

Structure	Name	Historical[1]		2013		Comments
		Max (m)	Min (m)	Max (m)	Min (m)	
Water Elevation Readings						
Polishing Pond	PP	1030.33	1026.31	1029.37	1027.54	Target El. 1027 m
Standpipe Piezometers						
Dam Toe	CVDT-1	1018.57	1017.13	1017.91	1017.80	-
	CVDT-2	1019.5	1015.40[2]	1015.63	1015.40[2]	-
	P01-02	1018.3	1017.42	-	-	Shallow
		1019.73	1017.86	-	-	Deep
	P01-11	1017.83	1016.57	1016.74	1016.58	-
Dam Crest	CVDC-4	1019.05	1016.72	1018.77	1018.55	Deep
	CVDC-7	1017.74	1015.14	1015.34	1015.15	Shallow
		1019.21	1015.27	1017.66	1017.39	Deep
	94CVDC-1	1024.58	1022.71	1023.34	1023.21	-
	CVDC-9	1024.74	1019.91	1020.85	1020.47	Shallow
		1025.61	1021.18	1023.66	1023.22	Deep
Pneumatic Piezometers						
Dam Toe	CVDP-1	1019.83	1017.38	1018.22	1018.08	-
	CVDP-3[3]	1017.65	1016.11	-	-	-
	CVDP-5	1022.05	1018.13	1020.86	1020.44	-
	CVDP-6	1019.55	1016.99	1017.94	1017.8	-

Notes:
1. Historical data taken from Geotechnical 2011 Data Review (Golder 2011c).
2. CVDT-2: Historical minimum has been reduced by 0.03 m from 1015.43 m to 1015.40 m on May 22, 2013.
3. CVDP-3 broken in winter 2011/2012.

Table 2.9 Cross Valley Dam - Weir Flows

Weir Number	Historical[1]		2013	
	Maximum (L/s)	Minimum (L/s)	Maximum (L/s)	Minimum (L/s)
X11 (North)	20.9	2.56	14.62	3.79
W3 (Central)	7.1	0.13	5.59	1.9
X12 (South)	2.03	0.02[2]	0.8	0.02[2]
X13 (Combined)	43.9	7.45[3]	41.64	7.45[3]

Notes:
1. Historical data was taken from 2011 Annual Geotechnical Review (KCB, 2012).
2. X12: Minimum flow decreased by 0.01 L/s from 0.03 to 0.02 L/s on January 24, 2013.
3. X13: Minimum flow decreased by 0.63 L/s from 8.08 to 7.45 L/s on November 21, 2013.

2.8.3 Comments and Recommendations

- Continue to monitor pond, piezometric levels and weir flows on a regular basis.
- Since geothermal profiles at the Cross Valley Dam indicate that the temperature at depth is essentially thawed, Thermistor reading at the dam can be stopped, and instrumentation protected for potential future use.
- Continue to monitor longitudinal tension cracks on dam crest in the spring, and seal these cracks by grading to minimize water ingress to the embankment dam.
- The Polishing Pond level should be drawn down to the targeted level, once normal water treatment operation resumes at the Faro Site.

3 VANGORDA PLATEAU SITE FACILITIES

3.1 Grum Pit

Grum Pit (GP) (see Photos 57 to 62 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, 2013), and ongoing monitoring of potential pit-wall rim movement started in the summer of 2010.

3.1.1 Observations

Our 2013 observations of the Grum Pit are as follows:

- The pond level has risen to slightly above the contact level between overburden and bedrock (see Section II-J.1 of Appendix II).
- A pump barge at Grum Pit was used to lower the pond level, and to transfer water from Grum to Vangorda Pit for treatment. Pumping from Grum Pit, however, lasted only for a brief period from August to October in 2013.
- East wall instability appears to be continually evolving, with wet streaks of surface runoff running down the pit wall in the spring.
- Longitudinal crack at GP-N2 survey rod on the north array increased in width and depth since August 2012 (see Photos 59 and 60), and a slump occurred at the pit rim in the general area (see Photo 61).
- Ground deformation along the south array remains similar to that in 2012 (see Photo 62).
- Surface runoff in the pit rim area above the East Instability Zones has not been directed toward the Grum Interceptor Ditch, as recommended by Golder (2013), due to other more urgent maintenance work.

3.1.2 Instrumentation

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

Following Golder's recommendation, CH2MHILL (2013a) established 14 locations of survey prisms for ongoing monitoring of Grum Pit wall and rim movement. YES (2013b) installed and surveyed the initial 4 prisms, MP005 to MP008, in September 2013 and provided installation details for additional

prisms for TEES to complete the installation work in 2014 (see Figure 11). We note that 7 of these potential prisms are located below the pit brim with associated risk to installation personnel. YG may wish to avoid this risk by adopting an alternative survey technique.

Plots showing changes of the distances, measured by TEES from monitoring rods along two arrays to their respective stationary reference rod, are given in Section II-J.2 of Appendix II. A summary of these relative distances measured in 2010 and 2013 are compared in Table 3.1.

Table 3.1 Grum Pit - Wall Movement

Location	Rod Name	Distance Measured Relative to Rod GP-S4 or GP-N6, (m)		
		June 24, 2010[3]/July 29, 2010[2]	December 18, 2013	Comment
South Array				Relative to GP-S4[1]
	GP-S1	29.006[2]	29.011	GP-S1
	GP-S2	23.444[2]	23.444	GP-S2
	GP-S3	15.630[2]	15.634	GP-S3
	GP-S4	0	0	GP-S4
North Array				Relative to GP-N6[1]
	GP-N1	28.738[3]	28.779[4]	GP-N1 (August 28)
	GP-N2	23.356[3]	23.397[4]	GP-N2 (August 28)
	GP-N3	18.130[3]	18.146	GP-N3
	GP-N4	12.004[3]	12.004	GP-N4
	GP-N5	5.740[3]	5.72	GP-N5
	GP-N6	0	0	GP-N6

Notes:
1. GP-S4 and GP-N6 Rods assumed stationary.
2. South array distance measurements initiated on July 29, 2010.
3. North array distance measurements initiated on June 24, 2010.
4. August 28, 2012 is the date when these distance measurements were made by TEES.

Detailed data of pit lake level, monitoring-rod survey and cut slot piezometers, as provided by TEES, are included in Section II-J of Appendix II. A pump barge was set up in the pit lake to pump water from Grum to Vangorda Pit from August to October 2013. As shown on the chart in Section II-J.1, the pit lake level at Grum rose to 1216.1 m on December 16, 2013, 0.1 m above the minimum overburden/bedrock contact elevation.

3.1.3 Comments and Recommendations

- An error on the record for Rod GP-N5 on January 5, 2012 (prior to TEES presence on site) was corrected as shown on the plots in Appendix II-J.2.
- Records of both north and south arrays show little change in the relative distances measured to date.
- The calculation and plotting of “velocity of rod’s movement” do not enhance the interpretation of monitored data, and should be discontinued.
- Continue visual monitoring of pit wall conditions with photos taken from the same vantage points (see Photos 57 and 58).
- Continue distance measurements of monitoring rods installed on the pit rim.

- Continue to install 3 additional survey prisms (MP-002 to MP-004) on the pit brim in 2014 per recommendation by CH2MHill (2013a), and survey 4 prisms (MP-005 to MP-008) installed by YES (2013b) and the above 3 additional prisms to be installed by TEES in 2014.
- Review with YG regarding the risk associated with installing 7 prisms on the pit wall below the pit brim and potential options by adopting other survey techniques.
- Personnel safety is an important concern with respect to setting up survey prisms in the instability zone and ongoing distance measurements of reference rods. Ongoing monitoring program should include consideration of other non-technical factors: such as the pit is inactive and site personnel who conduct distance measurement are not geotechnical professionals.
- Piezometric level at both piezometers at the Grum Cut 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 lake level is slightly above the minimum contact elevation between overburden and bedrock at El. 1216 m. Drawdown below this contact level is needed to prevent potential increase in seepage from the Grum Pit and toe instability.

3.2 Vangorda Pit

Vangorda Pit (VP) (see Photos 63 to 66 and Figures 3 to 5)

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

Our 2013 observations are as follows:

There appeared little change in the condition of the Vangorda pit walls since 2012 except some minor rock falls as shown on Photo 63.

3.2.2 Instrumentation

There is currently only a pit lake-level measurement point at the Vangorda Pit. Pit lake-level plot provided by TEES is included in Section II-K.1 of Appendix II.

3.2.3 Comments and recommendations

- Pit lake level has decreased by about 5 m from 2009 to 2012 with the maximum lake level at 1088.49 m in 2012. The maximum level in 2013 was at 1088.8 m on June 10 about 0.3 m higher than the peak level in 2012. At end of December 2013, the pit lake level was at 1086.3 m, about 5.5 m below the recommended maximum elevation of 1091.8 m.
- Continue to monitor the pit lake level on a regular basis.
- Continue visual monitoring of pit wall condition with photos taken at same vantage points at least at yearly interval (see Photos 63 to 66).

3.3 Grum Waste Rock Dump

Grum Waste Rock Dump (GD) (see Photos 67 to 70 and Figures 3 to 5)

The Grum Waste Rock Dump is an old waste dump located just south of the Grum Pit. The dump is currently undergoing reclamation.

Although it is not within the scope of our 2013 work, we recommend that regular visual monitoring be carried out for the Grum Waste Rock Dump, including taking photos.

Grum Waste Rock Dump has been the source of excess inflow into Moose Pond in the spring freshets of 2011 (YG 2011a and 2011b) and 2013 (YG 2013). Since the 2013 spring freshet excess runoff event, we understand that retention dyke has been improved along the edge of two lower berms of the Grum Waste Rock Dump below the Grum Sulphide Cell to increase their storage capacity. Moreover, re-grading in the upper Grum Waste Rock Dump area was carried out to re-direct surface runoff towards the road ditch. The road ditch would convey the runoff to the Vangorda Pit by gravity (BGC 2013). A new pump and pipeline are currently being installed at the V15 Ditch area to increase pumping capacity during spring freshet. All these efforts are aimed to prevent potential excess surface runoff from the Grum Waste Rock Dump entering into Moose Pond and/or Vangorda Creek during freshet.

3.4 Vangorda Waste Rock Dump

Vangorda Waste Rock Dump (VWRD) (see Photos 71 to 86)

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

Our 2013 observations of the Vangorda Waste Rock Dump and its transverse base drains are as follows:

- Drain No. 1 – was dry. Does not have a weir.
- Drain No. 2 - was flowing at a trickle. Has a v-notch weir.
- Drain No. 3 – was flowing. Staff gauge was tilted and the v-notch weir plate was delaminated. Flow is usually measured with a bottle and a watch.
- Drain No. 4 – Does not have a weir. Usually only a small trickle flows through the drain, and flow is estimated by eye. TEES has excavated a small hole at the drain to collect seepage water. A weir could be installed at the drain to measure the flow.
- Drain No. 5 – was flowing at a trickle. Has a v-notch weir, but the 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 – was flowing. Weir plate and channel are in satisfactory condition for flow measurement.

3.4.2 Instrumentation

Instrumentation at the Vangorda Waste Dump (see Figures 4, 5 and 12) consists of four V-notch weirs, V30 to V33, at transverse base Drains 2, 3, 5 and 6 for flow measurement, 16 piezometers and 4 groundwater monitoring wells in the dump area. Detailed data on base drain flows and piezometric levels provided by TEES are included in Section II-L of Appendix II. The weir flow data in 2013 are summarized in Table 3.2. The maximum piezometric level in 2013, and the corresponding date as well as trigger level as provided by SRK (2011b), are shown in Table 3.3.

Table 3.2 Vangorda Waste Dump - 2013 Weir Flow

Weir No.[1]	Maximum Flow		Minimum Flow	
	Flow (L/s)	Date Measured	Flow (L/s)	Date Measured
V30 (Drain No. 3)	0.18	May 28	0.05	November 8
V31 (Drain No. 4)	0.21	May 29	No flow	-
V32 (Drain No. 5)	0.13	September 4	No flow	-
V33 (Drain No. 6)	0.52	May 29	0.07	June 12

Note:
1. Drain number at each weir has been confirmed by TEES.

Table 3.3 Vangorda Waste Dump - 2013 Piezometer Levels p

Groundwater Monitoring Well/ Piezometer		Date of Max. Piez. Level in 2013[3]	Max. Piez. Level (m)	Trigger Level[1] (m)	Above Trigger Level?
V34	GW-94-01	September 24	1111.68	1115	No
V35	GW-94-02	September 24	1109.39	1115	No
V36	GW-94-03	September 24	1109.72	1113	No
V37	GW-94-04	May 29	1107.2	1109	No
V39	P-94-01A	September 25	1125.97	1131	No
V40	P-94-01B	May 28	1131.28	1133	No
V41	P-94-02A	May 28/September 25	1130.64	1133	No
V42	P-94-02B	May 28/September 25	1132.2	1134	No
V43	P-94-02C	September 25	1121.6	1125	No
V44	P-94-03A	September 25	1121.13	1126	No
V45	P-94-03B	May 28/September 25	1124.66	1126	No
V47	P-94-04B	September 25	1125.39	1126	No
-	P-2001-02A	May 29	1118.56	1123	No
-	P-2001-02B	May 29	1118.38	1123	No
-	P-2001-03	May 29	1106.24	1120	No
DH1	PW-10-01	July 17	1129.11	1135	No
DH2	PW-10-02	May 28	1129.63	1131	No
DH3	PW-10-03	July 17	1127.18	1130	No
DH4	PW-10-04	July 17/September 24	1132.55	1133[2]	No
DH5	PW-10-05	July 17	1137.93	1139	No

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

3.4.3 Comments and Recommendations

Comments and recommendations regarding future geotechnical performance of the Vangorda Waste Rock Dump are as follows:

- 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 the slump of waste dump slope above the drain observed in the past (see Photo 71).
- Flows at all base drains are consistent with historical data.
- Piezometric level at all piezometers and groundwater monitoring wells in 2013 varies within the historical range, and is below the trigger level provided by SRK (2011b).

3.5 Grum Pit Interceptor Ditch

Grum Pit Interceptor Ditch (see Photos 87 to 92 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.

3.5.1 Observations

Our 2013 observations of the Grum Pit Interceptor Ditch are as follows:

- Stable channel and side slopes.
- Light to heavy vegetation growth, particularly along the upper reaches of the ditch.
- There appeared to be no change in condition of culverts since 2012 fall site visit:
  - Top of the culvert under the road to Grum Settling Pond (site coordinates 6 905 250N, 592 790E) is deformed approximately 300 mm to 600 mm, and there is sediment deposit in the culvert.
  - Top of culvert at site coordinates 6 905 107N, 592 890E is deformed approximately 200 mm to 300 mm.

- The road to the Water Treatment Plant has three culverts: one CSP at the ditch invert; and two HDPE pipe at higher level. The top of the CSP is deformed by approximately 100 mm and its inlet is partially blocked with riprap. Both HDPE pipes are deformed by approximately 20% to 30%.
- Culvert at site coordinates 6 904 990N, 593 035E is slightly deformed, but is considered to be functional.

3.5.2 Comments and Recommendations

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. The following recommendations from the 2012 Annual Geotechnical Review remain valid:

- Clear vegetation from ditch.
- Check capacity of culvert under the road to Grum Settling Pond under its current condition against its design discharge. Replace culvert if capacity is less than design discharge. Alternatively, remove culvert if the road is no longer required. Removal of culvert will improve the conveyance of flow in the ditch.
- Replace the existing culverts under the road to the Water Treatment Plant, if required.
- Remove culvert at site coordinates 6 905 107N, 592 890E if access provided by this culvert is no longer required.
- Continue routine monitoring of ditch and culverts along the ditch.

3.6 North East Interceptor Ditch

North East Interceptor Ditch (NEID) (see Photos 93 to 96, Figures 4 and 5)

The North East Interceptor Ditch diverts surface runoff away from the Vangorda Pit. Our 2013 observations of the ditch are as follows:

- Relatively small flow in ditch along the upper (50%) reach of the ditch; increased flow along the reach downstream of the tributary confluence.
- Four ditch side-slope slumps were observed in the fall along the lower reach: one at the road embankment slope was repaired with large boulders during 2013 freshet, and remaining slumps are to be repaired before next spring freshet including two on the bank slope on the opposite side from the road.

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

- Continue to monitor ditch side slopes, especially along reaches with slope slumps during spring freshet.

- When slope slumps are repaired, filter materials are to be placed between the existing slope and newly added riprap materials. Installation of filter fabric at the contact between material zones of different grain sizes would also be useful.

3.7 Vangorda Creek Diversion Flume

Vangorda Creek Diversion Flume (see Photos 97 to 108 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 Photos 100 and 101), and two emergency spillway culverts with a trash rack at a higher level under the road (see Photos 97 to 99). At the end of the diversion, the flume discharges to a plunge pool, 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 Photos 107 and 108). There is no instrumentation related to the diversion flume.

A flash flood occurred in June 2012, and the flume overflowed. The flood flow was barely contained by the ditch bank slopes above the flume without spilling into the Vangorda Pit. During repair after the flood, the road surface adjacent to the flume ditch was raised in the area to help contain the flood flow (see Photo 106). This flood and its impact were similar to what occurred in June 2004 (SRK, 2004).

3.7.1 Observations

Our 2013 observations of the Vangorda Creek Diversion Flume are as follows:

- At the upstream end of the flume main culvert, large boulders were added as riprap but no filter materials appeared to be present between the riprap and road embankment fill. A small steel trashrack, tied to a few boulders by ropes, has been installed to prevent unravelling of the boulders over the culvert entrance.
- Woody debris has accumulated at the trashracks for the culverts at the upstream end of the flume as well as to the drop box.
- Some sediments were observed at the bottom of twin emergency culverts, and channel invert downstream of the culverts appeared to be slightly too high.
- Some flume braces appeared to bend under stress.
- The CSP flume has holes or is torn at several locations.
- Flume was weighed down by steel canopy (sections of a truck box) at two locations, and the road embankment surface was raised by 0.5 m at the low spot.
- Replacement of the flume along an alignment upslope of the existing alignment is being investigated/designed by CH2MHILL.

3.7.2 Comments and Recommendations

- Remove excess materials from emergency spillway channel for the upstream flume intake downstream of the twin emergency culverts to clear minor blockage at culvert exit.
- Replace the steel trashrack, which is tied to boulders with ropes, with a permanent installation.
- Remove debris from trashracks at the culverts.
- Where flume braces were distressed, add additional braces to stiffen the flume in local areas.
- 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.
- Replace the flume with a new structure as early as practical.

3.8 Little Creek Dam

Little Creek Dam (LCD) (see *Photos* 109 to 118 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 114 to 116).

3.8.1 Observations

Our 2013 observations of the Little Creek Dam are as follows:

- Stable dam slopes with rill erosions developed on the downstream and upstream crest shoulders and slopes.
- A rill erosion began to undermine the foundation of the transformer situated at the downstream crest shoulder (see Photo 112).
- Culvert spillway in good condition, and a relatively low pond level.
- There are cracks in the ground at the downstream end of the spillway outfall channel, at the top of bank slope above Vangorda Creek.

3.8.2 Instrumentation

Instrumentation at the Little Creek Dam (see Figures 13 and 14) 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 for monitoring groundwater quality (SRK 2011b). Detailed data of the pond and piezometric levels and ground temperatures, as provided by TEES, are included in Section II-M of Appendix II. The pond level and maximum piezometric level and corresponding date in 2013 for these piezometers are summarized in Table 3.4.

Since mid-2010, the pond level has been lowered by about 2 m from the range of 1109 m to 1111 m to the range of 1107 m to 1109 m. The ground temperature profiles beneath the dam crest monitored in 2013 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.

Table 3.4 Little Creek Dam - Pond and Piezometer Levels

Location	Name	Historical		2013		Comments
		Max (masl)	Min (masl)	Max (masl)	Min (masl)	
Water Elevation Readings						
Pond Level	LCD	1111.70	1106.48	1110.68	1107.92	Licence Limit = 1111.80
Standpipe Piezometers						
Downstream Toe	P09-LCD-1[1]	1093.74	1093.45	-	-	-
	P09-LCD-2[1]	1093.46	1093.26	-	-	-
	P09-LCD-3[1]	1092.10[2]	1091.83	-	-	-
	P09-LCD-4[1]	1091.62	1082.00	-	-	-
	P09-LCD-6[1]	1090.91[3]	1089.46	-	-	-
	P09-LCD-7[1]	1097.41	1096.93	-	-	-
Pneumatic Piezometers (BH94-LCD1 to LCD3 are nested piezometers with one tip deep and one shallow)						
Dam Crest	BH94-LCD1	1105.77	1104.16	1104.93	1104.86	Shallow
		1105.82	1103.79	1105.26	1104.98	Deep
	BH94-LCD2	1101.76	1100.50	-	1100.71	Shallow
		1102.39	1098.54	-	1099.31	Deep
	BH94-LCD3	1106.76	1105.50	1105.78	Dry[4]	Shallow
		1108.69	1102.89	1104.28	1103.65	Deep

Notes:
1. No reading is available for these instruments in 2013.
2. P09-LCD-3: Maximum level increased by 0.06 m from 1092.04 m to 1092.10 m on May 9, 2012.
3. P09-LCD-6: Maximum level increased by 0.34 m from 1090.57 m to 1090.91 m on May 9, 2012.
4. Tip elevation for BH94-LCD3 (shallow) is at 1105.50 m. Therefore, it is assumed that this piezometer is dry.

3.8.3 Comments and Recommendations

- Consider repair of rill erosions on both dam slopes, especially the erosion that began to undermine the transformer foundation.
- Monitor the cracks at the downstream end of the spillway outfall channel.

- For the BH94- series of pneumatic piezometers (LCD-1 to LCD-3 shallow and deep piezometers), the piezometric levels are in a range consistent with historical variations.
- 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 of P09- series of piezometers are needed for better interpretation of monitored data obtained from these piezometers.
- Since geothermal profiles at the Little Creek Dam indicate that the soil at depth is essentially thawed, no monitoring of thermistors is required for the Little Creek Dam, and existing instrumentation should be preserved for potential future use.

3.9 Sheep Pad Sediment Ponds

Sheep Pad Sediment Ponds (see Photos 119 to 124 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.

Our 2013 observations of the Sheep Pad Sediment Ponds are as follows:

- Freeze-and-thaw longitudinal cracks observed along dyke crest and upstream slope in the spring were subdued in the fall (see Photos 119 and 120).
- Large boulders, weighing down the half-round CSP between the Upper and Lower Ponds near the entrance, restricted flow. There are no stiffening braces across the top of the half-round CSP.
- At the spillway of the Lower Pond, geo-fabric under riprap boulders was exposed in places.

We recommend the following monitoring and maintenance measures:

- Monitor freeze-and-thaw dyke cracks in the spring and seal the cracks by grading the crest and slope to prevent ingress of water.
- Reduce the size of large boulders in the half-round CSP between the two ponds, and add stiffening braces to the top of the CSP to prevent further pipe deformation due to lateral pressure from riprap materials around the pipe.
- Cover exposed geo-fabric with riprap materials at the Lower Pond spillway.

3.10 Grum Settling Pond

Grum Settling Pond (see Photos 125 to 126 and Figures 4 to 5)

The Grum Settling Pond, located just northwest 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.

Our 2013 observations are as follows:

- Spillway channel appeared to be in good condition, with minor vegetation growth.
- Vegetation growth on dyke was relatively dense.

We recommend the following monitoring and maintenance measures:

- Continue to monitor spillway channel for erosion and vegetation growth.
- Continue to monitor retaining dyke embankment and clear vegetation growth, as required.

3.11 V-15 Seep Ditch and Moose Pond

V-15 Seep Ditch (see Photos 127 to 130 and Figures 4 to 5) and Moose Pond (see Photos 131 to 132 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).

Excess inflow entered into Moose Pond during 2013 spring freshet due to release of surface runoff from the Grum Waste Rock Dump (YG 2013). Moose Pond level rose quickly and reached a level slightly higher than that during a similar event in the spring of 2011. The minimum freeboard of the retaining esker ridge was about 1.2 m at the highest pond level in 2013.

3.11.1 Observations

Our 2013 observations of the Moose Pond are as:

- 2013 excess spring runoff inflow into Moose Pond potentially added additional sediment into the pond, and caused additional slumping of the downstream slope of the retaining esker over an area larger than that in 2011.
- Additional ditch erosion-protection materials were added along a steep reach upstream of the Moose Pond (see Photos 129 and 130).
- Pond level dropped significantly in the summer of 2013 due to the blockage of V-15 Ditch to facilitate pumping ditch flow to the Vangorda Pit.

3.11.2 Comments and Recommendations

- Prevent future inflow into Moose Pond from extraneous sources not in existence prior to 2011. A new pump and pipeline are currently being installed at the V15 Ditch area to increase pumping capacity during spring freshet.
- Determine Moose Pond bathymetry using latest survey information obtained in 2013.
- Continue to monitor pond level variation at Moose Pond and its exfiltration performance under current groundwater flow regime.
- 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 that may be required to restore the stability and integrity of the esker ridge.
- Evaluate the long-term impact of the 2011 and 2013 excess-inflow incidents on the normal exfiltration operation of the Moose Pond, as required.
- Remove sediments accumulated in the pond bottom during 2011 and 2013 excess inflows during late summer, if the pond becomes dry.

3.12 Sludge Pond Embankment at Vangorda Water Treatment

Sludge Pond Embankment at Vangorda Water Treatment (see Photos 133 and 134 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. There appears to be no instrumentation at this pond and its periphery dyke.

Our 2013 observations of the Sludge Pond Embankment are as follows:

- Freeze-and-thaw longitudinal cracks observed on the dyke crest in the spring were less obvious in the fall.
- Pond level in the fall of 2013 was higher than that in the fall of 2012.

We recommend the following monitoring and maintenance measures:

- Monitor freeze-and-thaw dyke cracks in the spring, and seal the cracks by grading the crest to prevent ingress of water.
- Continue existing monitoring and maintenance of the retaining embankment.

4 SUMMARY

Section 4 summarizes our 2013 annual review in two sub-sections by means of Tables 4.1 and 4.2:

- general review in Section 4.1; and
- proposed 2014 Faro Mine Complex geotechnical monitoring program in Section 4.2.

4.1 General Review

Table 4.1 provides a description of the structures inspected in 2013 and a summary of our observations and recommendations.

Table 4.1 Faro Mine Site Complex – 2013 Annual Review 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 Zones.	▪ Pit wall conditions similar to that observed in 2012 fall. ▪ TEES data appeared to indicate that no significant changes were measured at reference bars where distances between the pit wall and Faro Creek Diversion Channel have been monitored. ▪ The distance measurement at reference bar #15351 seemed to be improving in 2013 in terms of consistency. ▪ Faro pit is currently used to store water pumped back from Intermediate Pond. ▪ As treatment of water stored in the Faro Pit was suspended in 2013, pit-lake level has risen above the maximum recommended level, and is approaching the minimum overburden/bedrock contact elevation (see Section II-A.1).	▪ 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. ▪ Check distance measurement at reference bar #15351 to eliminate the survey error, which has persisted from 2010 to 2012. ▪ Continue to have pit slope stability reviewed periodically, especially in case of development of new sizable slumps. ▪ Once normal water treatment operation resumes at the Faro site in 2014, slowly lower the pit-lake level to minimize the potential of triggering pit wall instability.
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.	▪ Moderate flow in channel at time of inspection. ▪ Slumps that occurred on the hillside channel slope during 2013 spring freshet have not been repaired, due to safety concerns. ▪ Slumps on the roadside channel slope during 2013 spring freshet were repaired with additional rock armour during freshet.	▪ Continue monitoring of the staff gauges along the diversion channel. ▪ Purchase and install equipment for obtaining stage/discharge calibration data at flow monitoring stations during high flows. ▪ Repair slumps on the hillside slope of the channel safely as soon as practical. ▪ Continue visual monitoring of diversion channel and any seepage from the channel to the Faro Pit wall with photos taken at strategic locations.
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.	▪ Moderate flow in channel at time of inspection. ▪ Stable channel and side slopes along most of its length. ▪ Excessive sediment has been deposited at the inlet, outlet and inside the culverts (see Photos 12 and 13) under the well-access road, and there is also some slumping of the road toe. ▪ Clearance of heavy vegetation growth in upper constructed channel reach was done in the fall of 2012.	▪ Remove sediments from channel at the inlet and outlet of culverts and from inside the culverts under well-access road. The channel bottom at the culvert inlet and outlet could be slightly over-excavated to create a sediment trap and to minimize sediment deposition inside the culverts. ▪ Repair the well-access road embankment at the above culverts. ▪ Resume vegetation removal along upper and middle constructed channel reaches. ▪ Potential locations and construction detail for a weir in the ditch near the beginning of the upper constructed reach were established by Arvind Dalpatram and Tracey Parkin during fall site visit.
Rose Creek Diversion Channel (RCDC) and Canal Dyke	▪ Diverts creek channel flow around south side of tailings impoundment area. ▪ Approximately 3,800 m long with relatively flat to moderate channel gradients along upper reaches and steep gradients along lower reaches.	▪ Moderate flow in channel at time of inspection. ▪ Generally stable channel and side slopes, satisfactory rock armour conditions. ▪ Longitudinal cracks and slope slump scarps developed on the upper portion of the back slope of Rose Creek Diversion channel (see Photos 21 to 24) between Secondary Tailings Dam and Intermediate Dam in the spring of 2013. The condition of the slope in the fall was similar to that observed in the spring. ▪ A small washout of the Canal Dyke occurred near the Cross Valley Dam (see Photo 27). ▪ Moderate vegetation growth in lower channel reaches. ▪ Obvious seepage was observed from RCDC into tailings impoundment in the spring but not fall visit.	▪ Monitor condition of longitudinal cracks and slope slump scarps at the Back Slope of Diversion Channel, and resume instrumentation monitoring along the Back Slope, which was suspended in recent years. ▪ Explore permit requirements regarding investigation and repair of the above slope slumps, starting with obtaining a permit to allow personnel access to the Back Slope to inspect the condition closely under ice-snow free condition. RCDC is the main diversion channel at the Faro site, prevention of a major slump and blockage is a high priority. ▪ Continue to monitor the staff gauge. Extend staff gauge, if required, such that it can be read during high flows. ▪ Purchase and install equipment for obtaining stage/discharge calibration data at flow monitoring stations during high flows. ▪ Clear vegetation along lower channel reaches, and repair the small washout of the Canal Dyke shown on Photo 27 with proper filter material adjacent to ripraps. ▪ Continue to document seepage locations from RCDC into tailings impoundment area after fresh snow fall condition.
North Fork Rock Drain (NFRD)	▪ Mine haul road stream crossing constructed from coarse waste rock fill and drain rock. ▪ Road embankment is approximately 55 m high, with 25 m crest width. ▪ Downstream of the mine haul road, there is an auxiliary culvert beside the main culvert across the Main Access road to the mine.	▪ Generally stable crest and side slope of mine haul road. ▪ Erosion washouts of upstream and downstream road shoulder and embankment slope. ▪ 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. ▪ Repair downstream shoulder washout before next spring freshet to prevent washout fines from blocking drainage path through the existing rock drain at the base of the haul road.

Table 4.1 Faro Mine Site Complex – 2013 Annual Review Summary (cont'd)

Faro Site Facilities			
Structure	**Description**	**Observations**	**Comments and Recommendations**
K8 Creek Rock Drain (K8CRD)	▪ Mine haul road stream crossing constructed from coarse waste rock fill and rock drain. ▪ Road embankment is approximately 55 m high, with 25 m crest width.	▪ Generally stable crest and side slopes of mine haul road. ▪ Erosion washouts of upstream and downstream road shoulder and embankment slope. ▪ Downstream drainage condition acceptable.	▪ Continue to monitor head pond level and downstream flow conditions. ▪ Repair downstream shoulder washout before next spring freshet to prevent washout fines from blocking drainage path through the existing rock drain at the base of the haul road.
Secondary Tailings Impoundment (STI, including Original Tailings Impoundment)	▪ 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 downstream-berm road conditions are satisfactory. ▪ The annual appearance of longitudinal cracks along the downstream berm road surface in the spring and their subsequent disappearance appear to be related to seasonal freezing and thawing effect. This phenomenon repeated in 2013.	▪ Continue to monitor dam performance. ▪ Continue to monitor piezometer instrumentation. ▪ Continue to monitor any crack appearance on the downstream-berm road surface adjacent to the upstream end of the Rose Creek Diversion Channel in the spring, and seal these cracks by grading to minimize water ingress into the road embankment. ▪ Check vegetation growth on the downstream slope and clear, as 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: 32 m. ▪ Crest approximately 650 m long, 7 m wide at El. 1049.2 m and spillway channel invert at El. 1047.7 m. ▪ Downstream berm: about 7 m wide, berm surface at approximate 1031.7 m. ▪ The Starter Dam has a vertical core, which was modified to an upstream sloping core during subsequent dam raises. The rest of dam zones consist of gravel shells and filters.	▪ Pond level was relatively high. ▪ Stable crest, upstream slope and spillway channel, in general. ▪ Near south abutment, a remnant construction feature along the upstream crest shoulder was noted (see Photo 42). ▪ Downstream slope rill erosion condition similar to that in the 2012 fall, with longitudinal cracks and minor slope slumps, and eroded materials depositing on the downstream berm.	▪ Continue to experiment with the increased maximum drawdown rate of Intermediate Pond at 40 mm/day. ▪ Draw down the pond to the targeted drawdown level once normal water treatment operation resumes at the Faro Site. ▪ Continue to monitor instrumentation. ▪ Continue to monitor wave erosion along upstream face. ▪ Continue to monitor a construction feature of upstream crest shoulder near the south abutment. ▪ Continue to monitor rill erosion along downstream face. ▪ Re-grading of downstream slope is planned. Tilted above-ground portion of existing instrumentation on the berm surface to be restored after downstream slope re-grading work.
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. ▪ The annual appearance of longitudinal cracks along the dam crest in the spring and their subsequent disappearance seem to be related to freezing and spring thawing effect. This phenomenon repeated in 2013. ▪ Water stored in the Polishing Pond was being treated through a rental filtration plant at the time of the fall site visit. Compliance water was then released from the filtration plant via the North Valley Wall Interceptor Ditch.	▪ Continue to monitor piezometer and weir instrumentation. ▪ Continue to monitor longitudinal tension cracks on dam crest in the spring, and seal these cracks by grading to minimize water ingress to the embankment dam. ▪ Repair rill erosion in local areas as required.
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, with wet streaks of surface runoff running down the pit wall. ▪ Longitudinal crack at N2 survey rod on the north array increased in width and depth since August 2012 (see Photos 59 and 60), and a slump occurred at the pit brim in the general area (see Photo 61). ▪ Two nearby power poles seemed to tilt towards the pit. ▪ A wire fence encloses a former deep-well site near the transformer station and the south survey road array. The fence closest to the pit brim showed significant distortion as compared to that furthest from the brim. ▪ The pit-lake level has risen above the maximum recommended level and the minimum overburden/bedrock contact elevation (see Section II-J.1). ▪ A pump barge was set up at Grum Pit in 2013, and used to transfer water from Grum to Vangorda Pit for treatment. Pumping from Grum Pit, however, lasted only for a brief period from August to October 2013.	▪ Control of surface runoff in the area between the access road and pit brim above the east wall instability zones was planned. Collected water from the area was to be pumped across the road to the Grum Pit Interceptor Ditch. This work was not carried out in 2013 due to other urgent work on site. ▪ Two tilted power poles near GP-N2 survey rod are closest to the moving pit wall. Further behind there are two power lines. Contingency planning regarding power supply in the area is needed relative to the impact of potential progressive failure of the pit wall. ▪ Continue visual monitoring of pit wall conditions with photos taken from same vantage points. ▪ Installation of prisms as well as prism survey of pit wall brim were carried out by YES (2013b). Additional prisms will be installed by TEES in 2014. ▪ Continue to clear vegetation cover along the north survey-rod array to reveal any surface cracks in the vicinity. ▪ Continue distance monitoring from each survey rod to its respective reference stationary rod along the north and south arrays located on the pit brim, and adjust the monitoring program, as required, to safeguard personnel safety. ▪ Avoid rapid drawdown of pit-lake level, during water treatment period to mitigate slope instability.

Table 4.1 Faro Mine Site Complex – 2013 Annual Review Summary (cont'd)

Faro Site Facilities			
Structure	**Description**	**Observations**	**Comments and Recommendations**
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.	▪ Minor rock fall appeared to occur in an area at the lower portion of the northwest Vangorda pit wall.	▪ Continue visual monitoring of pit wall conditions with photos taken from same vantage points at least at yearly interval.
Grum Dump	▪ The dump is not within the current scope of work. ▪ The dump was visited due to excess surface runoff occurred during spring freshet in 2011 and 2013.	▪ Dykes along the edge of berms downslope of Sulphide Cell were reinforced by re-grading to prevent their breach during spring freshet. ▪ The upper portion of the dump surface was re-graded towards the road side ditch, which facilitated draining of surface runoff by gravity to the Vangorda Pit.	▪ Continue regular monitoring. ▪ Prevent the escape of excess surface runoff from the Grum Dump during spring freshet and flowing into Vangorda Creek or 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.	▪ As noted in previous reports, the steel weir plate at Drain 5 is split. The weir plate at Drain 3 is delaminated and the staff gauge has tipped over. ▪ A small hole has been dug at Drain 4 to collect seepage water. A weir could be installed at the drain to measure the flow.	▪ Repairs at Drains 3 and 5 are to be carried out. ▪ A weir could be installed at Drain 4
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 to heavy vegetation growth, particularly along the upper reaches of the ditch. ▪ Construction area with silt fence was observed on till overburden dump slope. ▪ No change in condition of culverts since 2012 fall site visit.	▪ Clear vegetation from ditch. ▪ Continue routine monitoring of ditch and culverts along the ditch. ▪ For recommendations on culvert maintenance/repairs see Table 4.1 in the 2012 Annual Geotechnical Review report.
Vangorda North East Interceptor Ditch	▪ Located uphill of the Vangorda Pit. ▪ Diverts surface runoff away from the pit.	▪ Small flow in ditch along the upper (50%) reach of the ditch; increased flow along the reach downstream of the tributary confluence. ▪ Four ditch side-slope slumps were observed along the lower reach: one at the road embankment slope was repaired with large boulders, and remaining slumps are to be repaired before next spring freshet including two on the bank slope on the opposite side from the road.	▪ Continue to monitor ditch side slopes, especially along reaches with slope slumps during spring freshet. ▪ When slope slumps are repaired, filter materials are to be placed between existing slope and newly added riprap materials. Addition of filter fabric at the contact between material zones of different grain sizes would be useful.
Vangorda Creek Diversion Flume	▪ 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.	▪ At the upstream end of the flume main culvert, large boulders were added as riprap but no filter materials appeared to be present between the riprap and road embankment fill. A small steel trashrack, tied to a few boulders by ropes, has been installed to prevent unravelling of the boulders over the culvert entrance. ▪ Woody debris has accumulated at the trashracks for the culverts at the upstream end of the flume as well as to the drop box. ▪ Some sediments were observed at the bottom of twin emergency culverts, and channel invert downstream of the culverts appeared to be slightly too high. ▪ Some flume braces appeared to bend under stress. ▪ Flume was weighed down by steel canopy (sections of a truck box) at two locations, and the road embankment surface was raised by 0.5 m at the low spot. ▪ Replacement of the flume along an alignment upslope of the existing alignment is being investigated/designed by CH2MHILL.	▪ Remove excess materials from emergency spillway channel for the upstream flume intake downstream of the twin emergency culverts to clear minor blockage at culvert exit. ▪ Replace the steel trashrack, which is tied to boulders with ropes, with a permanent installation. ▪ Remove debris from trashracks at the culverts. ▪ Where flume braces were distressed, add additional braces to stiffen the flume in local areas. ▪ 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. ▪ Replace the flume with a new structure as early as practical.

Table 4.1 Faro Mine Site Complex – 2013 Annual Review Summary (cont'd)

Faro Site Facilities			
Structure	**Description**	**Observations**	**Comments and Recommendations**
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 erosions developed on the downstream and upstream crest shoulders and slopes. ▪ A rill erosion began to undermine the foundation of the transformer situated at the downstream crest shoulder (see Photo 112). ▪ Culvert spillway in good condition, and a relatively low pond level. ▪ There are cracks in the ground at the downstream end of the spillway outfall channel (see Photo 116) at the top of bank slope above Vangorda Creek.	▪ Repair of rill erosions on both dam slopes, as required. ▪ Monitor the cracks at the downstream end of the spillway outfall channel.
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.	▪ Freeze-and-thaw longitudinal cracks observed along dyke crest and upstream slope in the spring were subdued in the fall (see Photos 119 and 120). ▪ Large boulders weighing down the half-round CSP between the Upper and Lower Ponds near the entrance restricted flow. There are no stiffening braces across the top of the half-round CSP (see Photo 122). ▪ At the spillway of the Lower Pond, geofabric under riprap boulders was exposed in places.	▪ Monitor freeze-and-thaw dyke cracks in the spring and seal the cracks by grading the crest and slope to prevent ingress of water. ▪ Reduce the size of large boulders near the entrance of the half-round CSP between the two ponds, and add stiffening braces to the top of the CSP to prevent further pipe deformation due to lateral pressure from riprap materials around the pipe. ▪ Cover exposed geofabric with riprap materials at the Lower Pond spillway.
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. ▪ Vegetation growth on dyke was relatively dense.	▪ Continue to monitor spillway channel for erosion and vegetation growth. ▪ Continue to monitor retaining dyke embankment and clear vegetation growth, as required.
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.	▪ 2011 excess spring runoff inflow into Moose Pond contributed to the following changes: sealing off the pond bottom by silt deposits, raising pond level and slumping of the downstream slope of a retaining esker at the locations of 2011 raised seepage exit points. ▪ Exfiltration from Moose Pond potentially has changed from occurring at the pond bottom to from the pond bank slope at higher elevations since 2011. ▪ 2013 excess spring runoff inflow into Moose Pond potentially added additional sediment into the pond, and caused additional slumping of the downstream slope of the retaining esker over an area larger than that in 2011. ▪ Additional ditch erosion-protection materials were added along a steep reach of the ditch upstream of Moose Pond (see Photos 129 and 130). ▪ Pond level dropped significantly in the summer of 2013 due to the blockage of V-15 Ditch to facilitate pumping ditch flow to Vangorda Pit.	▪ Prevent future inflow into Moose Pond from extraneous sources not in existence prior to 2011. A new pump and pipeline are being installed in the spring of 2014 at the V15 Ditch area to increase pumping capacity during spring freshet to achieve this objective. ▪ Determine Moose Pond bathymetry using latest survey information obtained in 2013. ▪ Continue to monitor pond level variation at Moose Pond and its exfiltration performance under current groundwater flow regime. ▪ 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 that may be required to restore the stability and integrity of the esker ridge. ▪ Evaluate the long-term impact of the 2011 and 2013 excess-inflow incidents on the normal exfiltration operation of the Moose Pond, as required. ▪ Remove sediments accumulated in the pond bottom during 2011 and 2013 excess inflows during late summer, if the pond becomes dry.
Sludge Pond Embankment at Vangorda Water Treatment Plant	▪ Rectangular-shaped sludge pond retained by embankment dyke.	▪ Freeze-and-thaw longitudinal cracks observed on the dyke crest in the spring were less obvious in the fall. ▪ Pond level higher than that observed in the fall of 2012.	▪ Monitor freeze-and-thaw dyke cracks in the spring, and seal the cracks by grading the crest to prevent ingress of water. ▪ Continue existing monitoring.

4.2 Proposed 2014 Faro Mine Complex Geotechnical-hydrotechnical Monitoring Program

The Faro Mine Complex is currently under a care and maintenance program. Table 4.2 presents our proposed 2014 Faro Mine Complex geotechnical - hydrotechnical monitoring program, which is the same as Table III.3 in Appendix III. As outlined in Appendix III, current site instrumentation monitoring program essentially followed the recommendations by BGC (2010) as shown in Table III.2. The status of 2013 instrumentation monitoring is summarized in Table III.1.

As discussed in Appendix III, the main adjustment proposed in Table 4.2 (Table III.3) is to drop readings of those thermistors installed in the region where permafrost is already thawed. Also the emphasis is on resuming monitoring of thermistors, inclinometers and piezometers in region of technical importance, i.e., the Back Slope of Rose Creek Diversion Channel. Current restrictions by regulators to access the Back Slope of the diversion channel need to be resolved in 2014 in order to cope with the slumps and cracking problem of the hillside slope of the Rose Creek Diversion Channel observed in 2013.

As indicated in Appendix III, the monthly observations for the K8 Rock Drain and the Vangorda Creek Diversion Trash Rack at Headworks have also been revised to require observations during the spring freshet period.

Table 4.2 Proposed 2014 Faro Mine Complex Geotechnical – Hydrotechnical Monitoring Program

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rose Creek Diversion Canal													
Thermistors	Canal Dyke: CD-10[2], CD-15[2], CD-21[2], BGC05-04, BGC05-07, CD-26						M						
	Spoil Pile[2]: SP-2, SP-3, SP-5						M						
	Backslope[2]: BS-5, BS-9, BS-10, BS-12						M			M			
Slope Indicators	Canal Dyke: CD-10, -15, -19, -21. BH94CD-1. BH91-CD1. BGC05-05, -08.					One successful reading for all inclinometers							
	Spoil Pile: SP-2, SP-5					One successful reading for all inclinometers							
	Backslope: BS-5, BS-9, BS-10					Two successful readings for all inclinometers:							
						one set in spring/summer, the other in fall							
Piezometers	Canal Dyke: CD-13, -15,-21. BGC05-02, -03, -06. CD-26.					M	M			M			
	Backslope: BS-5, BS-9					M	M			M			
Staff Gauges	RCDC-4				Daily	Daily	Daily	Daily	Daily	Daily			
Cross Valley Dam													
Thermistors	CVDC-6, BH88-4												
Piezometers	CVDC-4, -7, -9. CVDT-1, -2. CVDP-1, -3, -5, -6. 94 CVDC-1.					M	M			M			
Weir Flows	X11, X12, Weir 3	M	M	M	M	M	M	M	M	M	M	M	M
	X13	W	W	W	W	W	W	W	W	W	W	W	W
Elevations	Polishing Pond	W	W	W	W	W	W	W	W	W	W	W	W
Intermediate Dam													
Piezometers	91ID-4, -6, -7. 94-IDC-1, 96-1, -2, -3, -4. P01-03, -04. BKS04-06, -07.					M	M			M			
	91-ID3					M	M		M	M			
Observe	Seepage observations near south abutment					M	M		M	M			
Elevations	Intermediate Pond	W	W	W	W	W	W	W	W	W	W	W	W
Secondary Tailings Dam													
Piezometers	P81-6, P81-7, P81-8, P03-01, P03-02, P03-03					M	M			M			
North Fork Rock Drain													
Data loggers	NFRD23				M	M	M	M	M	M	M		
Staff Gauges	NFRD23, X2				Daily	Daily	Daily	W	W	W	W		
Elevations	NF1, NF2					W	W	W	TAM	TAM			
Observe	NF1, NF2	M	M	M	M	M	M	M	M	M	M	M	M
K8 Rock Drain													
Observe						M	M	M					
Faro Creek Diversion Channel													
Staff Gauges	FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	TAM	TAM	TAM	TAM	TAM		
Flows	FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	TAM	TAM	TAM	TAM	TAM		
Faro Pit													
Measure	15356, 15717, 15355, 15737, 15354, 15742, 13908, 15352, 15351					M				M			
Observe	Faro Pit	M	M	M	M	M	M	M	M	M	M	M	M
Haul Road													
Observe	K8 Rock Drain					M	M	M					
Grum Pit													
Measure	GP-S1, -S2,-S3, -S4. GP-N1, -N2, -N3, -N4, -N5, -N6.	M	M	M	M	M	M	M	M	M	M	M	M
Observe	Grum Pit Wall	M	M	M	M	M	M	M	M	M	M	M	M
Piezometers	SRK09-GSA, SRK09-GSB	M	M	M	M	M	M	M	M	M	M	M	M
Vangorda Pit													
Observe	Vangorda Pit Wall	M	M	M	M	M	M	M	M	M	M	M	M
Vangorda Waste Rock Dump													
Observe	V28, V29, V30, V31, V32, V33					M	M	M	M	M	M		
Observe	Drainage Ditch						M						
Observe	Northeast Dump Crest						M						
Flows	V29, V30, V31, V32, V33					TAM	TAM	TAM	TAM	TAM	TAM		
Piezometers	V39, 40, 41, 42, 43, 44, 45, 46, 47. PW-10-01, -02, -03, -04, -05.					M				M			
Data loggers	PW-10-01, PW-10-02, PW-10-03, PW-10-5					M				M			
Little Creek Dam													
Piezometers	BH94 LCD-1, BH94 LCD-2, BH94 LCD-3					M				M			
Thermistors	BH94 LCD-4, BH94 LCD-5, BH94 LCD-6												
Observe	Dam Crest						M						
Observe	Inlet of Culvert Spillway						M						
Vangorda Creek Diversion													
Observe	Trash Rack at Headworks					M	M	M					
Observe	Seepage Collection Pond						M						
Observe	Sideslopes Above Flume					M	M	M					
Sludge Pond Embankment													
Observe	Downstream slopes and Embankments						M						
Grum Settling Pond													
Observe	Spillway from Grum Settling Pond to Grum Inteceptor Ditch						M						
Grum Interceptor Ditch and Sheep Pad Pond													
Observe	Outlets / Inlets to Ditch						M						
	Sheep Pad Pond Dyke						M						

Notes: 1. M means monthly, W means weekly and TAM means twice a month

2. It is critical to take readings of thermistors located in Back Slope and Spoil Pile as well as Thermistors CD-10, CD-15 and CD-21 in 2014.

5 CONCLUSIONS AND RECOMMENDATIONS

Based on our 2013 annual review including spring and fall site visits, ongoing review of TEES monitoring data and periodical discussions with YG and TEES, the main conclusions and recommendations are presented in Sections 5.1 and 5.2.

5.1 Conclusions

Our major conclusions are as follows:

- The key waste and water management facilities at both the Faro and Vangorda Plateau sites have in general functioned satisfactorily in 2013 as in the past. The care and maintenance activities, including instrument monitoring, survey measurement and surveillance / maintenance, are performed generally following the planned schedules.
- The pit-wall rim movement monitoring programs at the Faro and Grum Pits indicate that the measured distance changes are within the measurement accuracy.
- At the instability zones along the east wall of Grum Pit, cracks and ground deformation observed by TEES in August 2012 continued to develop in 2013. In response, YG initiated installation and survey of prisms along the pit rim in the fall of 2013 and will extend the program in 2014 (CH2MHILL 2013a and YES 2013b).
- The latest dam-safety related activities carried out for the Faro Mine Complex included the following:
  - A dam breach and inundation study for the Intermediate, Cross Valley and Little Creek Dams was issued (KCB 2014a).
  - The Operations, Maintenance and Surveillance (OMS) Manual for the above three dams was updated (KCB 2014b).
  - The Emergency Response Plan (ERP) for the above three dams, Faro Creek Diversion Channel, Rose Creek Diversion Channel and Vangorda Creek Diversion Flume was updated (KCB 2014c).
  - The Government of Yukon plans to conduct the third dam safety review in 2014 for the Intermediate, Cross Valley and Little Creek Dams.
- In 2013, normal water treatment operation continued at the Vangorda Treatment Plant. However, at the Faro site water treatment plant operation was suspended due to safety issue. To cope with this temporary situation, a rental filtration plant was set up at the north abutment of the Cross Valley Dam in the summer to treat and release water from the Polishing Pond via North Valley Interceptor Ditch, when water quality is in compliance with discharge criteria. In addition, excess water in the Intermediate Pond was pumped back to the Faro Pit.

- A pump barge has been set up at the Grum Pit starting in 2013 to transfer water from the Grum Pit Lake to Vangorda Pit Lake from August to October, and, in turn, water was transferred to Vangorda Water Treatment Plant for treatment.
- In 2013 the pit lake level has risen towards the overburden/bedrock contact at the Faro Pit and Grum Pit with potential increase of seepage out of the pit lakes. The ongoing rise of pit lake level in the overburden zone could undermine local pit wall stability as well as increase groundwater degradation in the pit rim region.
- Excess inflow into Moose Pond occurred during 2013 spring freshet due to release of surface runoff from the Grum Waste Rock Dump. Measures were taken to drain some of this runoff directly to Vangorda Pit Lake by gravity and to improve retention dykes around surface water storage areas on the lower berms of the waste rock dump.

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 summarized below:

Hydrotechnical Aspects

- Faro Creek Diversion Channel:
  - Purchase and install equipment to allow flow measurements for staff gauge calibration under high flow conditions.
  - Continue monitoring of the staff gauges along the diversion channel.
- North Valley Wall Interceptor Ditch:
  - At the North Valley Wall Interceptor Ditch, sediments have been accumulated at the inlet and outlet of culverts and inside the culverts under the well-access road (see Photos 12 and 13). These sediments need to be removed to prevent blockage of culverts prior to the next spring freshet. The channel bottom at the culvert inlet and outlet could be slightly over-excavated to create a sediment trap and to minimize sediment deposition inside the culverts.
  - Continue vegetation clearance along the 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:
  - Purchase and install equipment to allow flow measurements for staff gauge calibration under high flow conditions. Staff gauges should also be extended in length so that high-flow readings could be recorded.

- Intermediate Dam:
  - Continue to experiment with the increased maximum drawdown rate of Intermediate Pond at 40 mm/day.
  - 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 not expected to occur within the next 10 years.
  - Site staff indicated that re-sloping of existing material on the downstream slope, with a dozer, has been successfully implemented in 2000s. We recommend that this practice be resumed as early as practical to prevent further degradation of the slope by rill erosion.
  - Monitor ongoing downstream slope rill erosions, and resulting slope slumps and longitudinal cracks prior to the restoration of the downstream slope.
  - Repair shoulder erosion of the downstream berm.
- Grum Pit:
  - Since 2012, the East Instability Zones of the Grum Pit wall has experienced additional movement and cracking near the North Surveying Array. To retard this ongoing movement, Golder (2013) recommended removing the surface runoff in the area between the pit wall and the haul road behind and diverting this water to the Grum Pit Interceptor Ditch. This recommendation needs to be implemented as early as practicable. In addition, contingency measures need to be taken to protect the power transmission system in this area in light of ongoing potential progressive slope failure of the pit wall in the East Instability Zones of the Grum Pit.
- Vangorda Waste Rock Dump:
  - Repair the weir plate at Drain No. 5. 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.
- Vangorda Northeast 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, especially prior to spring freshet.
- Vangorda Creek Diversion Flume:
  - We understand that YG and CH2MHILL are investigating the relocation of the Vangorda Creek Diversion Flume along an alignment upslope of the existing one. Prior to its relocation, ongoing surveillance and maintenance of the existing flume and the ditch channel containing it will be required to prevent the flume flow spilling into the Vangorda Pit, especially during flood events similar to those that occurred in 2004 and 2012.

- Little Creek Dam:
  - Monitor ongoing rill erosion along the downstream and upstream slopes.
  - Consider repair or restoration of the dam slopes at the locations of rill erosion, especially in the foundation area of the transformer located on the dam crest.
  - Monitor the cracks at the downstream end of the spillway outfall channel.
  - Investigate potential mitigation measures to reduce downstream impact of a dam breach of the Little Creek Dam on the Town of Faro as discussed in our inundation study (KCB 2014a).
- Sheep Pad Sediment Ponds:
  - Reduce the size of large boulders in the half-round CSP between the two ponds, and add stiffening braces to the top of the CSP to prevent further pipe deformation.
  - Cover exposed geo-fabric with riprap materials at the Lower Pond spillway.

Geotechnical Aspects

- Faro, Grum and Vangorda Pit Rims:
  - As recommended by Golder (2013), continue the prism survey program initiated by YES (2013b) to monitor the instability zones of the east pit wall at Grum Pit, in light of increasing deformation near the cracks developed along the north array of survey rods in the pit rim area since 2012.
  - Continue the current pit-rim movement monitoring programs, and watch out for personnel safety while carrying out monitoring work.
  - Continue to check pit slope stability periodically, especially in case of development of new sizable slope slumps.
  - Check distance measurement for reference bar #15351 at Faro Pit to eliminate the survey error which persisted from 2010 to 2012.
- Faro and Grum Pit-Lake Levels:
  - The suspension of water treatment operation at the Faro Water Treatment Plant in 2013 resulted in continued rise of Faro Pit Lake level within 1.9 m to the lowest contact elevation between bedrock and overburden at Faro Pit. Further rise of the lake level above this contact is expected to increase seepage from the Faro Pit Lake to its surrounding area, due to much higher permeability of overburden than that of bedrock, with potential impact on surrounding water quality and pit wall stability. Thus, close attention to monitor groundwater quality and pit wall stability at Faro Pit is required until the lake level is drawn down to below the recommended level, most likely after the commissioning of the new interim water treatment plant at the Faro site in the summer of 2014.
  - Similarly the lake level of the Grum Pit reached above the minimum bedrock/overburden contact elevation by 0.1 m by the end of 2013. The potential impact of increased seepage

from the Grum Pit Lake on surrounding water quality and pit wall stability will require close attention until the lake level is drawn down to below the recommended level.

- Rose Creek Diversion Channel:
  - Since 2013 spring, the hillside slope of the Rose Creek Diversion Channel developed slope slumps and cracks east of the Intermediate Dam. Currently, we understand that TEES and YG are working on the access issue to permit a close examination at the site of the affected slope. We believe that this issue needs to be resolved in 2014 so that the slope stability of the hillside slope of the Rose Creek Diversion Channel can be properly assessed and any remedial measures that may be required can be designed and implemented, as required. Since Rose Creek Diversion is the main diversion channel at the Faro site, prevention of a major slump and blockage of this diversion is a high priority.
- Intermediate Dam:
  - Both the upstream and downstream slope improvements should be guided by the long-term closure provision for the dam.
- Cross Valley Dam:
  - It would be desirable to construct a secondary access road to the crest of the Cross Valley Dam through the south abutment from the Rose Creek Diversion Channel access road as discussed in the updated Emergency Response Plan (KCB 2014c).
- Moose Pond:
  - Prevent extraneous surface runoff entering into the Moose Pond to compromise its exfiltration capacity and damage the stability and integrity of the downstream esker ridge that retain the pond.
  - Continue to monitor quality of seepage water downstream of the esker ridge to confirm that the Moose Pond continues to serve adequately its exfiltration function.
  - Monitor the downstream slope of the esker ridge where seepage flow daylights, and implement remedial measures, if required, to maintain the stability and integrity of the esker ridge.
  - Remove sediments accumulated in the pond bottom during 2011 and 2013 excess inflows during late summer, if the pond becomes dry.

Site Monitoring Data Collection and Presentation

The collection and presentation of site monitoring data by TEES in 2013 has improved considerably. However, the following suggestions are grouped together to serve as reminders for site personnel.

- Data collection:
  - Inclinometer data - The collected data in 2013 suggests that TEES may need to improve some of its personnel's capability to obtain correct inclinometer data. There are still significant portion of the collected data unusable.

- Staff gauge flow calibration - KCB provided 2013 flow calibration presented in Section II-B.1 and II-D.1 for staff gauges located in Faro Creek Diversion and Rose Creek Diversion, respectively. Further KCB review and assistance in flow calibration may be needed.

- Data Presentation
  - We suggest that TEES to review all data presented in Appendix II, and to confirm that future data presentation by TEES will produce similar plots in 2014. In other words, the presented plots would allow comparison of data for the current year with those in preceding years. The objective would be that data presented by TEES for the annual review will not require further work by KCB with the exception of inclinometer data, and possibly flow data from staff gauges.

We appreciate the opportunity to work on this interesting and environmentally important project, and to exchange information and ideas with you, your colleagues and site personnel.

KLOHN CRIPPEN BERGER LTD.

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Robert C. Lo, P.Eng. (YT)
Project Manager

August 20, 2014

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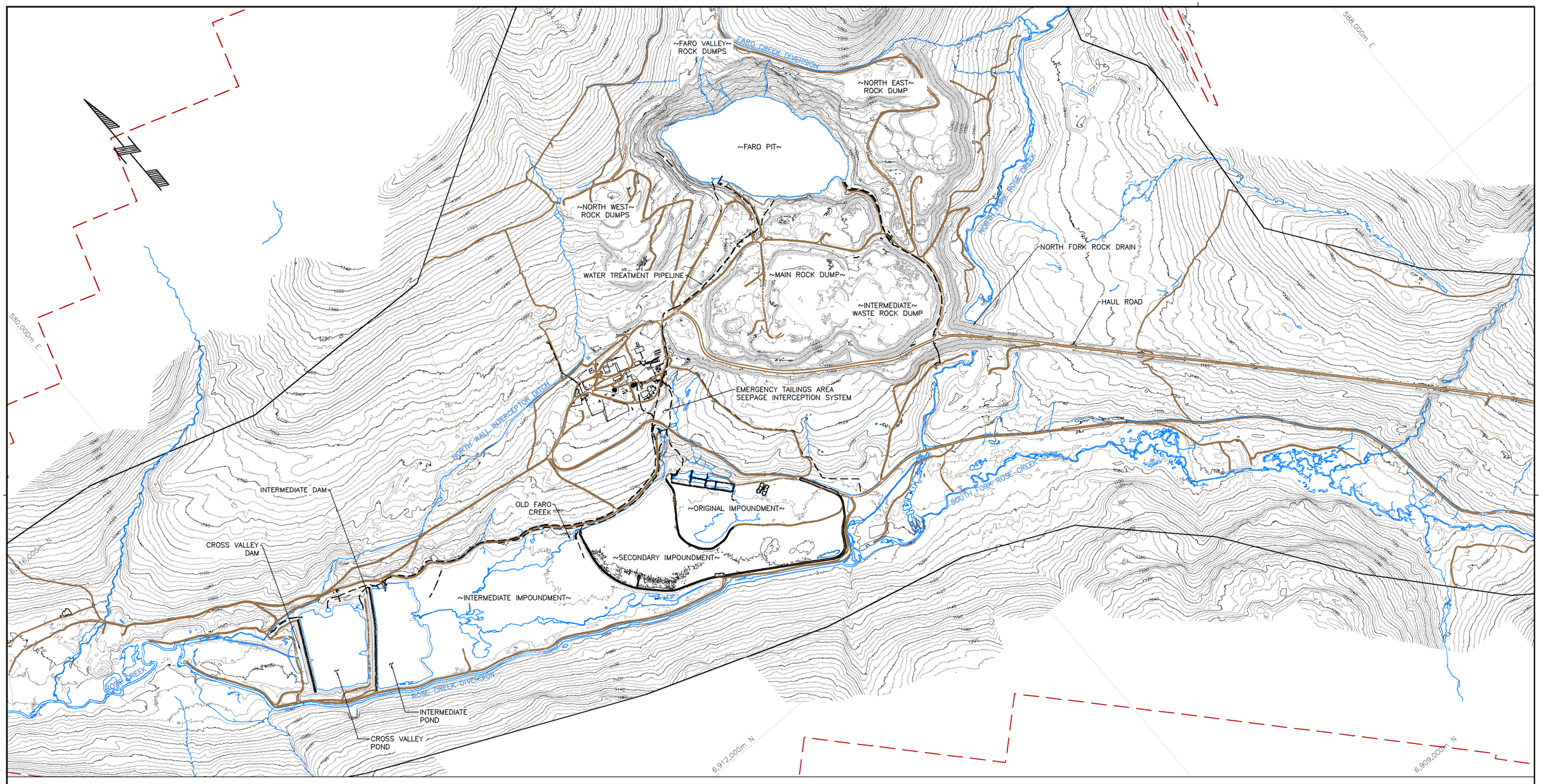
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FIGURES

Figure 1	Faro Site – General Layout
Figure 2	Faro Site – Air Photo
Figure 3	Vangorda Plateau Mine – Site Overview
Figure 4	Vangorda Plateau Site – General Arrangement Plan
Figure 5	Vangorda Plateau Site – Air Photo
Figure 6	Review of Pit Slope Monitoring Data – Site Plan
Figure 7	Down Valley Tailings Containment Instrument Location – 1 of 2
Figure 8	Down Valley Tailings Containment Instrument Location – 2 of 2
Figure 9	Section View of Intermediate Dam
Figure 10	Section View of Cross Valley Dam
Figure 11	Location Map for Survey Prisms Installed along Instability Zones of Grum Pit East Wall
Figure 12	General Arrangement Plan – Vangorda Waste Rock Dump
Figure 13	Little Creek Dam – General Arrangement Plan
Figure 14	Little Creek Dam – Section B-B



LEGEND

- IMPACTED AREA BOUNDARY
- ACESS ROADS
- STREAMS

NOT FOR CONSTRUCTION

To be read with Klohn Crippen Berger report dated

SCALE 0 1000m

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CLIENT: YUKON GOVERNMENT

Klohn Crippen Berger

PROJECT: FARO MINE COMPLEX
2012 ANNUAL GEOTECHNICAL REVIEW

TITLE: FARO SITE GENERAL LAYOUT

PROJECT No. M09770A02 02

FIG. No. FIGURE 1

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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		
CHECK	WJP	28FEB11	FIGURE 2-1	
REVIEW	JAH	28FEB11		

\\int.klohn.com\ProjData\M\VCR\M09770A01 - Gov't Yukon-FaroSiteGeotech\300 Design\Figures\GIMP_edited_files\Figure3_Vangorda_Plateau_Mine_Site_Overview.xcf (afischer)

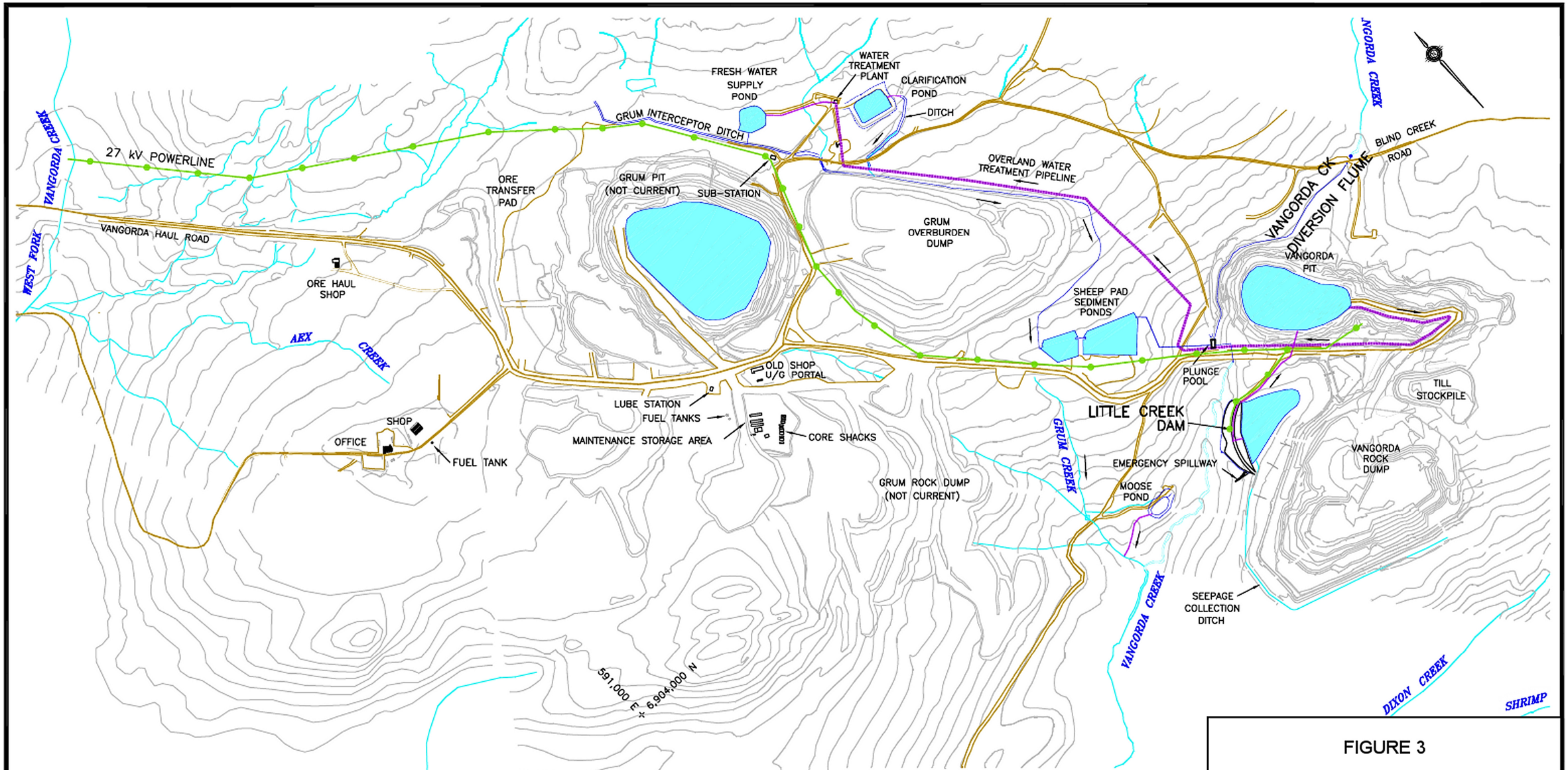


Fig. 3 Original Source: Figure 3 Vangorda Plateau Mine Site – Overview BGC 2003. Report on Emergency Preparedness Plan for Selected Dams and Water Diversion Structures

CLIENT: **Deloitte & Touche**

NOTE: BASE MAP FIGURE PROVIDED BY GARTNER LEE LTD.

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

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED

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DRAWN:	GEJ
DESIGNED:	KM
CHECKED:	HHH/JWC
APPROVED:	JWC

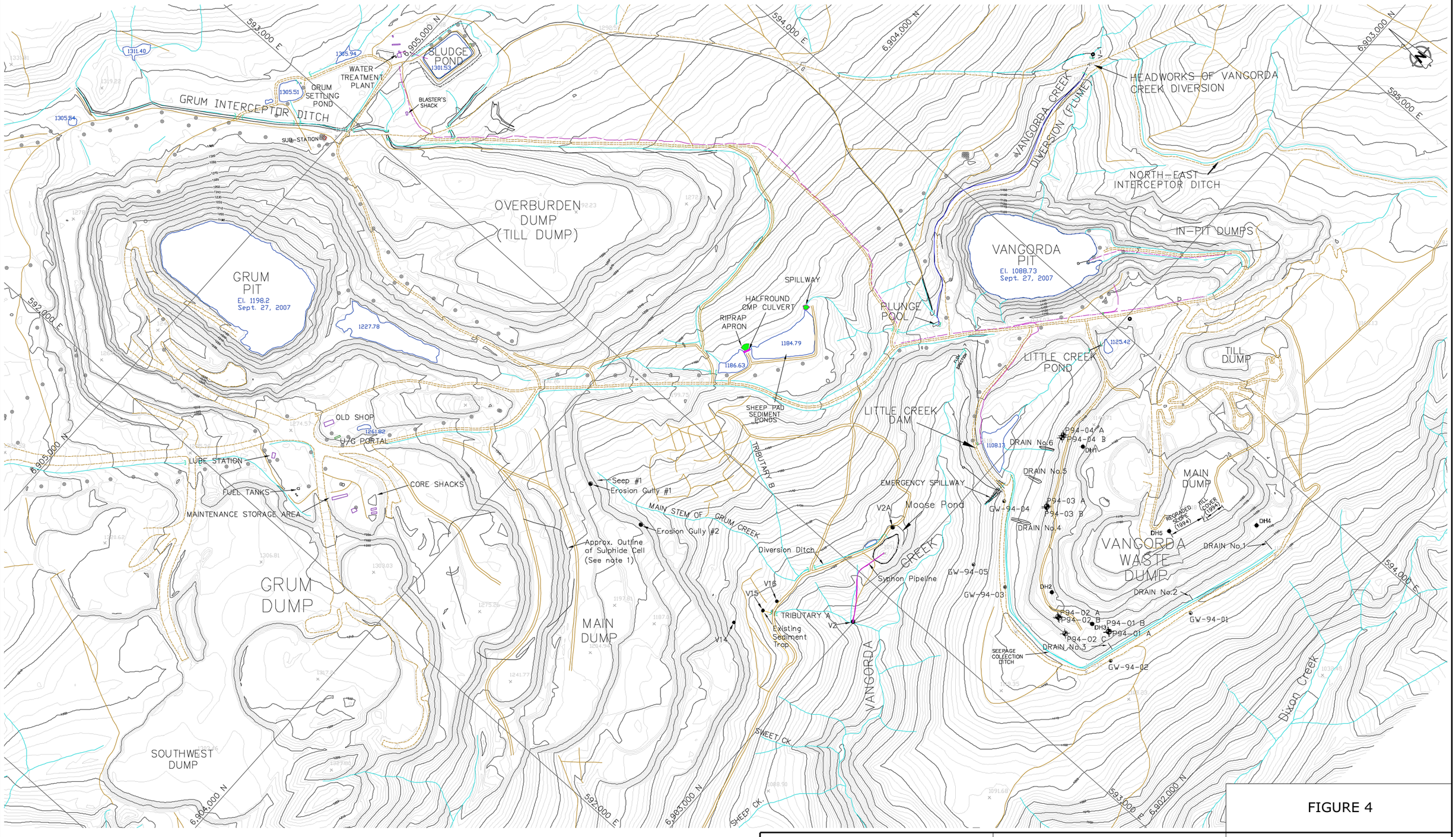
FIGURE 3

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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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

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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

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

Denison Environmental Services

FARO MINE COMPLEX

FIGURE 4

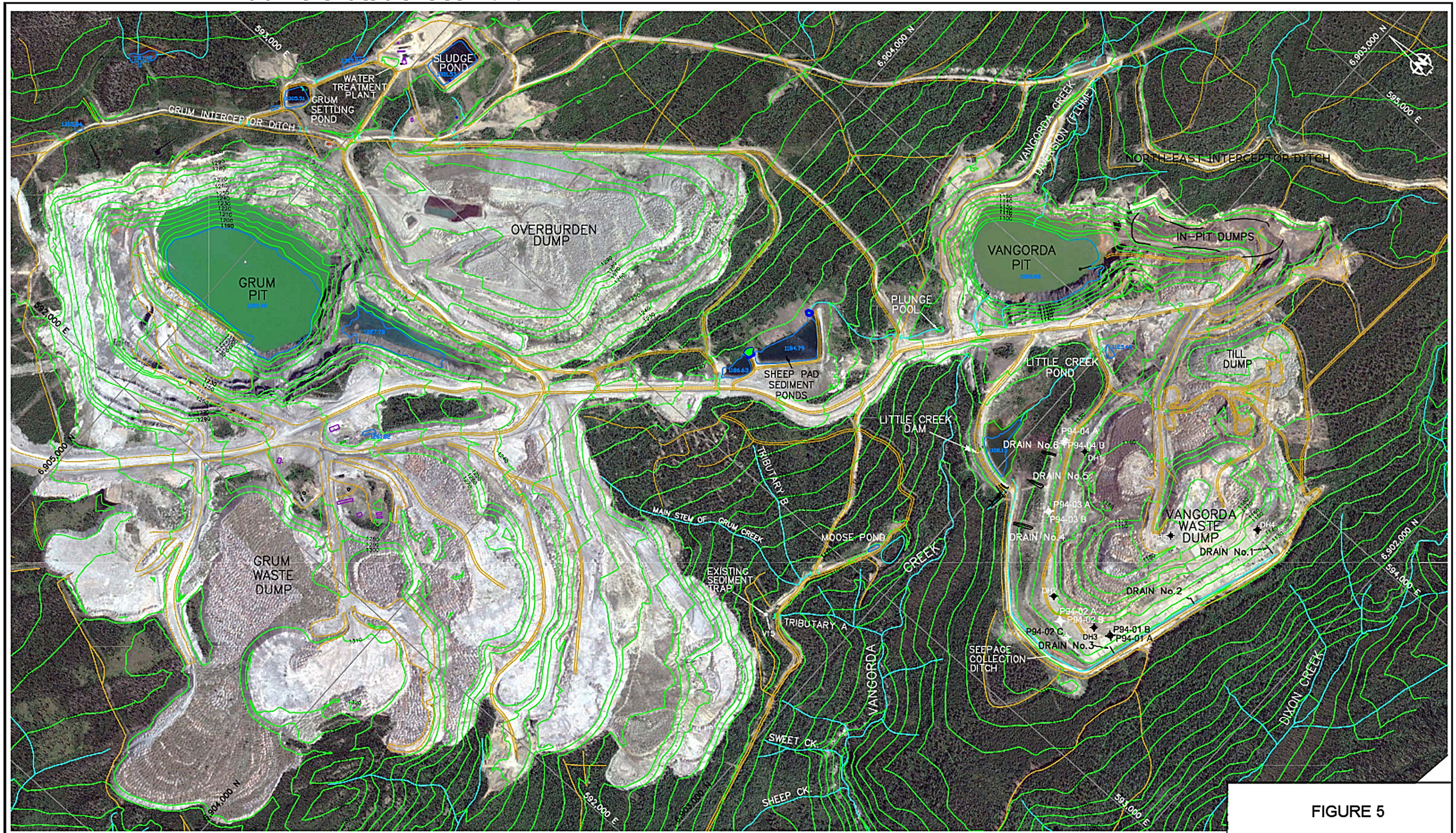
2010 Vangorda Annual Inspection

General Arrangement Plan

DATE:	APPROVED:	FIGURE:
Feb. 2011		2

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Date of Photography: 18/09/09
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Survey control based on: UTM Projection, NAD27

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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

SRK JOB NO.: 1CD009.005
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Denison Environmental Services

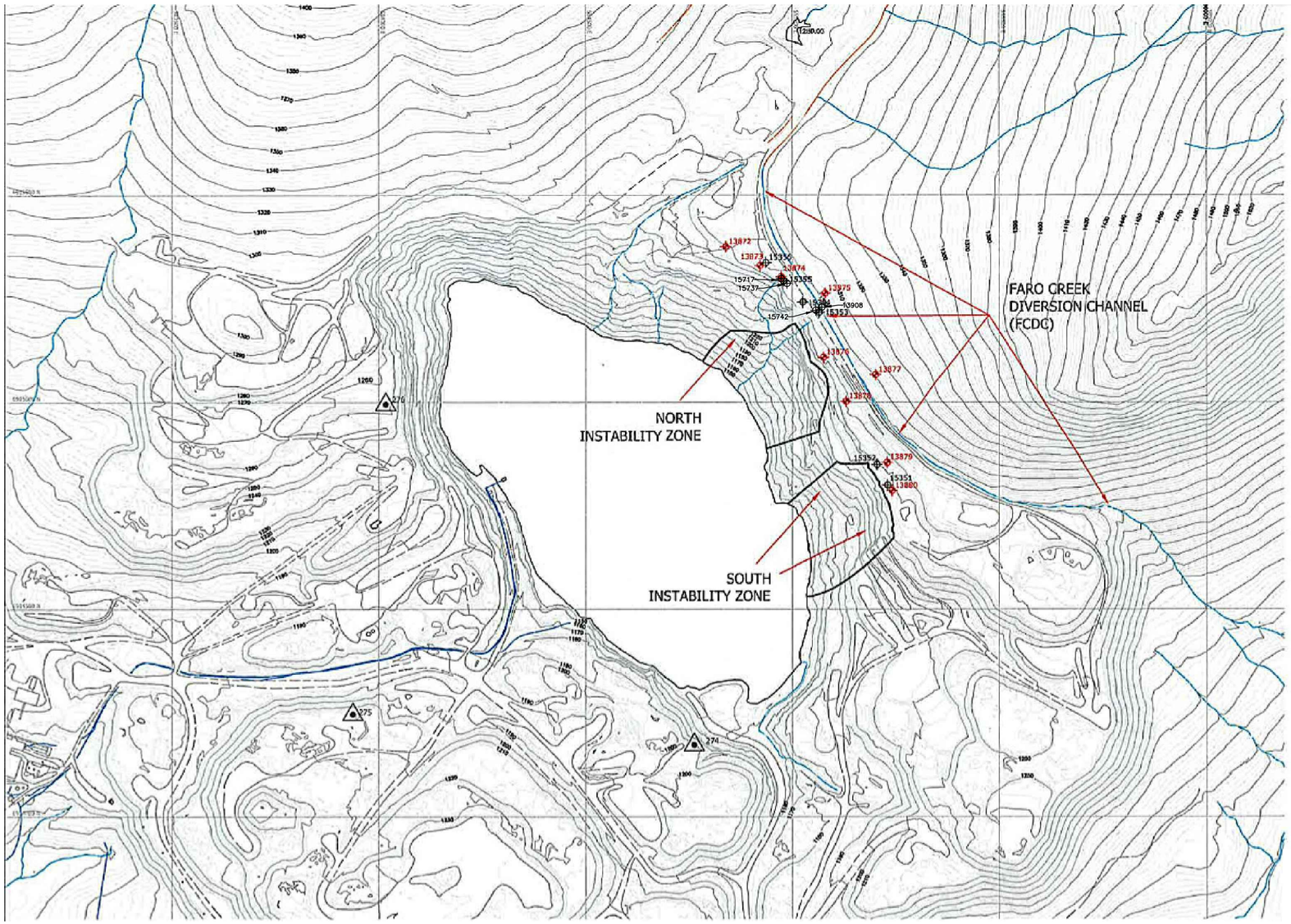
FARO MINE COMPLEX

FIGURE 5

2011 Vangorda Geotechnical Inspection

VANGORDA PLATEAU SITE AIR PHOTO

DATE:	APPROVED:	FIGURE:
July 2011	PMH	3



NOTES:

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

LEGEND:

- 13878 — MONITORING SURVEY PRISMS
- 13912 — SLOPE MOVEMENT OBSERVATIONS - REFERENCE BARS
- 274 — OBSERVATION POINTS-FIXED LOCATION

NOTES:
1. ORIGINAL FIGURE PROVIDED BY GOLDER ASSOCIATES.
2. SLOPE MOVEMENT OBSERVATIONS 15717, 15737, 15742 AND 13908 APPROXIMATELY LOCATED.

To be read with Klohn Crippen Berger report dated

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CLIENT: Yukon Government

Klohn Crippen Berger

PROJECT: FARO MINE COMPLEX
ANNUAL REVIEW

TITLE: FARO PIT BRIM
REFERENCE BARS AND SURVEY PRISMS

PROJECT No.: M09770A03 01

FIGURE 6

KCB-R-MLD

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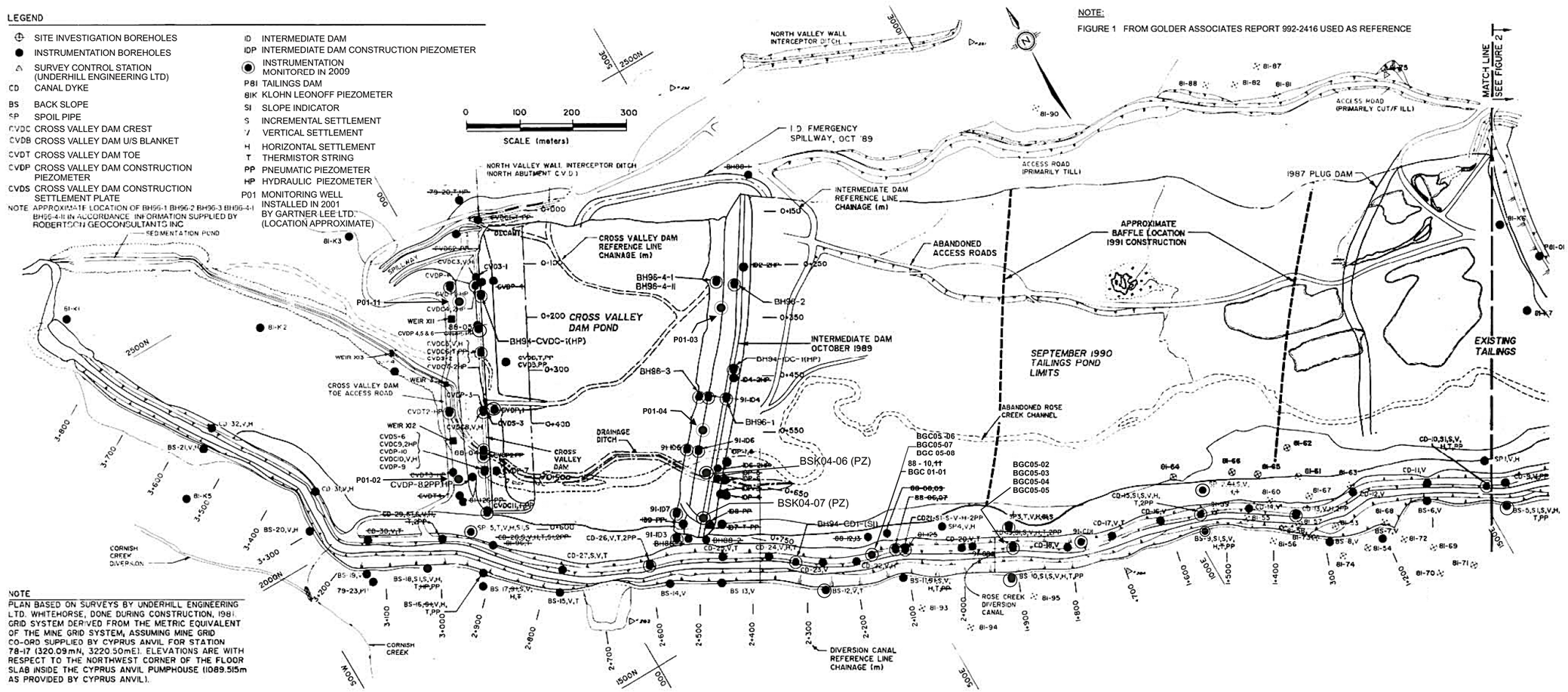


Fig. 7 Original Source: Figure 2 - 2009 Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 7

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DATE:	FEB 2010
DRAWN:	TMW
DESIGNED:	TMW
CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

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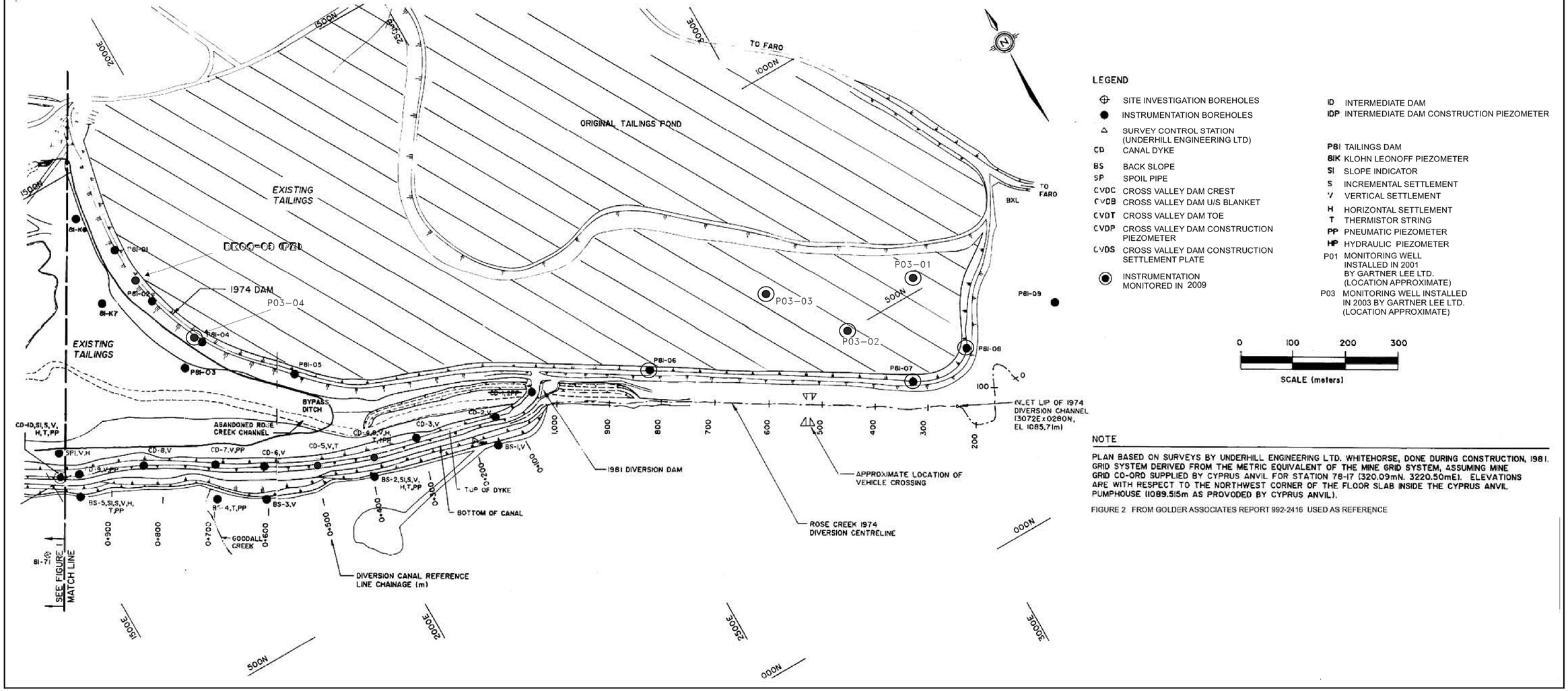
CLIENT: Denison Environmental Services

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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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
- INSTRUMENTATION MONITORED IN 2009
- ID INTERMEDIATE DAM
- IDP INTERMEDIATE DAM CONSTRUCTION PIEZOMETER
- PBI TAILINGS DAM
- BIK 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)
- P03 MONITORING WELL INSTALLED IN 2003 BY GARTNER LEE LTD. (LOCATION APPROXIMATE)

0 100 200 300

SCALE (meters)

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 PROVODED BY CYPRUS ANVIL).

FIGURE 2 FROM GOLDER ASSOCIATES REPORT 992-2416 USED AS REFERENCE

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

FIGURE 8

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DATE:	FEB 2010
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CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

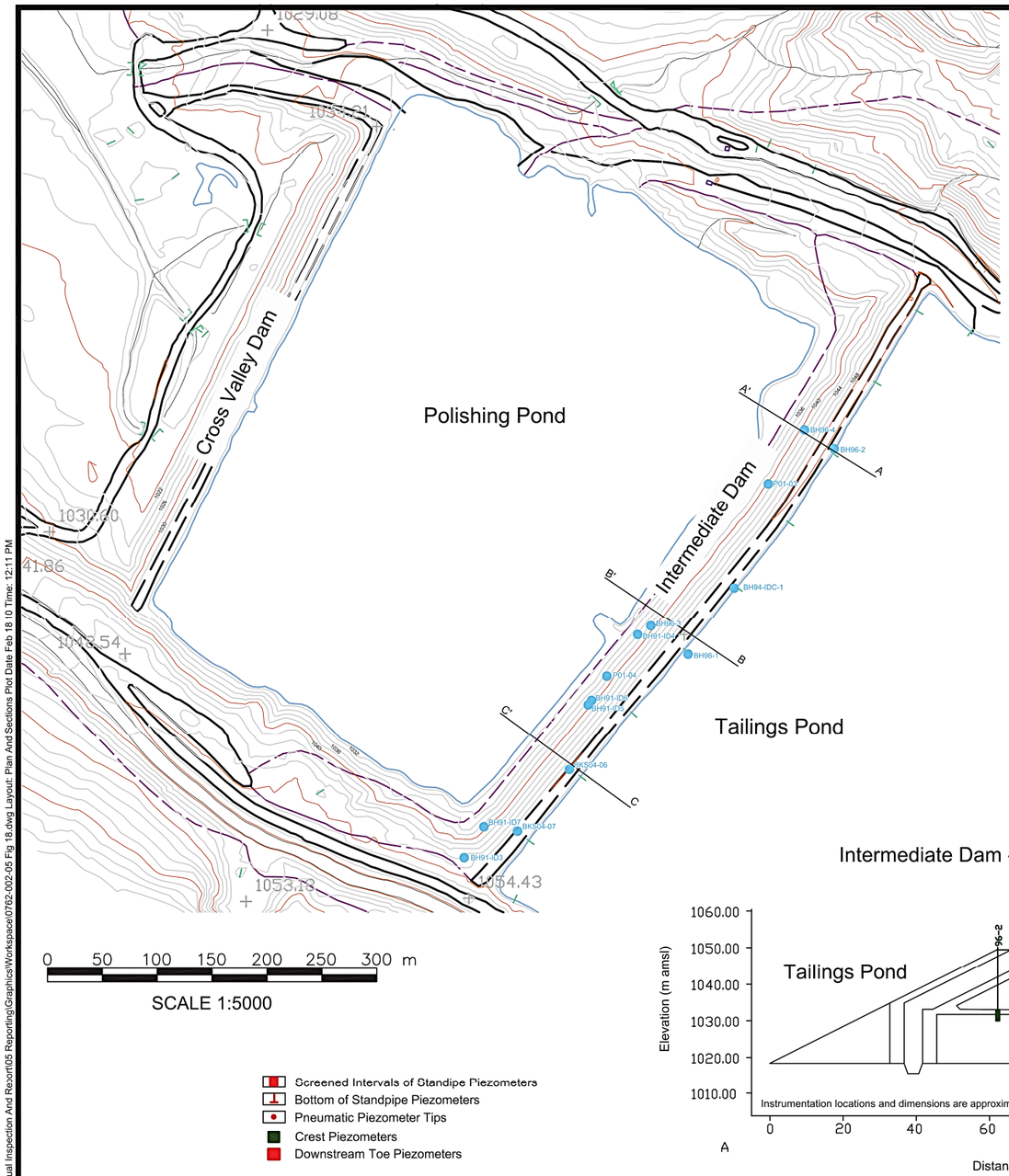
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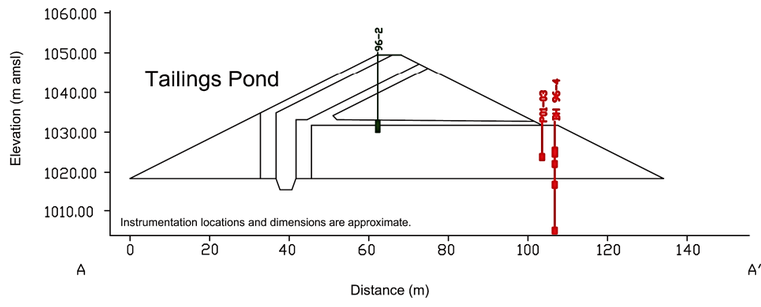
PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: DOWN VALLEY TAILINGS CONTAINMENT INSTRUMENT LOCATION 2 OF 2

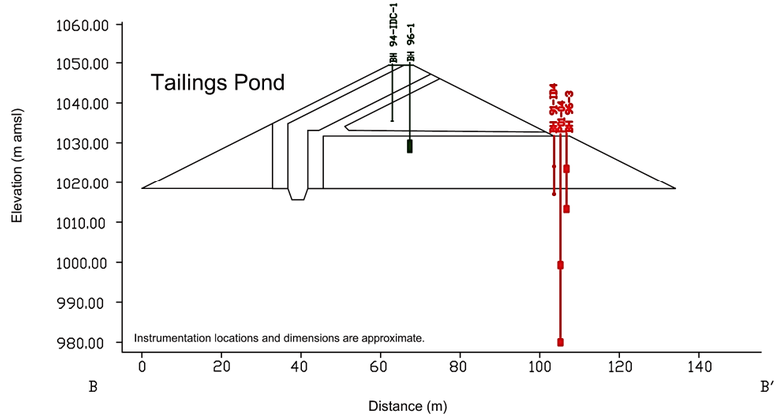
PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	3	0



Intermediate Dam - Cross-Section A - A'



Intermediate Dam - Cross-Section B - B'



Intermediate Dam - Cross-Section C - C'

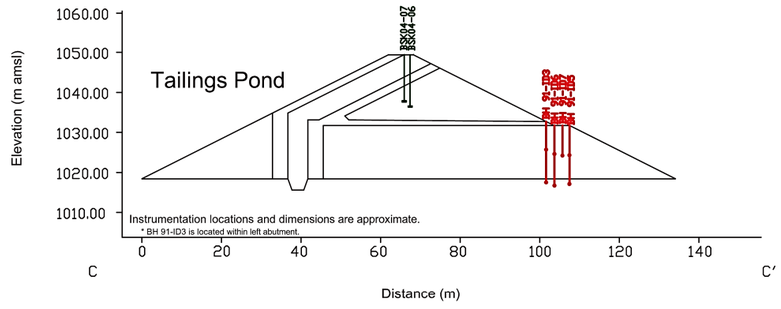


Fig. 9 Original Source: Figure 18 - 2009 Annual Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 9

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CHECKED:	HHH
APPROVED:	GWF

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CLIENT: Denison Environmental Services

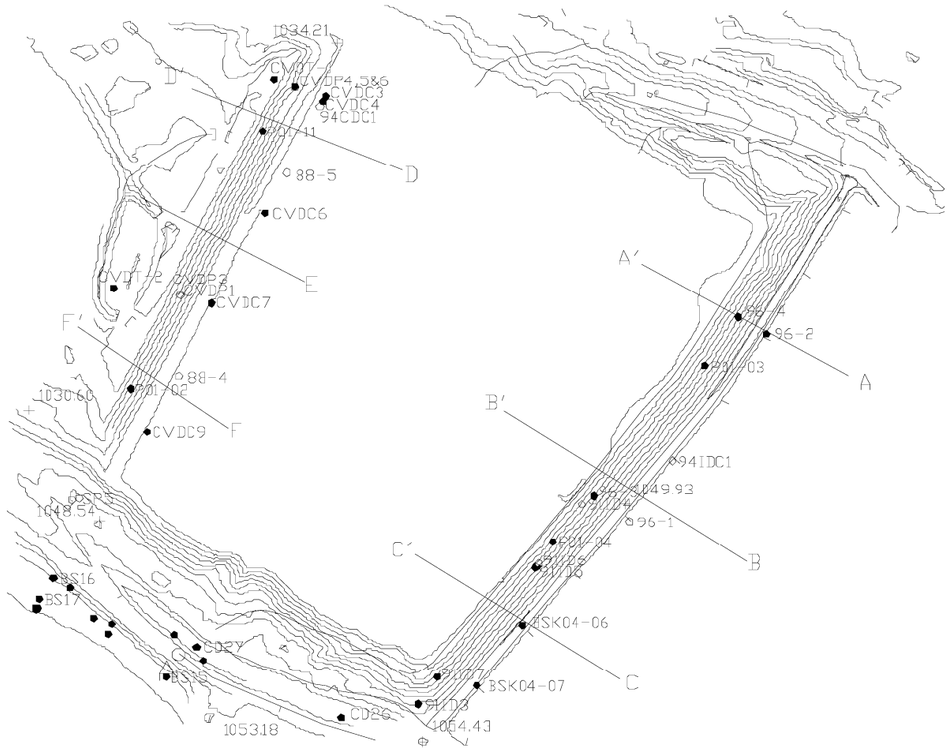
PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: SECTION VIEW OF INTERMEDIATE DAM

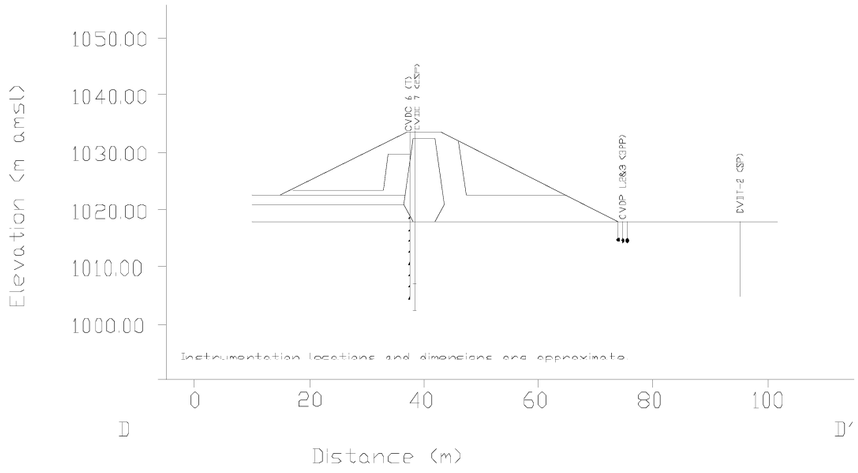
PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	18	0

K:\Projects\0762 Denison Environmental\02 2009 Annual Inspection And Report\05 Reporting\Graphics\Workspace\0762-002-05 Fig 18.dwg Layout: Plan And Sections Plot Date Feb 18 10 Time: 12:11 PM

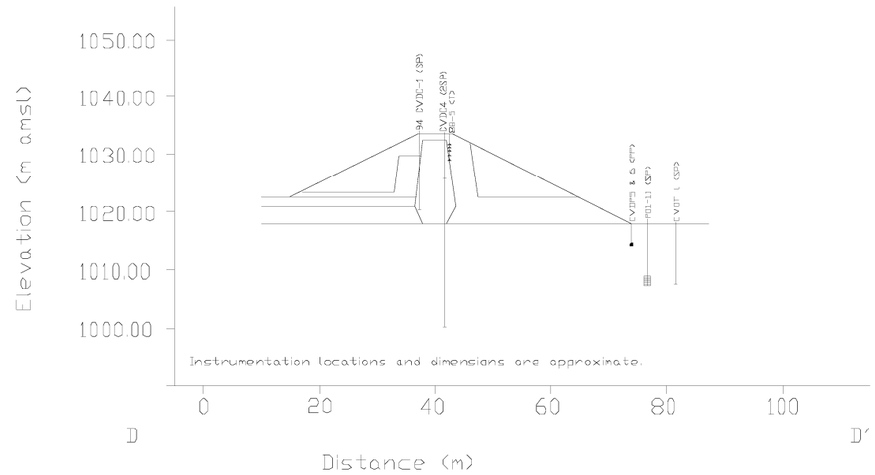
DWG TO BE READ WITH BGC REPORT TITLED " 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENT REVIEW" DATED FEB 2010



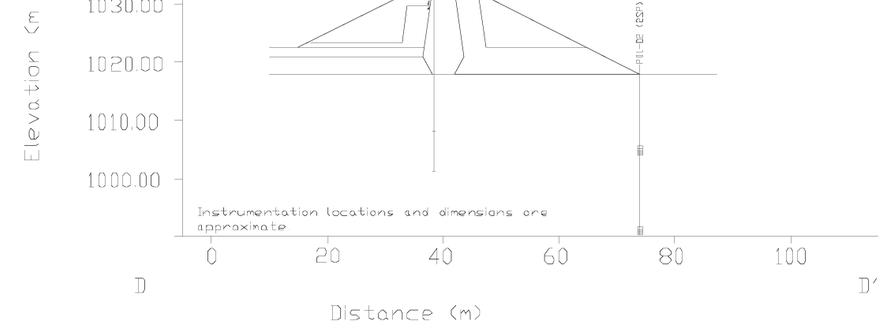
Cross Valley Dam - Cross-Section E - E′



Cross Valley Dam - Cross-Section D - D′



Cross Valley Dam - Cross-Section F - F′



SP Standpipe Piezometers
PP Pneumatic Piezometers
T Thermistor Cables
Screened Intervals of Standpipe Piezometers
Bottom of Standpipe Piezometers
Pneumatic Piezometer Tips
Thermistor Nodes

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

FIGURE 10

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BGC ENGINEERING INC.
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CLIENT: Duncan 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

592,500m E
593,000m E
593,500m E
592,000m E
6,905,500m N
6,905,000m N
6,904,500m N
6,904,000m N

GRUM SETTLING POND
SLUDGE POND
OVERLAND WATER TREATMENT PIPELINE
~GRUM OVERBURDEN DUMP~
~GRUM PIT~ (NOT CURRENT)
~VANGORDA PIT~
SLOT CUT
LITTLE CREEK POND

GP-N1
GP-N2
GP-N3
GP-N4
GP-N5
GP-N6
GP-S1
GP-S2
GP-S3
GP-S4

MP001
MP002
MP003
MP004
MP005
MP006
MP007
MP008
MP009
MP010
MP011
MP012
MP013
MP014

LEGEND

- ACESS ROADS
- STREAMS
- POWER POLE
- MP014 — 2014 SURVEY PRISM
- MP005 — 2013 SURVEY PRISM
- GP-N1 — REFERENCE ROD

To be read with Klohn Crippen Berger report dated

SCALE 0 750m

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CLIENT: Yukon Government

Klohn Crippen Berger

PROJECT: FARO MINE COMPLEX ANNUAL REVIEW

TITLE: GRUM PIT BRIM REFERENCE RODS AND SURVEY PRISMS

PROJECT No. M09770A03 01

FIGURE 11

KCB-F-MD

Date: 1/29/2013 Time: 13:25:10 Scale: 1:2,585
Filename: \\NT.KLOHN.COM\PROJDATA\M\VCR\M09770A03-GOVTYUKON-2013 FARO\400 DRAWINGS\ANNUALREVIEW\FIG_11.DWG



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

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

Denison Environmental Services

FARO MINE COMPLEX

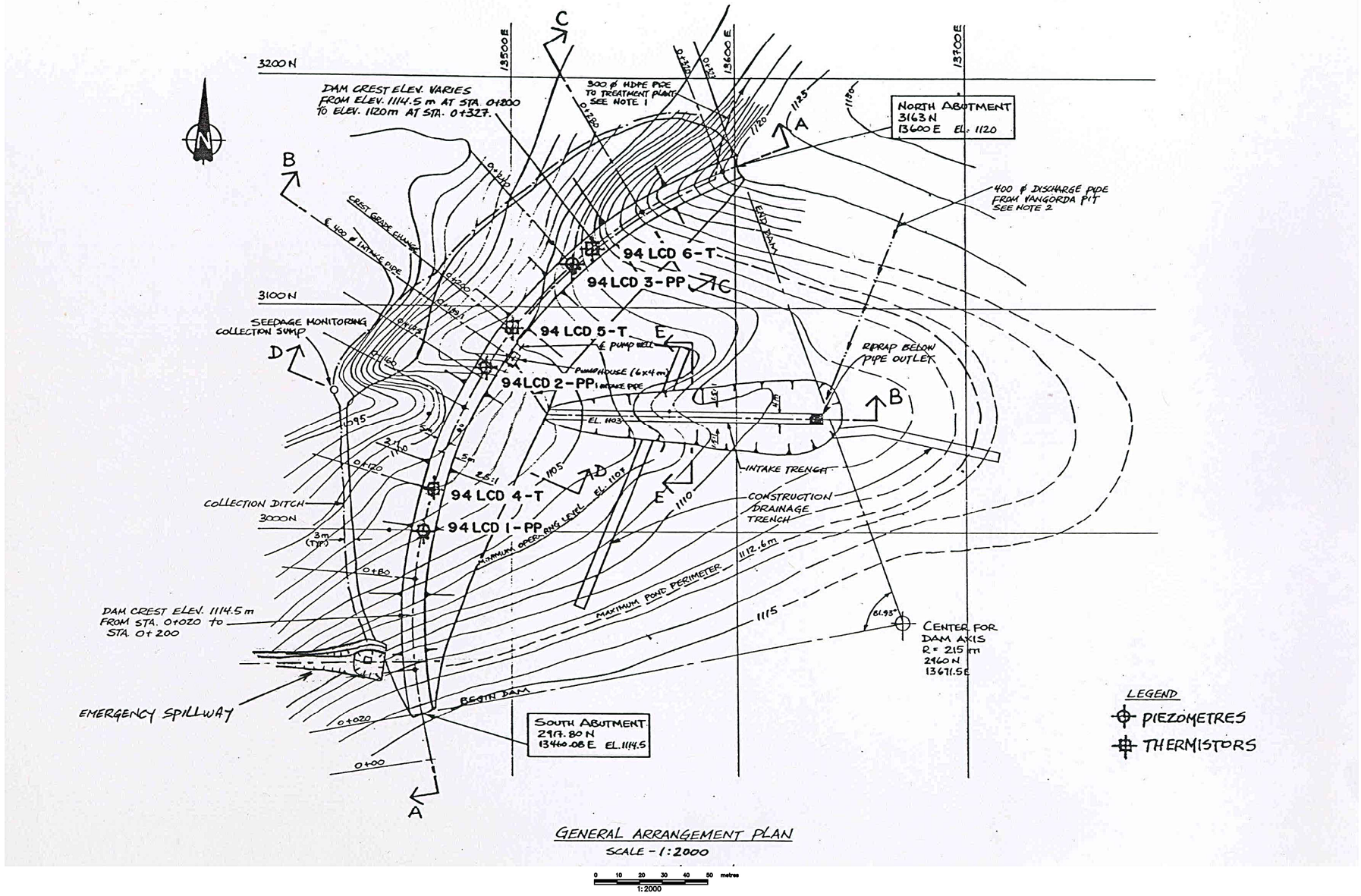
FIGURE 12

2011 Vangorda Geotechnical Inspection

General Arrangement Plan
Vangorda Waste Rock Dump

DATE:	APPROVED:	FIGURE:
July 2011	JK	4

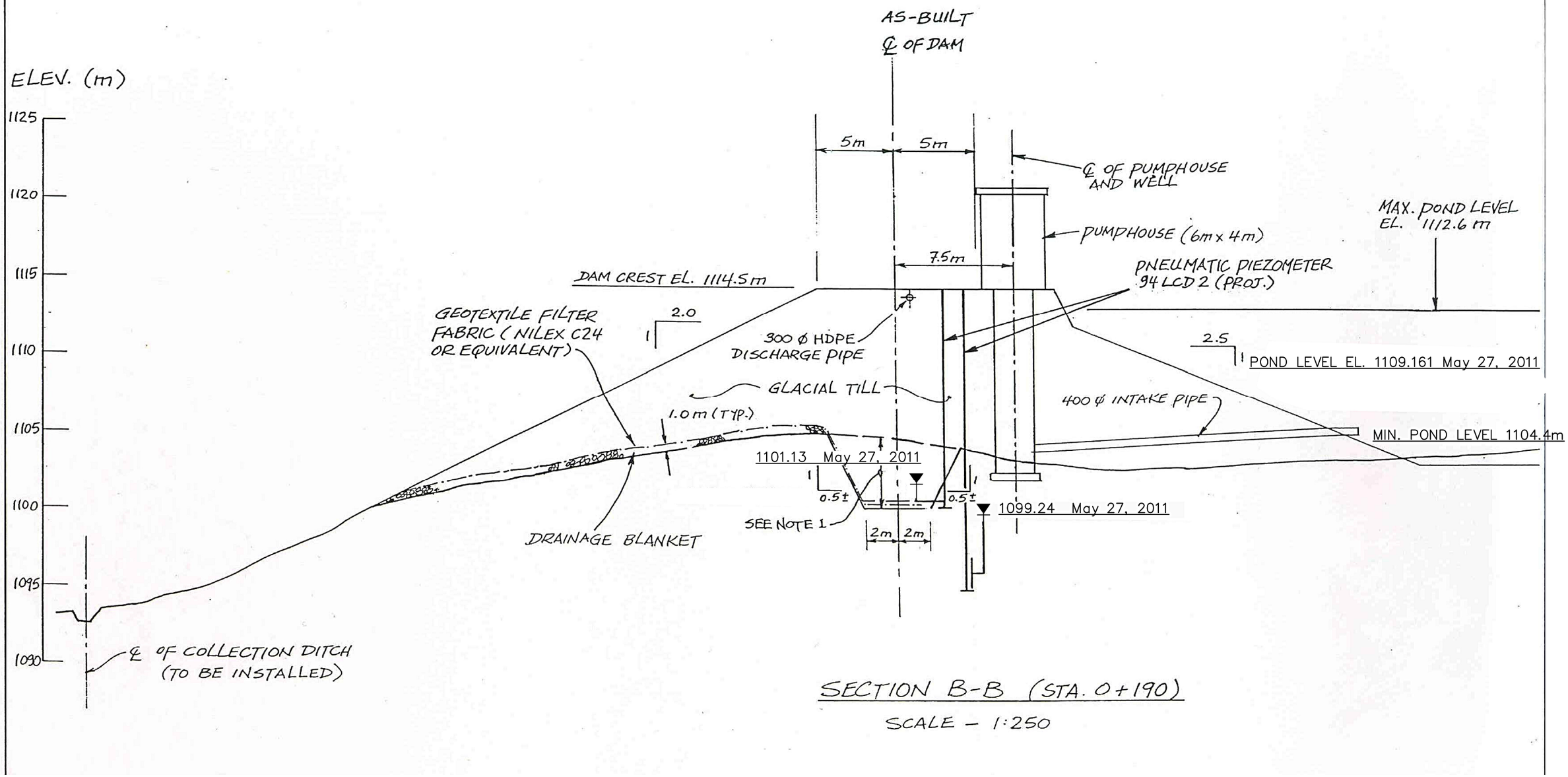
J:\01_SITES\FARO\22I0_1CD009.005 _Vangorda 2011 Geotech Inspection\C40_AutoCad\site_plan nad 83.dwg



GENERAL ARRANGEMENT PLAN
SCALE - 1:2000

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



SECTION B-B (STA. 0+190)

SCALE – 1:250

0 2 4 6 8 10 METRES

1:250

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

J:\01_SITES\FARO\2210_1CD009.005 _Vangorda 2011 Geotech Inspection\340_AutoCad\FIG-11.dwg

srk consulting	Denison Environmental Services	FIGURE 14
SRK JOB NO.: 1CD009.005		2011 Vangorda Geotechnical Inspection
FILE NAME: FIG-11.dwg	FARO MINE COMPLEX	LITTLE CREEK DAM SECTION B-B
		DATE: July 2011 / APPROVED: PMH / FIGURE: 11

APPENDIX I

2013 Site Visit Photographs

Appendix I
Site Visit Photos

Faro Pit



Photo 1 **Faro Pit East Wall North Instability Zone (September 2013)**



Photo 2 **Faro Pit East Wall South Instability Zone (September 2013)**

Faro Creek Diversion Channel



Photo 3 **Diversion Channel at upstream end, near streamflow station FD-1 (September 2013)**



Photo 4 **Diversion Channel looking downstream from streamflow station FD-1 (September 2013)**

Faro Creek Diversion Channel



Photo 5 **Diversion Channel between streamflow stations FD-1 and FD-2 (September 2013)**



Photo 6 **Diversion Channel at streamflow station FD-2 (September 2013)**

Faro Creek Diversion Channel



Photo 7 **Diversion Channel between streamflow stations FD-2 and FD-3 (September 2013)**



Photo 8 **Diversion Channel at streamflow station FD-3 (September 2013)**

Faro Creek Diversion Channel



Photo 9 Diversion Channel near streamflow station FD-4 (September 2013)



Photo 10 Diversion Channel near downstream end (September 2013)

North Valley Wall Interceptor Ditch



Photo 11 **Potential site for proposed weir construction upstream of upper constructed reach (September 2013)**



Photo 12 **Sediment deposit at inlet of culverts under the Well-Access Road (September 2013)**

North Valley Wall Interceptor Ditch



Photo 13 **Sediment deposit at outlet of culverts under the Well-Access Road (September 2013)**



Photo 14 **Upper reach of Interceptor Ditch looking downstream from Well-Access Road (September 2013)**

North Valley Wall Interceptor Ditch



Photo 15 **Middle reach of Interceptor Ditch above Tailings Impoundment (September 2013)**



Photo 16 **Middle reach of Interceptor Ditch above Tailings Impoundment - note heavy vegetation in the ditch and on the dyke (September 2013)**

North Valley Wall Interceptor Ditch



Photo 17 **Middle reach of Interceptor Ditch above Tailings Impoundment - note vegetation in the ditch and on the dyke (September 2013)**



Photo 18 **Lower reach of Interceptor Ditch between Intermediate and Cross Valley Dams - looking upstream (September 2013)**

Rose Creek Diversion Channel



Photo 19 **Diversion Channel at streamflow station RCDC-4 (September 2013)**



Photo 20 **Diversion Channel fuse plug - looking towards channel from Secondary Dam (September 2013)**

Rose Creek Diversion Channel



Photo 21 **Diversion Channel - longitudinal cracks and slumps on hillside slope (June 2013)**



Photo 22 **Diversion Channel – longitudinal cracks and slumps on hillside slope near upstream end of reach (September 2013)**

Rose Creek Diversion Channel



Photo 23 **Diversion Channel – longitudinal cracks and slumps on hillside slope near downstream end of reach (September 2013)**



Photo 24 **Canal Dyke opposite to slumps on hillside (September 2013)**

Rose Creek Diversion Channel



Photo 25 **Diversion Channel adjacent to Intermediate Dam (September 2013)**



Photo 26 **Canal Dyke adjacent to Intermediate Dam (September 2013)**

Rose Creek Diversion Channel



Photo 27 **Washout of Canal Dyke south shoulder near Cross Valley Dam (September 2013)**



Photo 28 **Lower reach of Diversion Channel - looking upstream (September 2013)**

North Fork and K8 Rock Drains



Photo 29 **North Fork Rock Drain upstream pool at access road between Faro and Vangorda Plateau (September 2013)**



Photo 30 **North Fork Rock Drain outlet - downstream slope washout (September 2013)**

North Fork and K8 Rock Drains



Photo 31 K8 Rock Drain Upstream Pool (September 2013)



Photo 32 K8 Rock Drain downstream outlet - downstream slope washout (September 2013)

Secondary Tailings Dam



Photo 33 **Downstream berm longitudinal crack at southeast corner of Secondary Tailings Dam after spring thaw (June 2013)**



Photo 34 **Downstream berm longitudinal crack hardly visible (September 2013)**

Secondary Tailings Dam



Photo 35 **Secondary Tailings Dam downstream of fuse plug in background - Canal Dyke in foreground (September 2013)**



Photo 36 **Downstream slope of Secondary Tailings Dam downstream of Photo 35 (September 2013)**

Original Tailings Dam



Photo 37 **Minor ponding within Original Tailings Impoundment (September 2013)**



Photo 38 **Original Tailings Dam – note tailings level inside the dam (on right side) being higher than outside (September 2013)**

Intermediate Tailings Dam



Photo 39 Upstream pump barge at northeast abutment (September 2013)



Photo 40 Spillway channel downstream reach – looking upstream (September 2013)

Intermediate Tailings Dam



Photo 41 **Upstream slope of Intermediate Dam – looking northeast (September 2013)**



Photo 42 **Dam crest and upstream slope – note minor construction surficial feature near crest shoulder marked by hard hat (September 2013)**

Intermediate Tailings Dam



Photo 43 Southwest abutment of upstream slope (September 2013)



Photo 44 Rill erosion along lower portion of downstream slope (September 2013)

Intermediate Tailings Dam

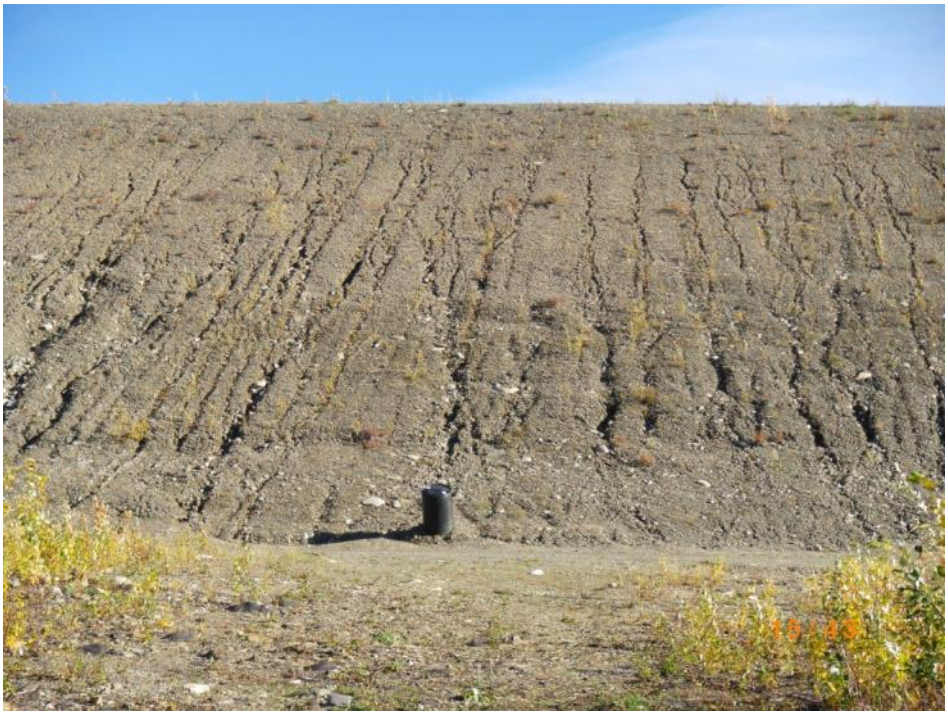


Photo 45 **Downstream dam slope – looking up from downstream berm (September 2013)**



Photo 46 **Downstream dam slope – close up of rill erosion and downslope deltaic deposit zone above berm (September 2013)**

Intermediate Tailings Dam



Photo 47 **Downstream berm - minor rill erosions on berm shoulder (September 2013)**



Photo 48 **Sampling groundwater from monitoring well – note slightly tilted above-ground portion of well casing (September 2013)**

Cross Valley Dam



Photo 49 Crest and downstream slope - looking southwest (September 2013)



Photo 50 Crest and upstream slope – looking southwest (September 2013)

Cross Valley Dam



Photo 51 **Longitudinal crack along dam crest after spring thaw (June 2013)**



Photo 52 **Dam crest along southwest segment – looking southwest, note no visible longitudinal cracks on crest surface (September 2013)**

Cross Valley Dam



Photo 53 **Downstream slope - looking northeast (September 2013)**



Photo 54 **Cross Valley Pond siphon pipelines and upstream end of spillway channel (September 2013)**

Cross Valley Dam



Photo 55 **Upstream reach of spillway channel looking downstream (September 2013)**



Photo 56 **Treated water being discharged from temporary filtration plant to North Valley Interceptor Ditch (September 2013)**

Grum Pit



Photo 57 Grum Pit east wall north instability zone (September 2013)



Photo 58 Grum Pit east wall south instability zone (September 2013)

Grum Pit



Photo 59 **Longitudinal crack passing through second Rod GP-N2 along north array (June 2013)**



Photo 60 **Widened longitudinal crack passing through second Rod GP-N2 along north array (September 2013)**

Grum Pit



Photo 61 Longitudinal crack at edge of Grum Pit brim (September 2013)



Photo 62 Reference Rods GP-S1 to GP-S4 along south array (September 2013)

Vangorda Pit

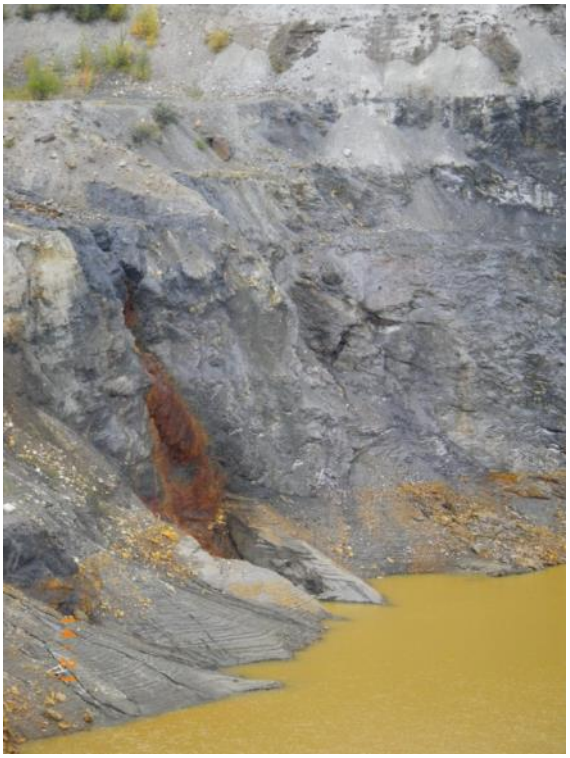


Photo 63 Pit northwest wall (September 2013)



Photo 64 Pit north wall (September 2013)

Vangorda Pit

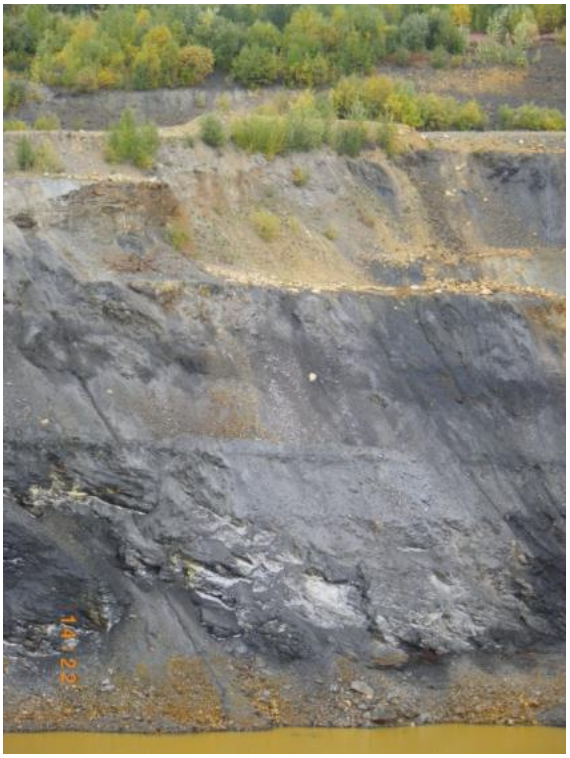


Photo 65 Pit north wall (September 2013)



Photo 66 Pit northeast wall (September 2013)

Grum Waste Rock Dump



Photo 67 **Excess surface runoff from Grum Waste Rock Dump escaped from the lowest berm and entered Vangorda Creek and Moose Pond in spring (June 2013)**



Photo 68 **Surface runoff retention pond below Grum Sulphide Cell storage pond (September 2013)**

Grum Waste Rock Dump



Photo 69 **Repair of damaged riprap protection zone of spillway channel from upper berm in Photo 68 to lower berm in Photo 70 (September 2013)**



Photo 70 **Lowest berm of Grum Waste Rock Dump (September 2013)**

Vangorda Waste Dump



Photo 71 **Waste Dump slope with old scarp and rill erosion above Drain 6 (September 2013)**



Photo 72 **Waste Dump slope with rill erosion above Drain 5 (September 2013)**

Vangorda Waste Dump



Photo 73 **Waste Dump slope with rill erosion between Drains 5 and 4 (September 2013)**



Photo 74 **Waste Dump slope with rill erosion above Drain 4 (September 2013)**

Vangorda Waste Dump



Photo 75 Waste Dump Drain No. 6 Weir (September 2013)



Photo 76 Waste Dump Drain No. 5. Weir – looking upstream weir plate split into two at the V-notch (September 2013)

Vangorda Waste Dump



Photo 77 **Seepage Collection Ditch near its downstream end looking upstream (September 2013)**



Photo 78 **Waste Dump Drain No. 4 looking upstream - note no weir at this drain (September 2013)**

Vangorda Waste Dump



Photo 79 **Waste Dump Drain No. 3 weir – weir plate delaminated on one side and staff gauge fell over (September 2013)**



Photo 80 **Waste Dump Seepage Collection Ditch at Drain No. 3 - looking upstream note rill erosion on waste dump slope. (September 2013)**

Vangorda Waste Dump



Photo 81 **Seepage Collection Ditch downstream of Drain No. 3 - looking downstream, note rill erosion on waste dump slope.(September 2013)**



Photo 82 **Waste Dump Drain No. 2 weir (September 2013)**

Vangorda Waste Dump



Photo 83 **Seepage Collection Ditch downstream of Drain No. 2 - looking downstream, note rill erosion of waste dump slope (September 2013)**



Photo 84 **Seepage Collection Ditch downstream of Drain No. 2 - looking upstream (September 2013)**

Vangorda Waste Dump



Photo 85 **Vangorda Waste Dump Drain No. 1 – no weir at this drain (September 2013)**



Photo 86 **Seepage Collection Ditch downstream of Drain No.1 (September 2013)**

Grump Pit Interceptor Ditch



Photo 87 **Runoff collection pond upstream of Interceptor Ditch - water to be pumped into Interceptor Ditch (September 2013)**



Photo 88 **Water ponding in a culvert at Interceptor Ditch road crossing (September 2013)**

Grump Pit Interceptor Ditch



Photo 89 **Interceptor Ditch near Grum Settling Pond - looking downstream (September 2013)**



Photo 90 **Interceptor Ditch looking downstream from road to Water Treatment Plant (September 2013)**

Grump Pit Interceptor Ditch



Photo 91 **Interceptor Ditch downslope of Glacial Till Overburden Dump (September 2013)**



Photo 92 **Interceptor Ditch lower reach at steep gradient (September 2013)**

Vangorda Northeast Interceptor



Photo 93 **Interceptor Ditch near its upstream end – looking downstream (September 2013)**



Photo 94 **Interceptor Ditch middle reach – looking upstream (September 2013)**

Vangorda Northeast Interceptor



Photo 95 **Interceptor Ditch – looking upstream note roadside lower slope repaired in spring and slumped slope on hillside (September 2013)**



Photo 96 **Interceptor Ditch lower reach – looking upstream (September 2013)**

Vangorda Creek Diversion Flume



Photo 97 **Trashrack upstream of flume emergency overflow culverts (September 2013)**



Photo 98 **Upstream end of emergency overflow culverts – note sediment deposit on inverts (September 2013)**

Vangorda Creek Diversion Flume



Photo 99 **Downstream end of emergency overflow culverts – note channel bottom higher than culvert inverts, and unravelling of riprap between culverts (September 2013)**



Photo 100 **Vangorda Flume intake culvert – new riprap placed above culvert, note metal riprap support temporarily held in place with rope (September 2013)**

Vangorda Creek Diversion Flume



Photo 101 **Trashrack upstream of Vangorda Flume intake culvert – note broken vertical piece, and accumulation of debris and sediment against the rack (September 2013)**



Photo 102 **Vangorda Flume upstream end – looking downstream (September 2013)**

Vangorda Creek Diversion Flume



Photo 103 Vangorda Flume upstream end – looking upstream (September 2013)



Photo 104 Bent bracing across flume (September 2013)

Vangorda Creek Diversion Flume



Photo 105 **Repaired Flume under substantial lateral stress (September 2013)**



Photo 106 **Flume weighed down by metal canopy – note road surface raised to increase freeboard during flood (September 2013)**

Vangorda Creek Diversion Flume



Photo 107 **Flume plunge pool and culvert to drop box – note accumulation of debris and sediment against the trashrack (September 2013)**



Photo 108 **Vangorda Creek Diversion outfall at Vangorda Creek downstream of drop box (September 2013)**

Little Creek Dam



Photo 109 **Dam crest/upstream slope and pond (September 2013)**



Photo 110 **Upstream dam slope and submersible pump mounted on pontoons (September 2013)**

Little Creek Dam



Photo 111 Crest and downstream slope (September 2013)



Photo 112 Close up of transformer base on dam crest (September 2013)

Little Creek Dam



Photo 113 Rill erosion on downstream dam slope (September 2013)



Photo 114 Upstream end of culvert emergency spillway at left (south) abutment (September 2013)

Little Creek Dam



Photo 115 Downstream end of culvert spillway (September 2013)



Photo 116 Spillway channel downstream end – note deep crack running perpendicular to channel direction (September 2013)

Little Creek Dam



Photo 117 Rill erosion on Downstream berm slopes (September 2013)



Photo 118 Downstream foundation piezometers at dam toe (September 2013)

Sheep Pad Sediment Ponds



Photo 119 **Upper Sheep Pad Sediment Pond (foreground) - note dyke slope longitudinal cracks (June 2013)**



Photo 120 **Subdued longitudinal cracks on dyke slope along Upper Sheep Pad Sediment Pond (September 2013)**

Sheep Pad Sediment Ponds



Photo 121 **Upper Sheep Pad Sediment Pond – note inlet of Grum Interceptor Ditch in background (September 2013)**



Photo 122 **Flume connecting Upper and Lower Sheep Pad Ponds - note boulders and no cross bracings on top of flume section (September 2013)**

Sheep Pad Sediment Ponds



Photo 123 **Lower Sheep Pad Pond viewing from pond - divider dyke (September 2013)**



Photo 124 **Lower Sheep Pad Pond riprap protected spillway channel (September 2013)**

Grum Settling Pond



Photo 125 **Grum Settling Pond – note spillway channel in foreground (September 2013)**



Photo 126 **Pond spillway channel, looking downstream towards Grum Interceptor Ditch (September 2013)**

V-15 Seepage Collection Ditch



Photo 127 **V-15 Ditch downstream of V-15 Pond – note submersible well Pumphouse on left (September 2013)**



Photo 128 **V-15 Diversion Ditch to Moose Pond downstream of access road culvert (September 2013)**

V-15 Seepage Collection Ditch



Photo 129 **V-15 Diversion Ditch at its downstream end near Moose Pond - note improved channel bed protection zone (September 2013)**



Photo 130 **V-15 Ditch outflow channel near Moose Pond (September 2013)**

Moose Pond



Photo 131 **Moose Pond with low pond level revealing sediment deposits (September 2013)**



Photo 132 **Fallen trees caused by seepage from esker slope during 2011/2013 spring freshets (September 2013)**

Sludge Pond Embankment - Vangorda Water Treatment Plant



Photo 133 Grum Sludge Pond (September 2013)



Photo 134 Grum Sludge Pond retention dyke (September 2013)

APPENDIX II

Instrumentation Plots and Data

Instrumentation Plots and Data

Site	Appendix Section: 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 Calibration	B.1
		Staff Gauge Flow	B.2
	II-C: North Valley Wall Interceptor Ditch	Ditch Flow	C.1
	II-D: Rose Creek Diversion Channel	Staff Gauge Calibration	D.1
		Staff Gauge Flow	D.2
	II-E: Canal Dyke	Piezometers	E.1
		Thermistors	E.2
		Inclinometers	E.3
	II-F: North Fork Rock Drain	U/S and D/S Water Elevations	F.1
	II-G: Secondary Tailings Impoundment	Piezometers	G.1
	II-H: Intermediate Dam	Pond Level (Intermediate Pond)	H.1
		Piezometers	H.2
	II-I: Cross Valley Dam	Pond Level (Polishing Pond)	I.1
		Piezometers	I.2
		Thermistors	I.3
		Downstream Weir Flow	I.4
Vangorda Plateau	II-J: Grum Pit	Pond Level	J.1
		Displacement Monitoring	J.2
		Piezometers (Cut Slot)	J.3
	II-K: Vangorda Pit	Pond Level	K.1
	II-L: Vangorda Waste Rock Dump	Weir Flow Measurement	L.1
		Piezometers	L.2
	II-M: Little Creek Dam	Pond Level	M.1
		Piezometers	M.2
		Thermistors	M.3
	II-N: Moose Pond	Pond Level	N.1

APPENDIX II-A

Faro Pit

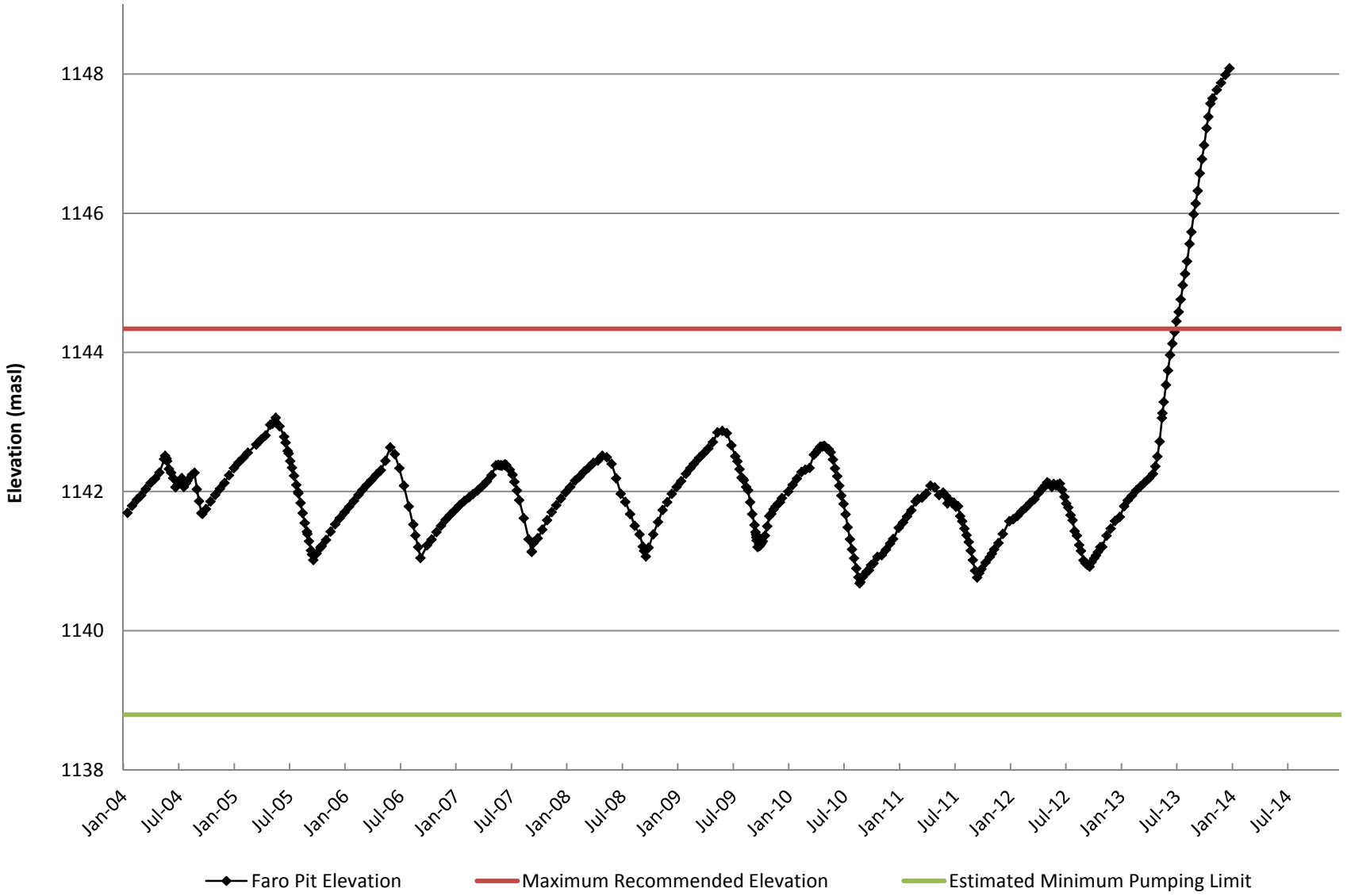
A.1 - Pond Level

A.2 - Pit Wall Regression

A.3 - Pit Wall Prism Monitoring

A.1 – Pond Level

Faro Pit Water Level



A1. Faro Pit Elevations.xlsx
M09770A03.730

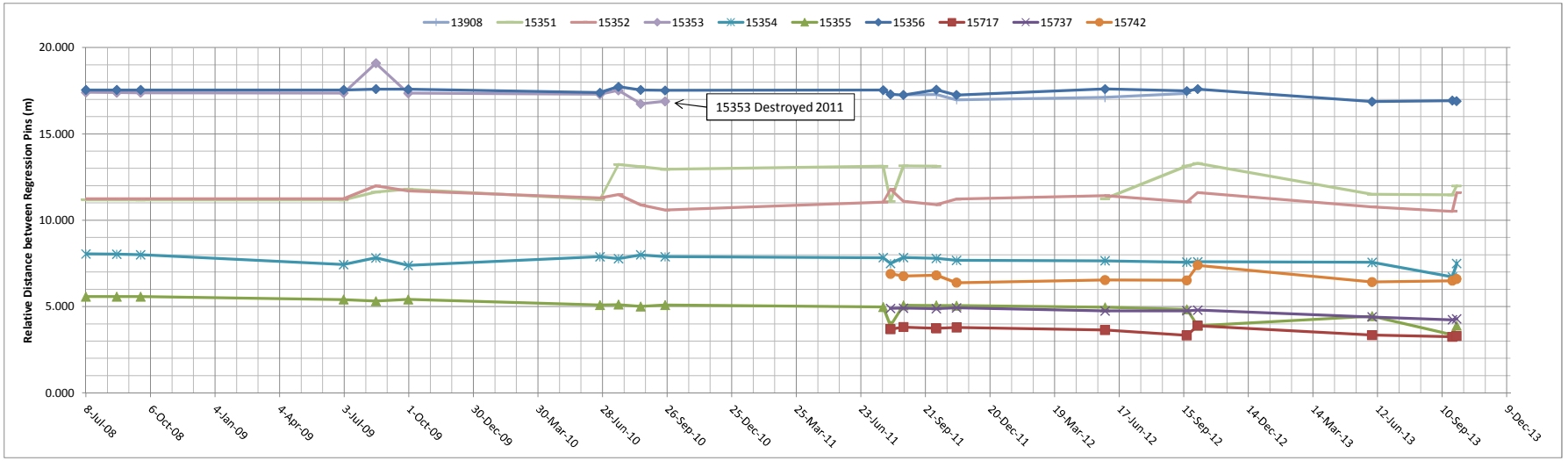
A.2 – Pit Wall Regression

2008 to 2013 Faro Pit Brim Regression Pins Survey Summary
DES/TEES Plus YES Data

Faro Pit Brim Regression Pins Survey Data (DES/TEES Plus YES)

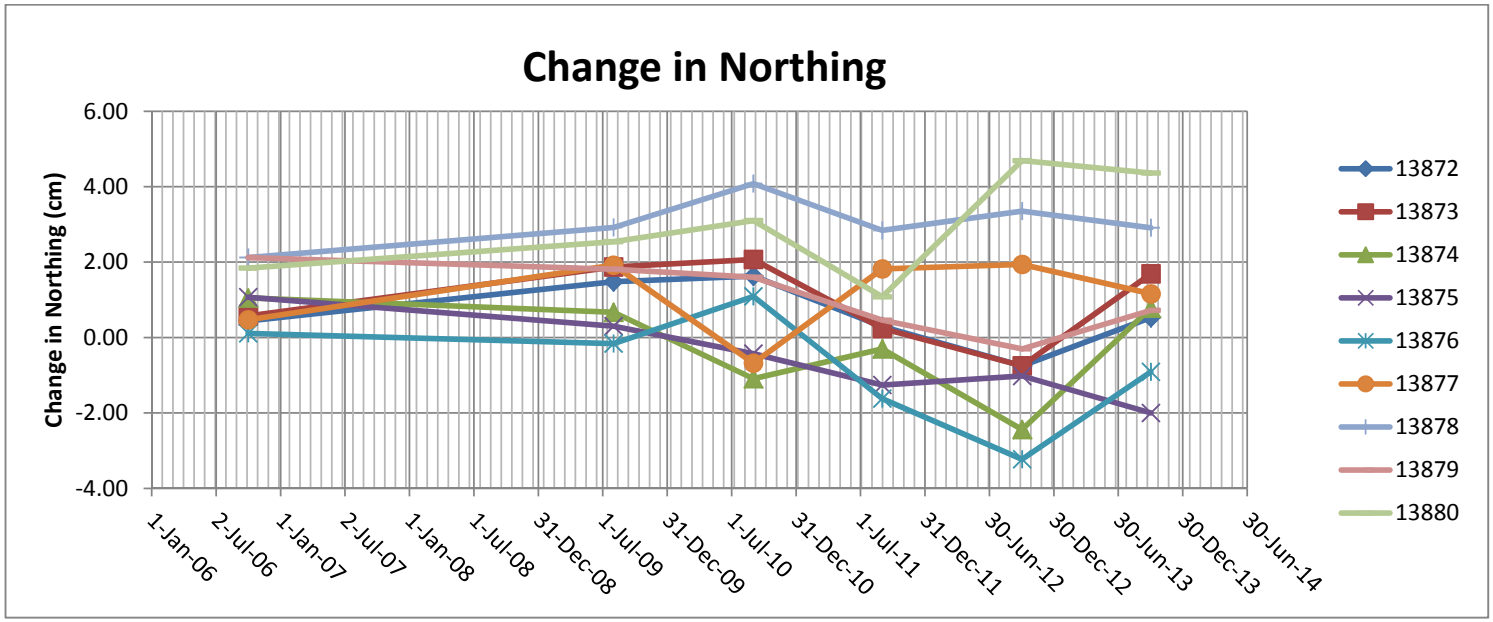
												YES						YES			YES
Pin	**8-Jul-08**	**20-Aug-08**	**22-Sep-08**	**2-Jul-09**	**16-Aug-09**	**30-Sep-09**	**24-Jun-10**	**20-Jul-10**	**20-Aug-10**	**23-Sep-10**	**24-Jul-11**	**3-Aug-11**	**21-Aug-11**	**6-Oct-11**	**3-Nov-11**	**28-May-12**	**19-Sep-12**	**4-Oct-12**	**4-Jun-13**	**24-Sep-13**	**30-Sep-13**
	(m)	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**
15356	17.550	17.550	17.550	17.550	17.600	17.590	17.400	17.740	17.55	17.530	17.540	17.300	17.260	17.570	17.260	17.61	17.500	17.60	16.877	16.935	16.900
15717												3.700	3.820	3.750	3.800	3.65	3.335	3.90	3.355	3.259	3.300
15355	5.590	5.580	5.580	5.415	5.320	5.420	5.100	5.120	5.02	5.100	4.980	3.900	5.080	5.070	5.060	4.97	4.845	3.90	4.455	3.378	3.900
15737												4.900	4.920	4.890	4.930	4.76	4.765	4.80	4.405	4.241	4.300
15354	8.060	8.040	8.010	7.440	7.830	7.395	7.900	7.780	8.00	7.900	7.840	7.500	7.850	7.800	7.680	7.66	7.580	7.60	7.575	6.722	7.500
15742												6.900	6.770	6.820	6.390	6.55	6.525	7.40	6.432	6.504	6.600
13908													17.270	17.290	16.980	17.12	17.350		16.915	17.004	
15352	11.250	11.250	11.250	11.250	12.000	11.710	11.300	11.500	10.89	10.600	11.050	11.800	11.100	10.910	11.230	11.43	11.065	11.60	10.785	10.523	11.600
15351	11.190	11.190	11.180	11.180	11.640	11.810	11.200	13.230	13.11	12.960	13.130	11.100	13.160	13.130		11.24	13.150	13.30	11.503	11.474	12.000
15353	17.410	17.400	17.390	17.375	19.100	17.360	17.300	17.530	16.75	16.890	Destroyed 2011										

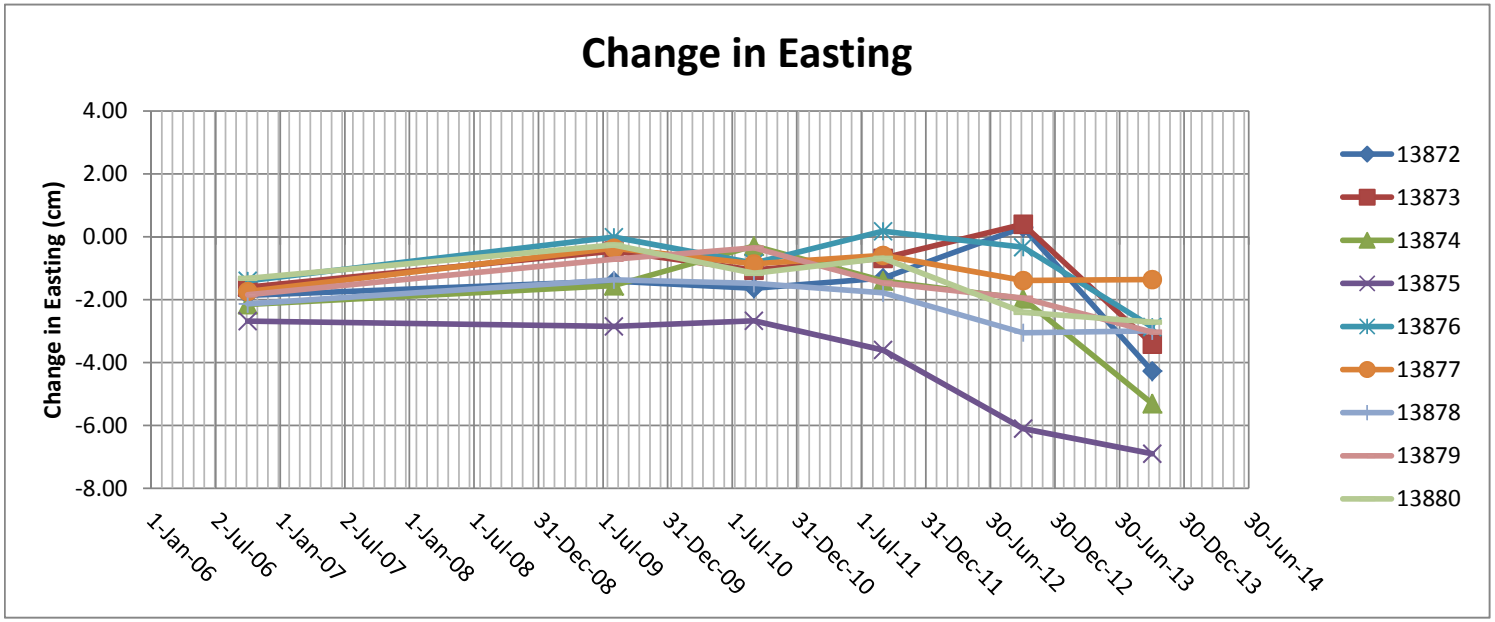
Faro Pit Brim Regression Pins Survey Summary Plot (DES/TEES Plus YES)



A.3 – Pit Wall Prism Monitoring

No 2012 Data


Change in Northing
Change in Northing (cm)
6.00
4.00
2.00
0.00
-2.00
-4.00
1-Jan-06
2-Jul-06
1-Jan-07
2-Jul-07
1-Jan-08
1-Jul-08
31-Dec-08
1-Jul-09
31-Dec-09
1-Jul-10
31-Dec-10
1-Jul-11
31-Dec-11
30-Jun-12
30-Dec-12
30-Jun-13
30-Dec-13
30-Jun-14
13872
13873
13874
13875
13876
13877
13878
13879
13880


Change in Easting
Change in Easting (cm)
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
1-Jan-06
2-Jul-06
1-Jan-07
2-Jul-07
1-Jan-08
1-Jul-08
31-Dec-08
1-Jul-09
31-Dec-09
1-Jul-10
31-Dec-10
1-Jul-11
31-Dec-11
30-Jun-12
30-Dec-12
30-Jun-13
30-Dec-13
30-Jun-14
13872
13873
13874
13875
13876
13877
13878
13879
13880

Delta Northing

Prism	Oct'06	Aug'09	Sep'10	Aug'11	Oct'12	Oct'13
	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
13872	0.440	1.480	1.630	0.290	-0.750	0.530
13873	0.570	1.870	2.070	0.240	-1.010	1.690
13874	1.050	0.670	-1.090	-0.300	-2.440	0.780
13875	1.070	0.300	-0.400	-1.300	-1.020	-2.000
13876	0.110	-0.160	1.090	-1.620	-3.230	-0.910
13877	0.470	1.920	-0.680	1.820	1.940	1.160
13878	2.120	2.920	4.080	2.840	3.350	2.910
13879	2.120	1.810	1.600	0.460	-0.300	0.720
13880	1.840	2.540	3.100	1.080	4.690	4.360

Delta Easting

Prism	Oct'06	Aug'09	Sep'10	Aug'11	Oct'12	Oct'13
	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
13872	-1.860	-1.410	-1.640	-1.310	0.300	-4.270
13873	-1.600	-0.450	-1.060	-0.680	0.400	-3.410
13874	-2.150	-1.550	-0.290	-1.400	-1.970	-5.300
13875	-2.700	-2.900	-2.700	-3.600	-6.100	-6.900
13876	-1.400	-0.010	-0.840	0.180	-0.330	-2.870
13877	-1.740	-0.360	-0.860	-0.590	-1.390	-1.360
13878	-2.130	-1.370	-1.480	-1.780	-3.050	-2.990
13879	-1.840	-0.710	-0.350	-1.470	-1.950	-3.030
13880	-1.320	-0.260	-1.160	-0.680	-2.400	-2.710

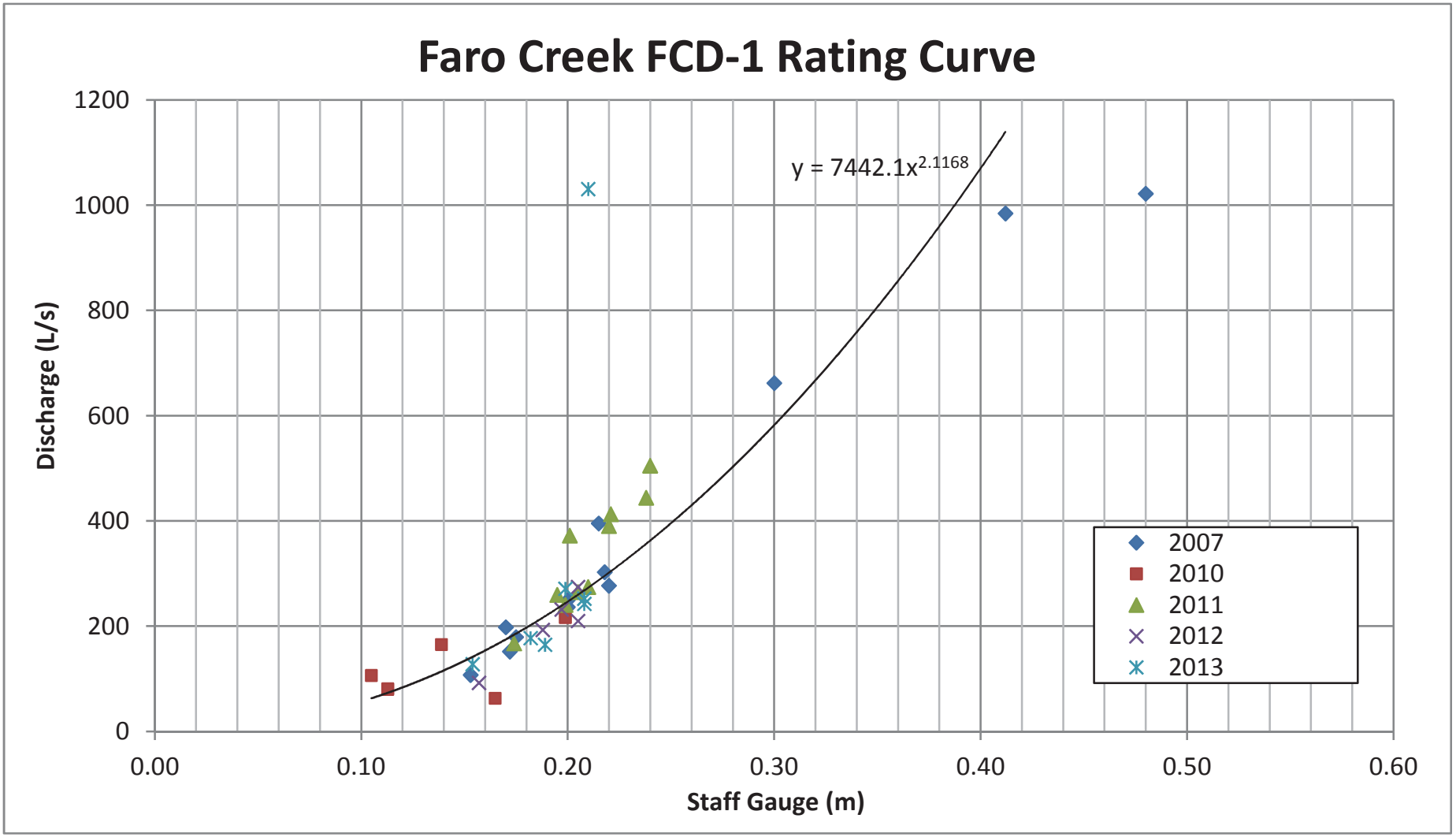
APPENDIX II-B

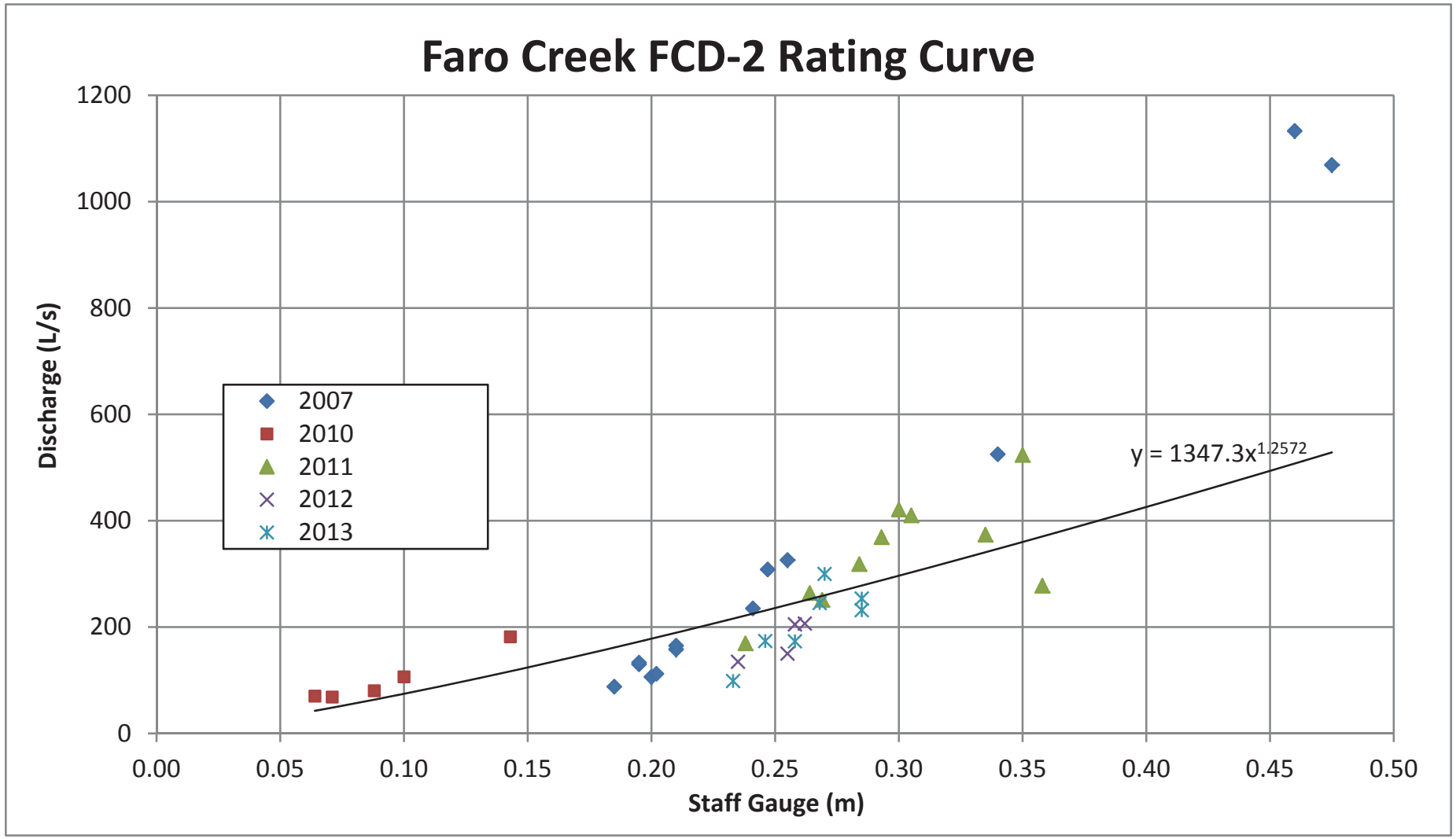
Faro Creek Diversion Channel

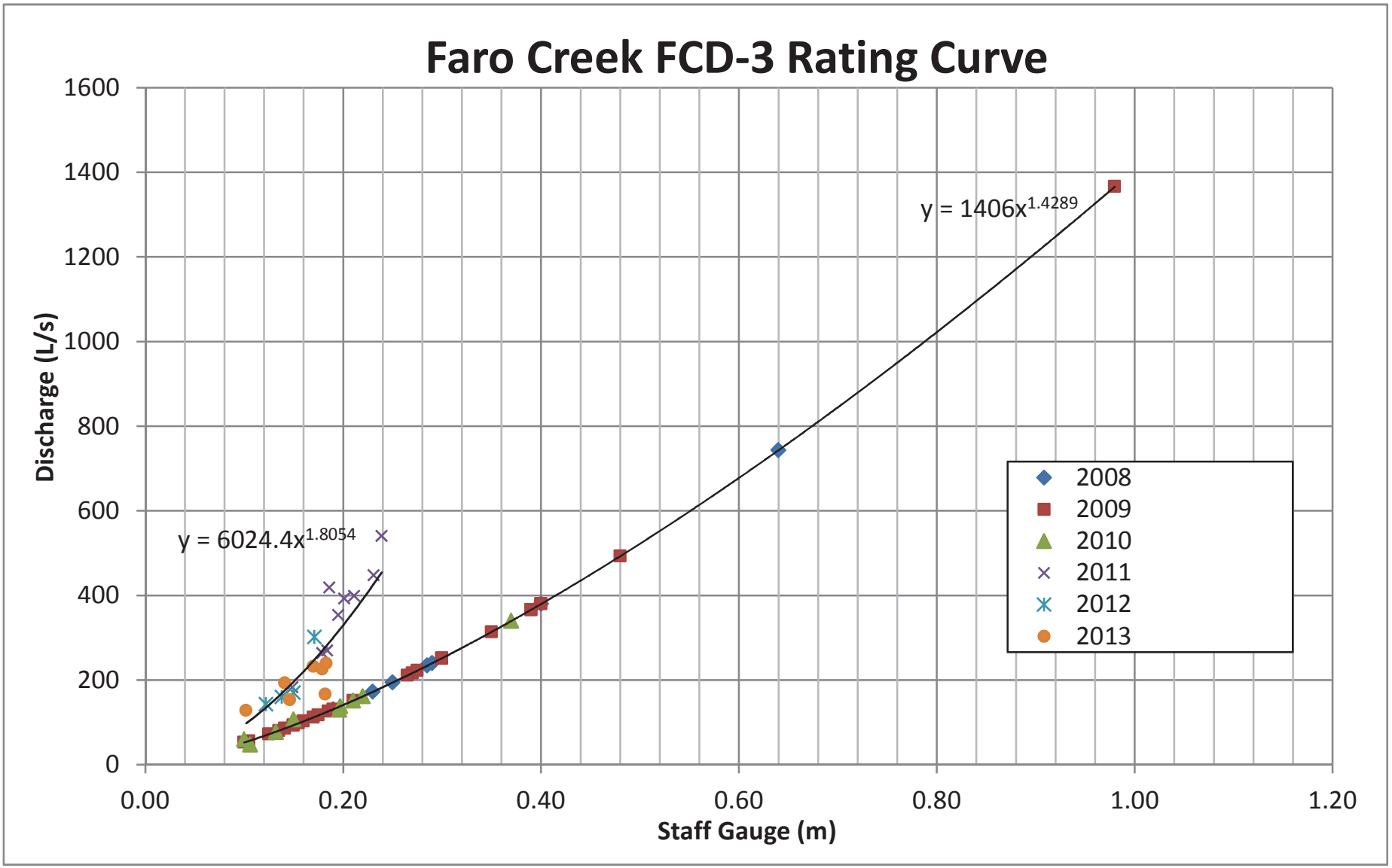
B.1 – Staff Gauge Calibration

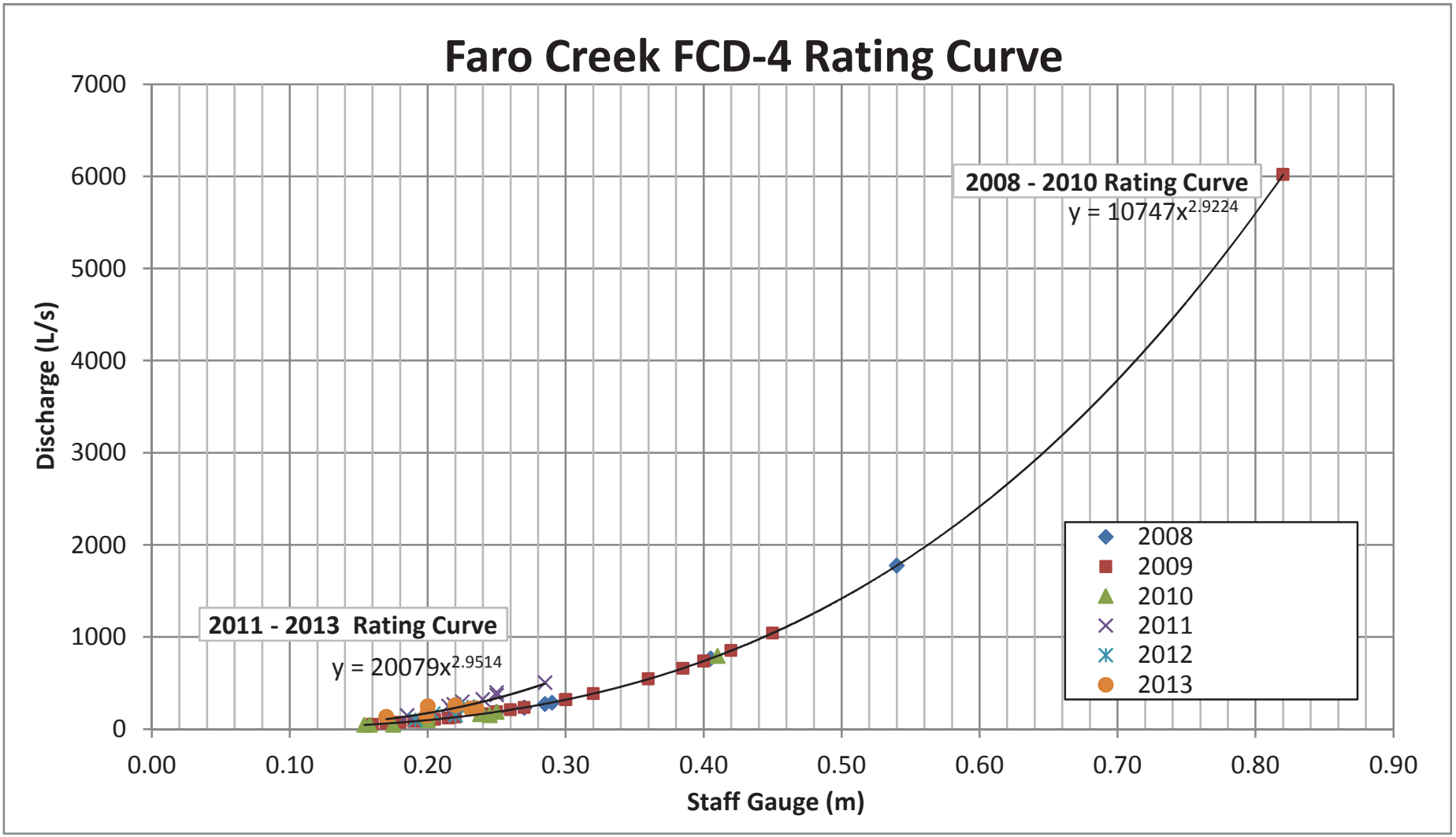
B.2 – Staff Gauge Flow

B.1 – Staff Gauge Calibration

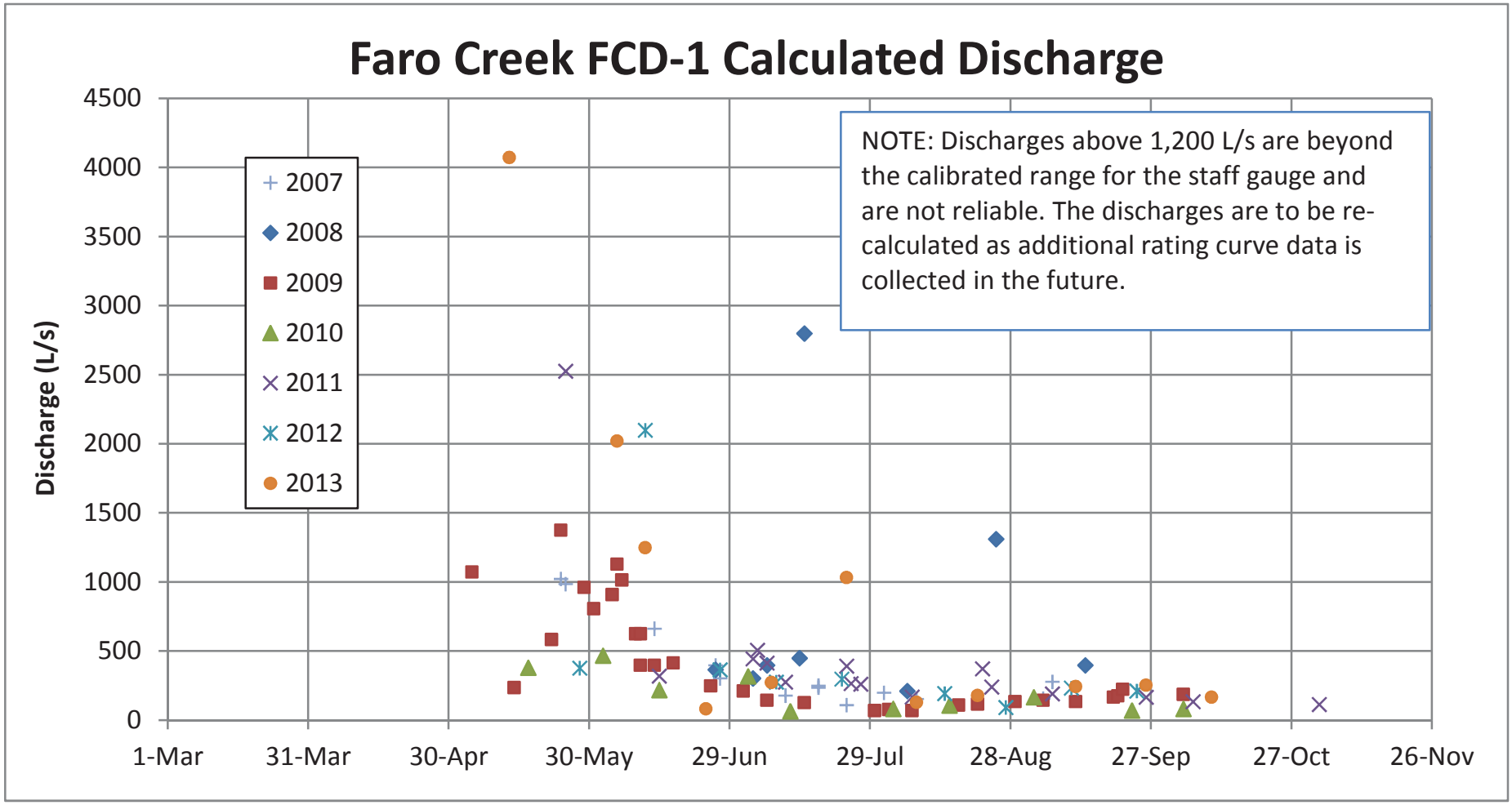

Faro Creek FCD-1 Rating Curve
y = 7442.1x^2.1168
Discharge (L/s)
Staff Gauge (m)
0
200
400
600
800
1000
1200
0.00
0.10
0.20
0.30
0.40
0.50
0.60
2007
2010
2011
2012
2013

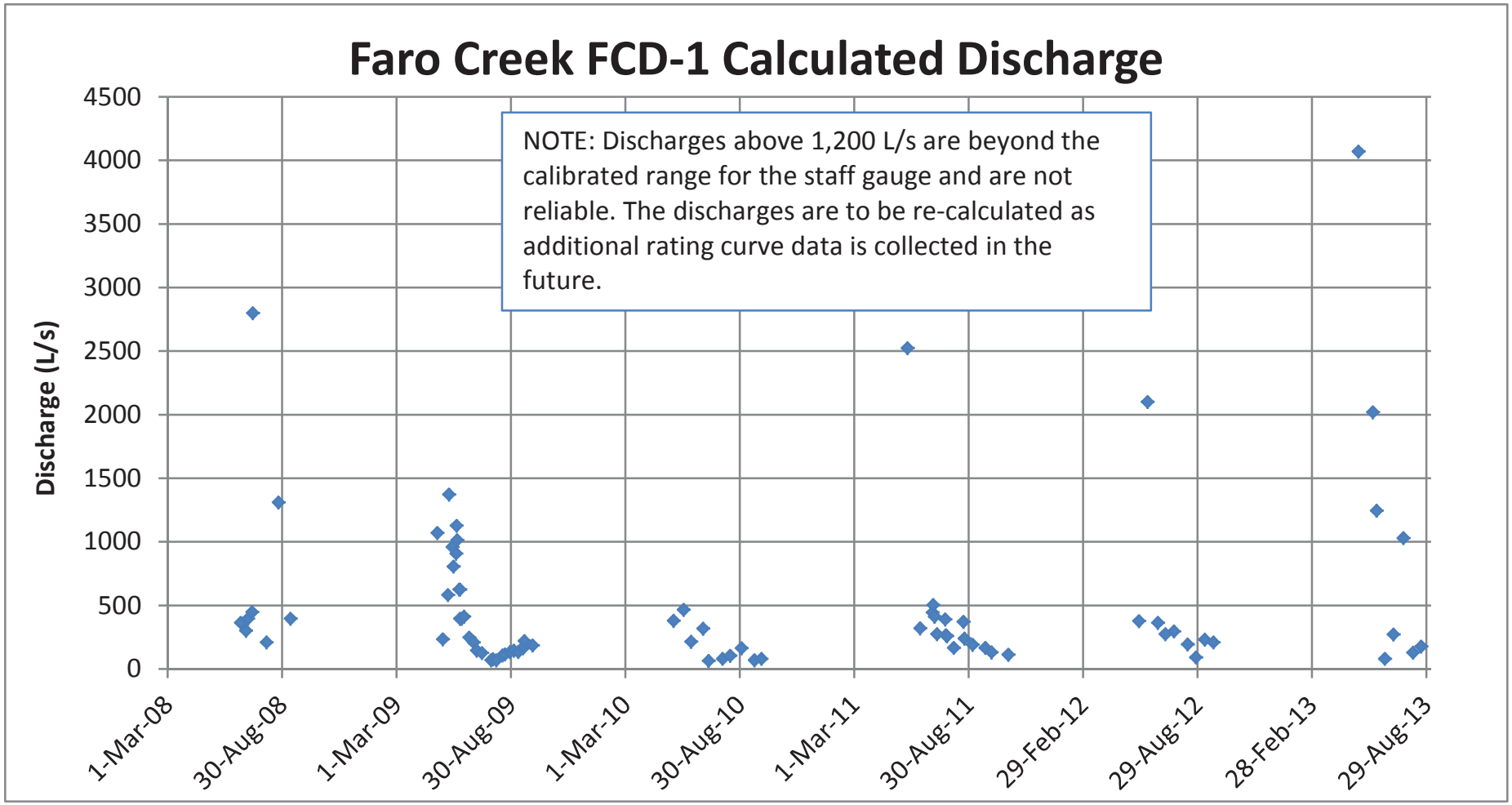

Faro Creek FCD-2 Rating Curve
Discharge (L/s)
Staff Gauge (m)
y = 1347.3x^1.2572
2007
2010
2011
2012
2013
0
200
400
600
800
1000
1200
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50

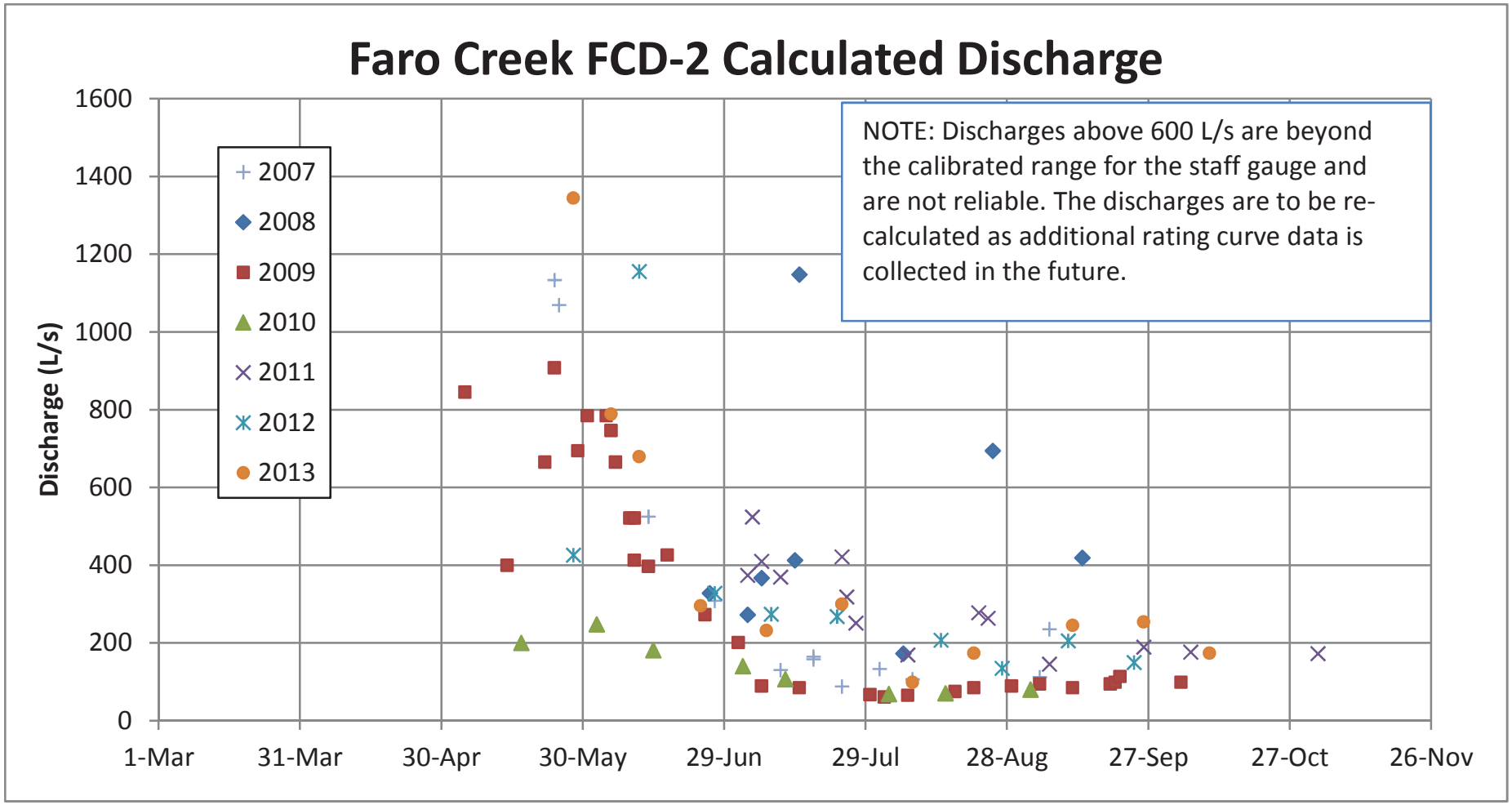

Faro Creek FCD-3 Rating Curve
Discharge (L/s)
Staff Gauge (m)
y = 1406x^1.4289
y = 6024.4x^1.8054
2008
2009
2010
2011
2012
2013
0
200
400
600
800
1000
1200
1400
1600
0.00
0.20
0.40
0.60
0.80
1.00
1.20

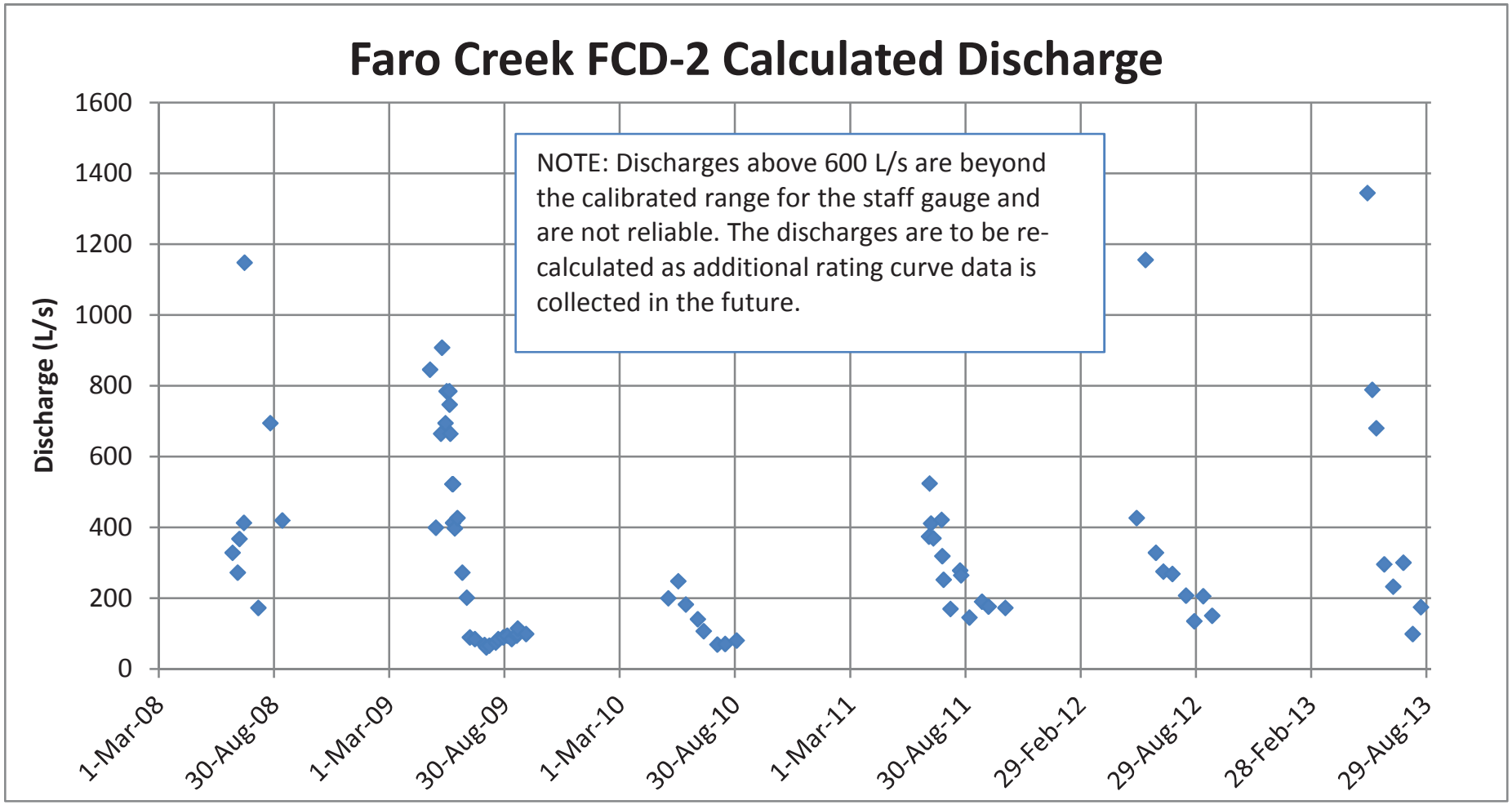

Faro Creek FCD-4 Rating Curve
Discharge (L/s)
Staff Gauge (m)
7000
6000
5000
4000
3000
2000
1000
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
2008 - 2010 Rating Curve
y = 10747x2.9224
2011 - 2013 Rating Curve
y = 20079x2.9514
2008
2009
2010
2011
2012
2013

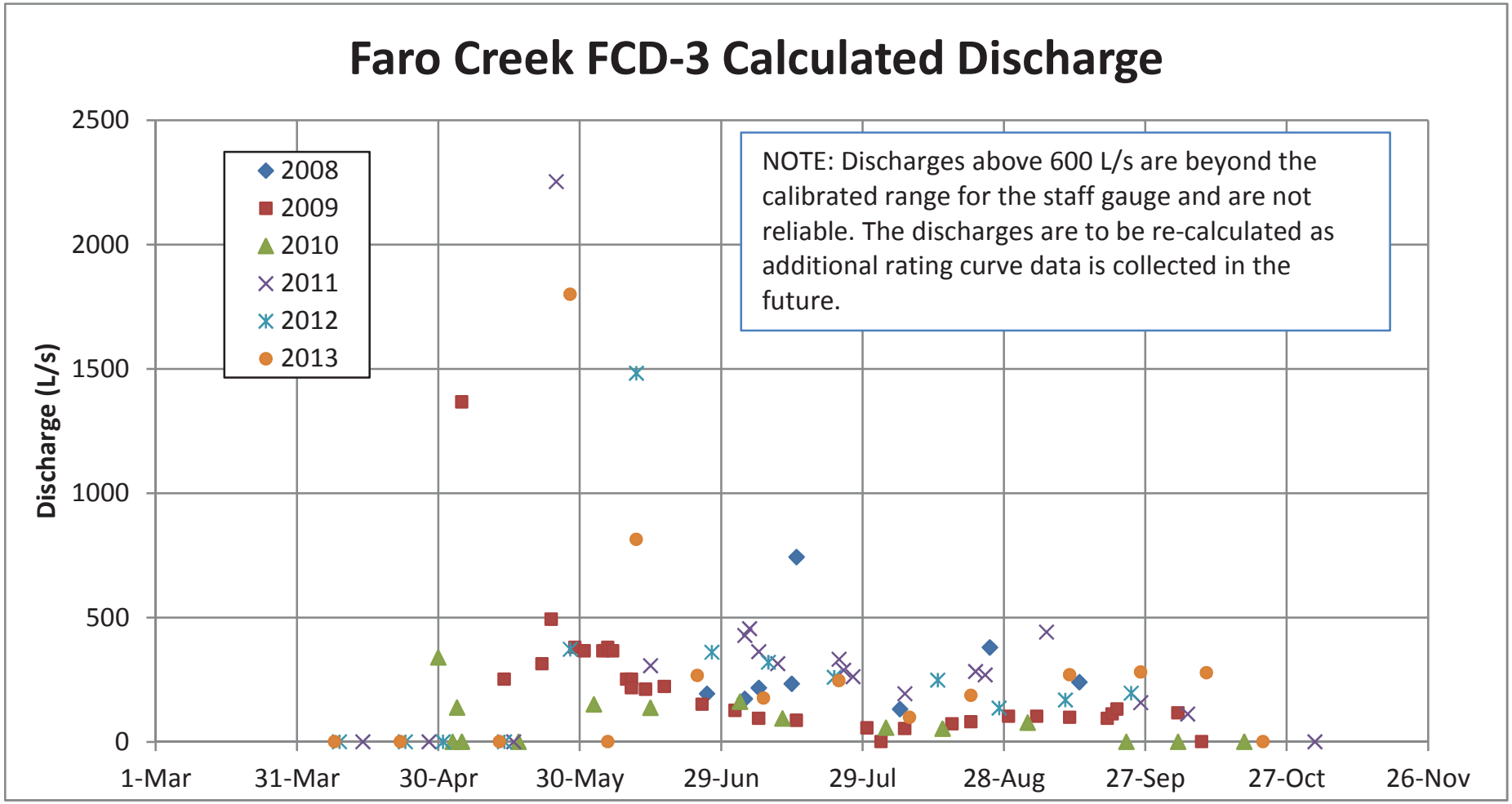
B.2 – Staff Gauge Flow

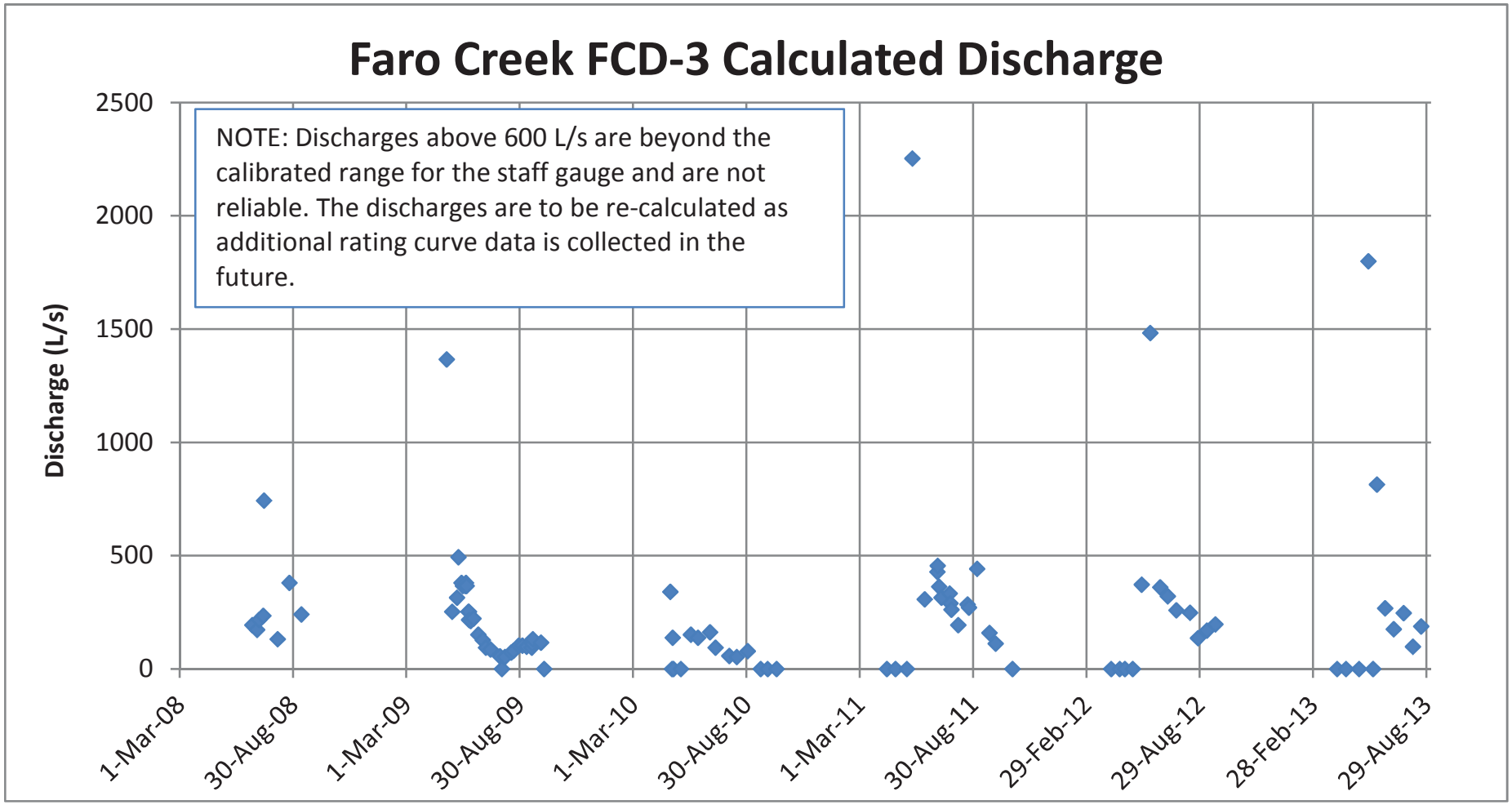

Faro Creek FCD-1 Calculated Discharge
Discharge (L/s)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
2007
2008
2009
2010
2011
2012
2013
NOTE: Discharges above 1,200 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.

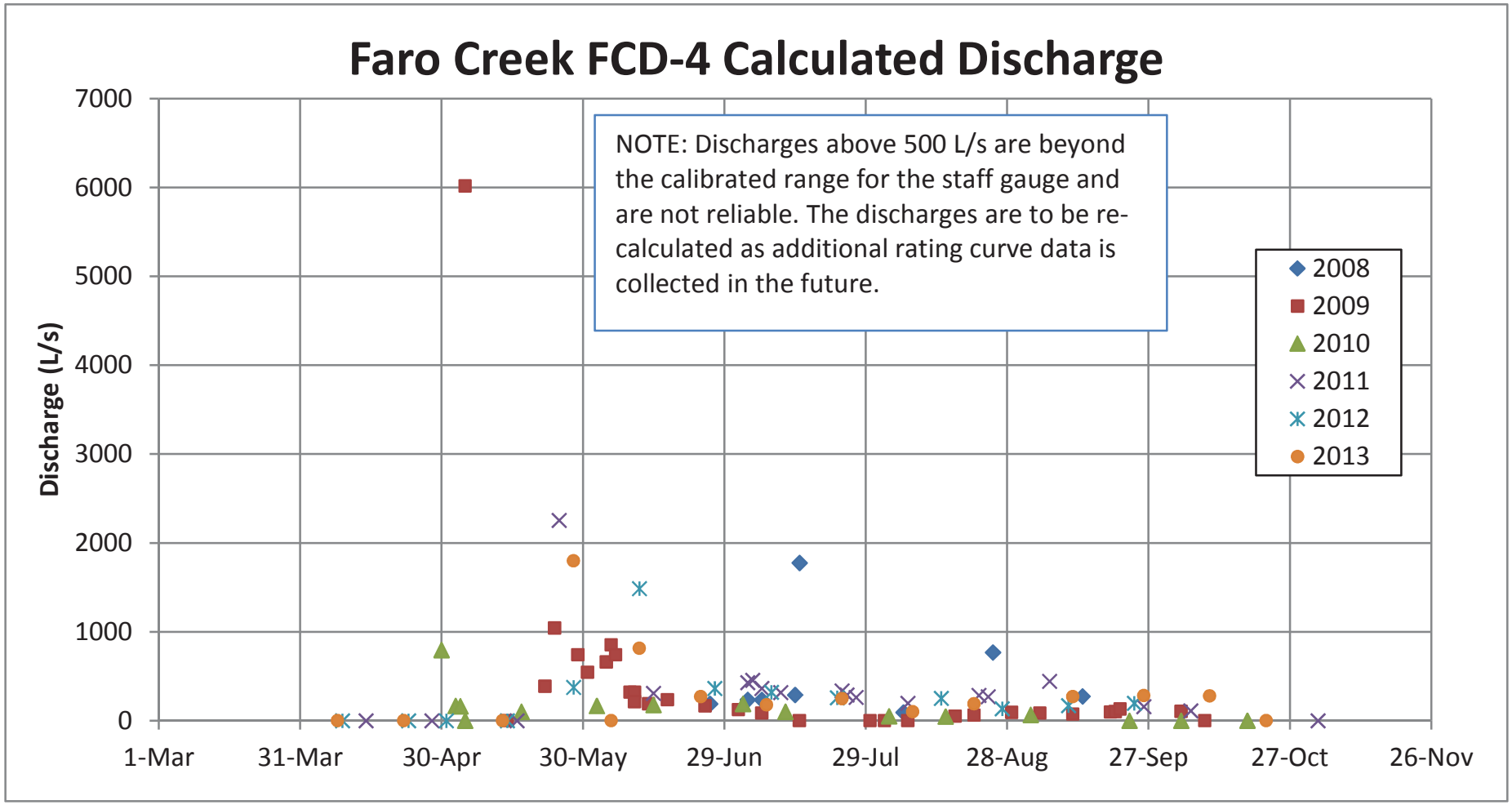

Faro Creek FCD-1 Calculated Discharge
Discharge (L/s)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1-Mar-08
30-Aug-08
1-Mar-09
30-Aug-09
1-Mar-10
30-Aug-10
1-Mar-11
30-Aug-11
29-Feb-12
29-Aug-12
28-Feb-13
29-Aug-13
NOTE: Discharges above 1,200 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.

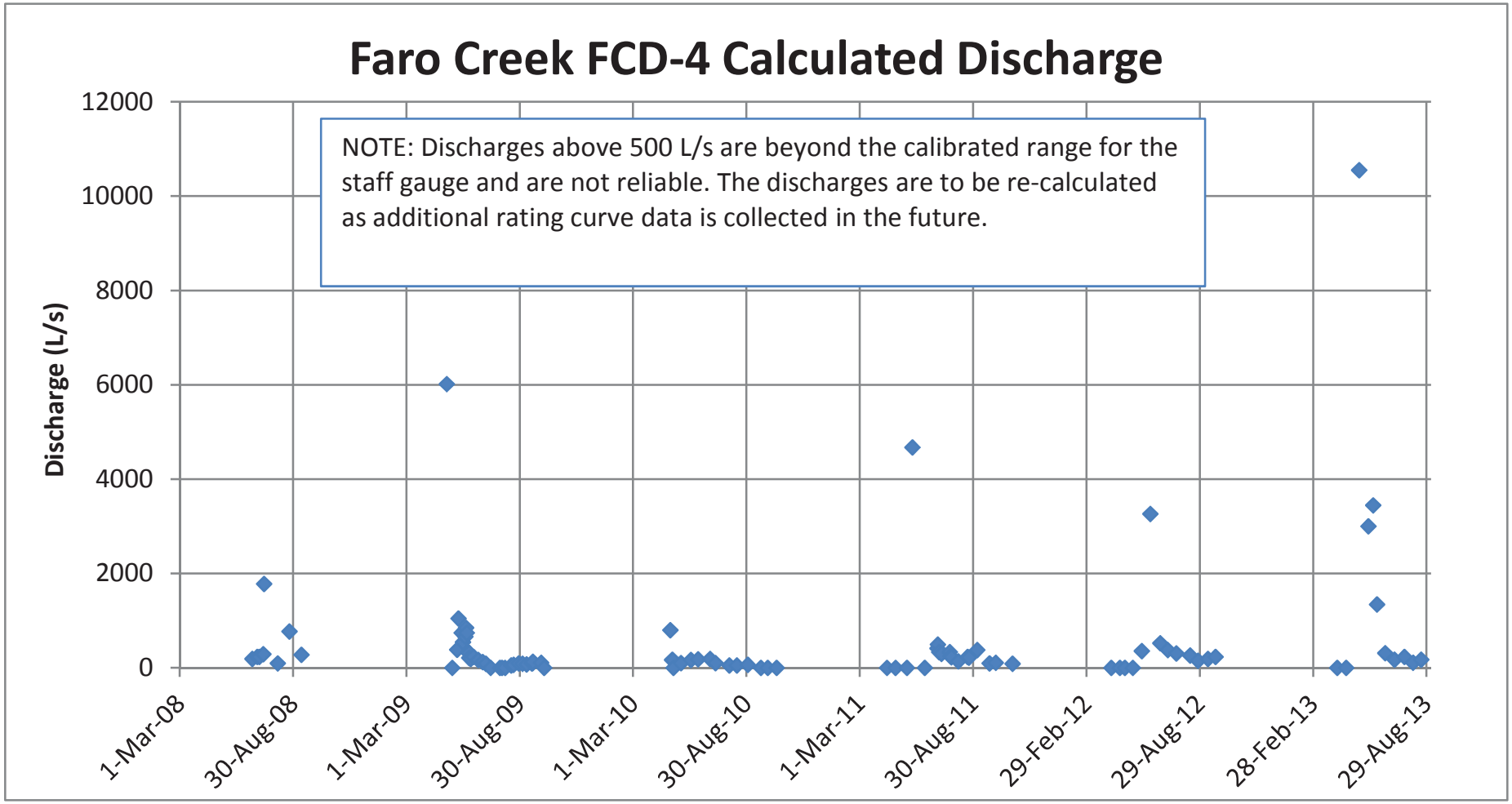

Faro Creek FCD-2 Calculated Discharge
Discharge (L/s)
1600
1400
1200
1000
800
600
400
200
0
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
2007
2008
2009
2010
2011
2012
2013
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Faro Creek FCD-2 Calculated Discharge
Discharge (L/s)
1600
1400
1200
1000
800
600
400
200
0
1-Mar-08
30-Aug-08
1-Mar-09
30-Aug-09
1-Mar-10
30-Aug-10
1-Mar-11
30-Aug-11
29-Feb-12
29-Aug-12
28-Feb-13
29-Aug-13
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Faro Creek FCD-3 Calculated Discharge
Discharge (L/s)
2500
2000
1500
1000
500
0
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
2008
2009
2010
2011
2012
2013
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Faro Creek FCD-3 Calculated Discharge
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
2500
2000
1500
1000
500
0
1-Mar-08
30-Aug-08
1-Mar-09
30-Aug-09
1-Mar-10
30-Aug-10
1-Mar-11
30-Aug-11
29-Feb-12
29-Aug-12
28-Feb-13
29-Aug-13


Faro Creek FCD-4 Calculated Discharge
NOTE: Discharges above 500 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
7000
6000
5000
4000
3000
2000
1000
0
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
2008
2009
2010
2011
2012
2013


Faro Creek FCD-4 Calculated Discharge
NOTE: Discharges above 500 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
12000
10000
8000
6000
4000
2000
0
1-Mar-08
30-Aug-08
1-Mar-09
30-Aug-09
1-Mar-10
30-Aug-10
1-Mar-11
30-Aug-11
29-Feb-12
29-Aug-12
28-Feb-13
29-Aug-13

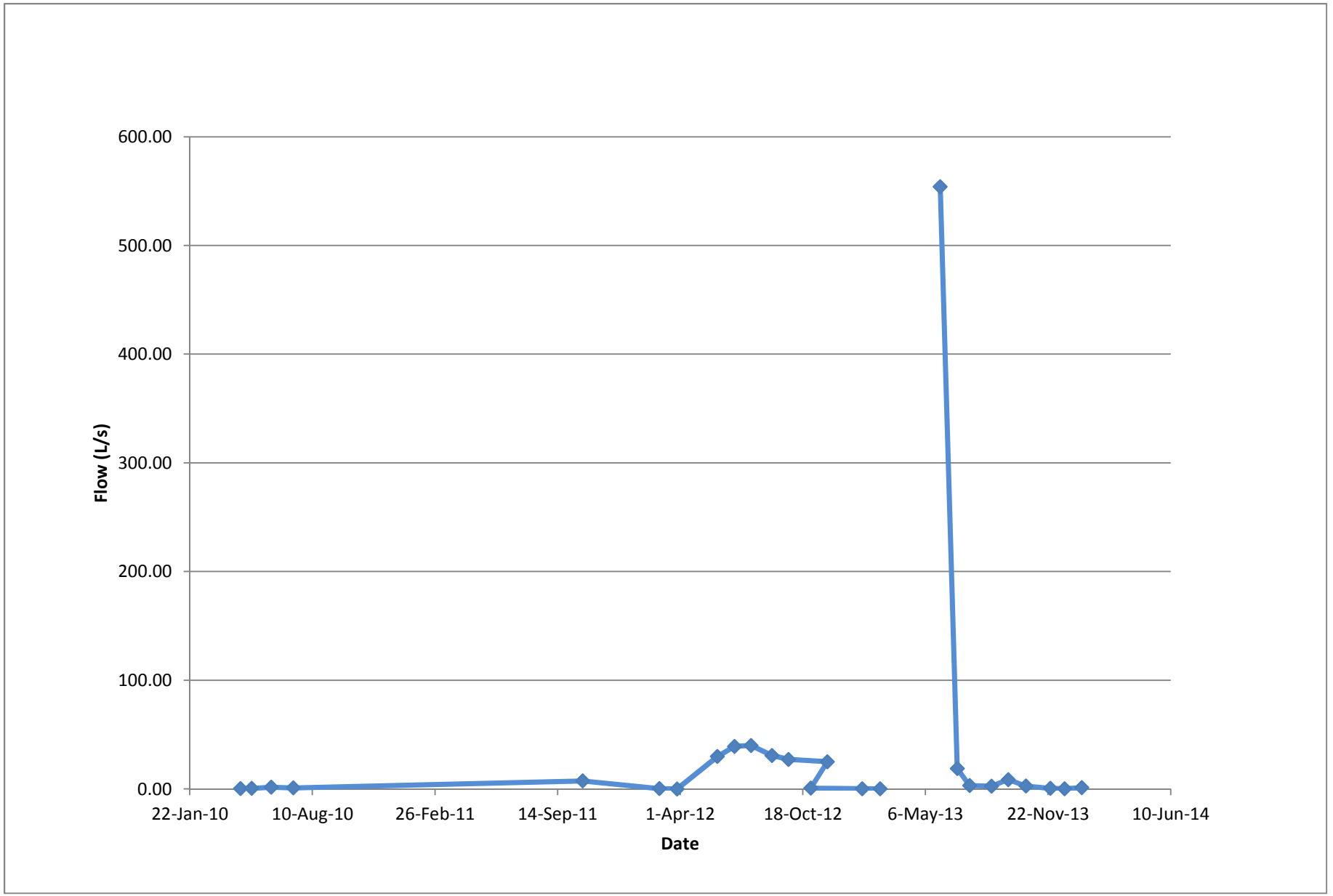
APPENDIX II-C

North Valley Wall Interceptor Ditch

C.1 – Ditch Flow

C.1 – Ditch Flow

NWID Flow Summary



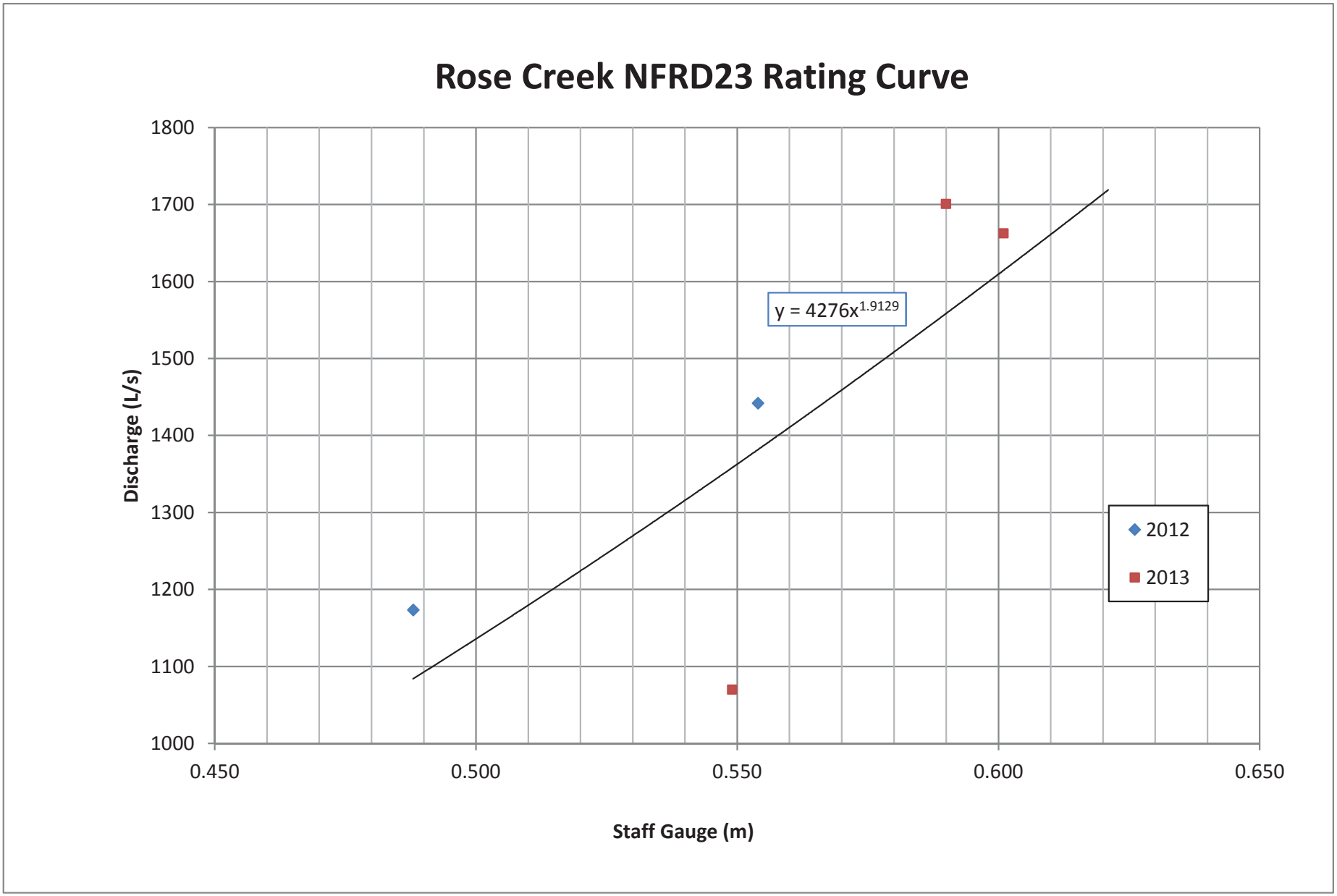
APPENDIX II-D

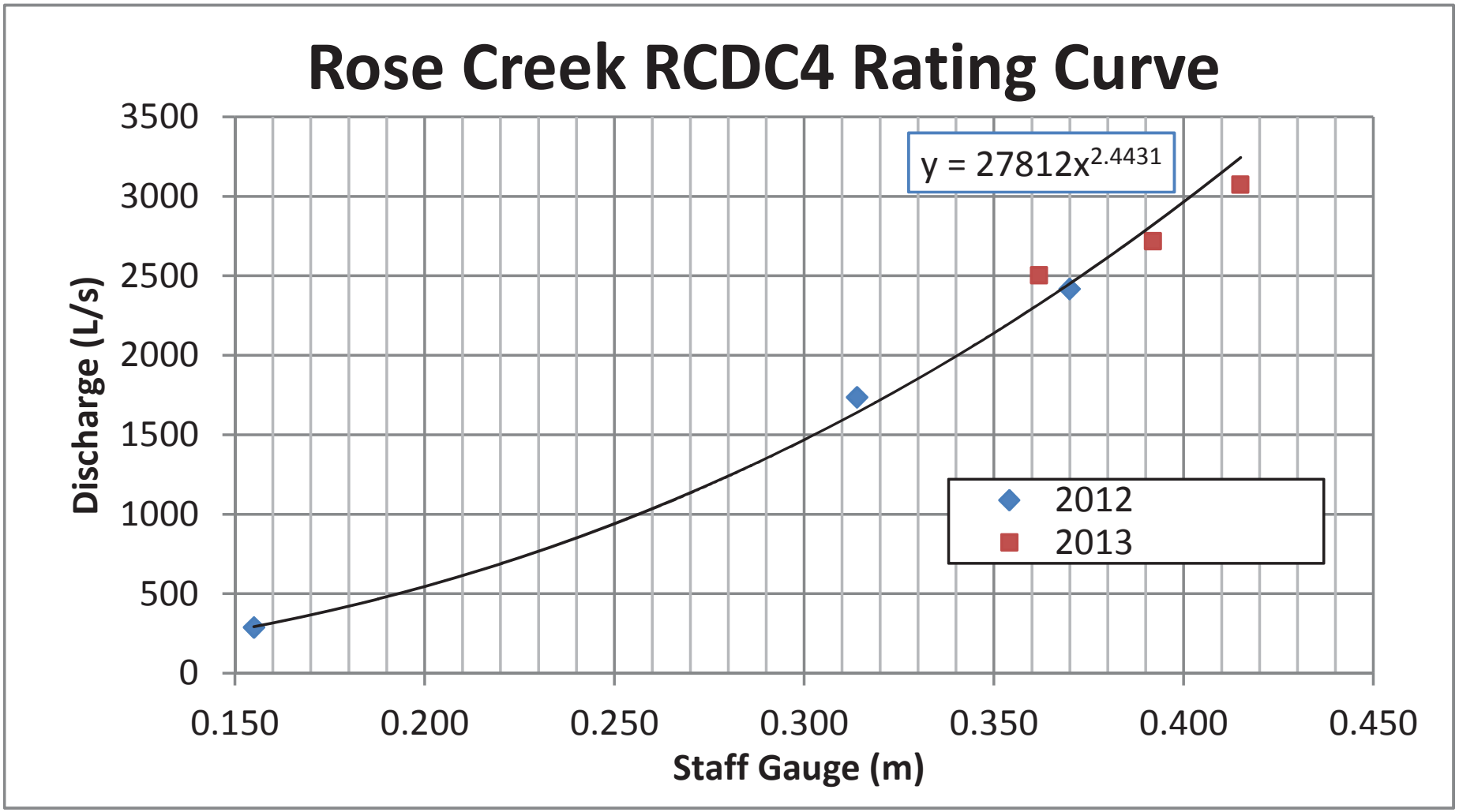
Rose Creek Diversion Channel

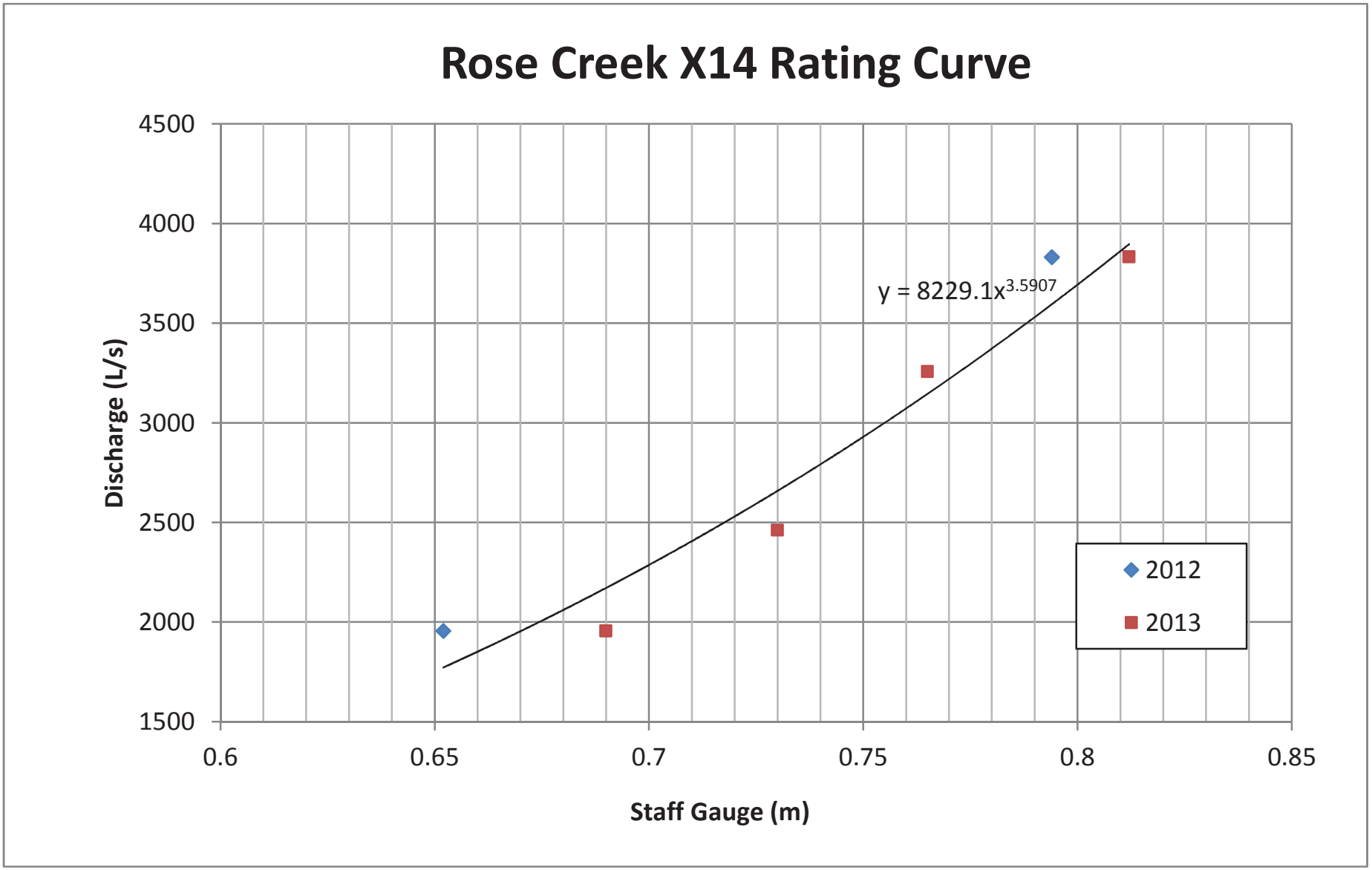
D.1 – Staff Gauge Calibration

D.2 – Staff Gauge Flow

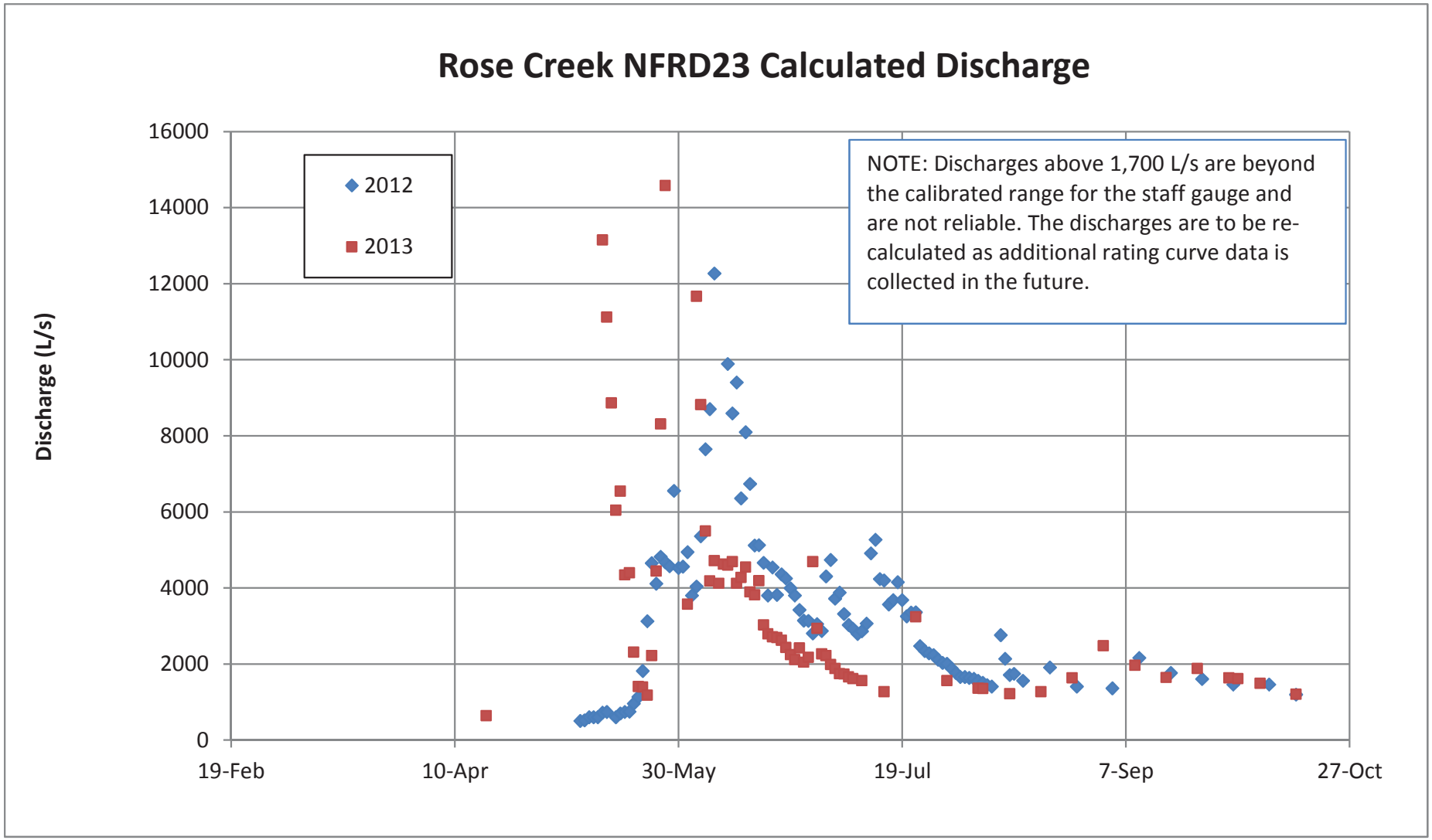
D.1 – Staff Gauge Calibration

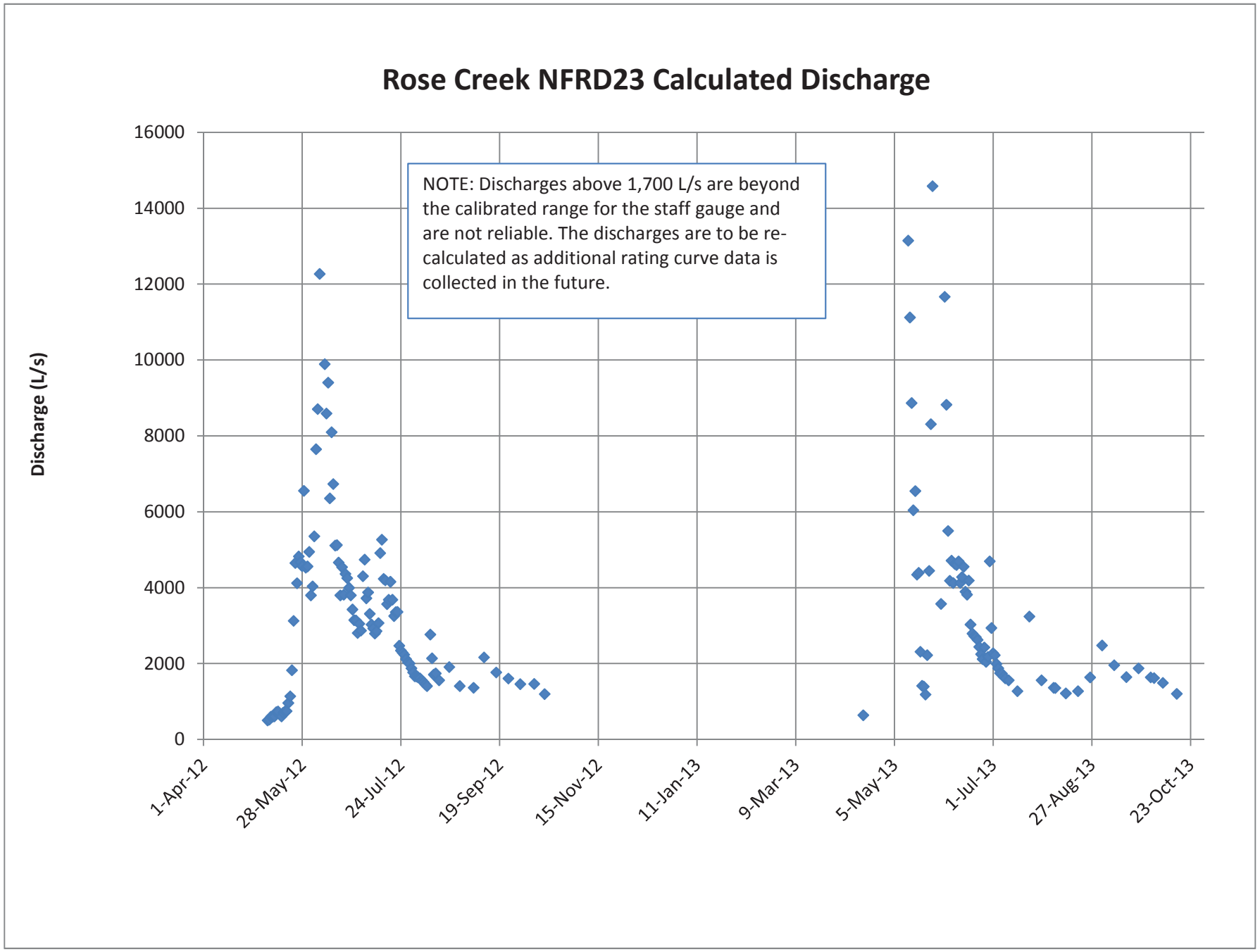

Rose Creek NFRD23 Rating Curve
1800
1700
1600
1500
1400
1300
1200
1100
1000
Discharge (L/s)
y = 4276x^1.9129
2012
2013
0.450
0.500
0.550
0.600
0.650
Staff Gauge (m)

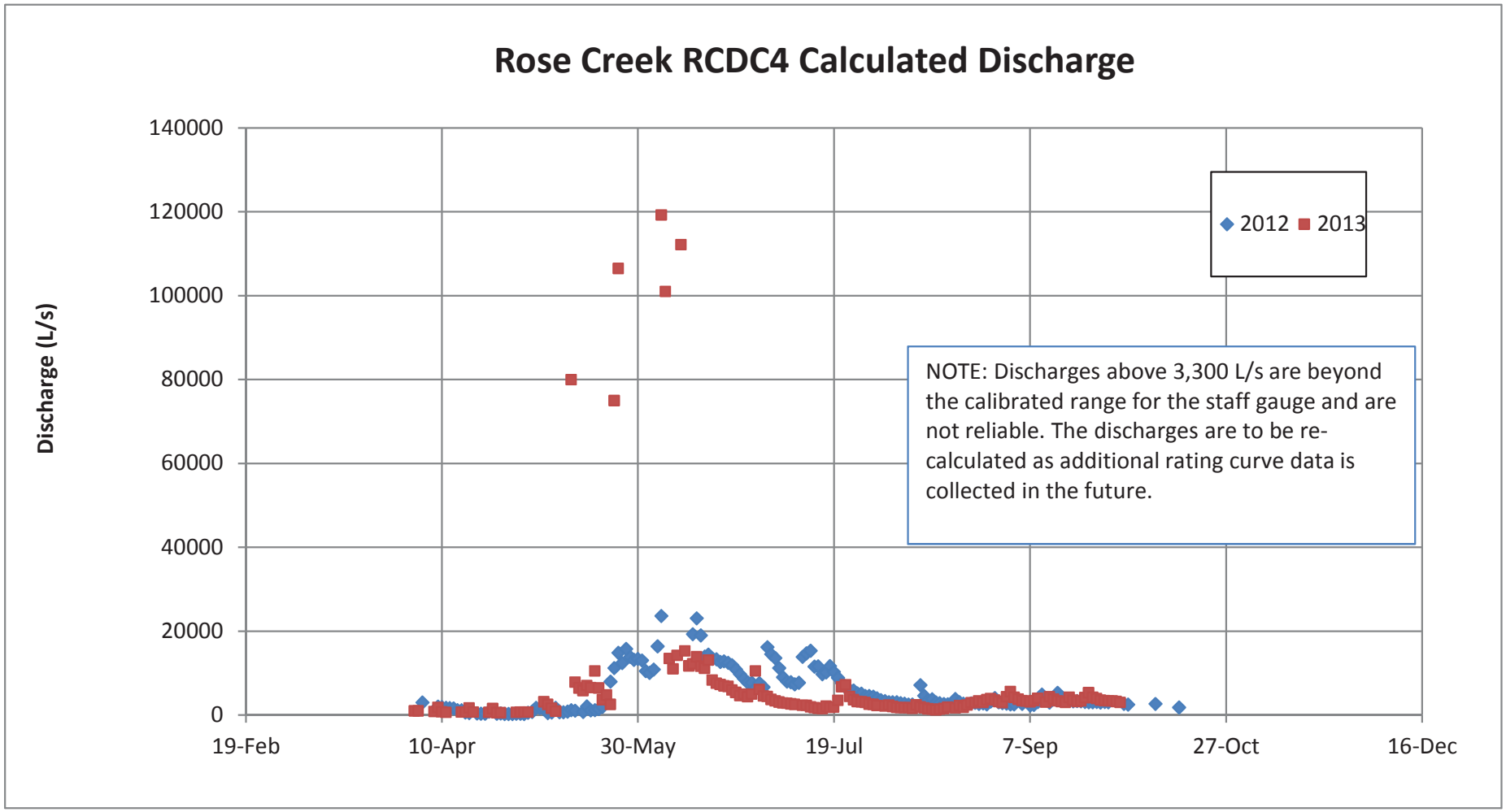

Rose Creek RCDC4 Rating Curve
y = 27812x^2.4431
2012
2013
Discharge (L/s)
Staff Gauge (m)
3500
3000
2500
2000
1500
1000
500
0
0.150
0.200
0.250
0.300
0.350
0.400
0.450

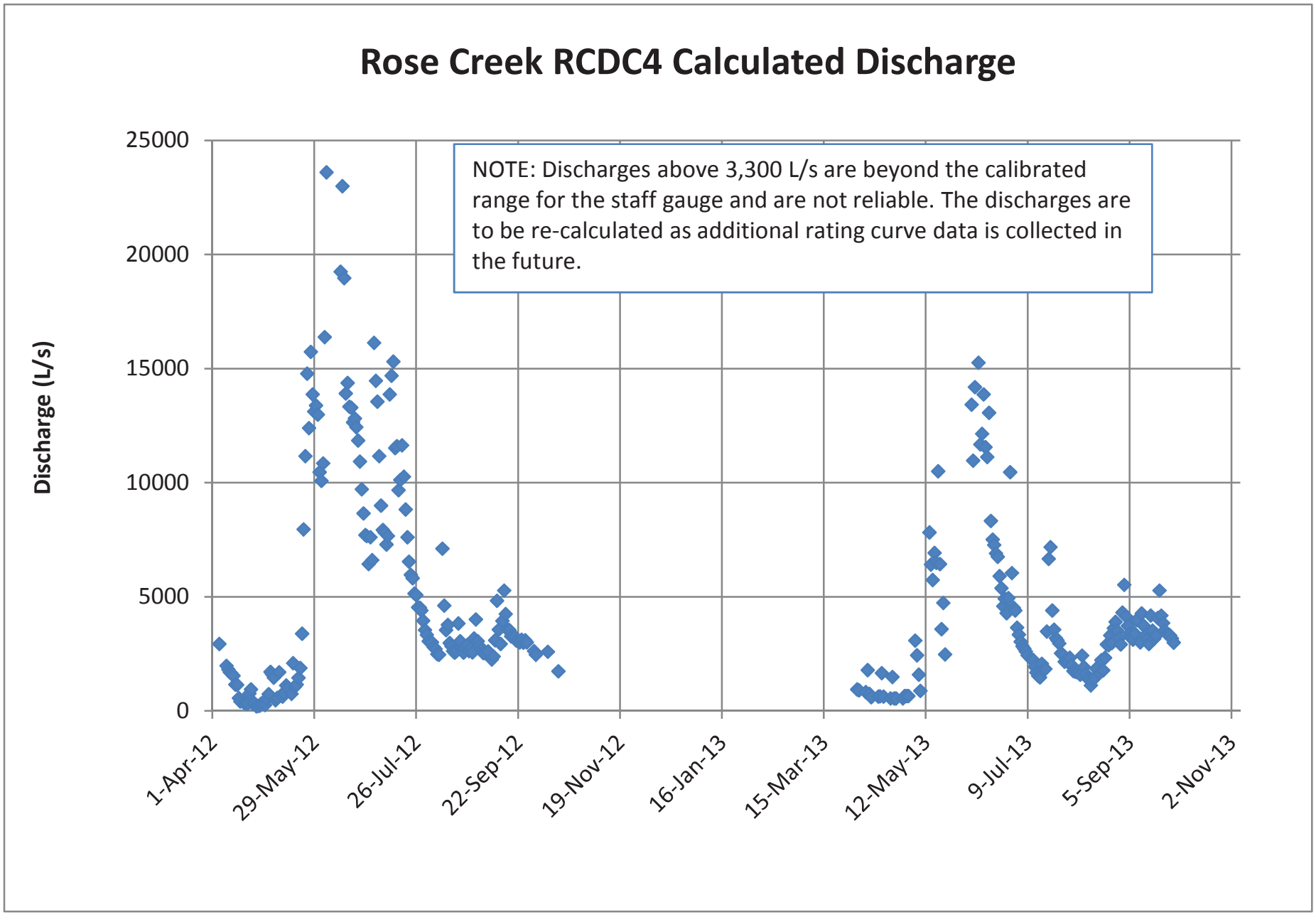

Rose Creek X14 Rating Curve
4500
4000
3500
3000
2500
2000
1500
Discharge (L/s)
0.6
0.65
0.7
0.75
0.8
0.85
Staff Gauge (m)
y = 8229.1x3.5907
2012
2013

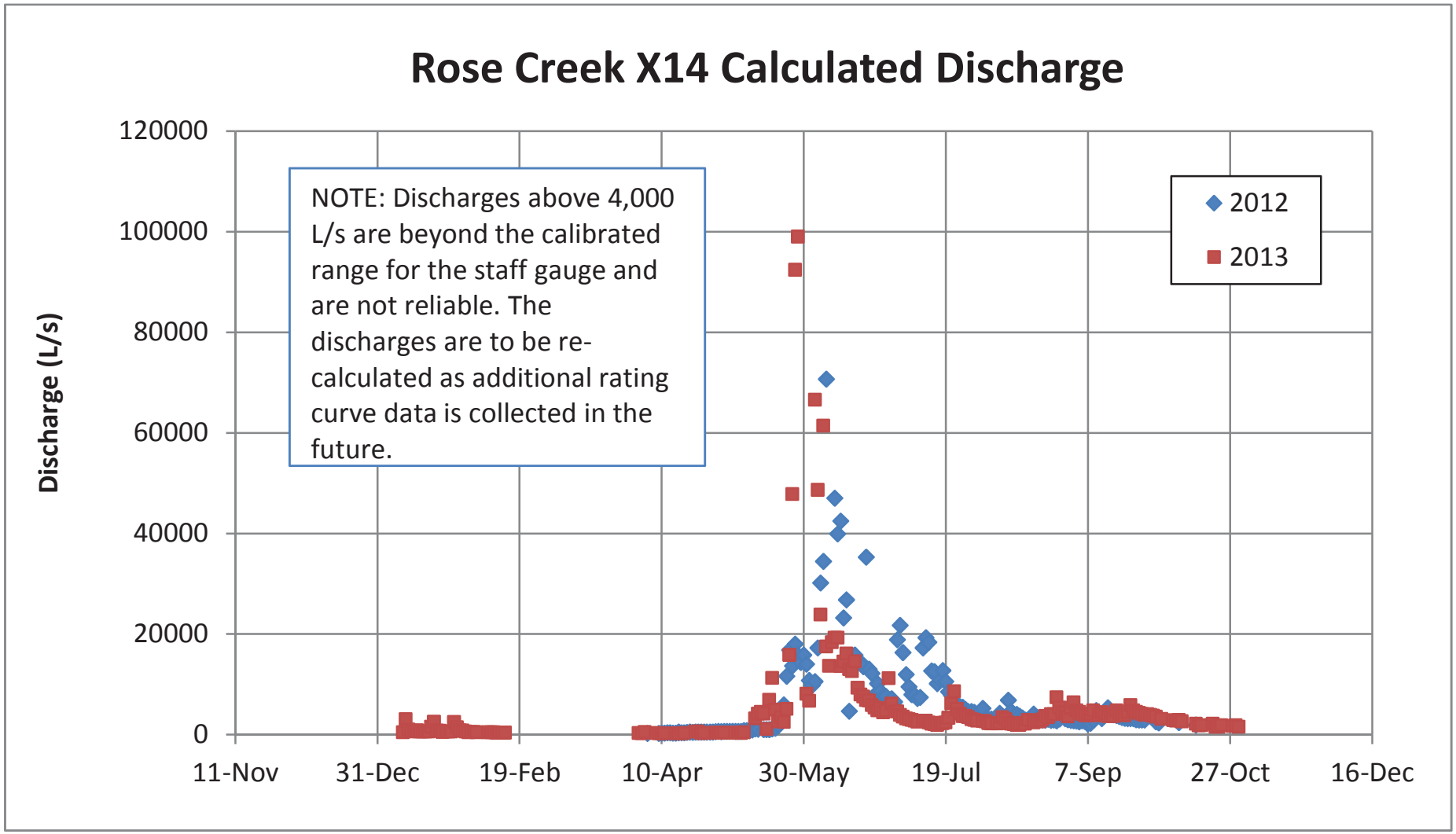
D.2 – Staff Gauge Flow

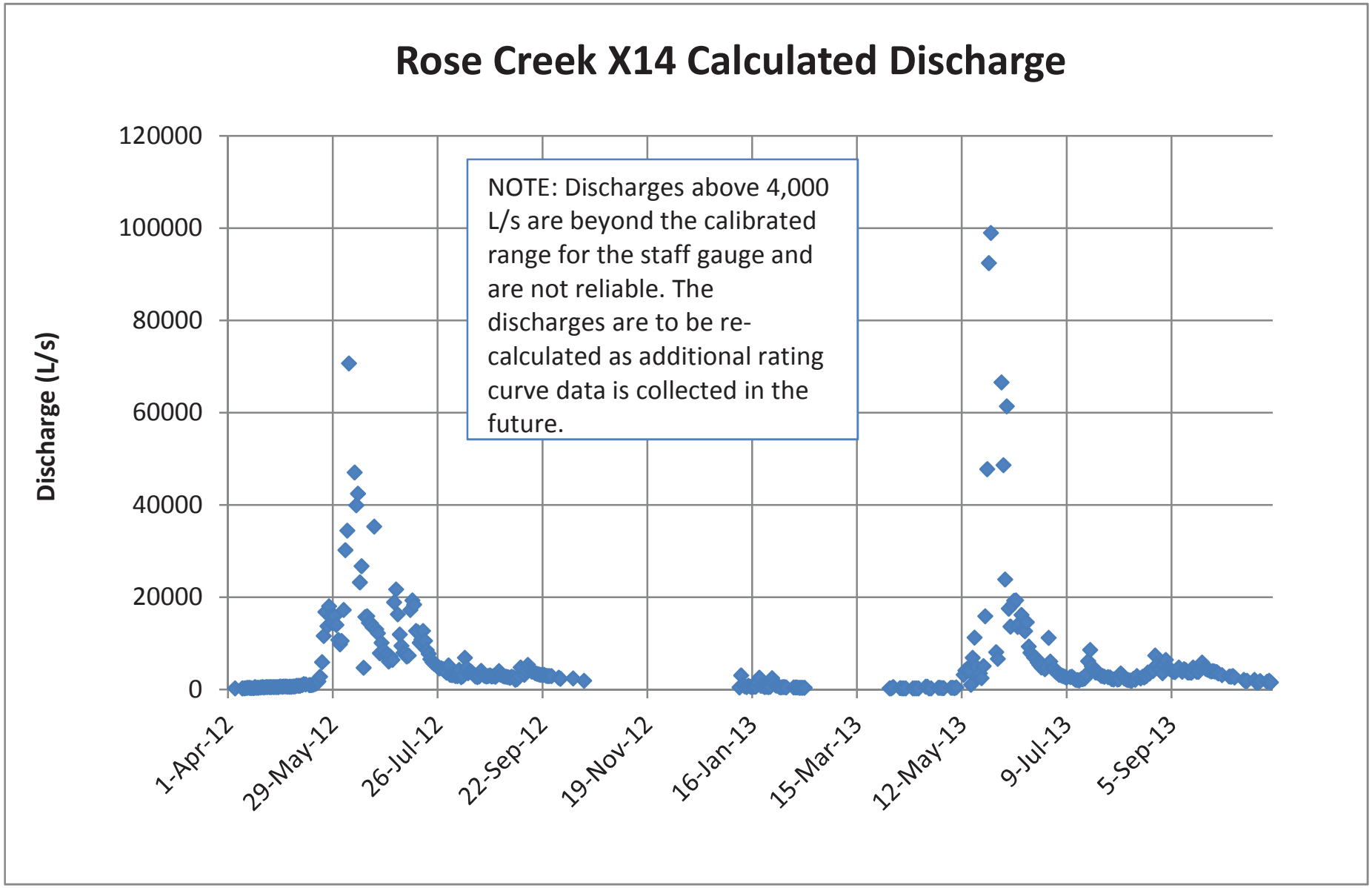

Rose Creek NFRD23 Calculated Discharge
Discharge (L/s)
16000
14000
12000
10000
8000
6000
4000
2000
0
19-Feb
10-Apr
30-May
19-Jul
7-Sep
27-Oct
2012
2013
NOTE: Discharges above 1,700 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Rose Creek NFRD23 Calculated Discharge
NOTE: Discharges above 1,700 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
16000
14000
12000
10000
8000
6000
4000
2000
0
1-Apr-12
28-May-12
24-Jul-12
19-Sep-12
15-Nov-12
11-Jan-13
9-Mar-13
5-May-13
1-Jul-13
27-Aug-13
23-Oct-13


Rose Creek RCDC4 Calculated Discharge
Discharge (L/s)
140000
120000
100000
80000
60000
40000
20000
0
19-Feb
10-Apr
30-May
19-Jul
7-Sep
27-Oct
16-Dec
2012
2013
NOTE: Discharges above 3,300 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Rose Creek RCDC4 Calculated Discharge
NOTE: Discharges above 3,300 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
25000
20000
15000
10000
5000
0
1-Apr-12
29-May-12
26-Jul-12
22-Sep-12
19-Nov-12
16-Jan-13
15-Mar-13
12-May-13
9-Jul-13
5-Sep-13
2-Nov-13


Rose Creek X14 Calculated Discharge
Discharge (L/s)
120000
100000
80000
60000
40000
20000
0
11-Nov
31-Dec
19-Feb
10-Apr
30-May
19-Jul
7-Sep
27-Oct
16-Dec
NOTE: Discharges above 4,000 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
2012
2013


Rose Creek X14 Calculated Discharge
Discharge (L/s)
120000
100000
80000
60000
40000
20000
0
NOTE: Discharges above 4,000 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
1-Apr-12
29-May-12
26-Jul-12
22-Sep-12
19-Nov-12
16-Jan-13
15-Mar-13
12-May-13
9-Jul-13
5-Sep-13

APPENDIX II-E

Canal Dyke

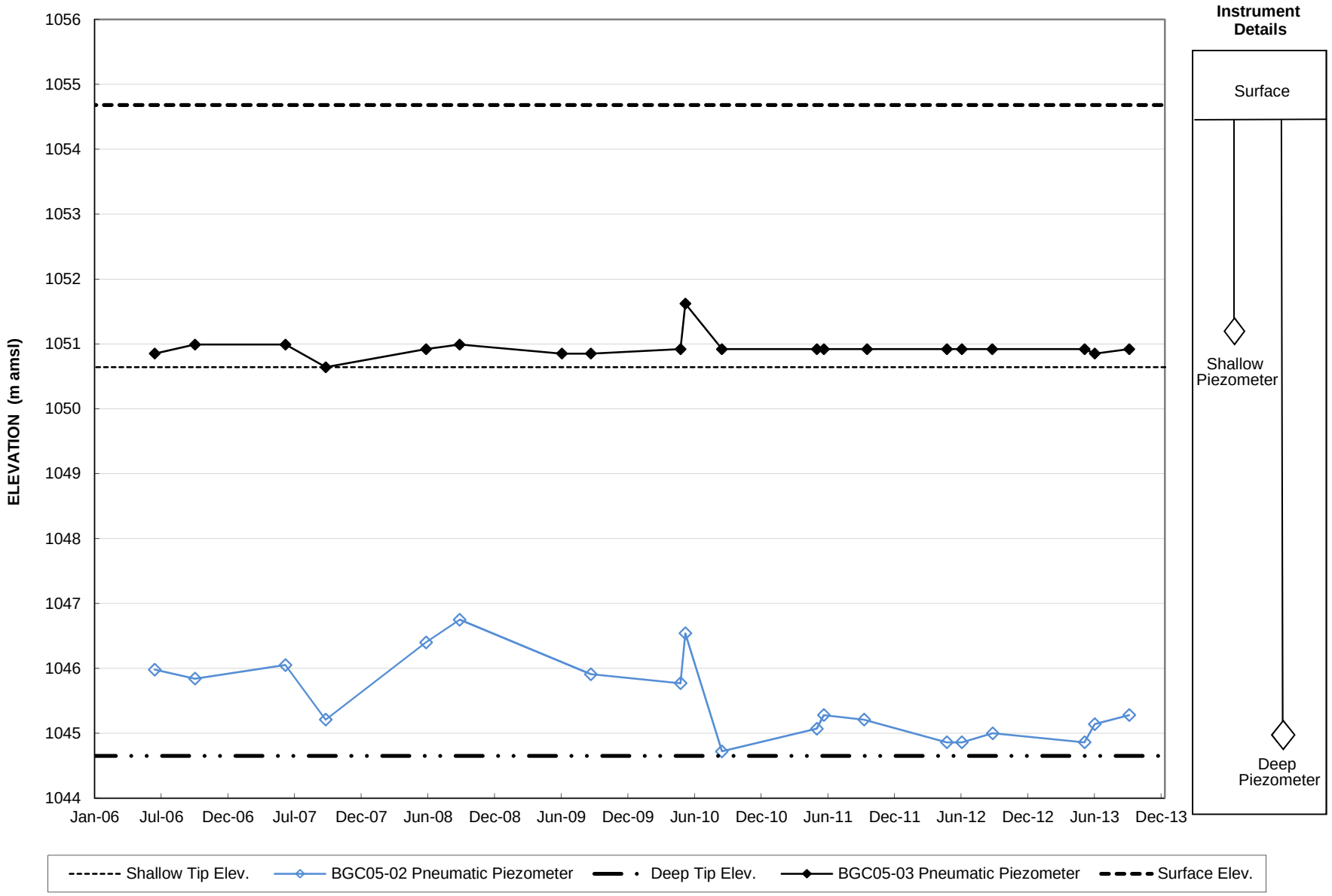
E.1 – Piezometers

E.2 – Thermistors

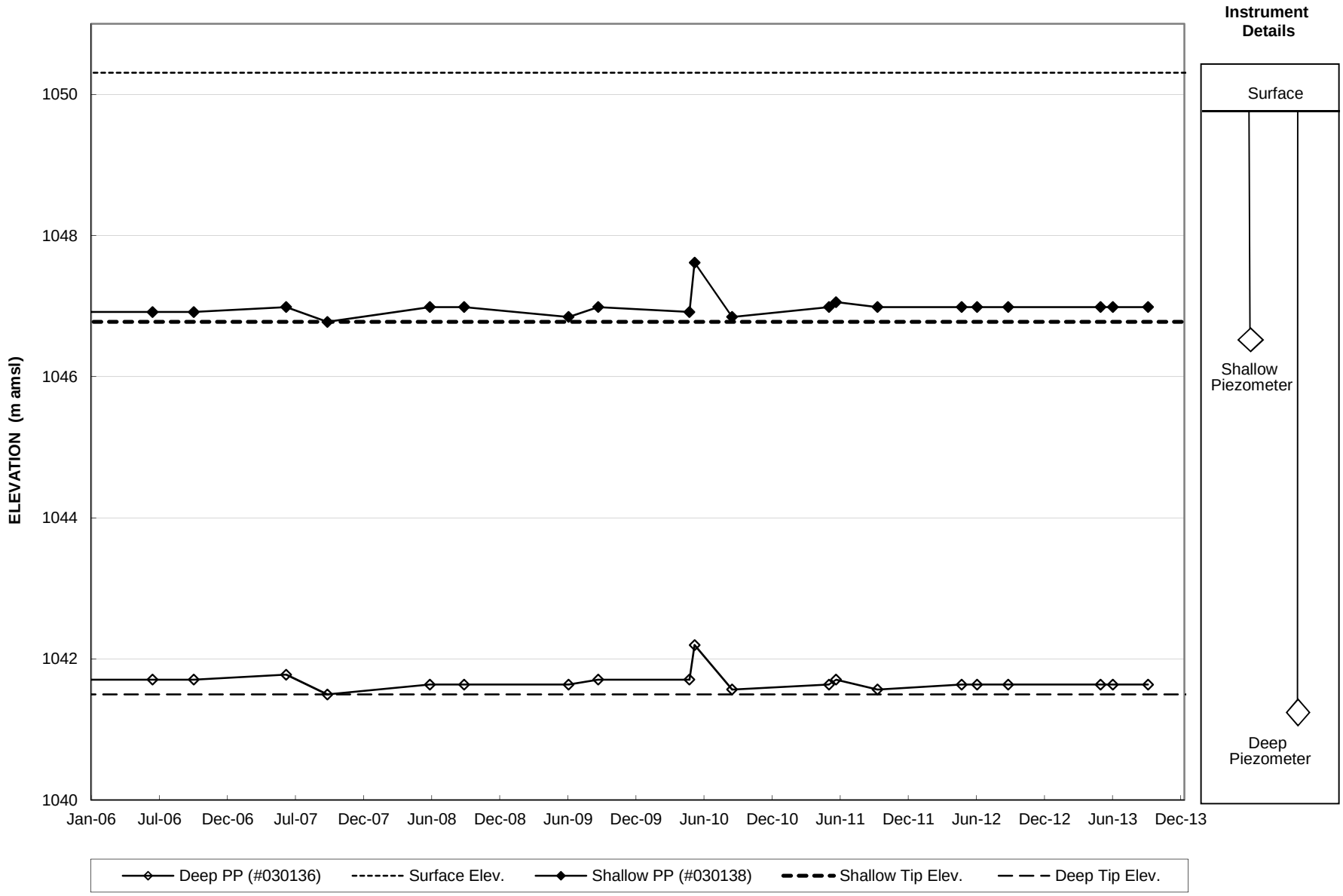
E.3 – Inclinometers

E.1 – Piezometers

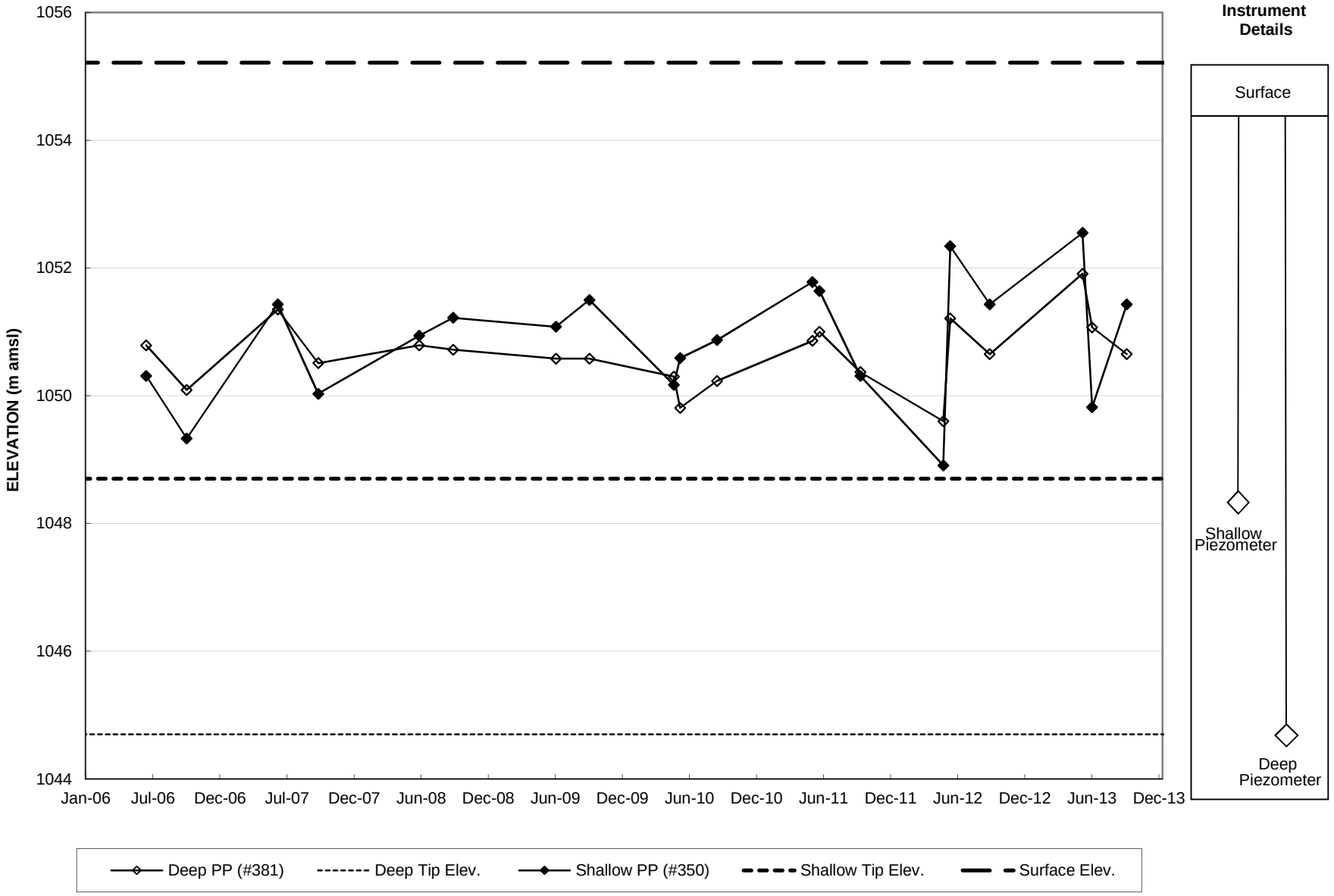
Diversion Canal (Canal Dyke) - Piezometers
BGC05- 02 03



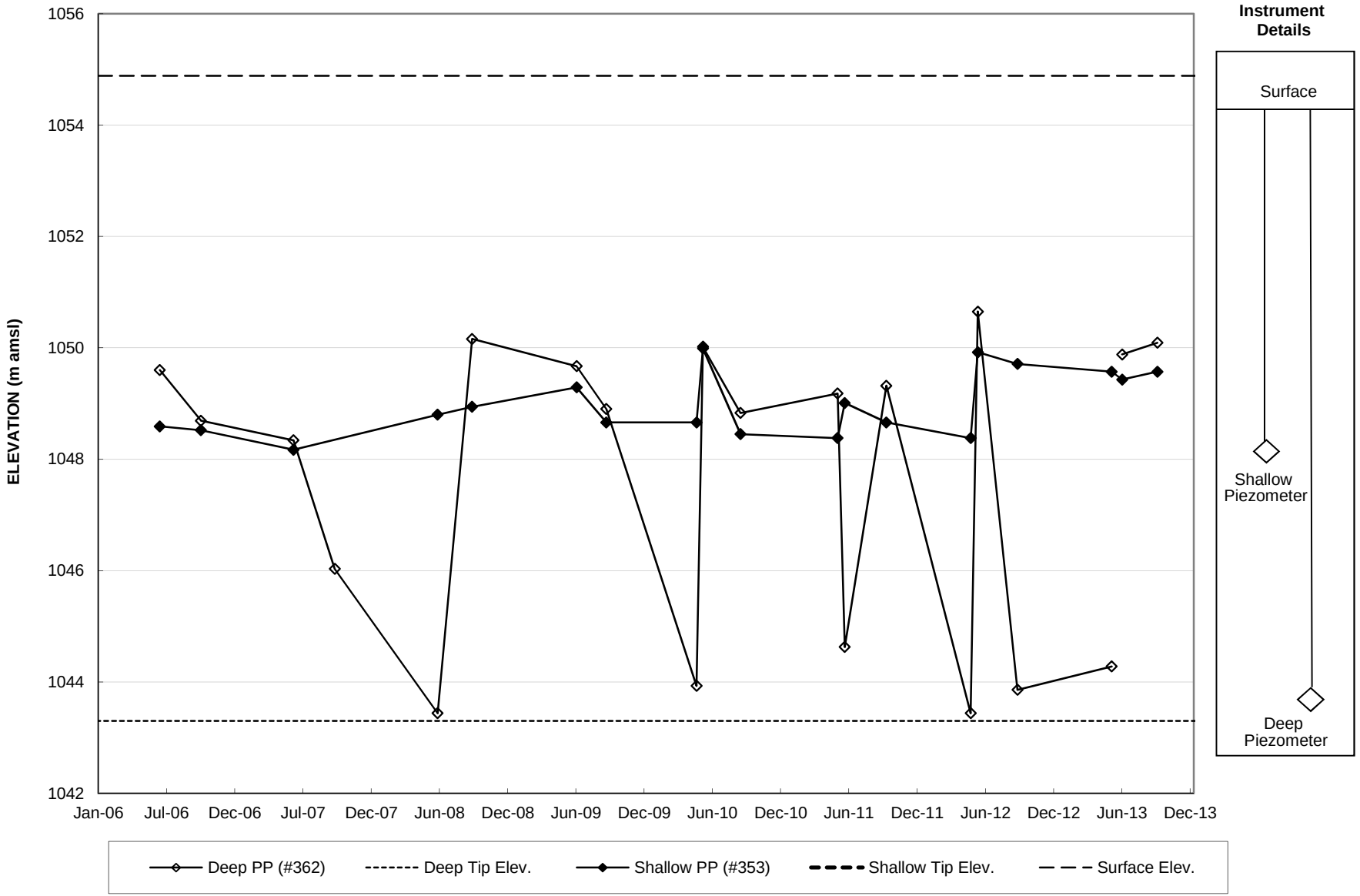
Diversion Canal (Canal Dyke)
Piezometers BGC05-06 (Both Tips)



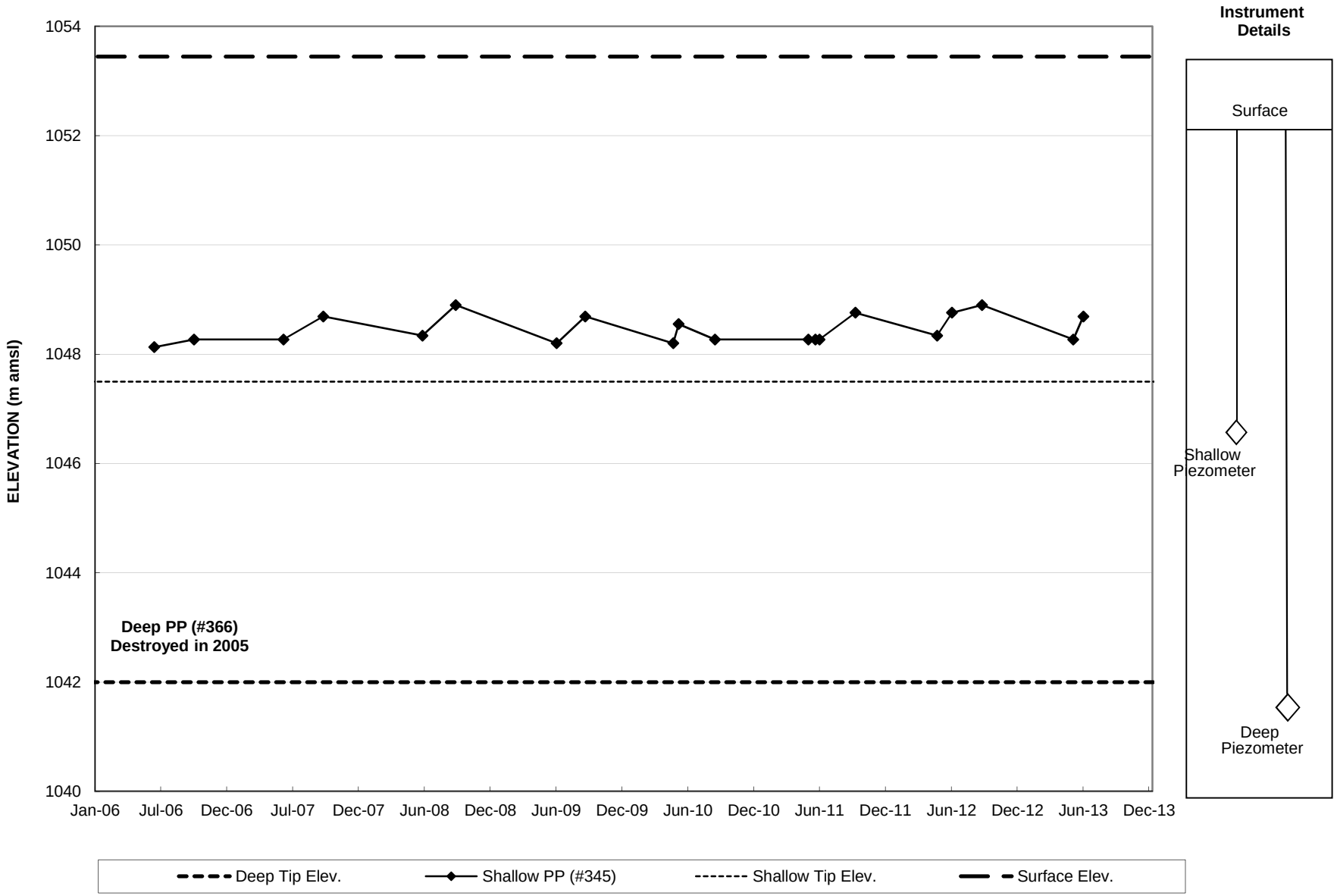
Diversion Canal (Canal Dyke)
Piezometers CD-13 (Both Tips)



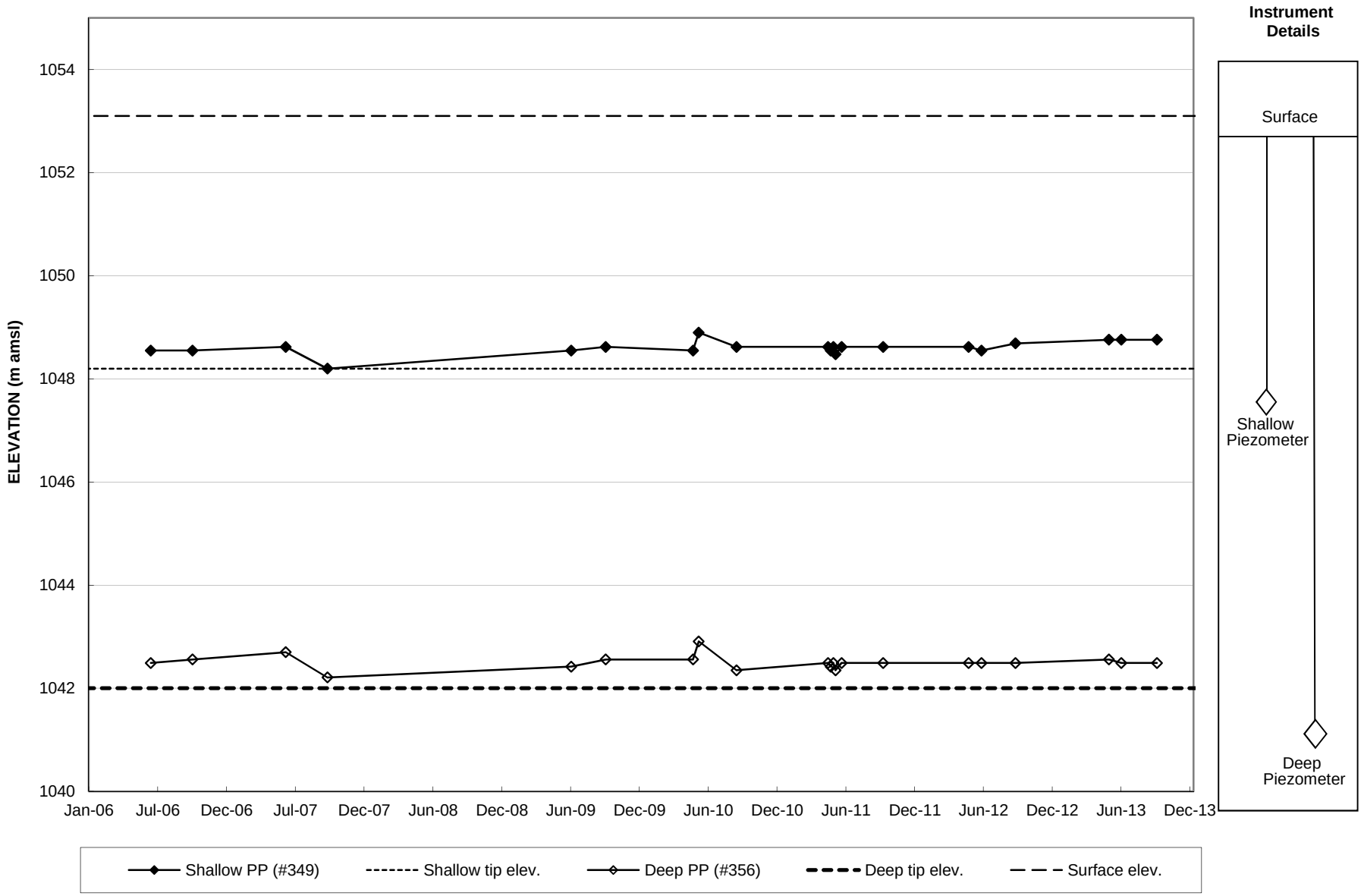
Diversion Canal (Canal Dyke)
Piezometers CD-15 (Both Tips)



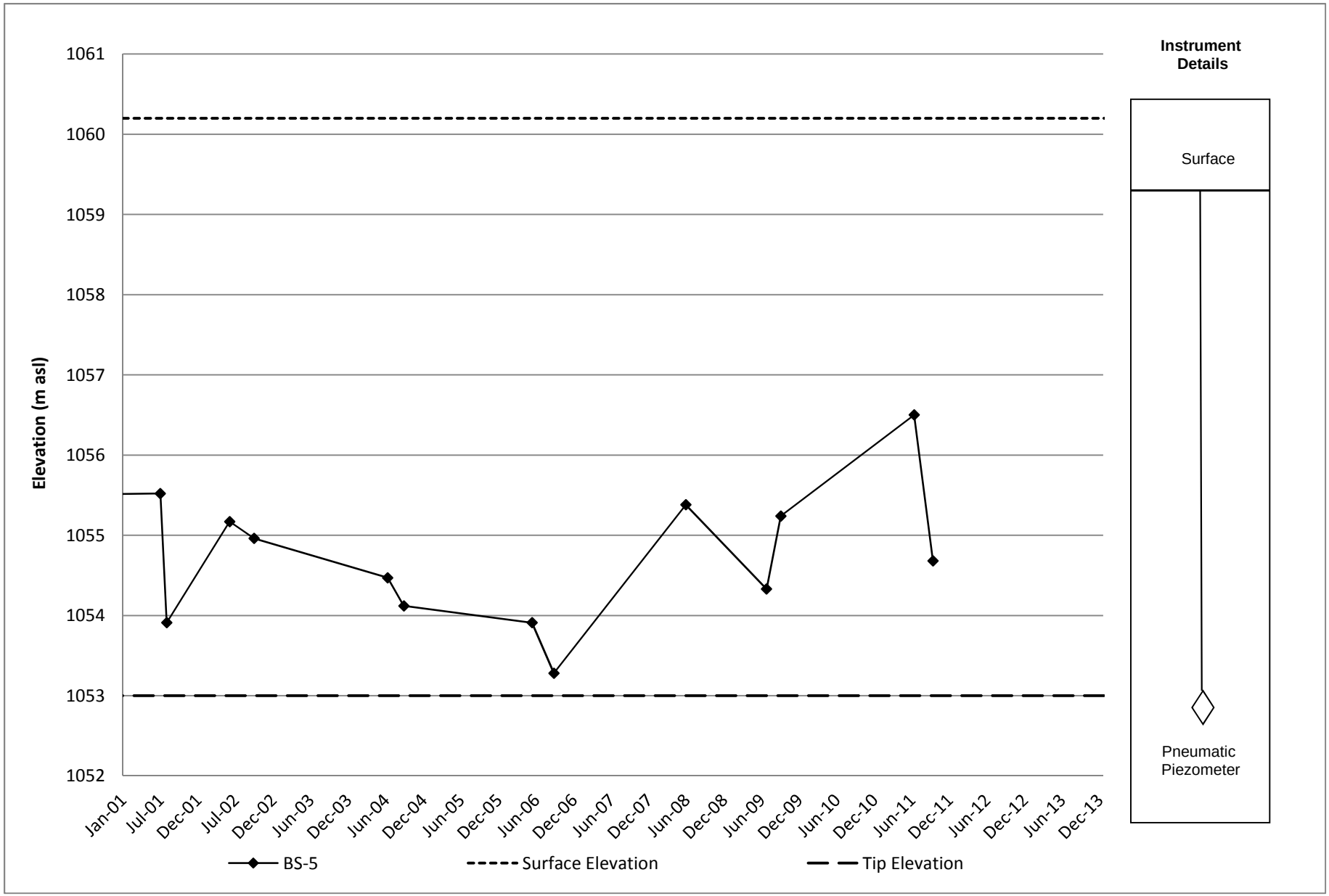
Diversion Canal (Canal Dyke)
Piezometers CD-21 (Both Tips)



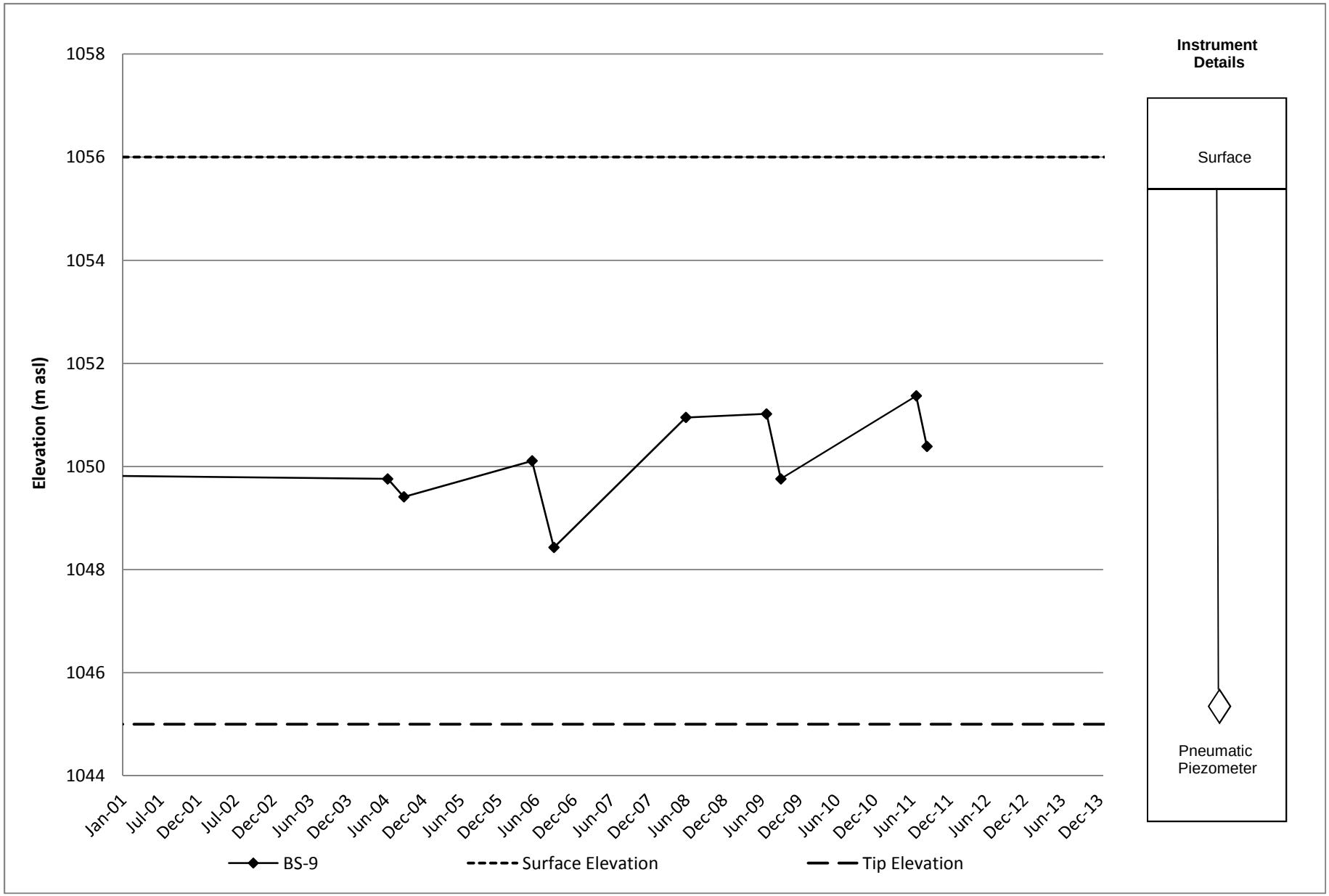
Diversion Canal (Canal Dyke)
Piezometers CD-26 (Both Tips)



Diversion Canal (Canal Dyke)
Piezometers BS-5

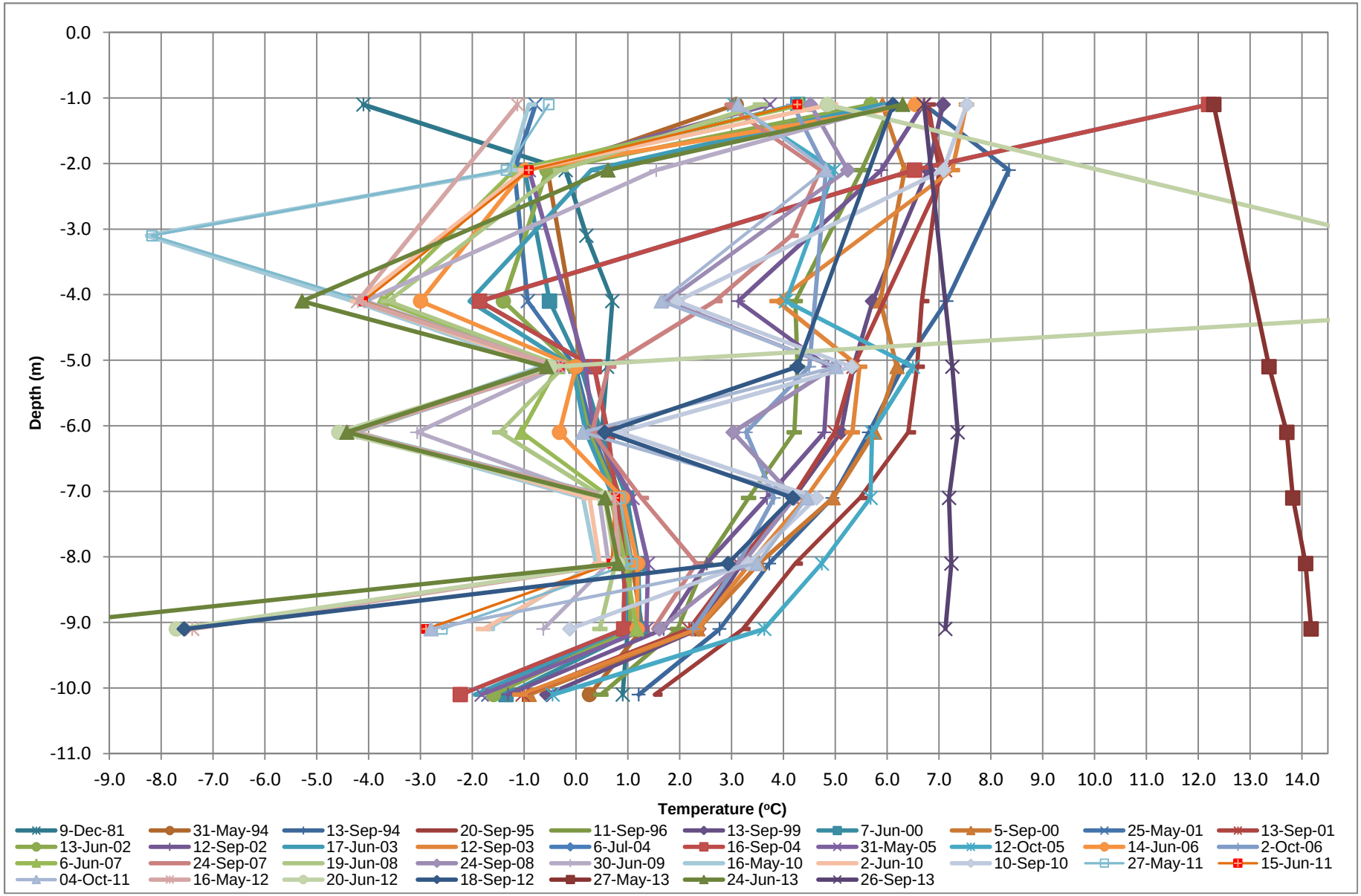


Diversion Canal (Canal Dyke)
Piezometers BS-9

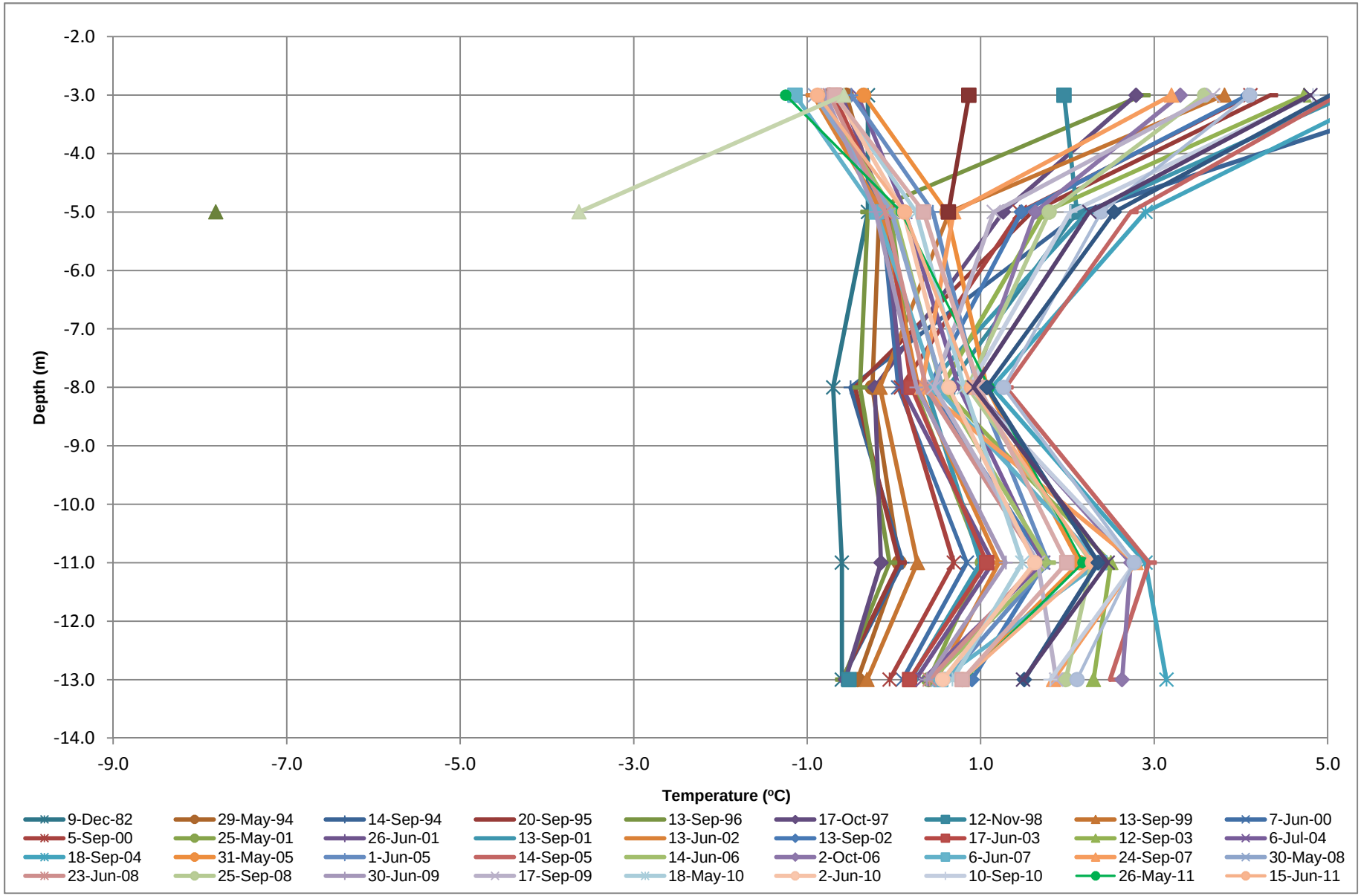


E.2 - Thermistors

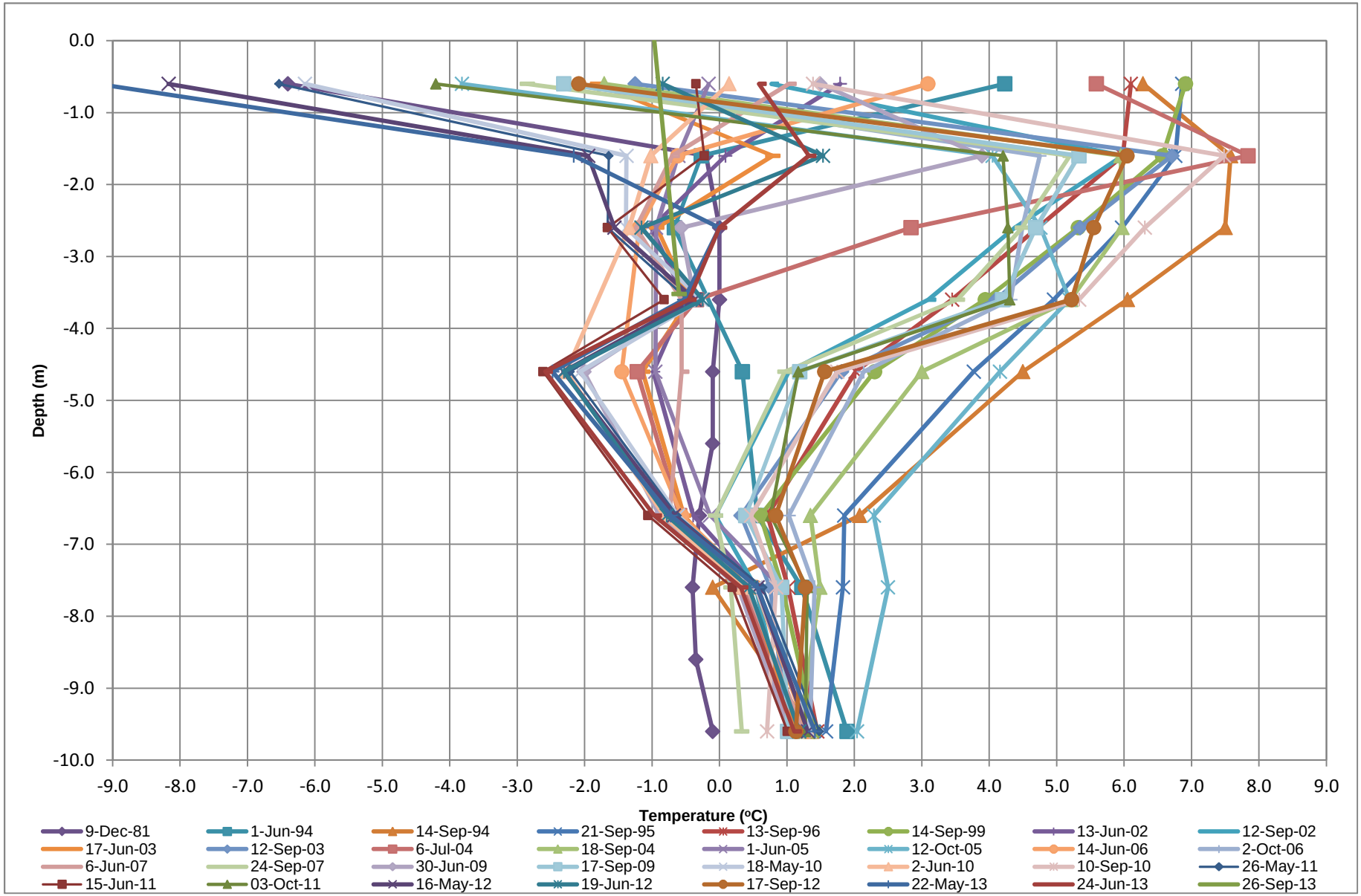
Diversion Canal (Canal Dyke)
Thermistor CD-15



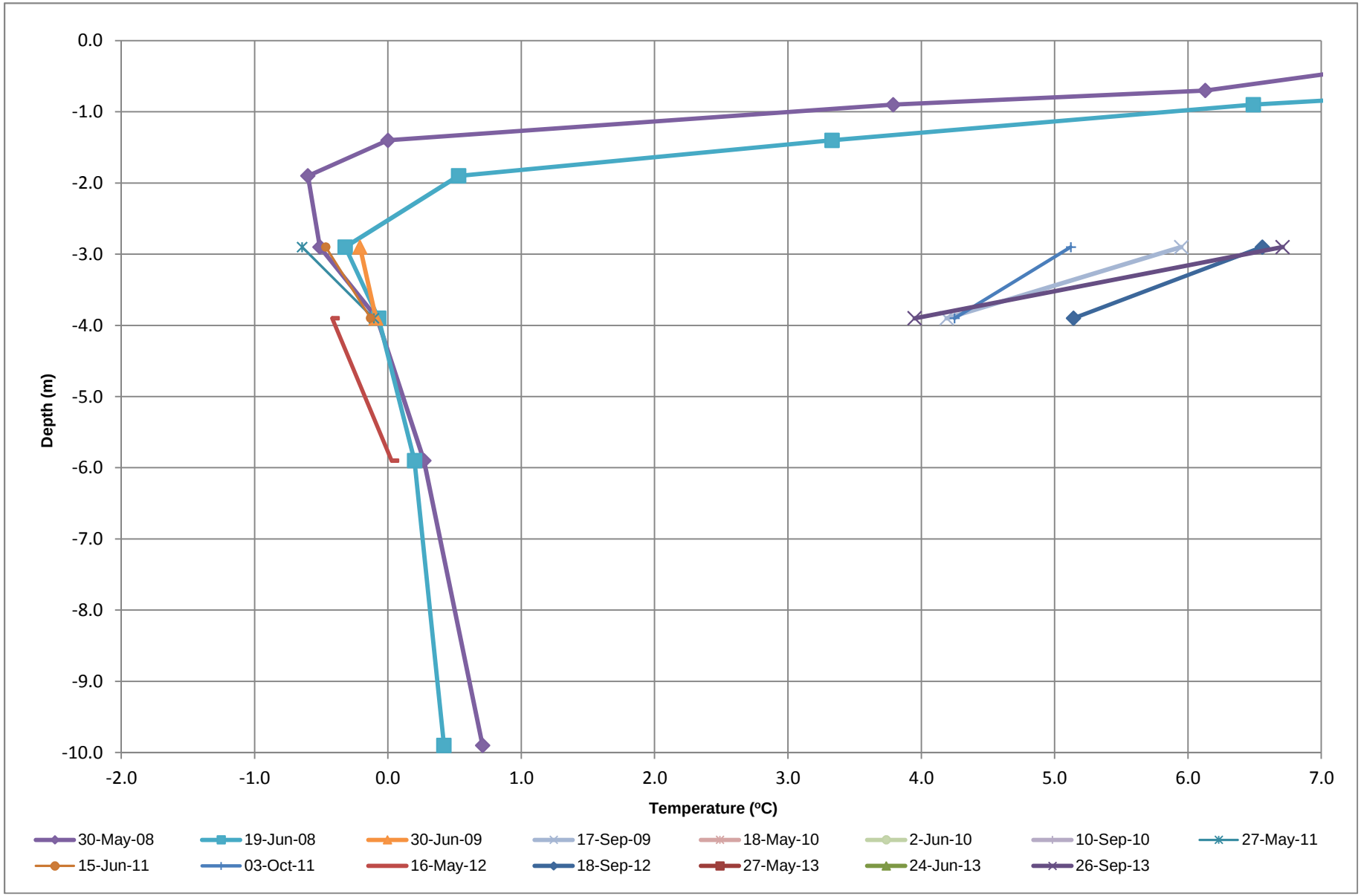
Diversion Canal (Canal Dyke)
Thermistor CD-21



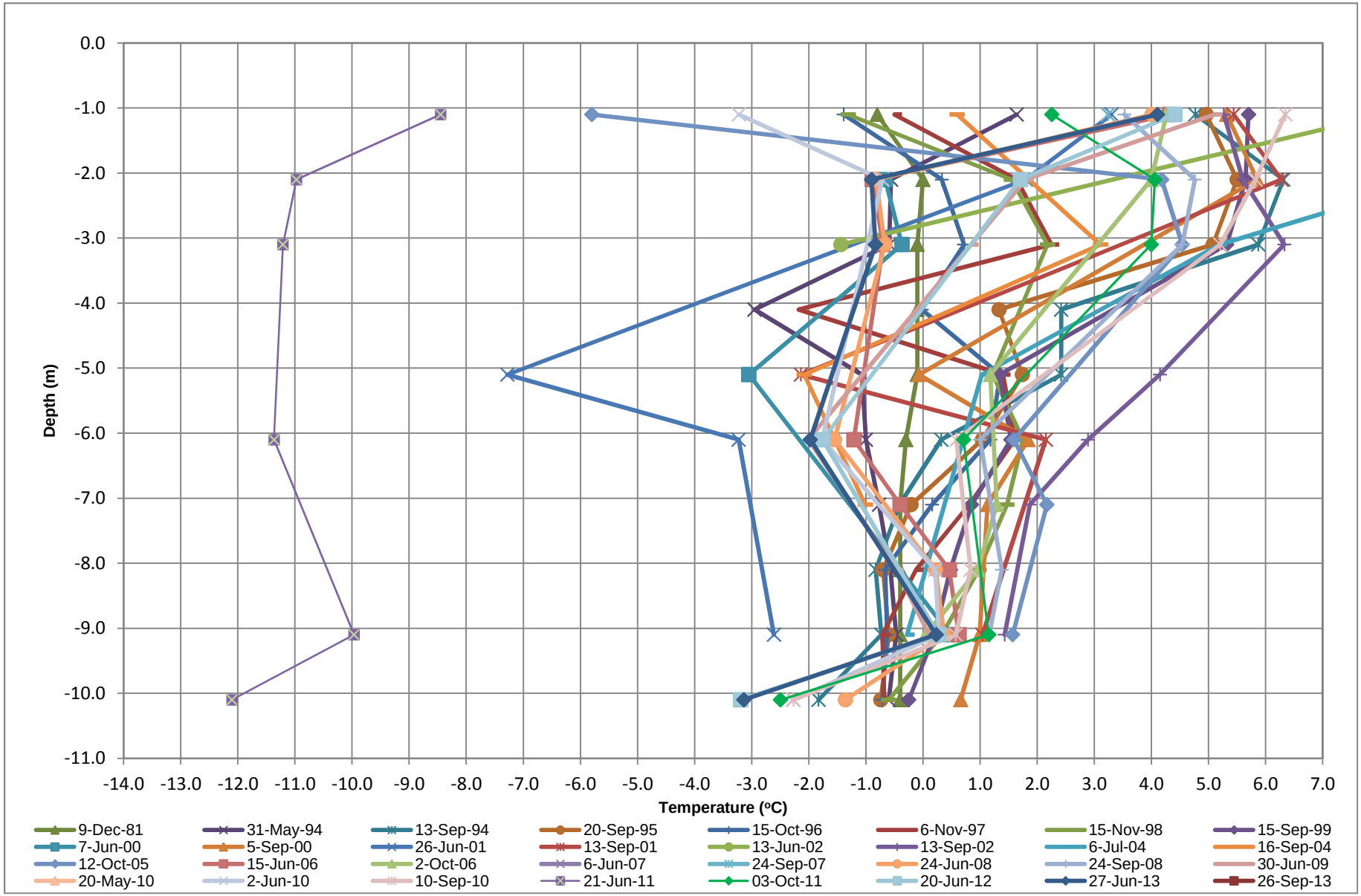
Diversion Canal (Canal Dyke)
Thermistor CD-26



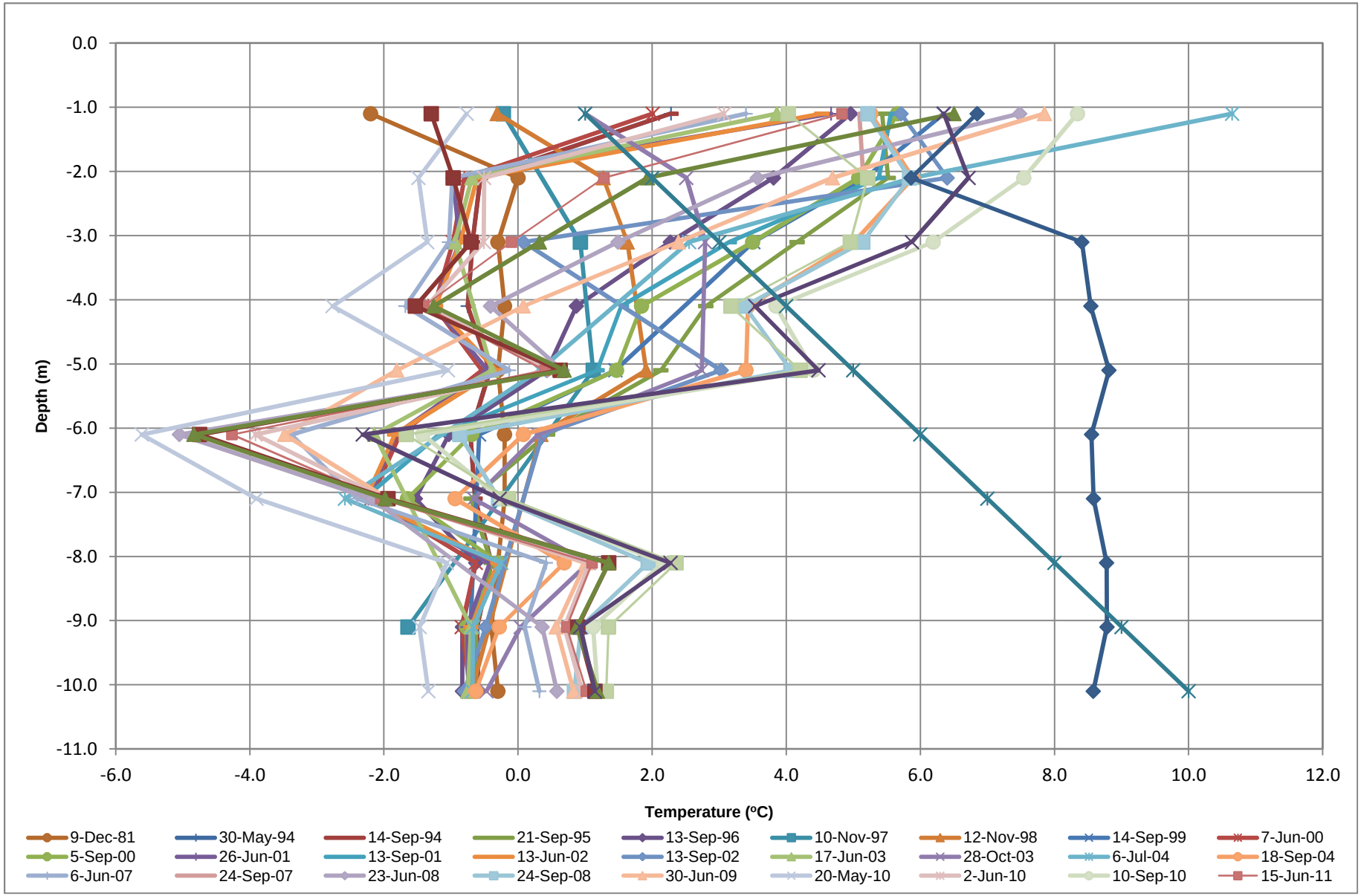
Diversion Canal (Canal Dyke)
Thermistor BGC05-04



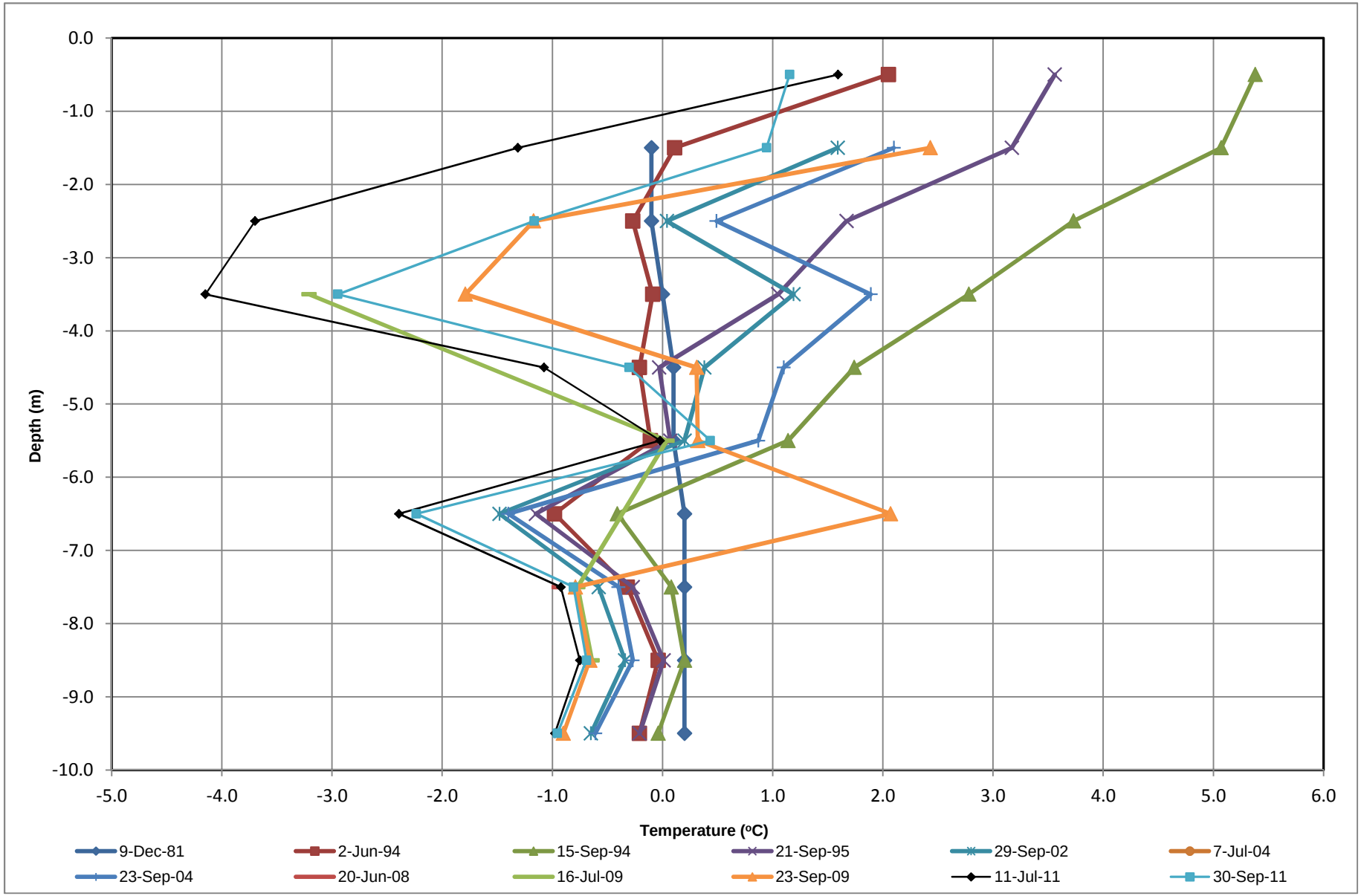
Diversion Canal (Spoil Pile)
Thermistor SP-3



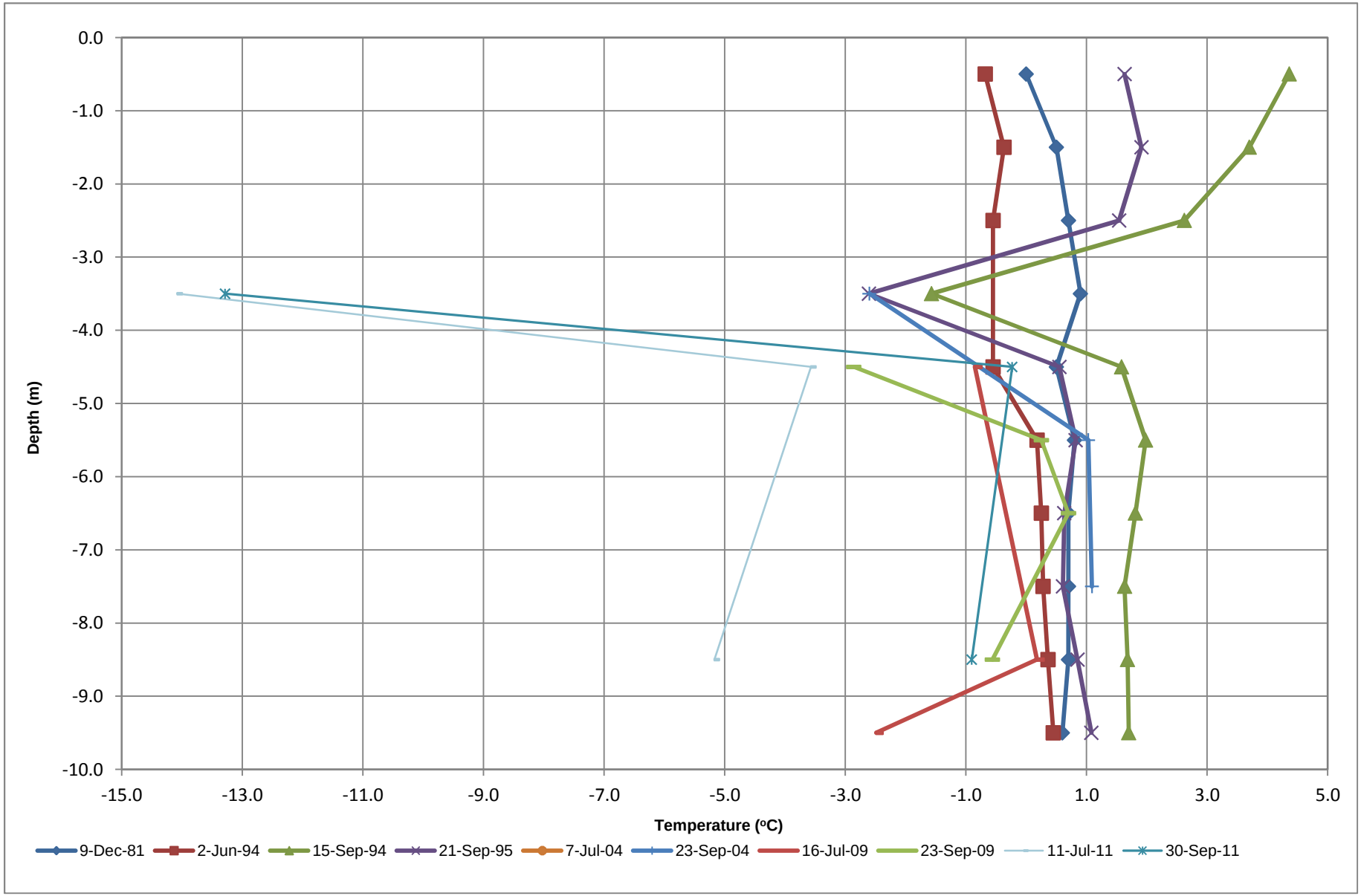
Diversion Canal (Spoil Pile)
Thermistor SP-5



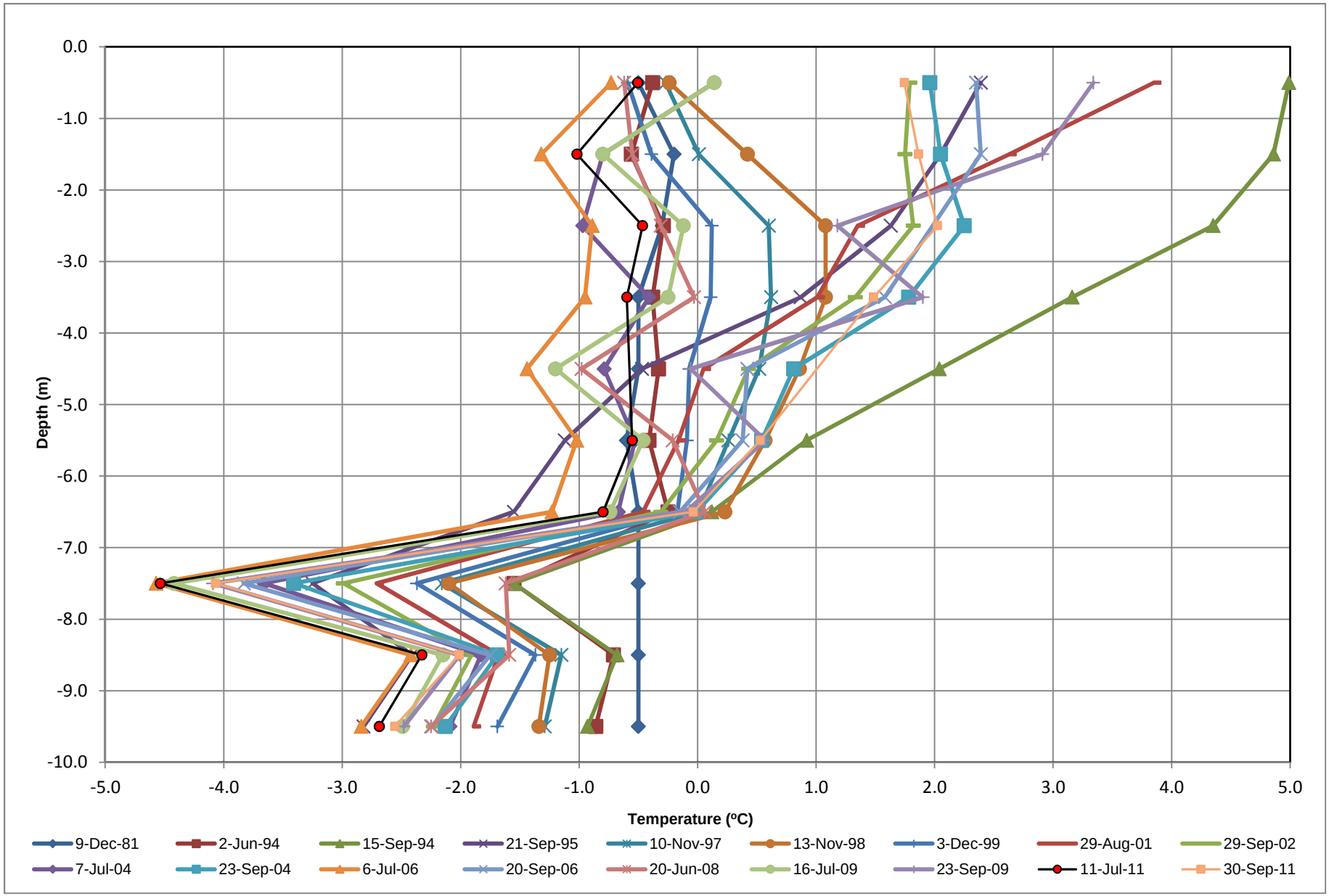
Diversion Canal (Backslope)
Thermistor BS-5



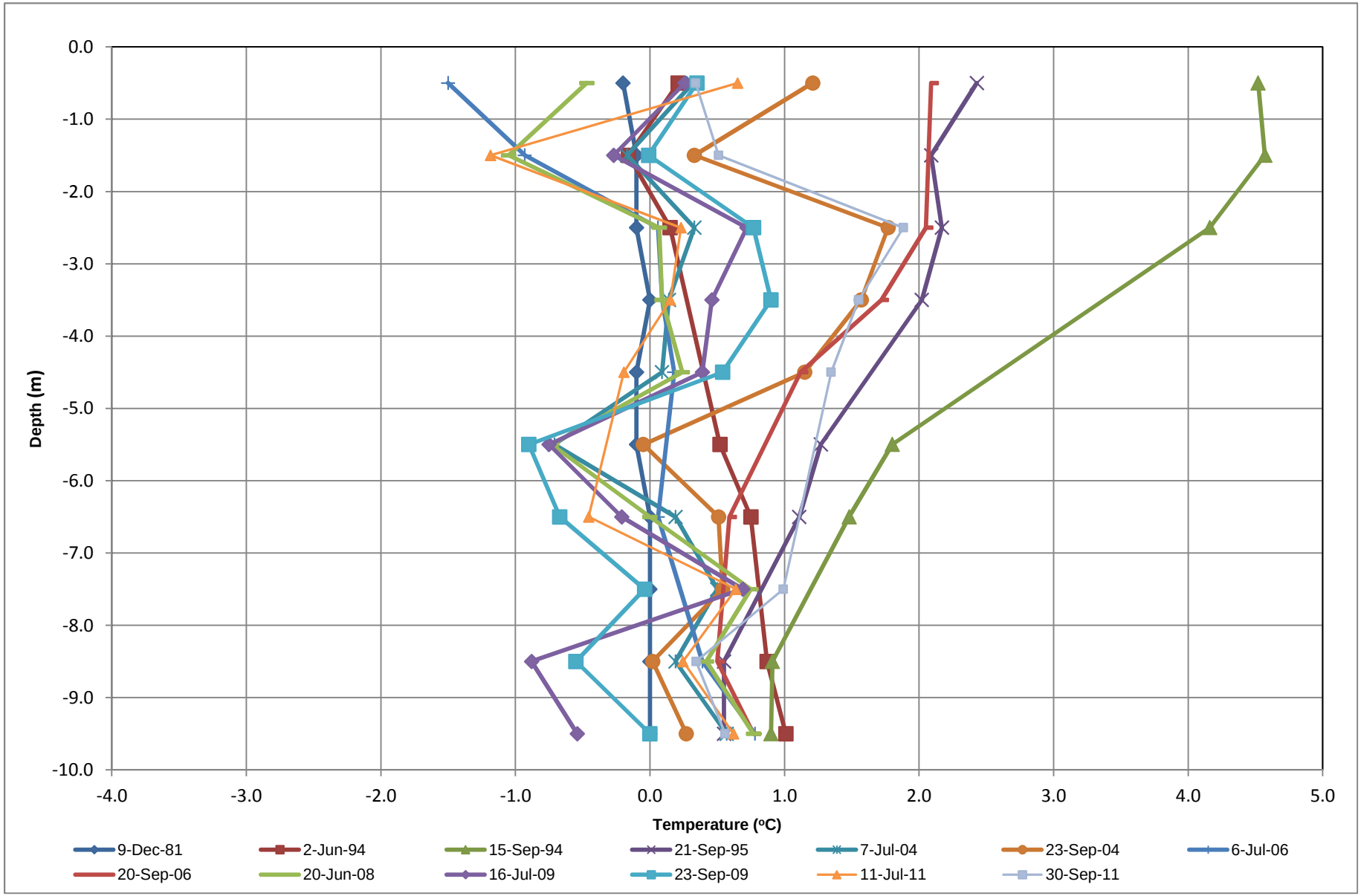
Diversion Canal (Backslope)
Thermistor BS-9



Diversion Canal (Backslope)
Thermistor BS-10

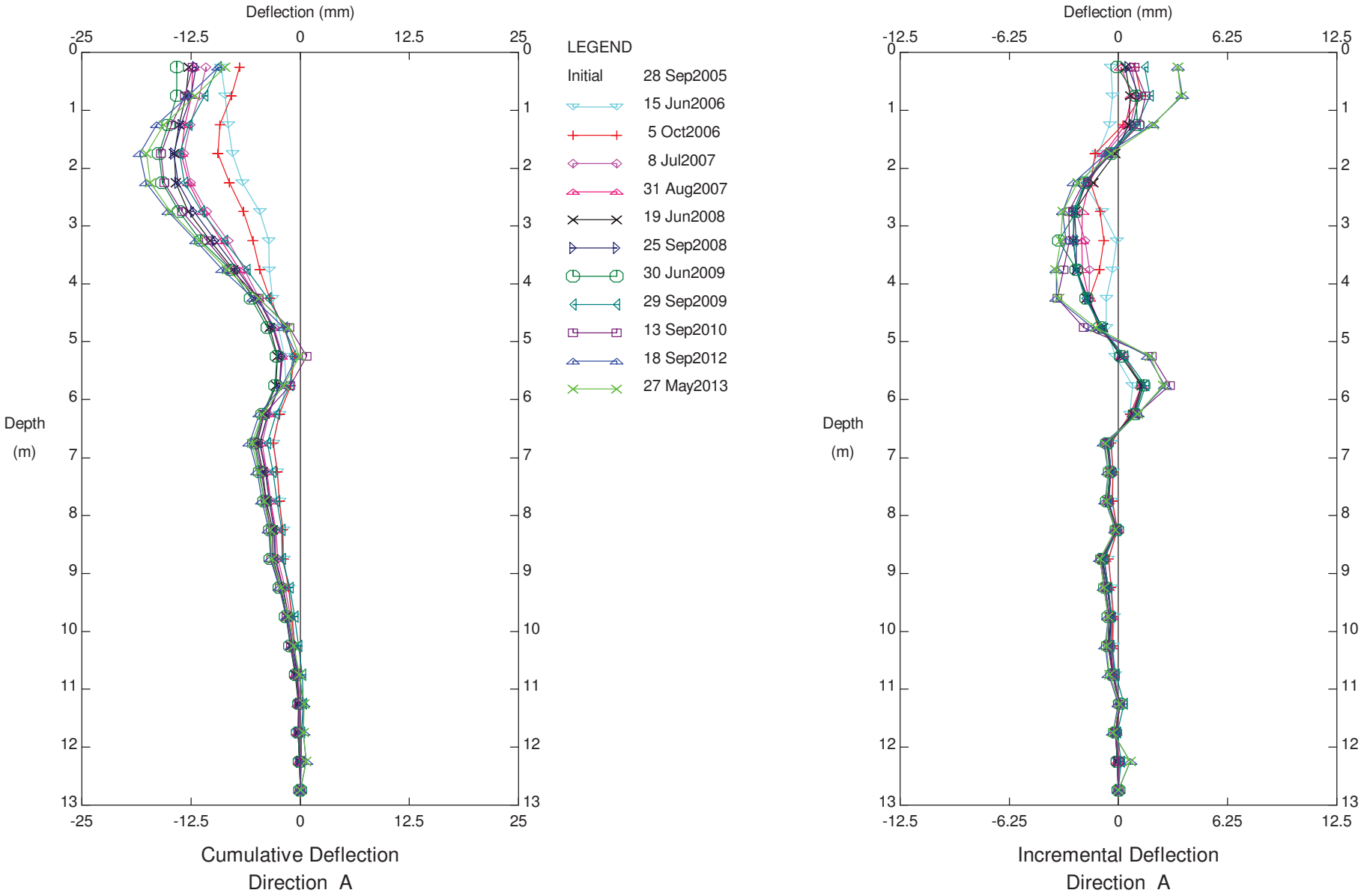


Diversion Canal (Backslope)
Thermistor BS-12



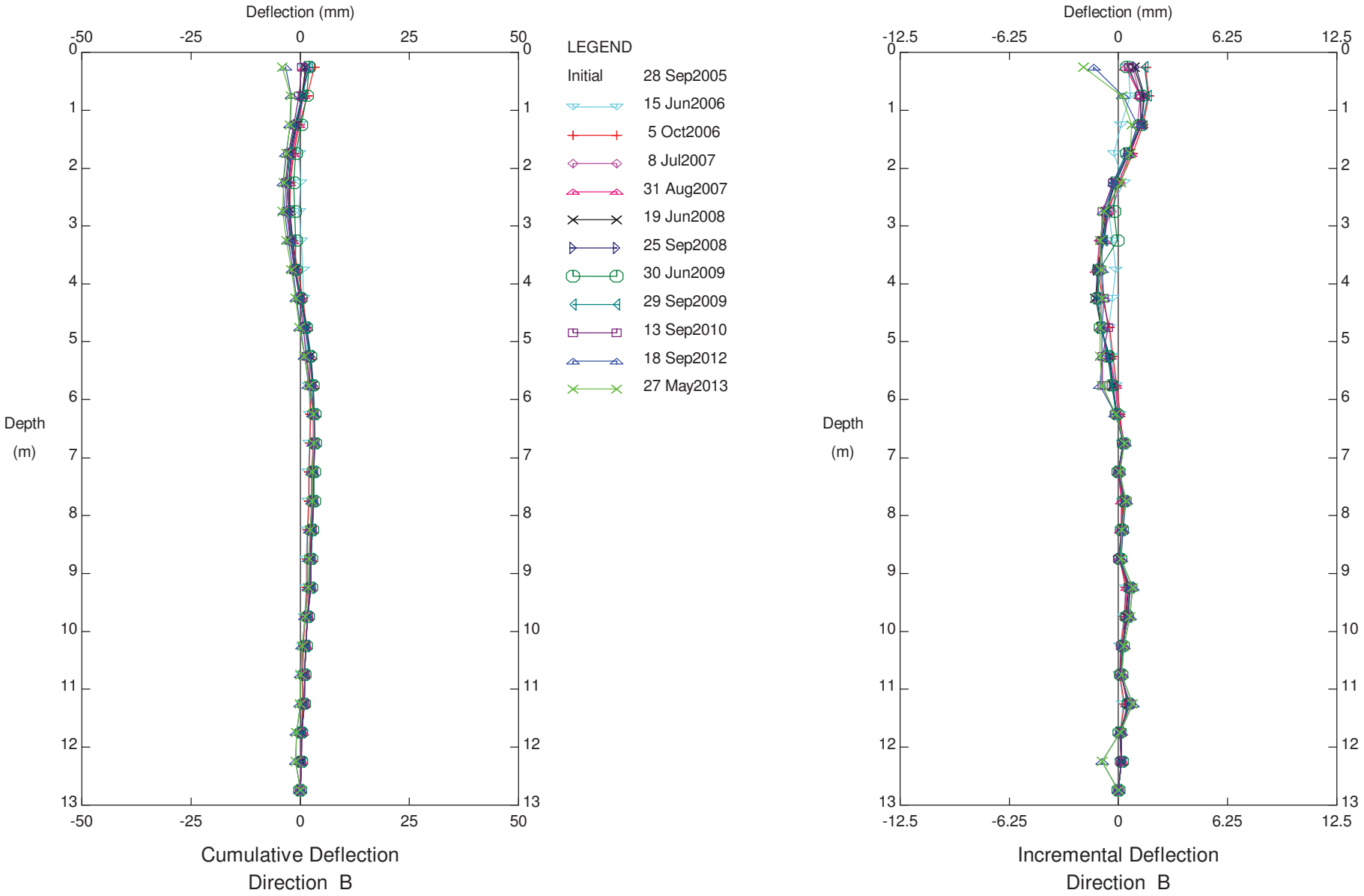
E.3 – Inclinometers

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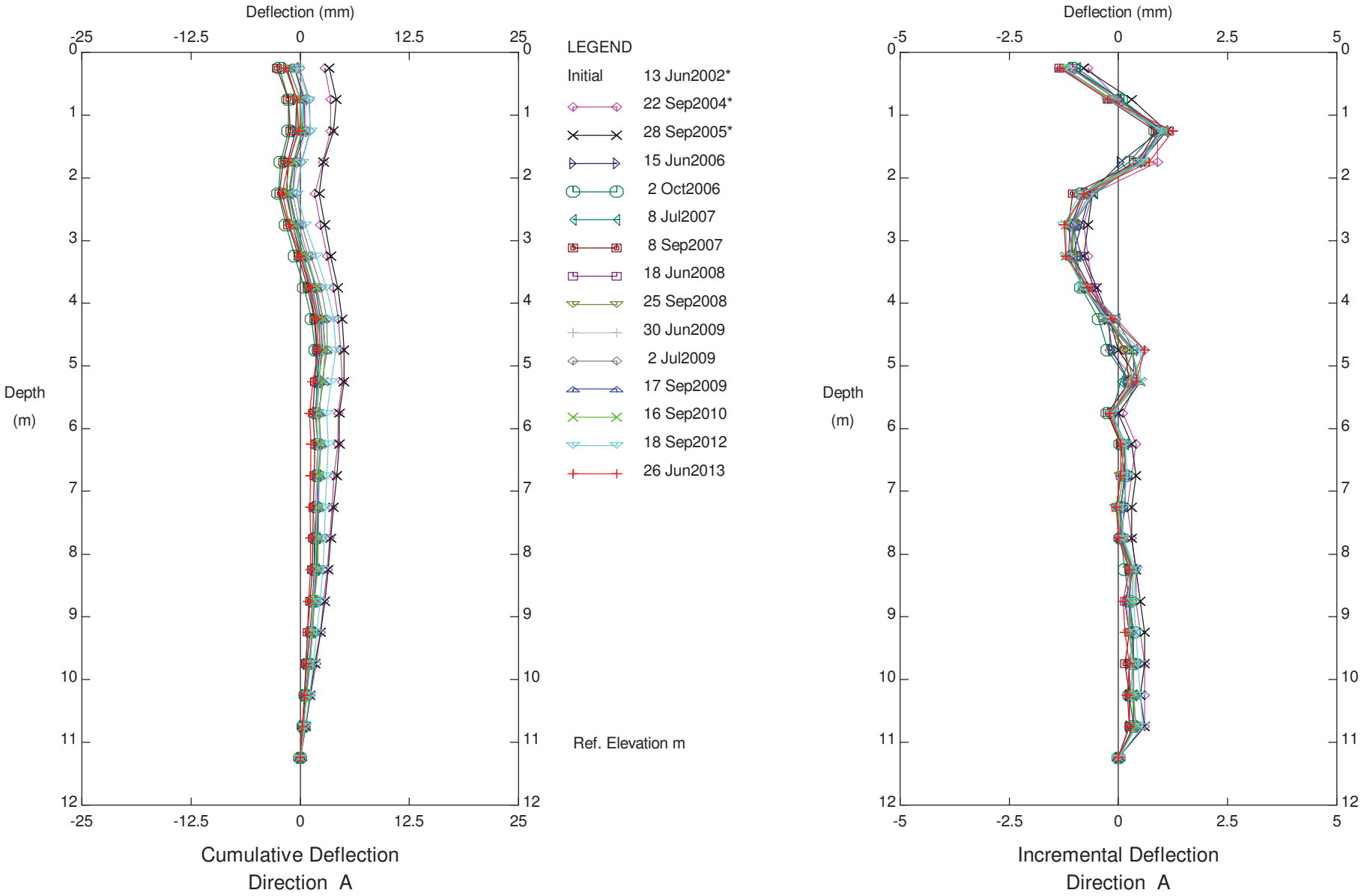
Canal Dike, Inclinometer BGC05-08

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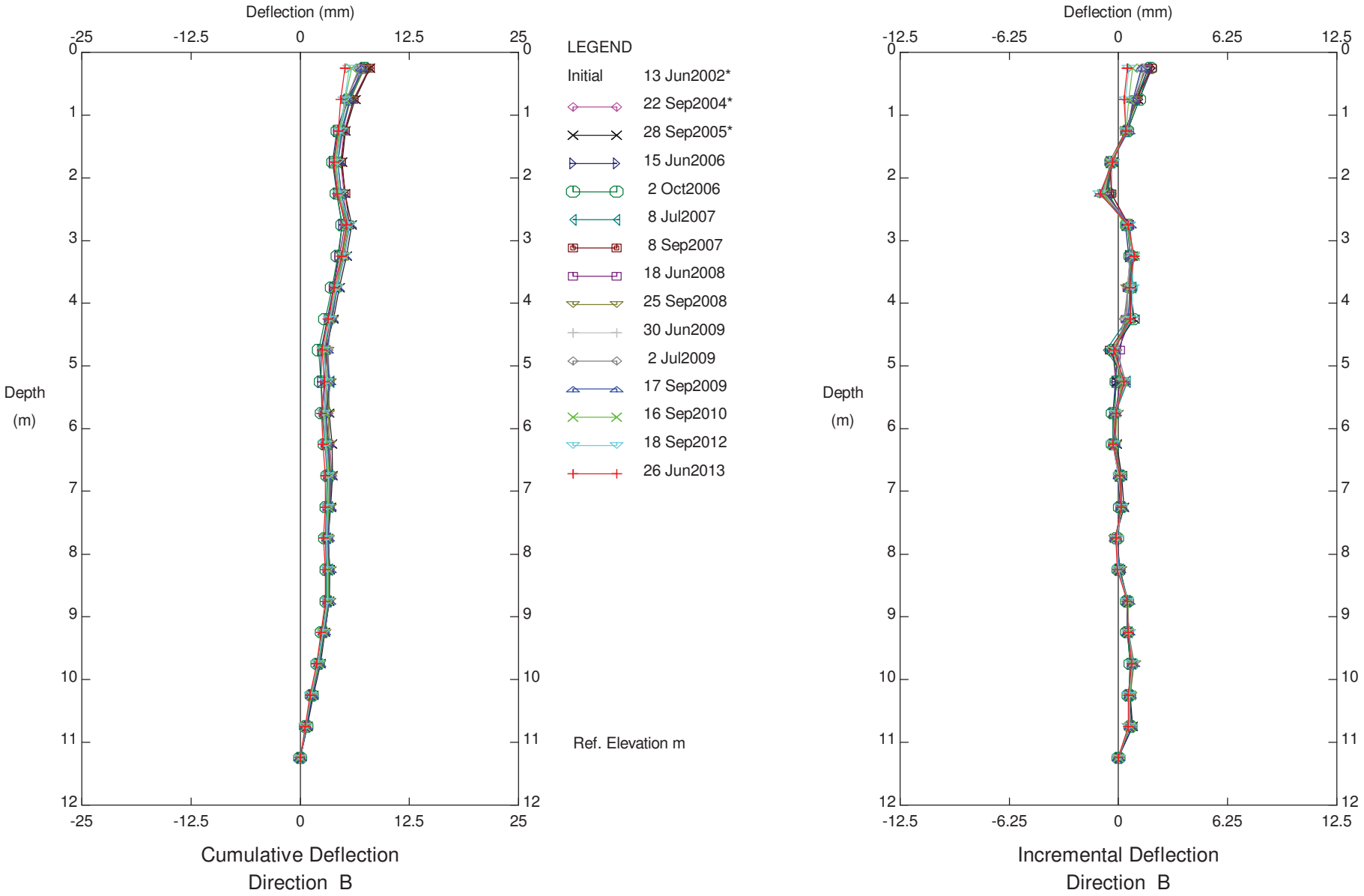
Canal Dike, Inclinometer BGC05-08

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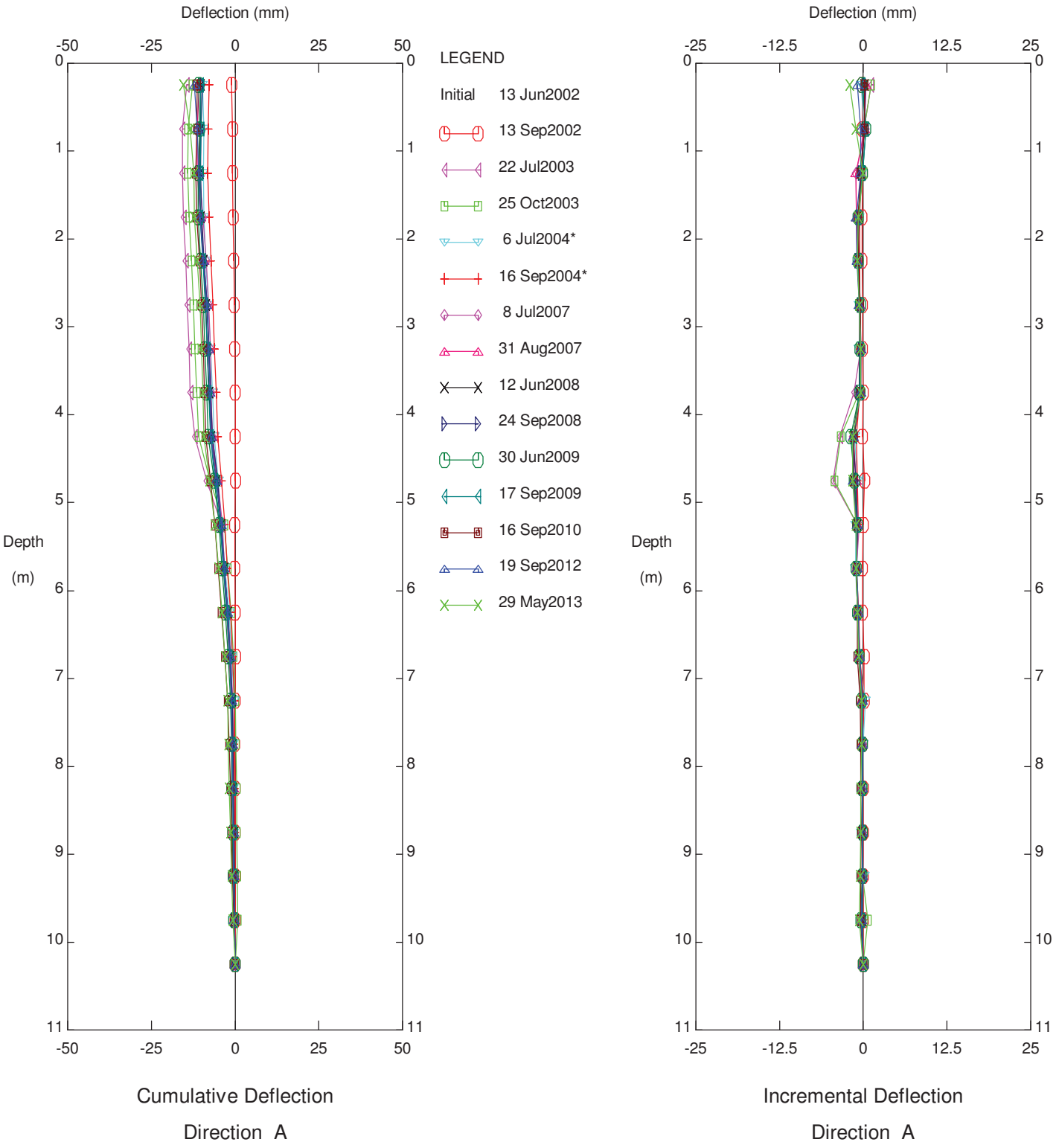
91CD-1, Inclinometer 1+767

Sets marked * include zero shift and/or rotation corrections.



91CD-1, Inclinometer 1+767

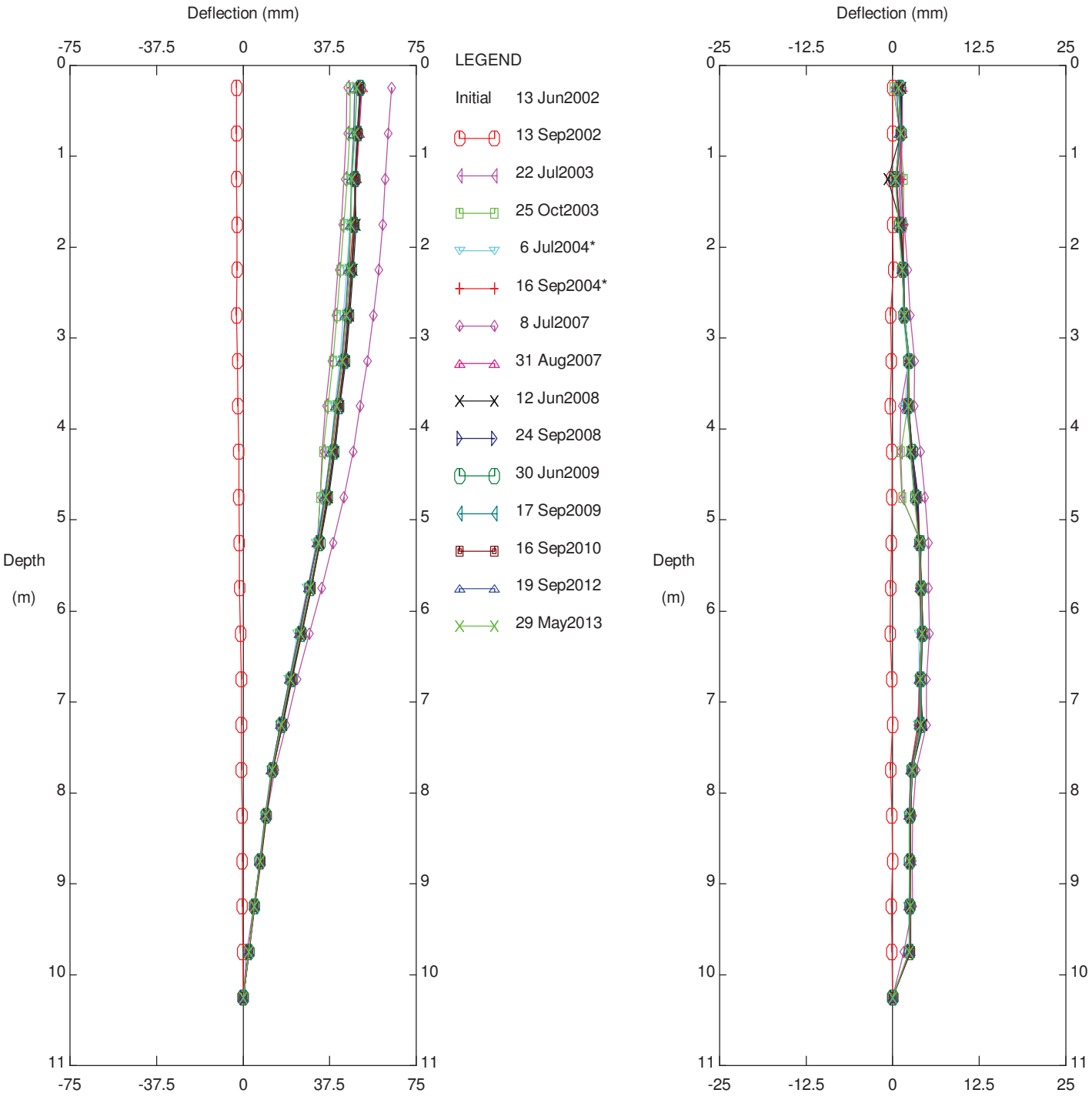
Sets marked * include zero shift and/or rotation corrections.



CD-10, Inclinometer 0+990

Sets marked * include zero shift and/or rotation corrections.

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Cumulative Deflection

Direction B

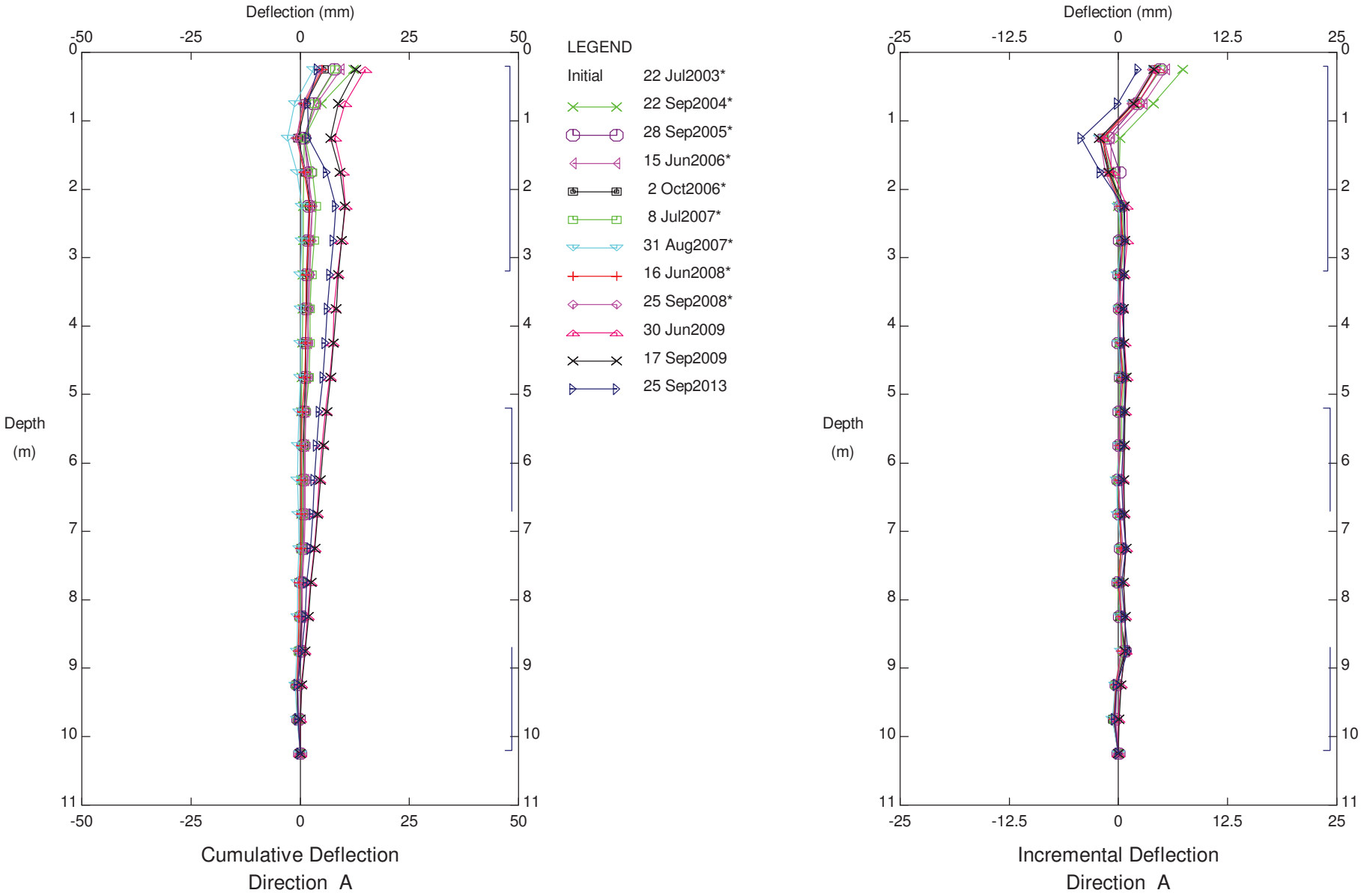
Incremental Deflection

Direction B

CD-10, Inclinometer 0+990

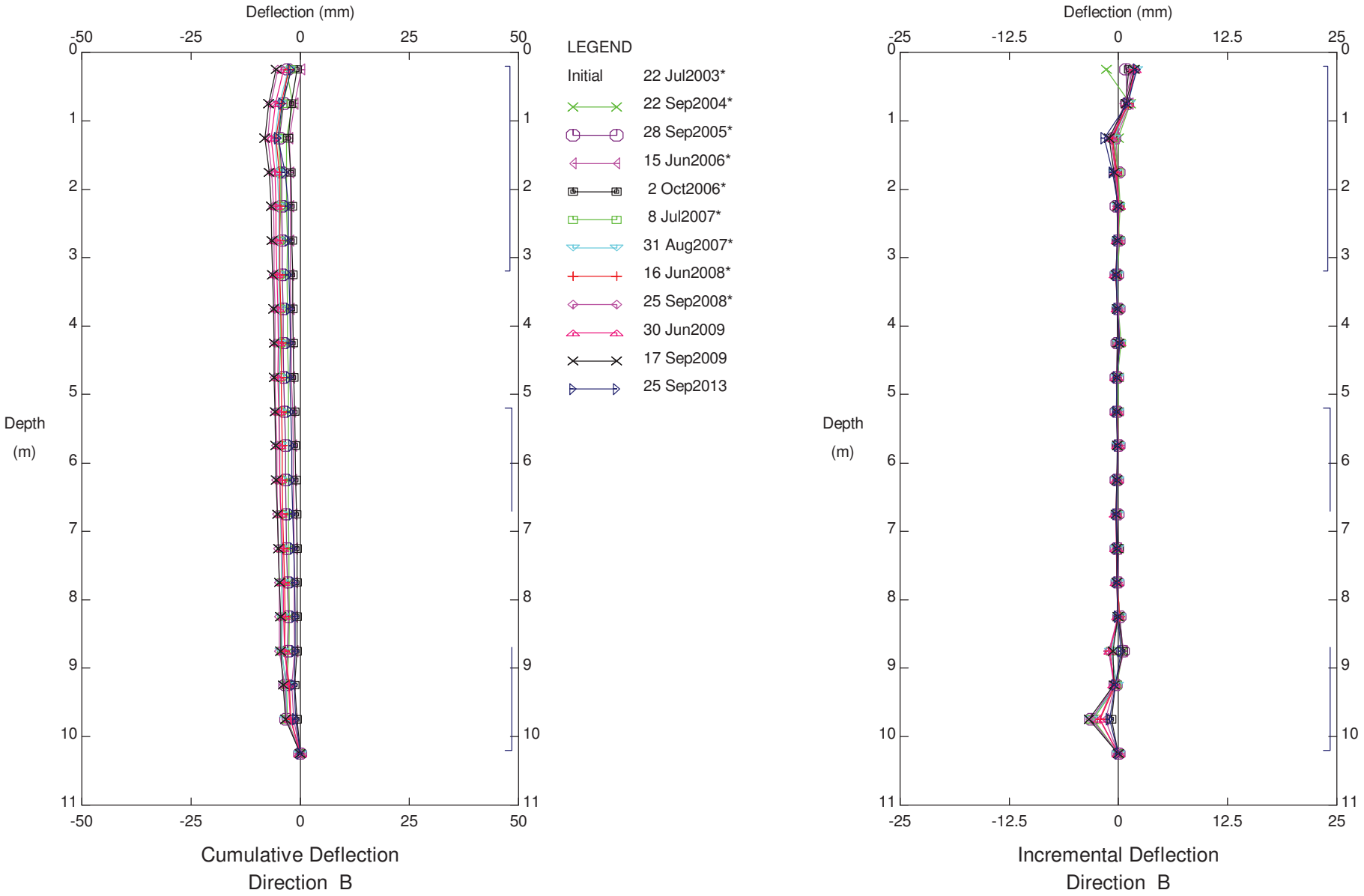
Sets marked * include zero shift and/or rotation corrections.

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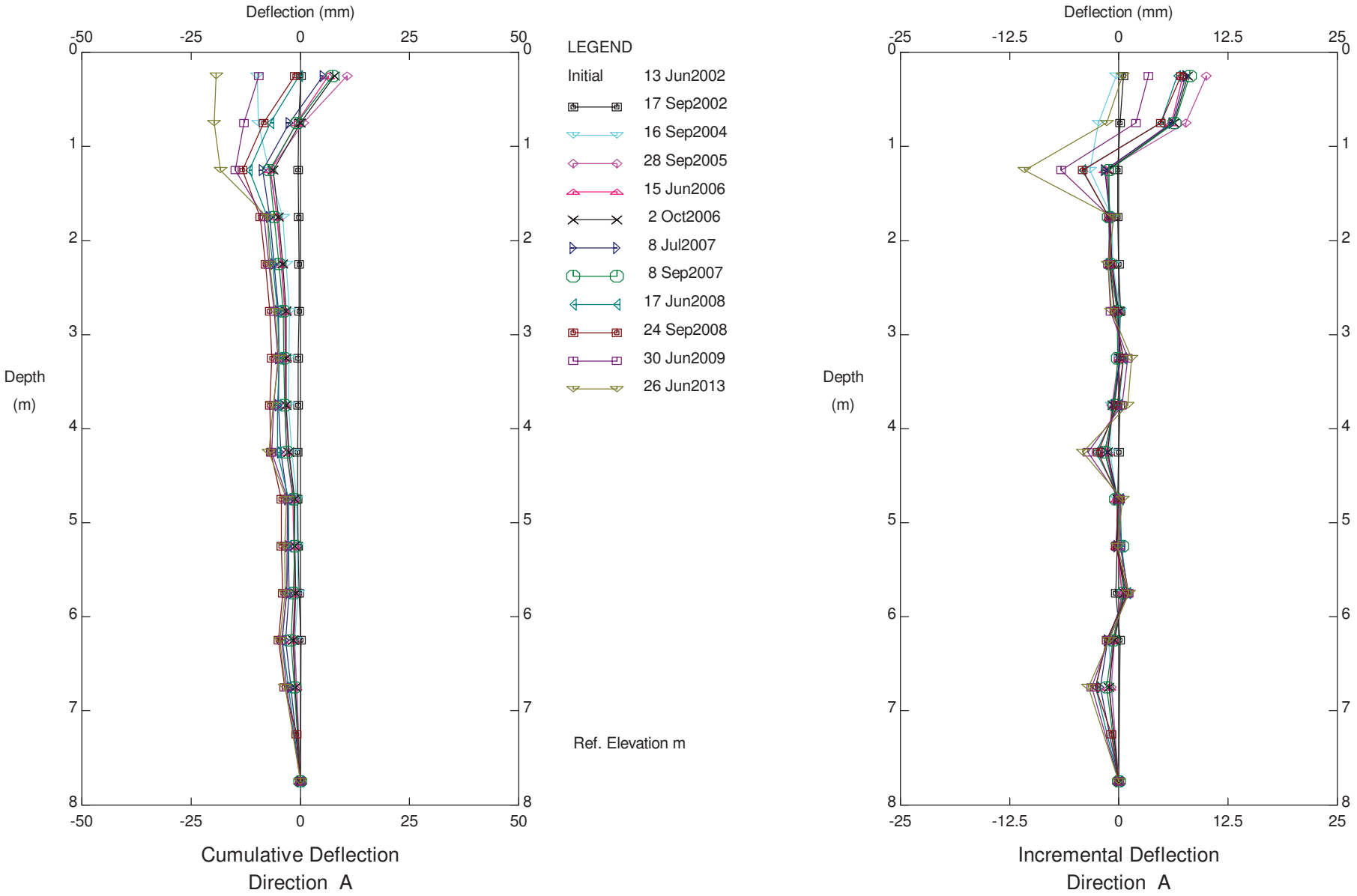
CD-19, Inclinometer 1+900

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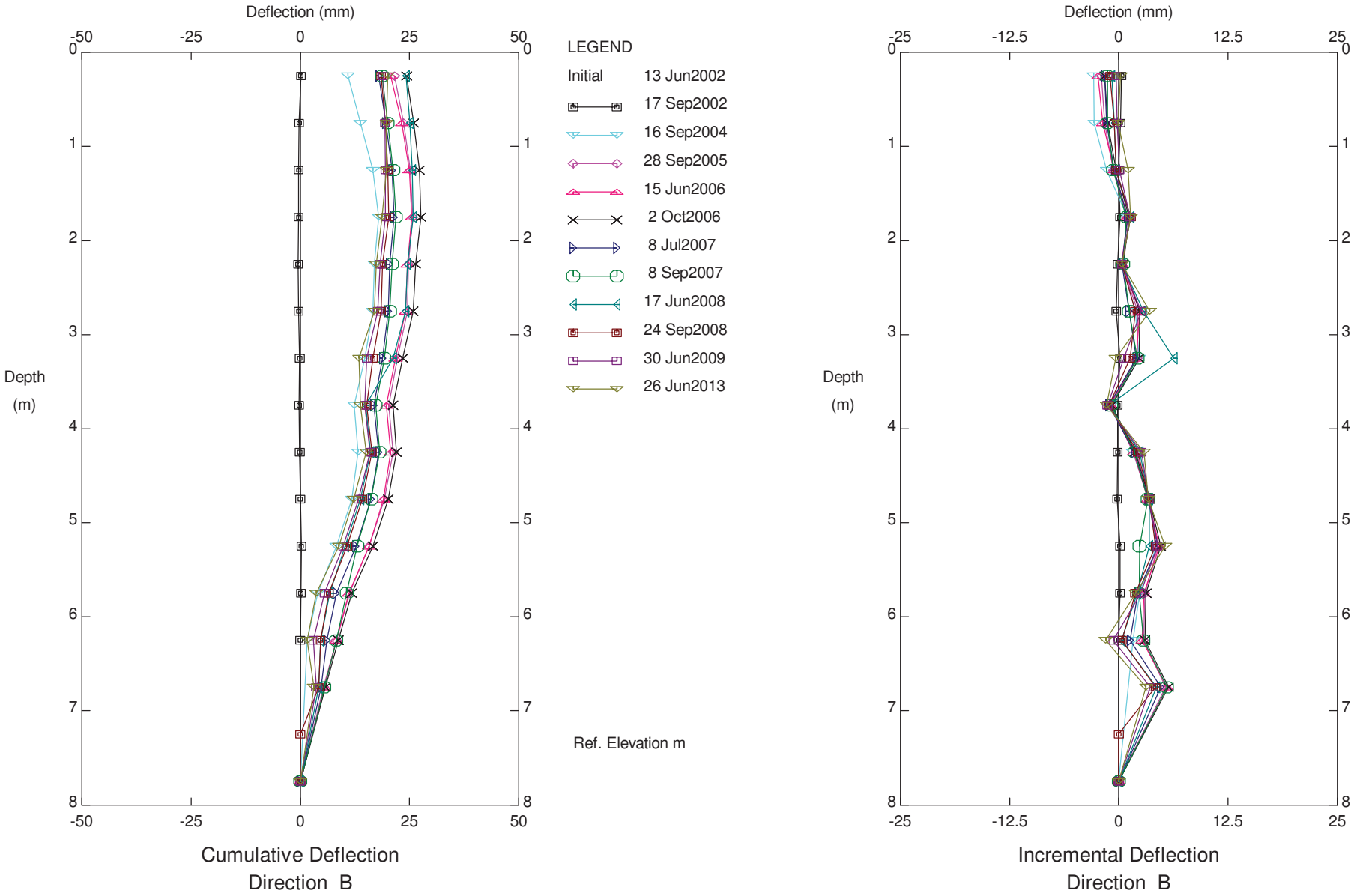
CD-19, Inclinometer 1+900

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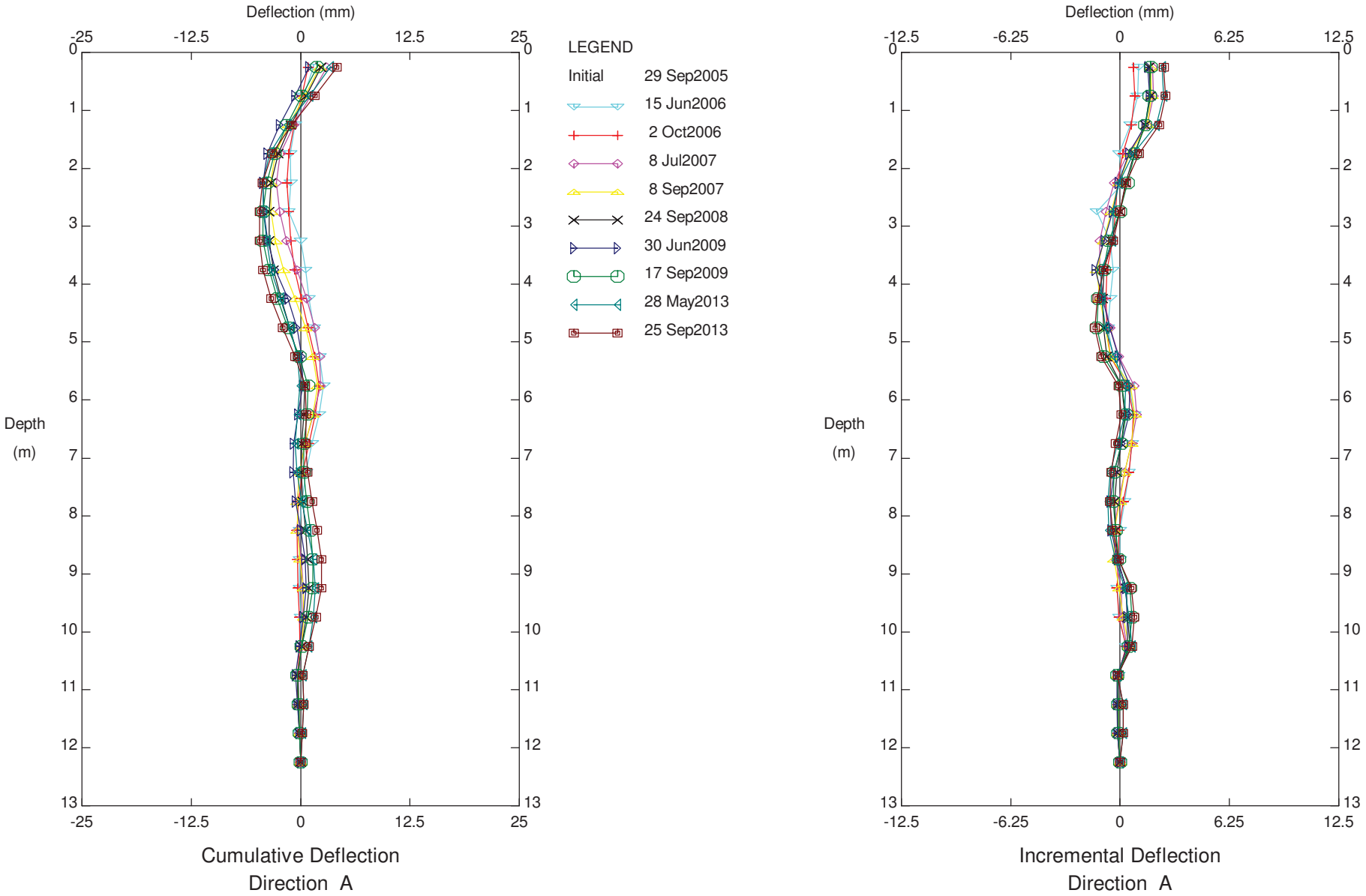
SP-2, Inclinometer 1+530

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SP-2, Inclinometer 1+530

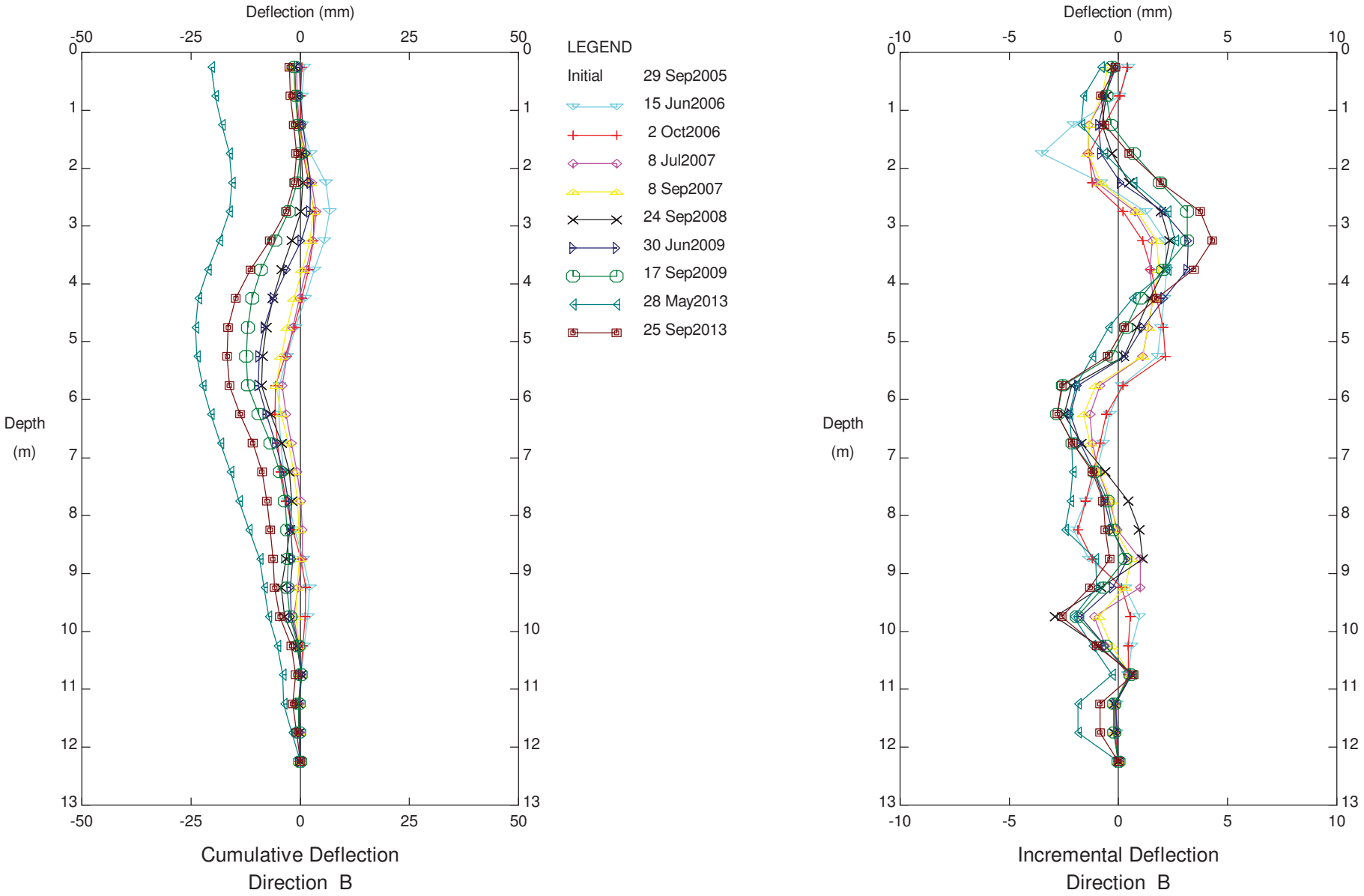
Klohn Crippen Berger Ltd. - Vancouver BC



Canal Dike, Inclinometer BGC05-05

Notes:
1. A0 and A180 readings on May 28, 2013 and September 25, 2013 interchanged with corresponding B0 and B180 readings
2. Readings below 11 m were not read on May 28, 2013 and September 25, 2013 and the readings at 11.5m and 12.0m were taken same as the readings at 11 m for plotting purposes assuming no movement below 11m.

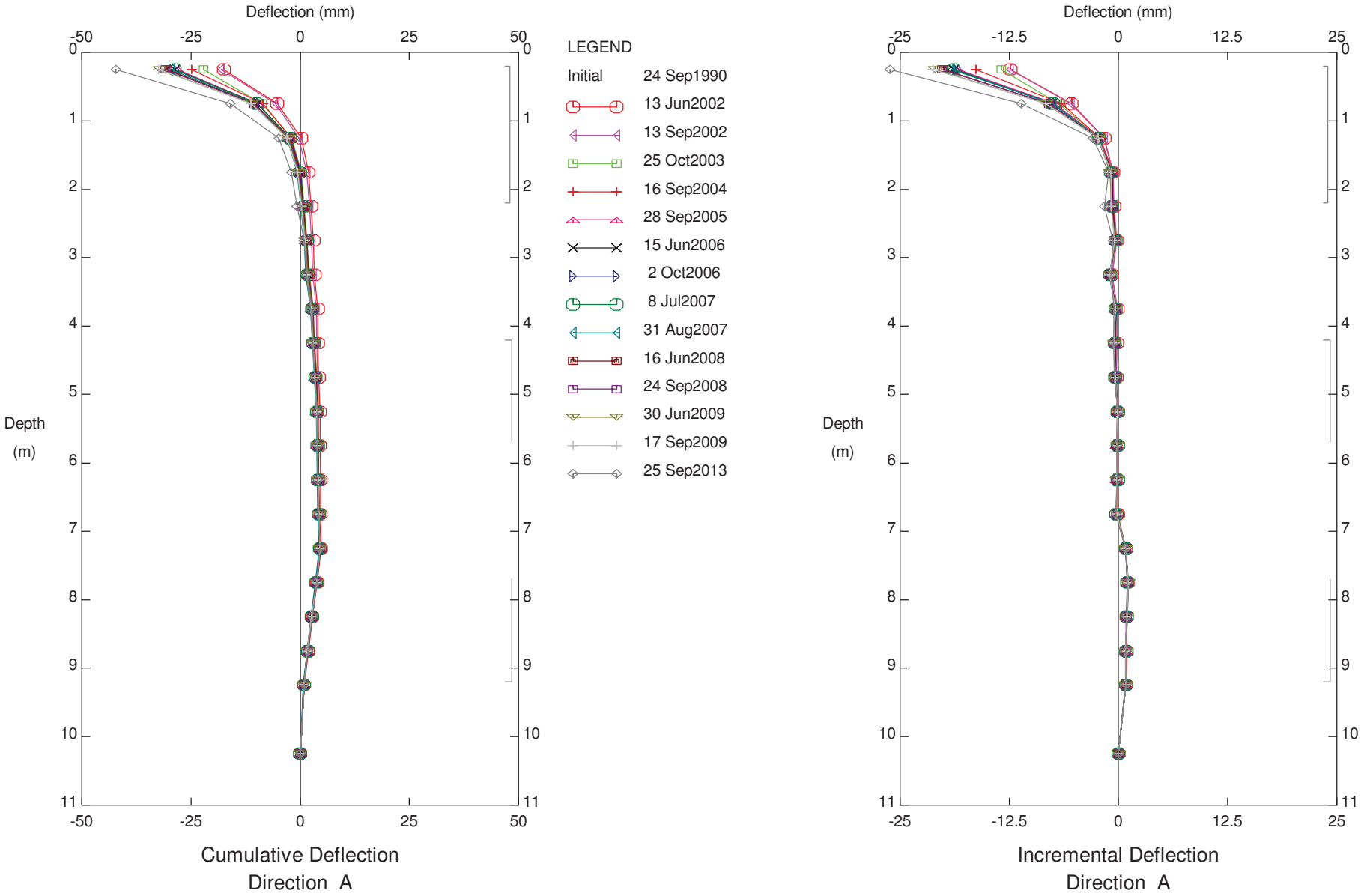
Klohn Crippen Berger Ltd. - Vancouver BC



Canal Dike, Inclinometer BGC05-05

Notes:
1. A0 and A180 readings on May 28, 2013 and September 25, 2013 interchanged with corresponding B0 and B180 readings
2. Readings below 11 m were not read on May 28, 2013 and September 25, 2013 and the readings at 11.5m and 12.0m were taken same as teh readings at 11 m for plotting purposes assuming no movement below 11m.

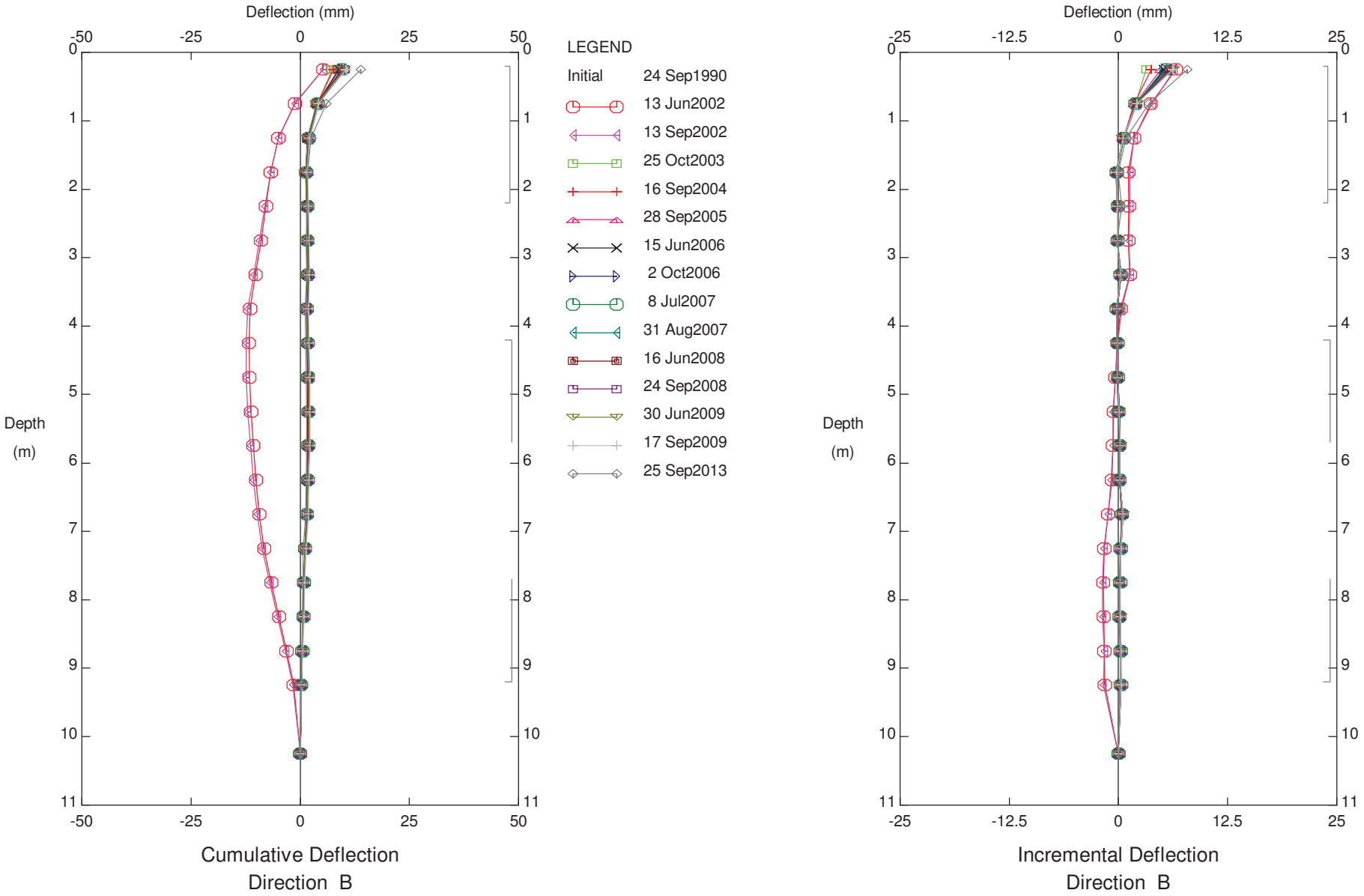
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CD-15, Inclinometer 1+530

Note: All raw readings on September 25, 2013 were multiplied by 0.5

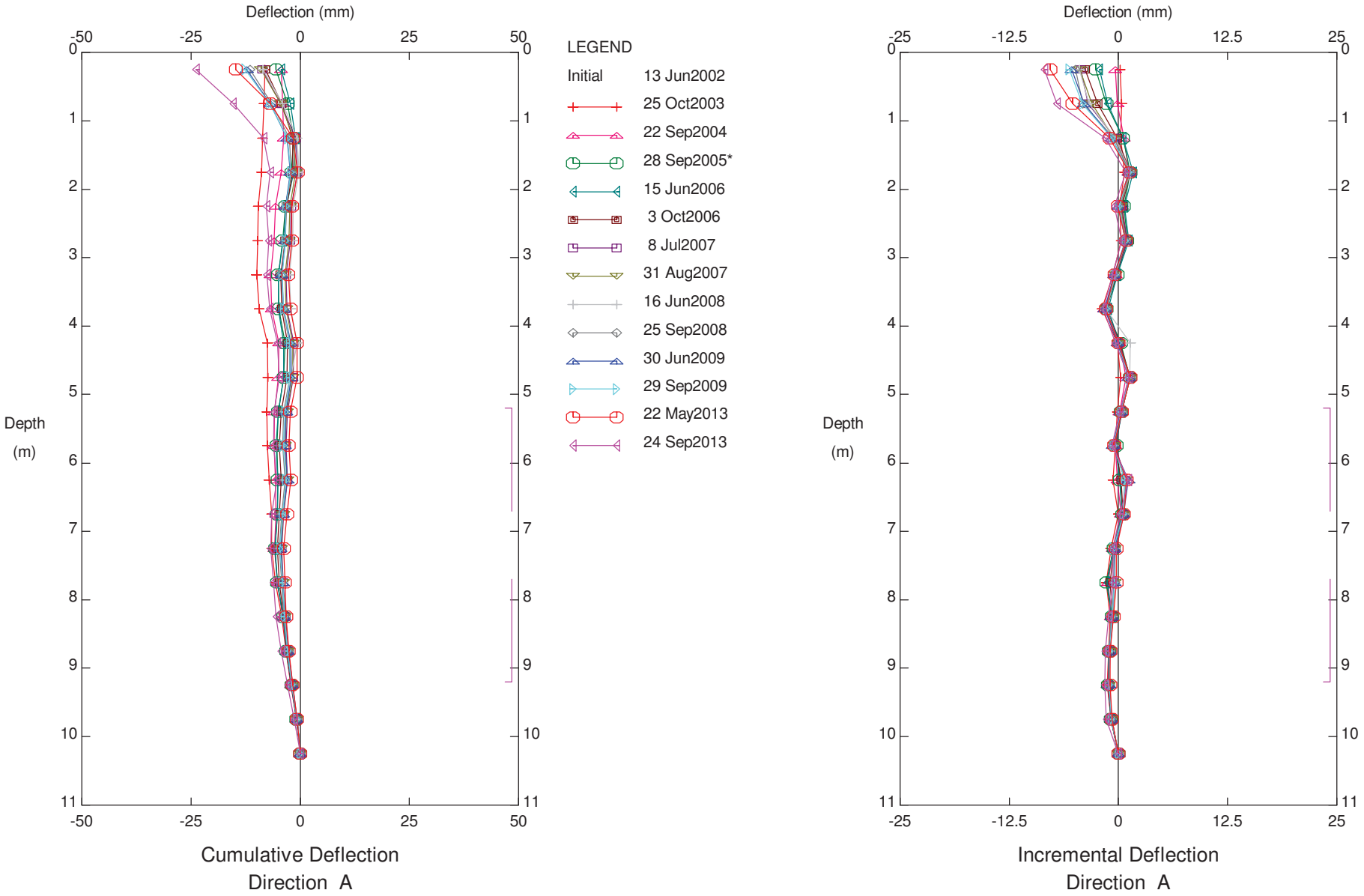
Klohn Crippen Berger Ltd. - Vancouver BC



CD-15, Inclinometer 1+530

Note: All raw readings on September 25, 2013 were multiplied by 0.5

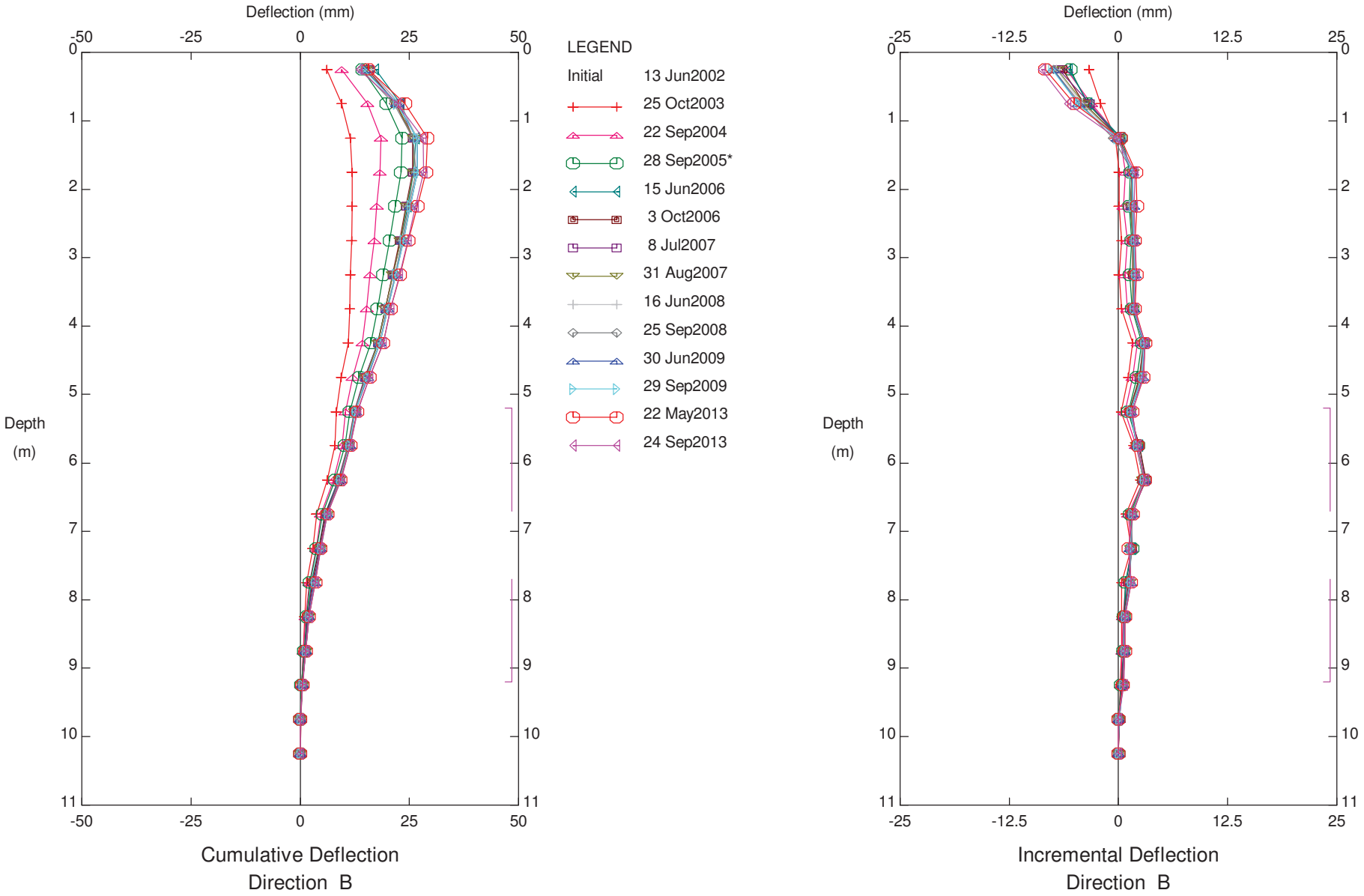
Klohn Crippen Berger Ltd. - Vancouver BC



CD-21, Inclinometer 2+100

Note: All raw readings on September 25, 2013 were multiplied by 0.5

Klohn Crippen Berger Ltd. - Vancouver BC



CD-21, Inclinometer 2+100

Note: All raw readings on September 25, 2013 were multiplied by 0.5

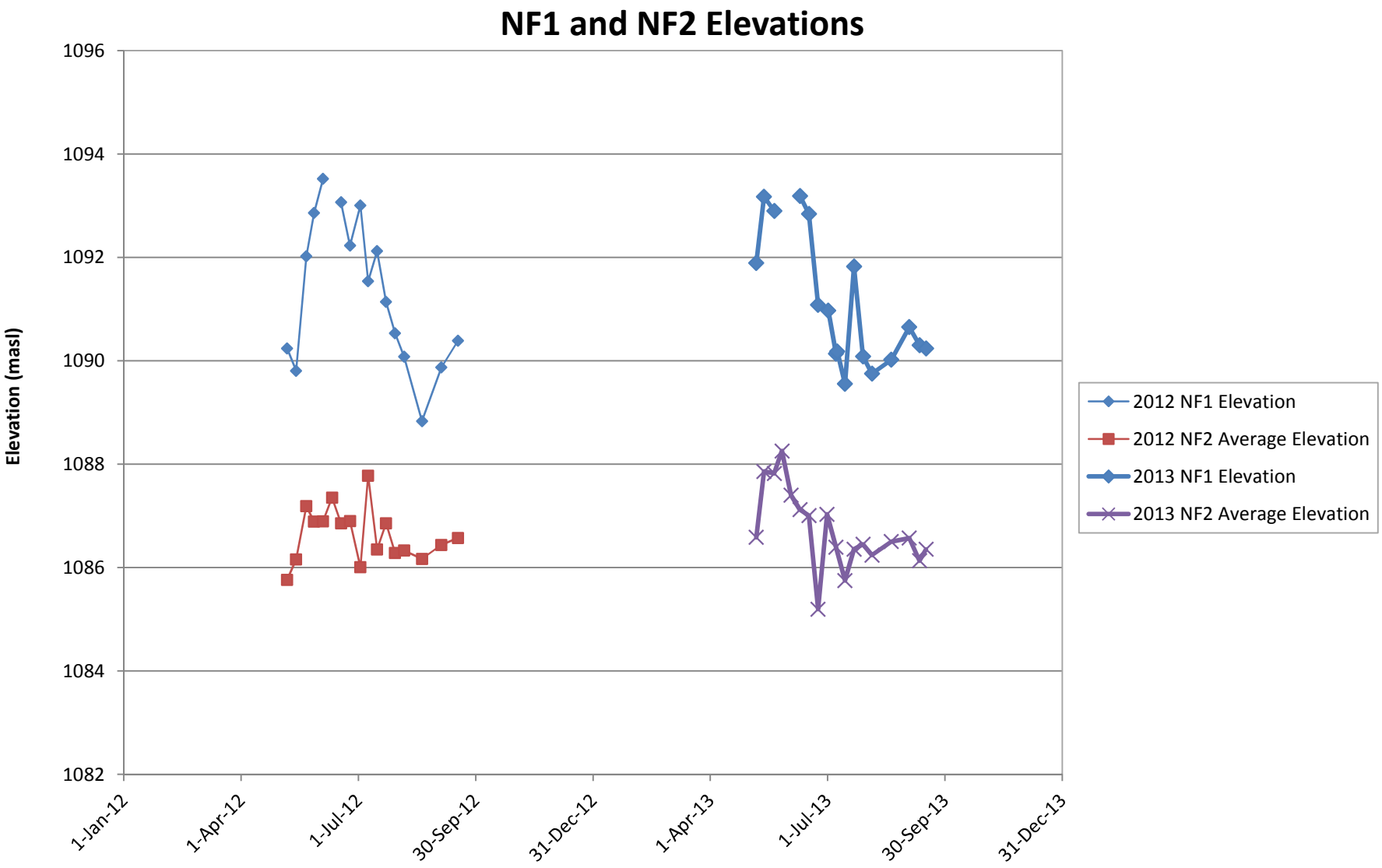
APPENDIX II-F

North Fork Rock Drain

F.1 – U/S and D/S Water Elevations

F.1 – U/S and D/S Water Elevations

North Fork of Rose Creek
NF1 NF2 Water Elevations



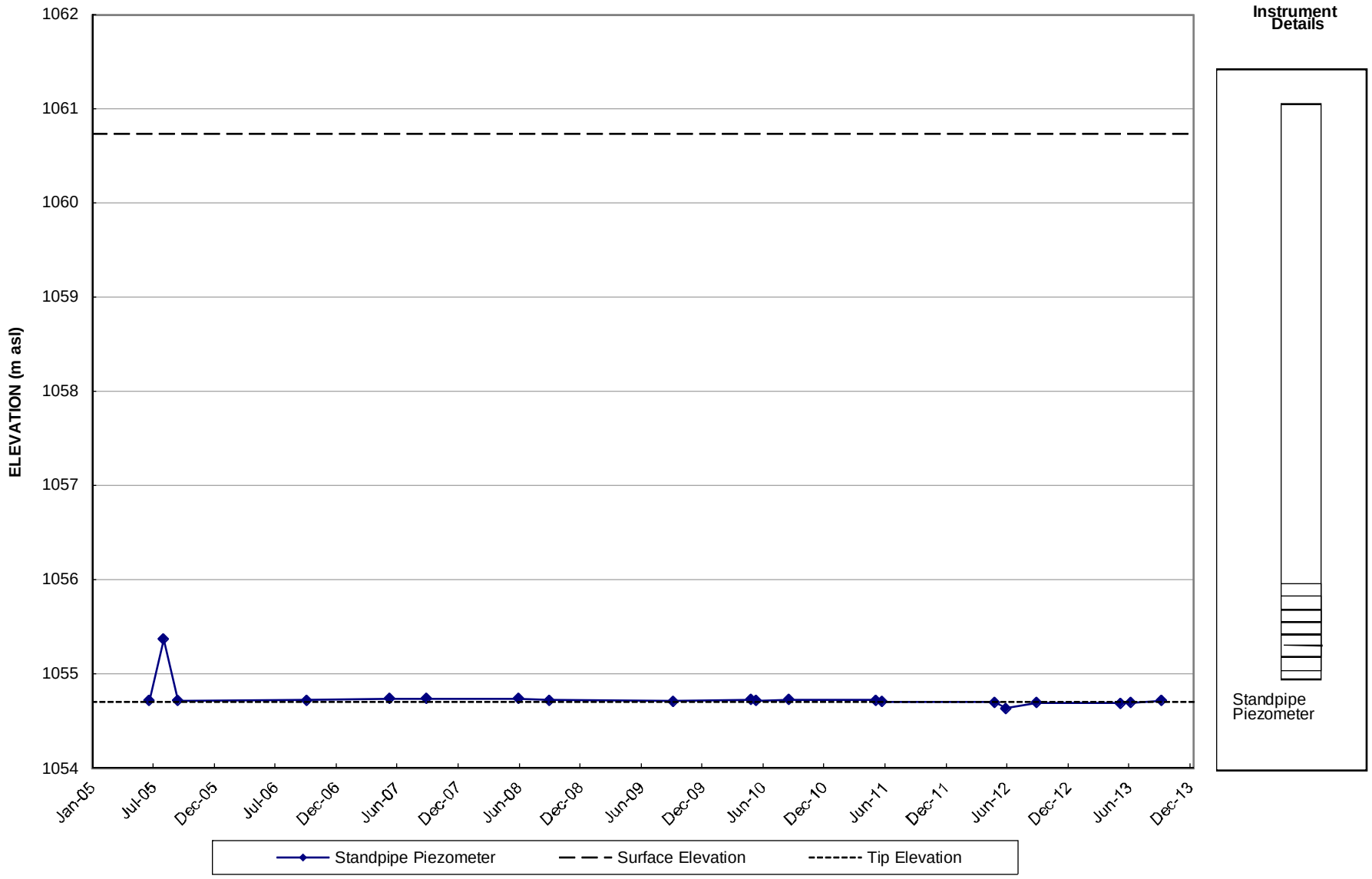
APPENDIX II-G

Secondary Tailings Impoundment

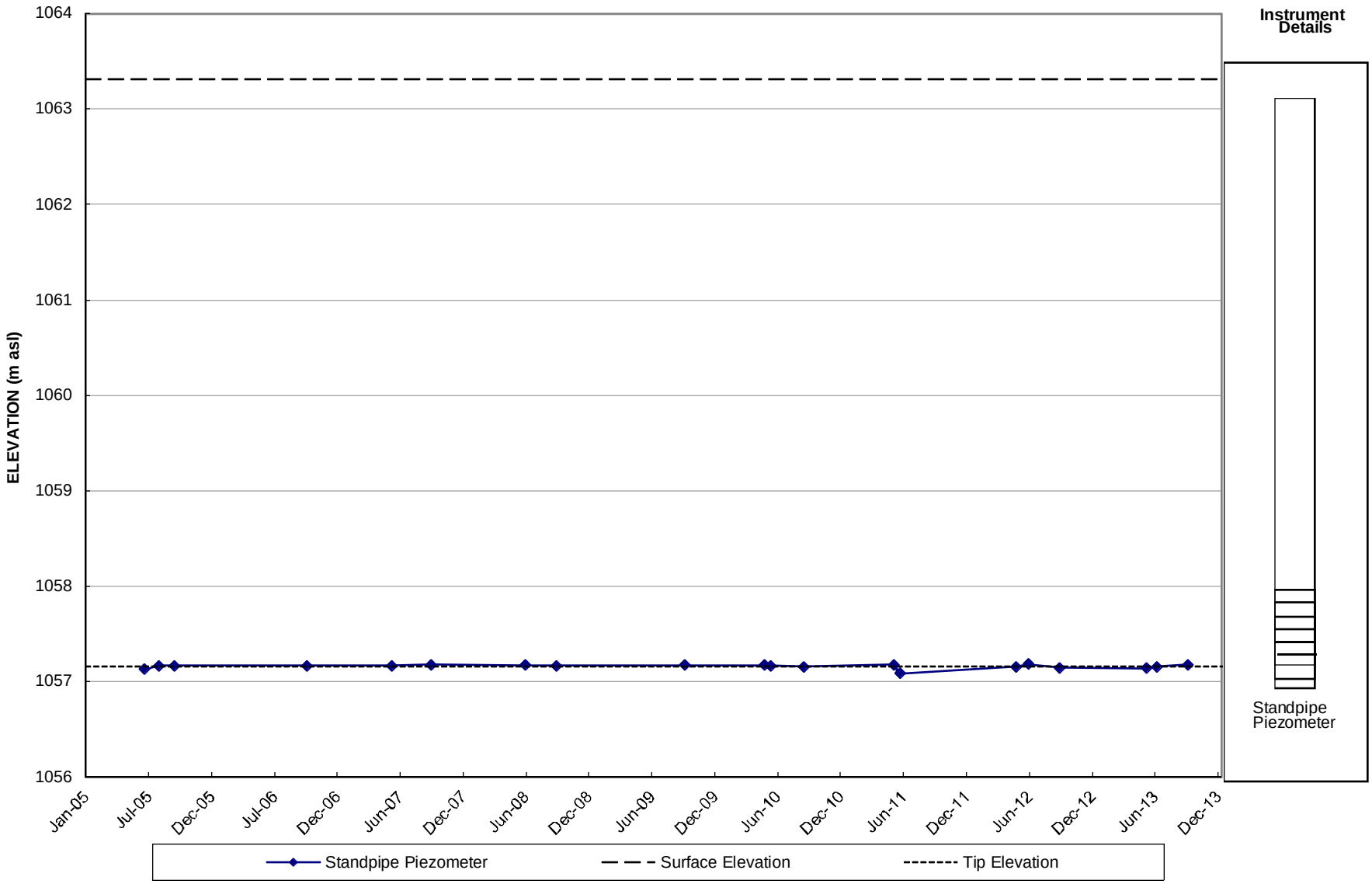
G.1 – Piezometers

G.1 – Piezometers

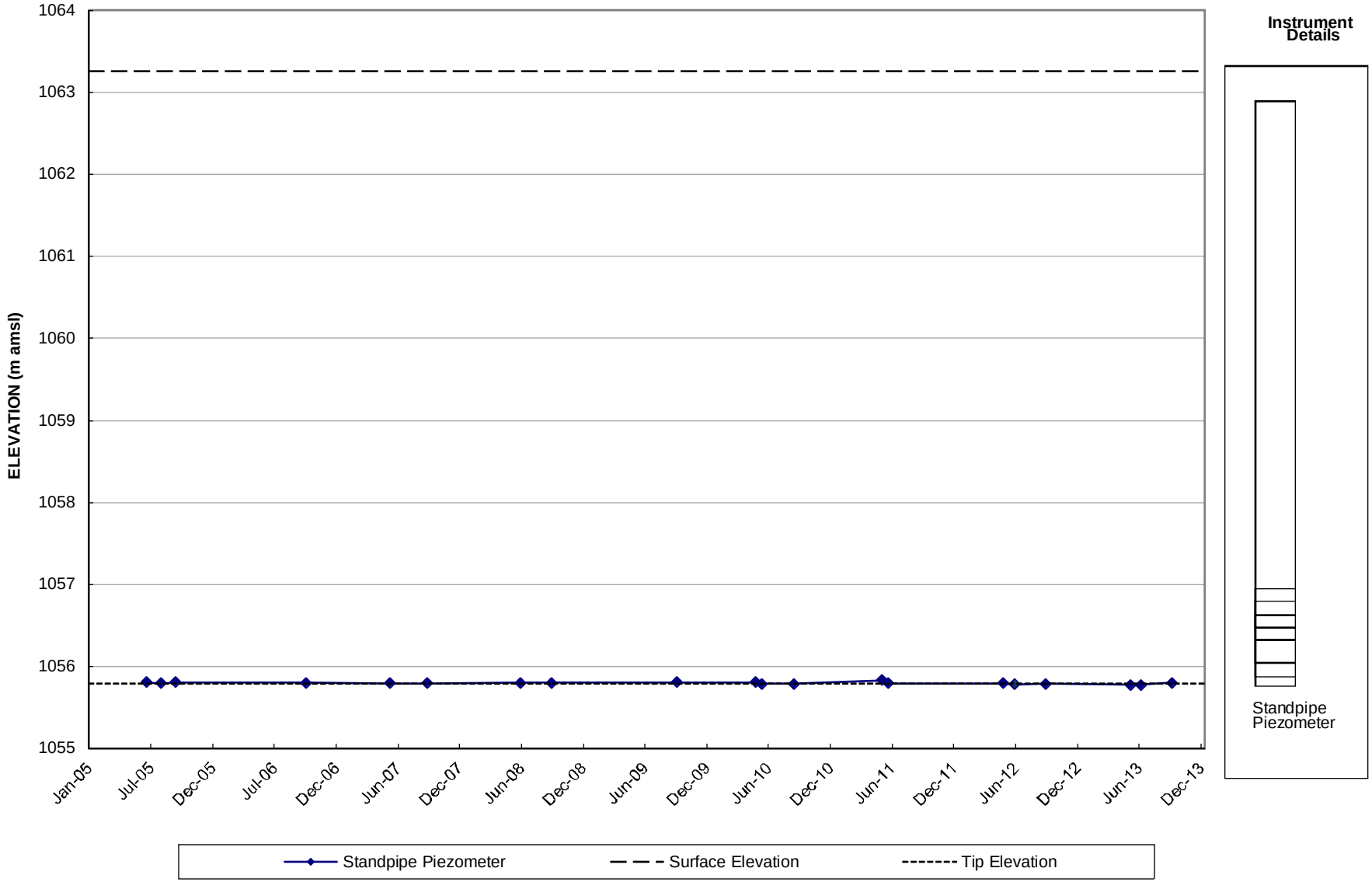
Secondary Tailings Dam
Piezometer P81-06



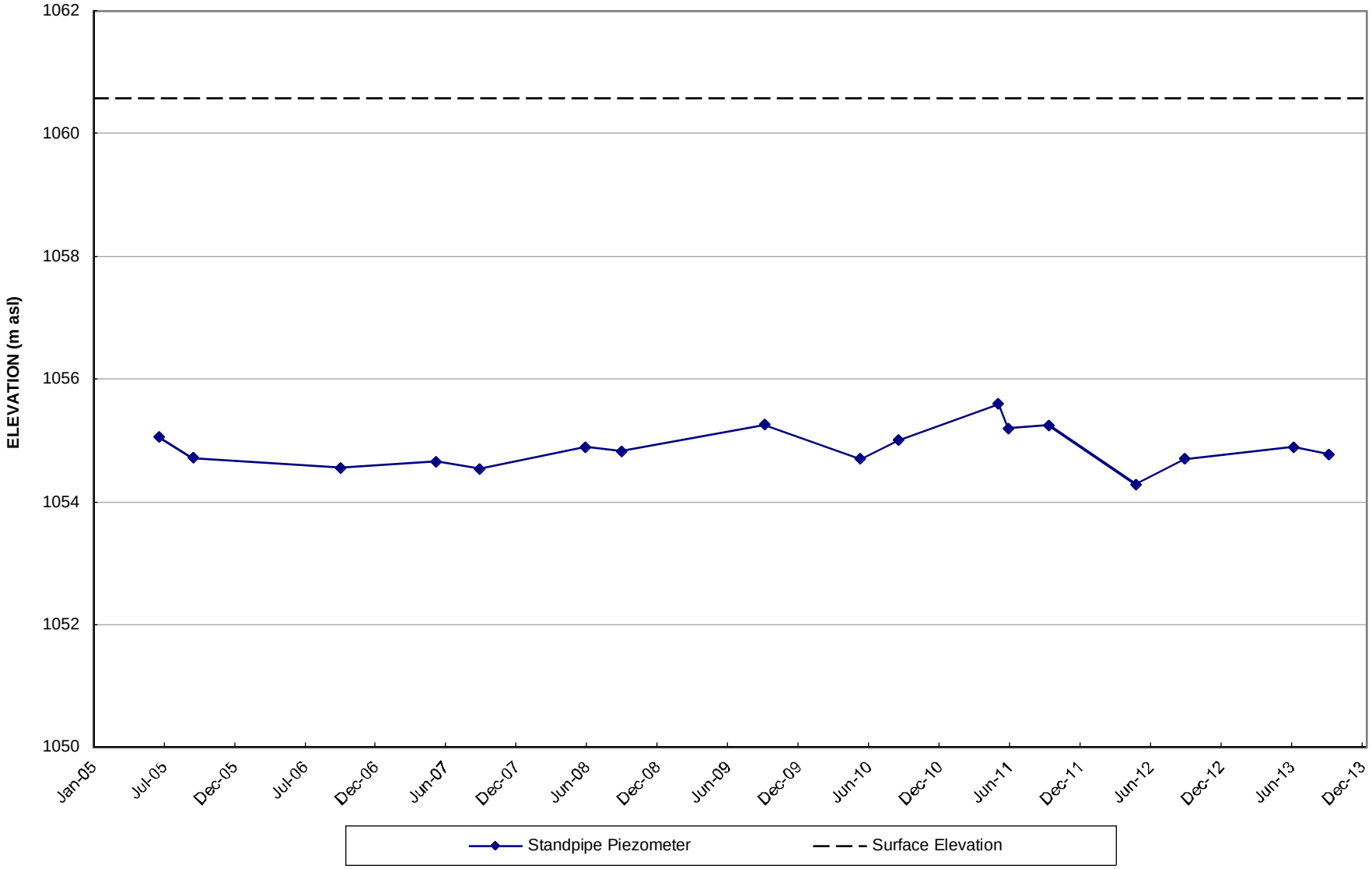
Secondary Tailings Dam
Piezometer P81-07



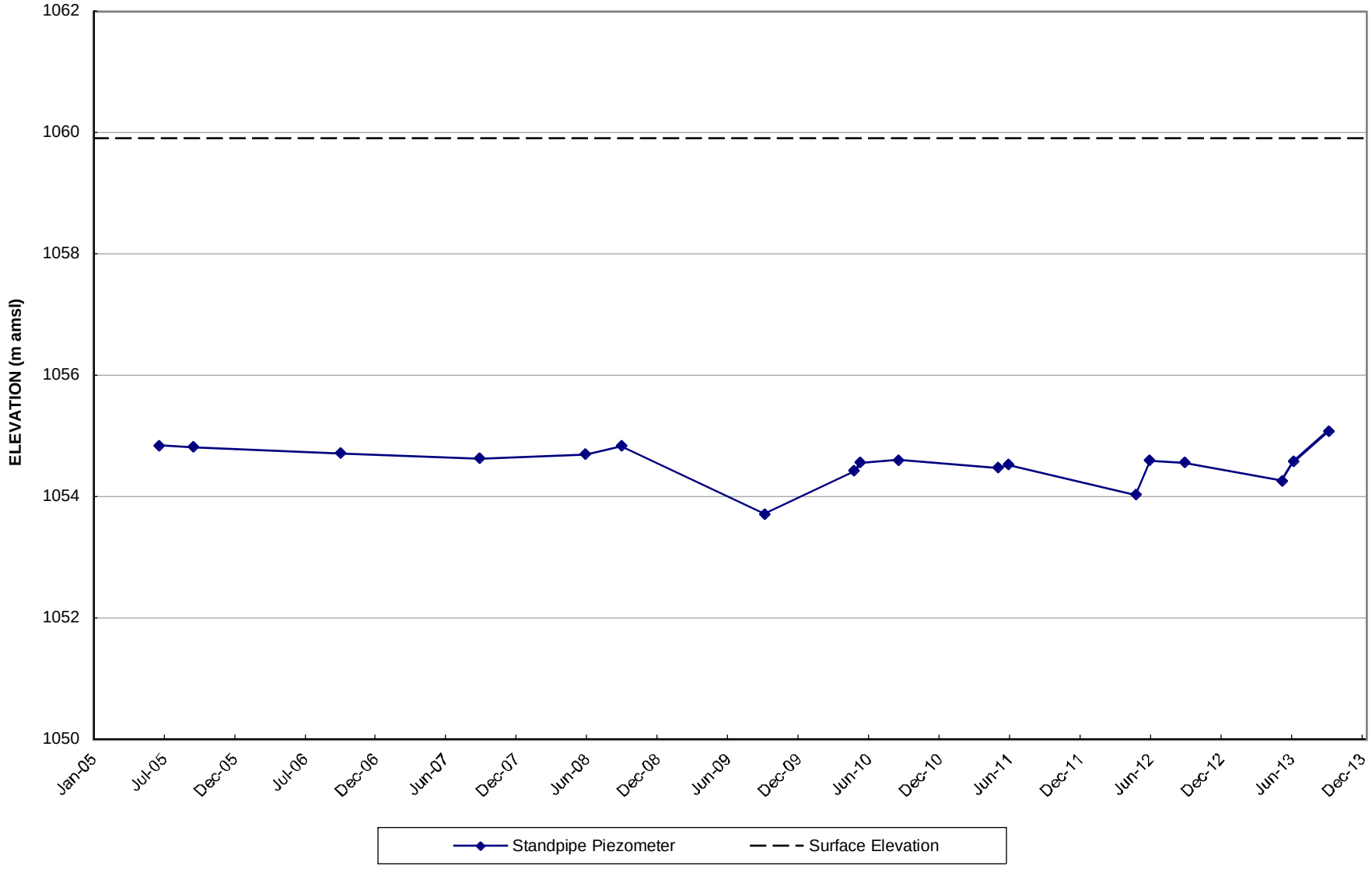
Secondary Tailings Dam
Piezometer P81-08



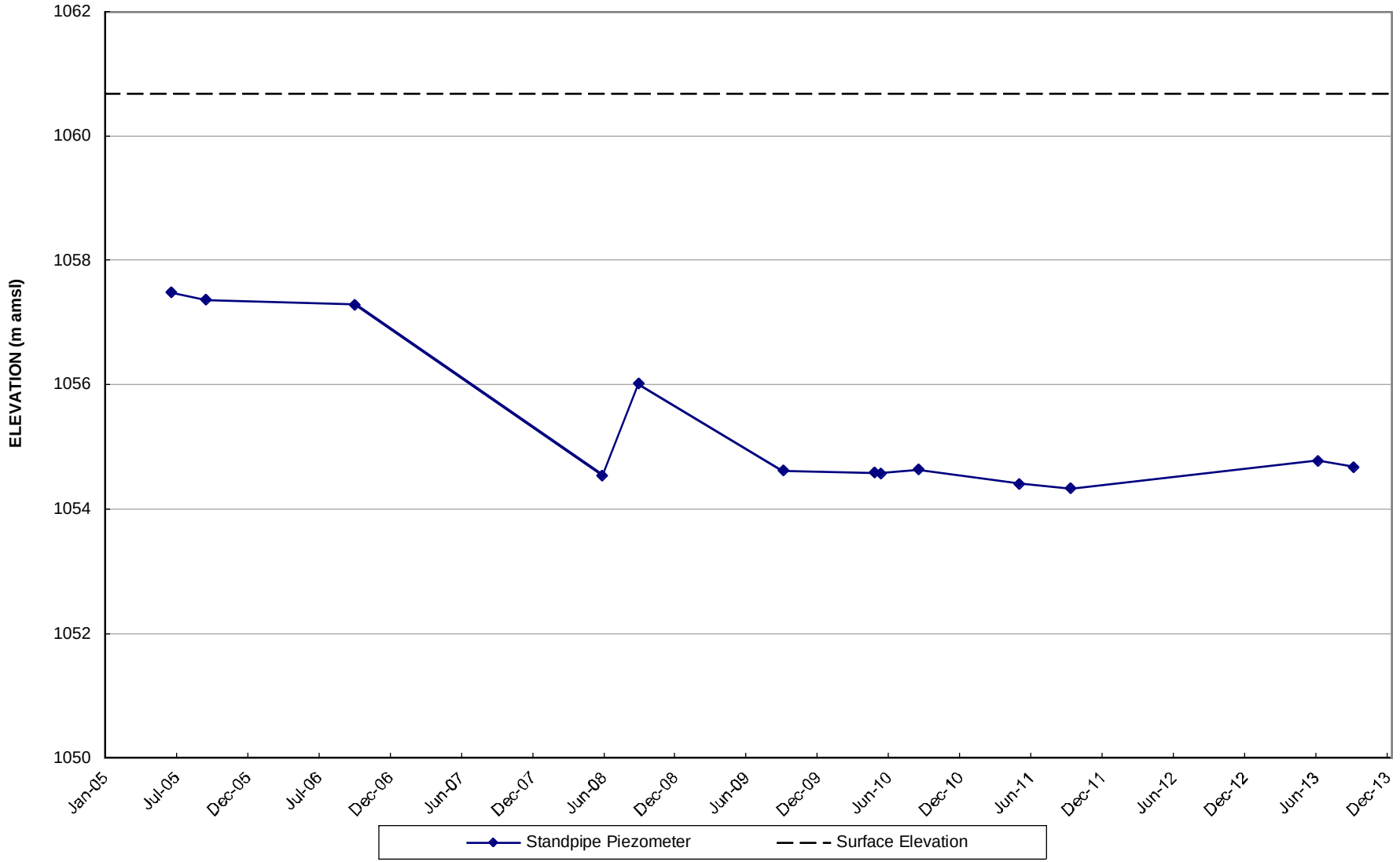
Secondary Tailings Dam
Piezometer P03-01



Secondary Tailings Dam
Piezometer P03-02



Secondary Tailings Dam
Piezometer P03-03



APPENDIX II-H

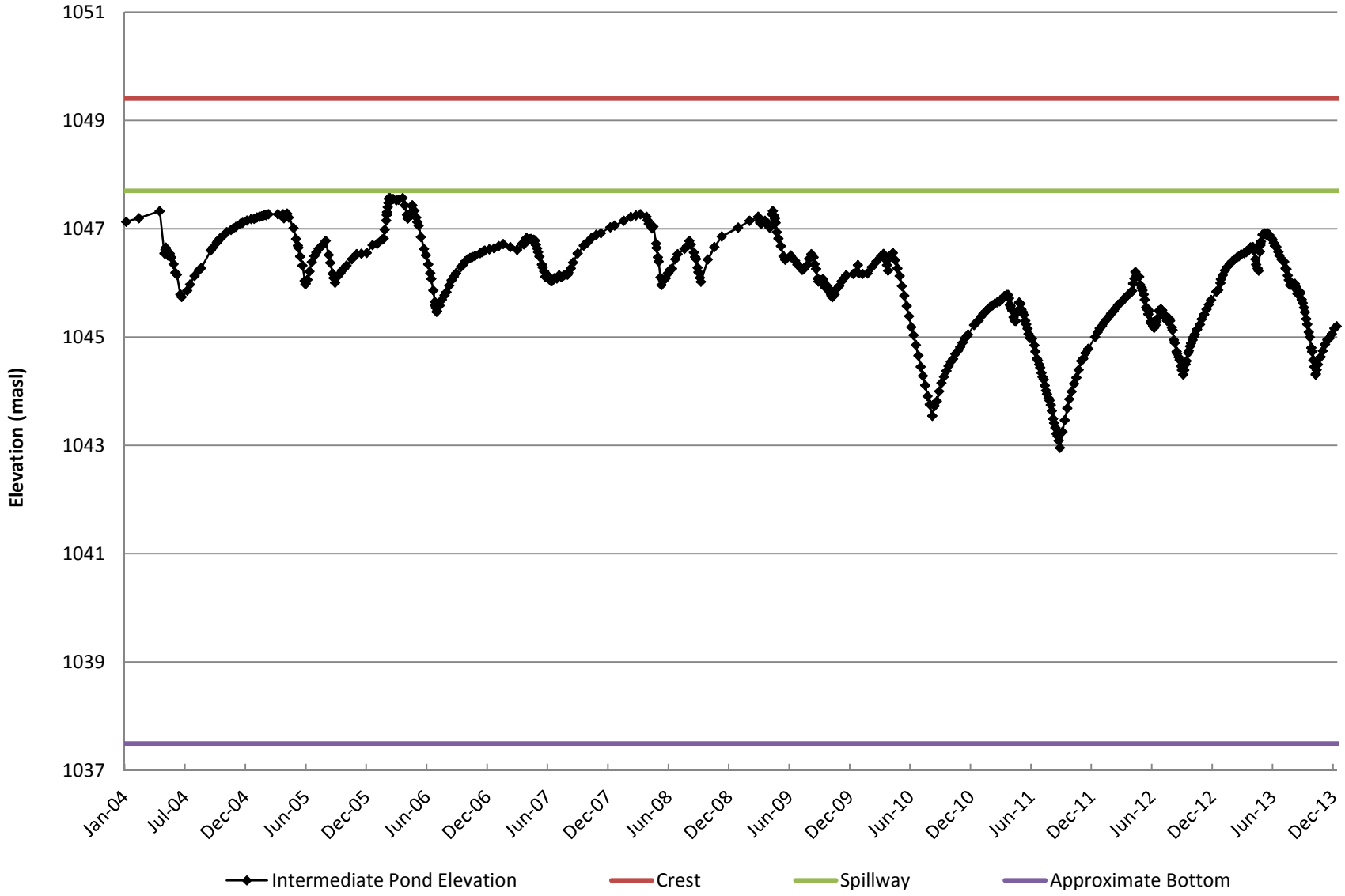
Intermediate Dam

H.1 – Pond Level (Intermediate Pond)

H.2 – Piezometers

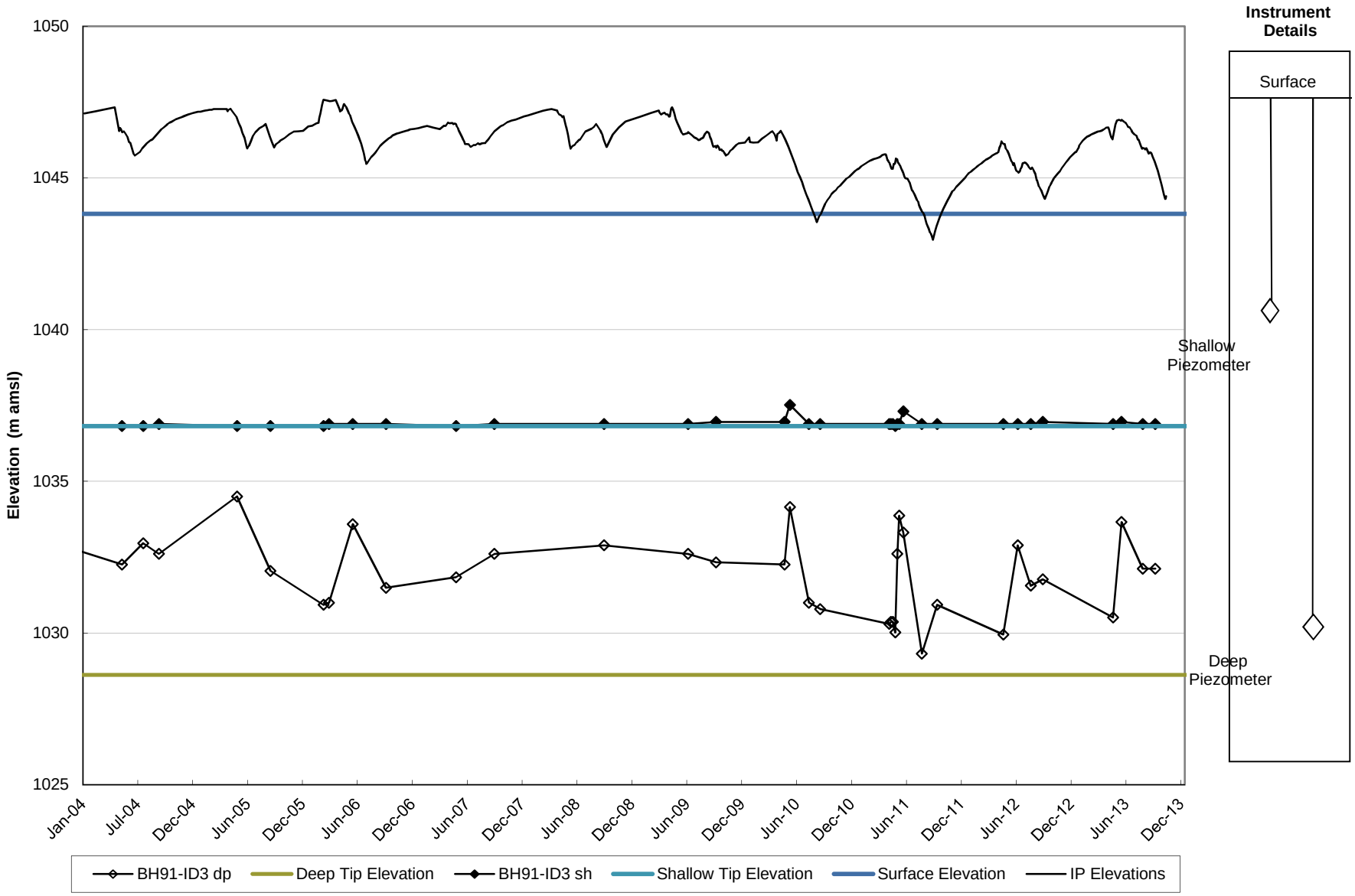
H.1 – Pond Level (Intermediate Pond)

Intermediate Pond Water Level

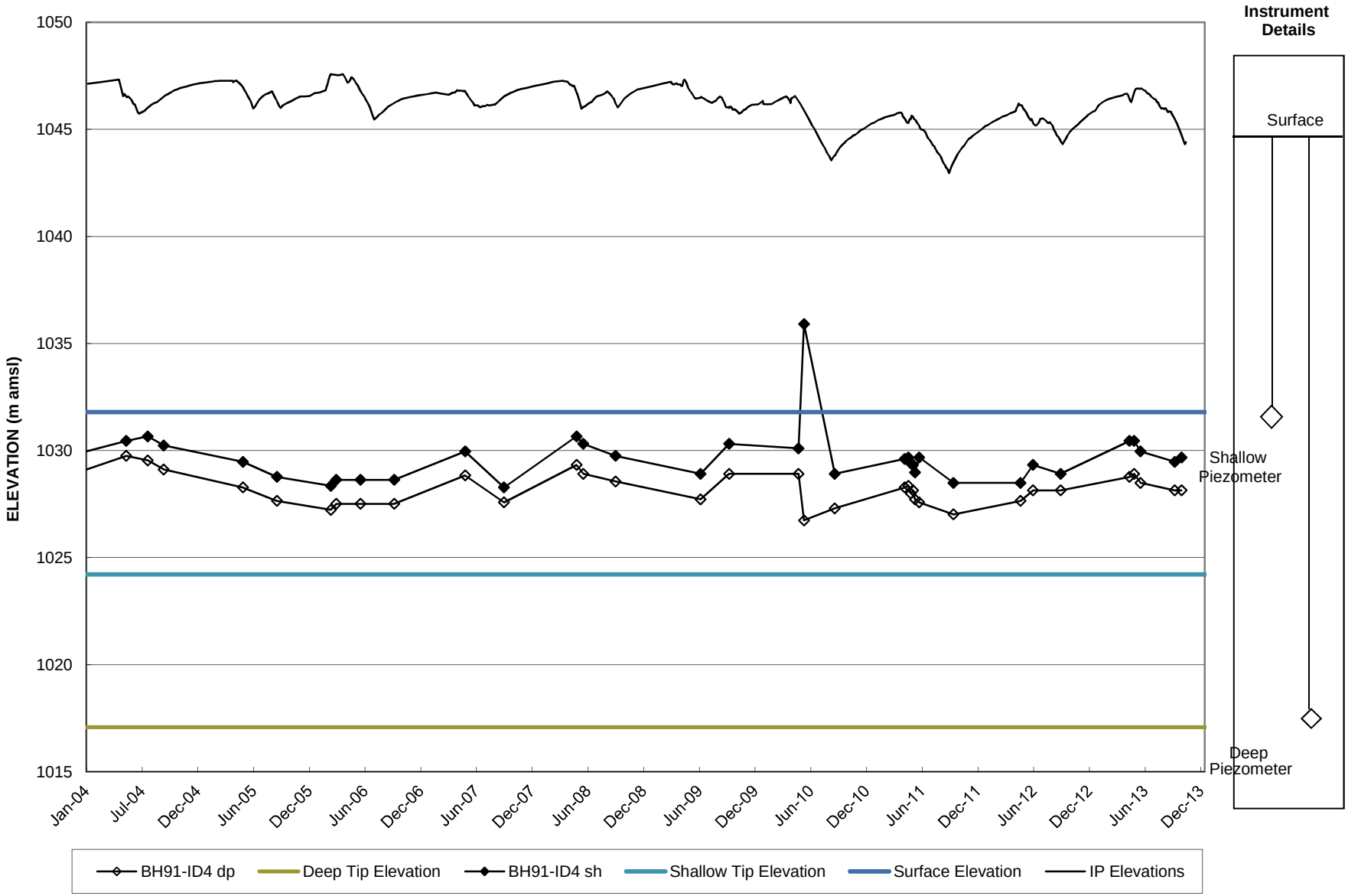


H.2 – Piezometers

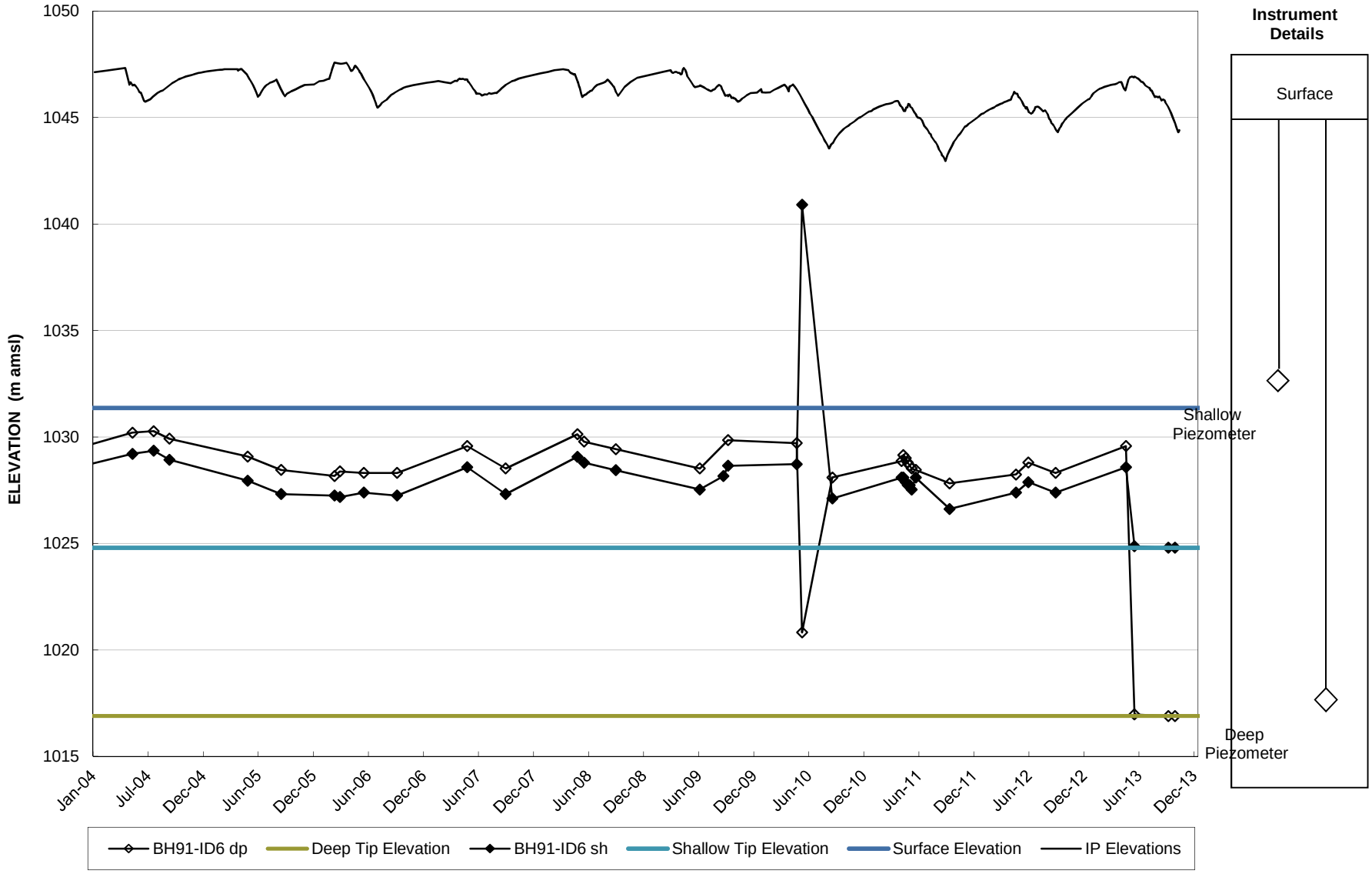
Intermediate Dam
Piezometer BH91-ID3



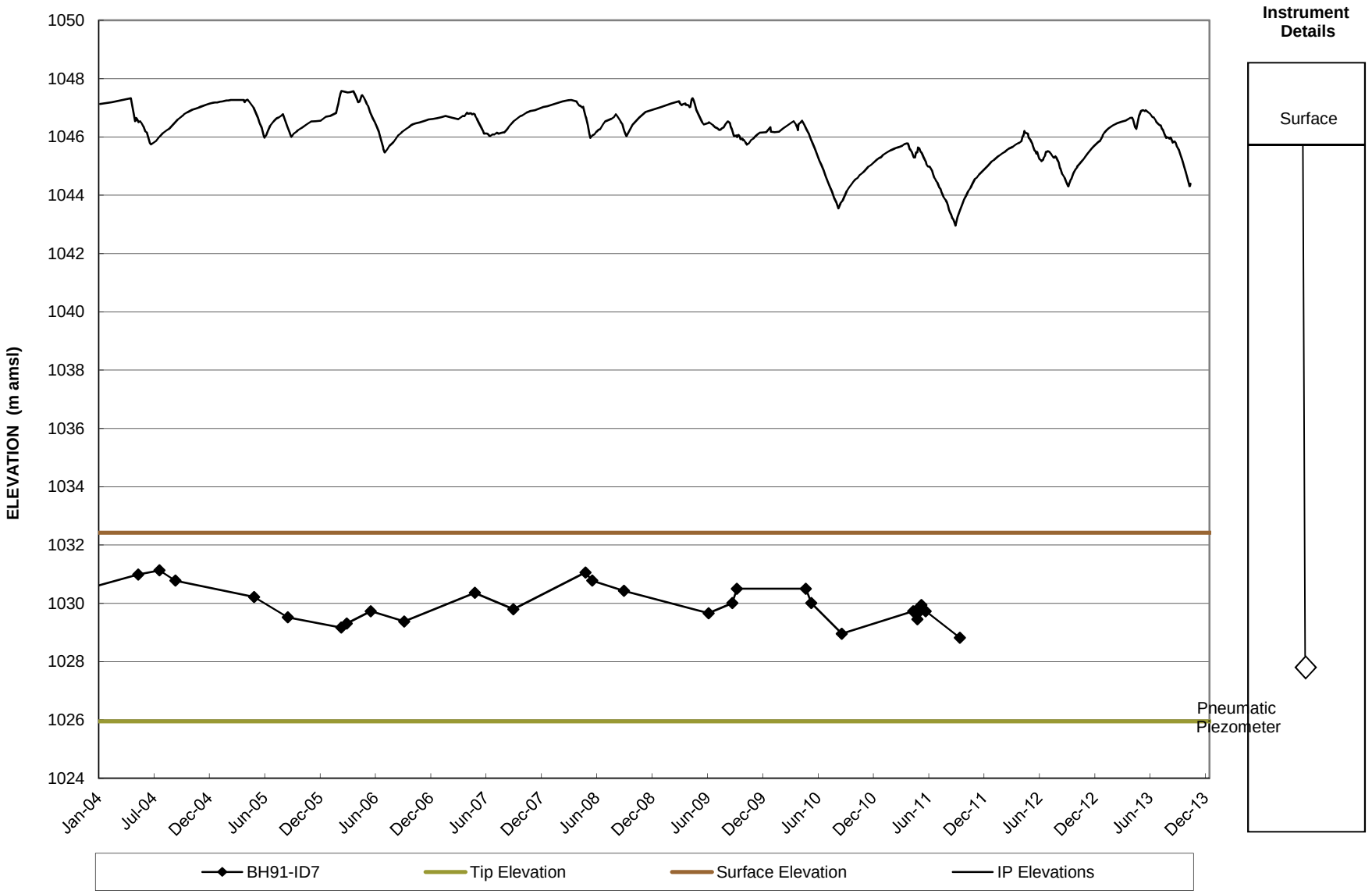
Intermediate Dam
Piezometer BH91-ID4



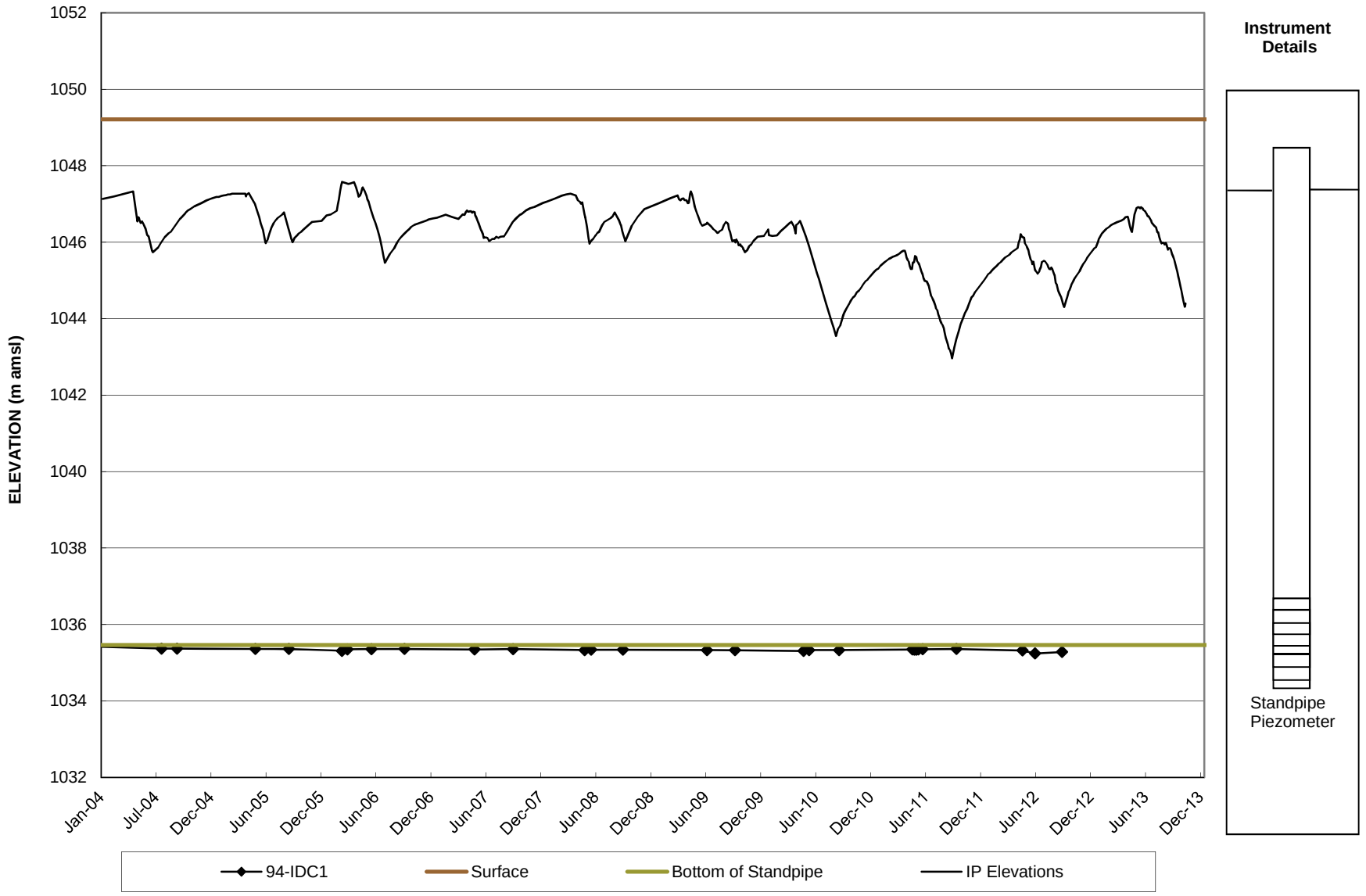
Intermediate Dam
Piezometer BH91-ID6



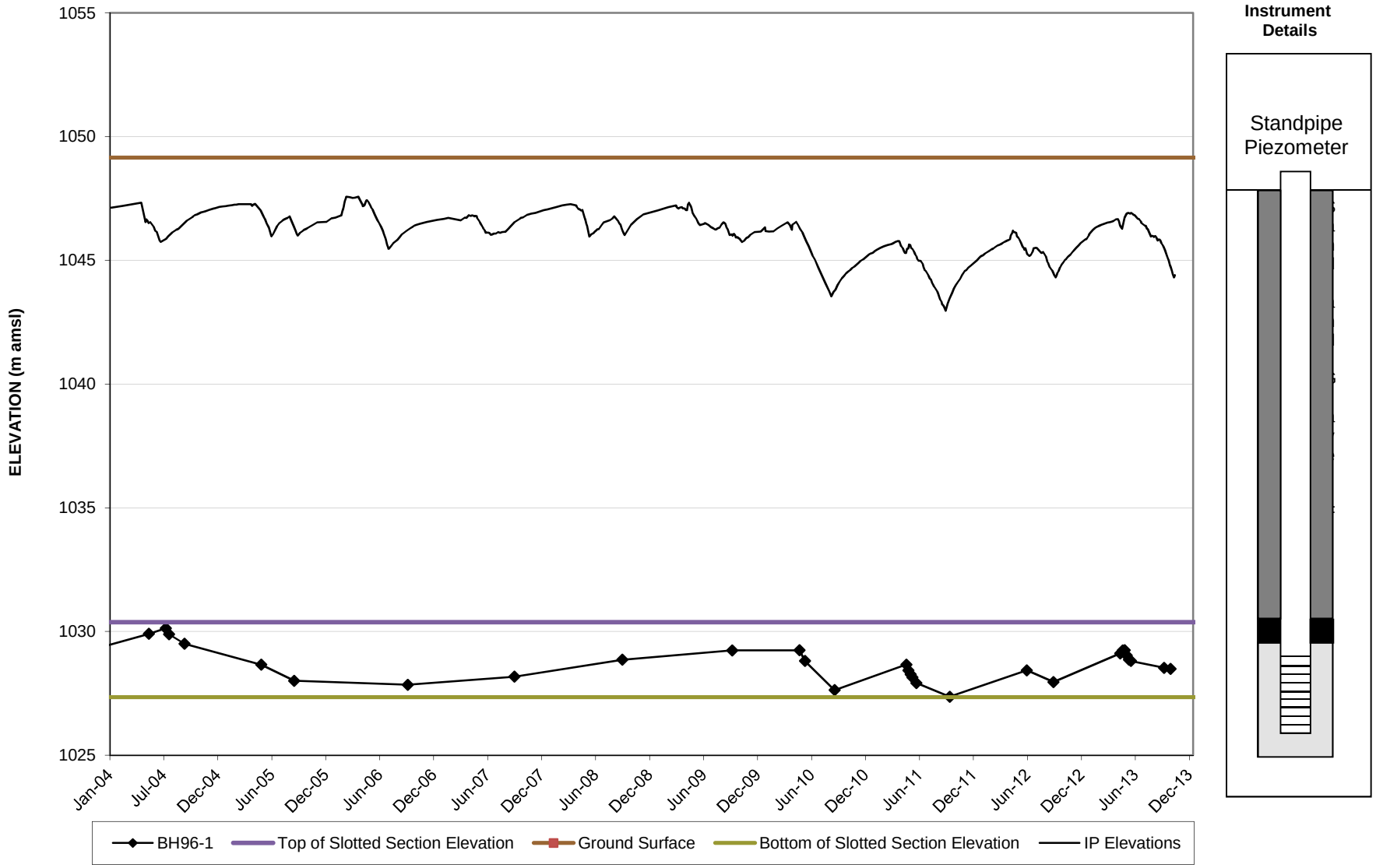
Intermediate Dam
Piezometer BH91-ID7



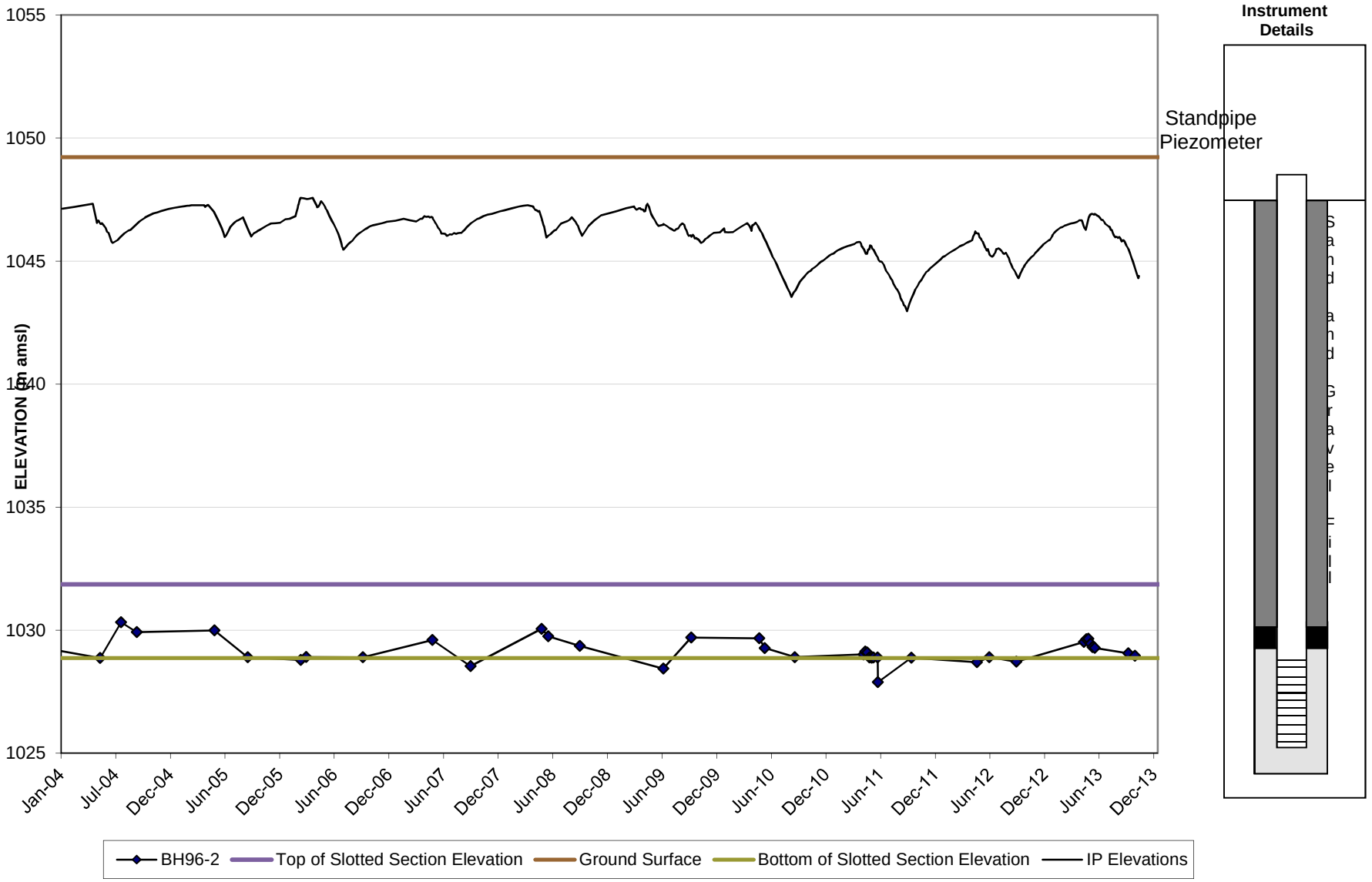
Intermediate Dam
Piezometer BH94-IDC-1



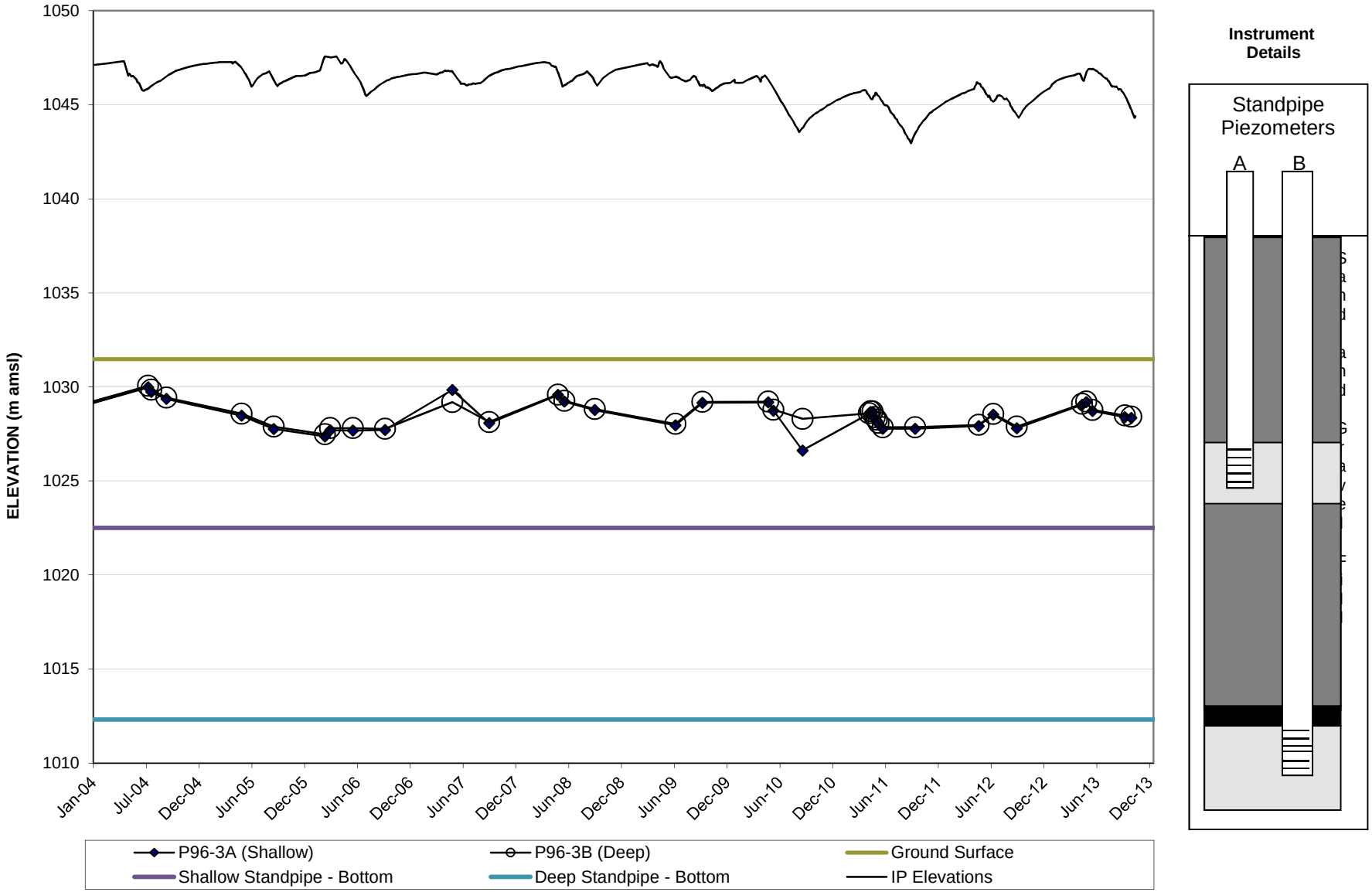
Intermediate Dam
Piezometer BH96-1



Intermediate Dam
Piezometer BH96-2

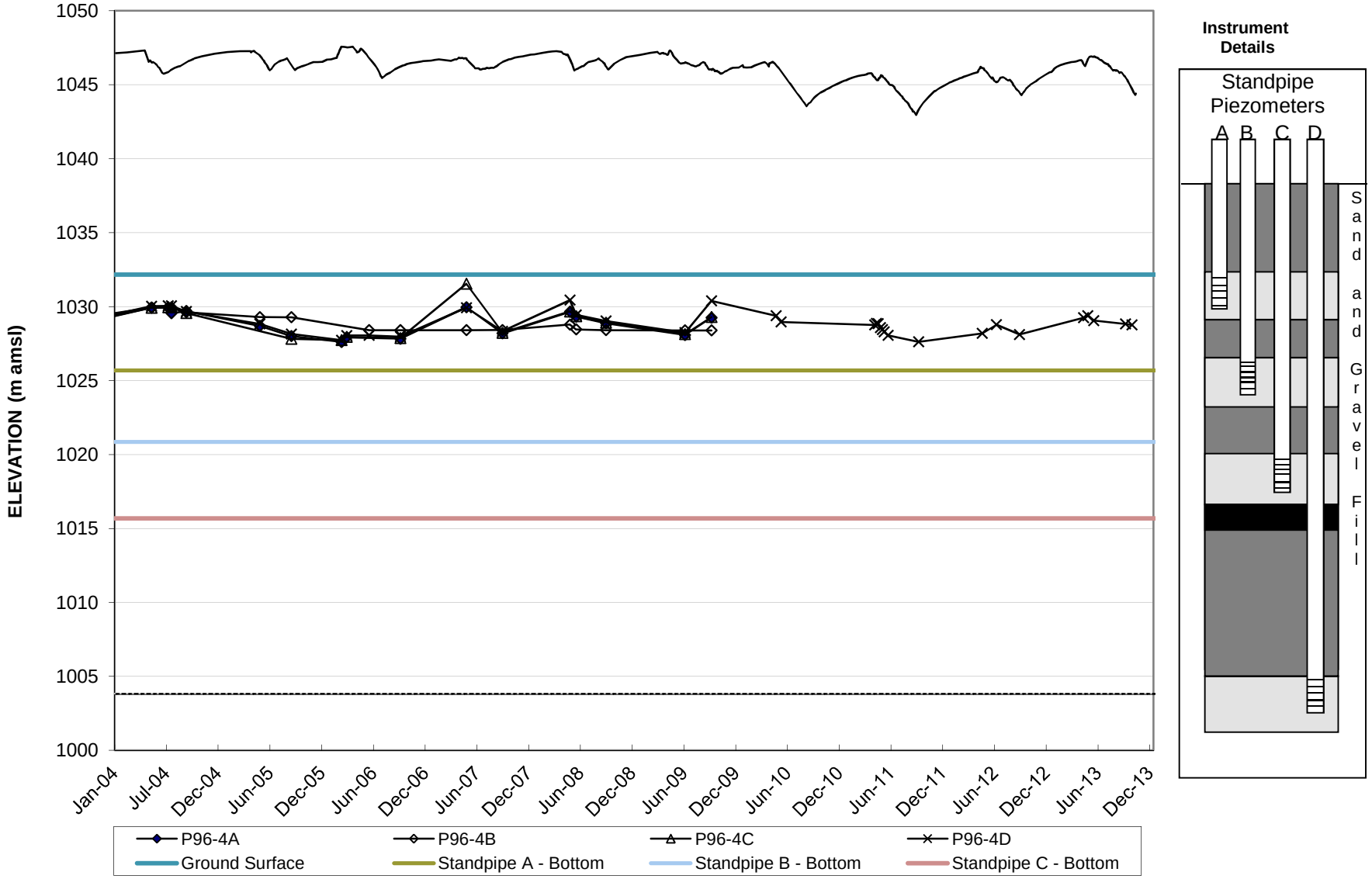


Intermediate Dam
Piezometer BH96-3

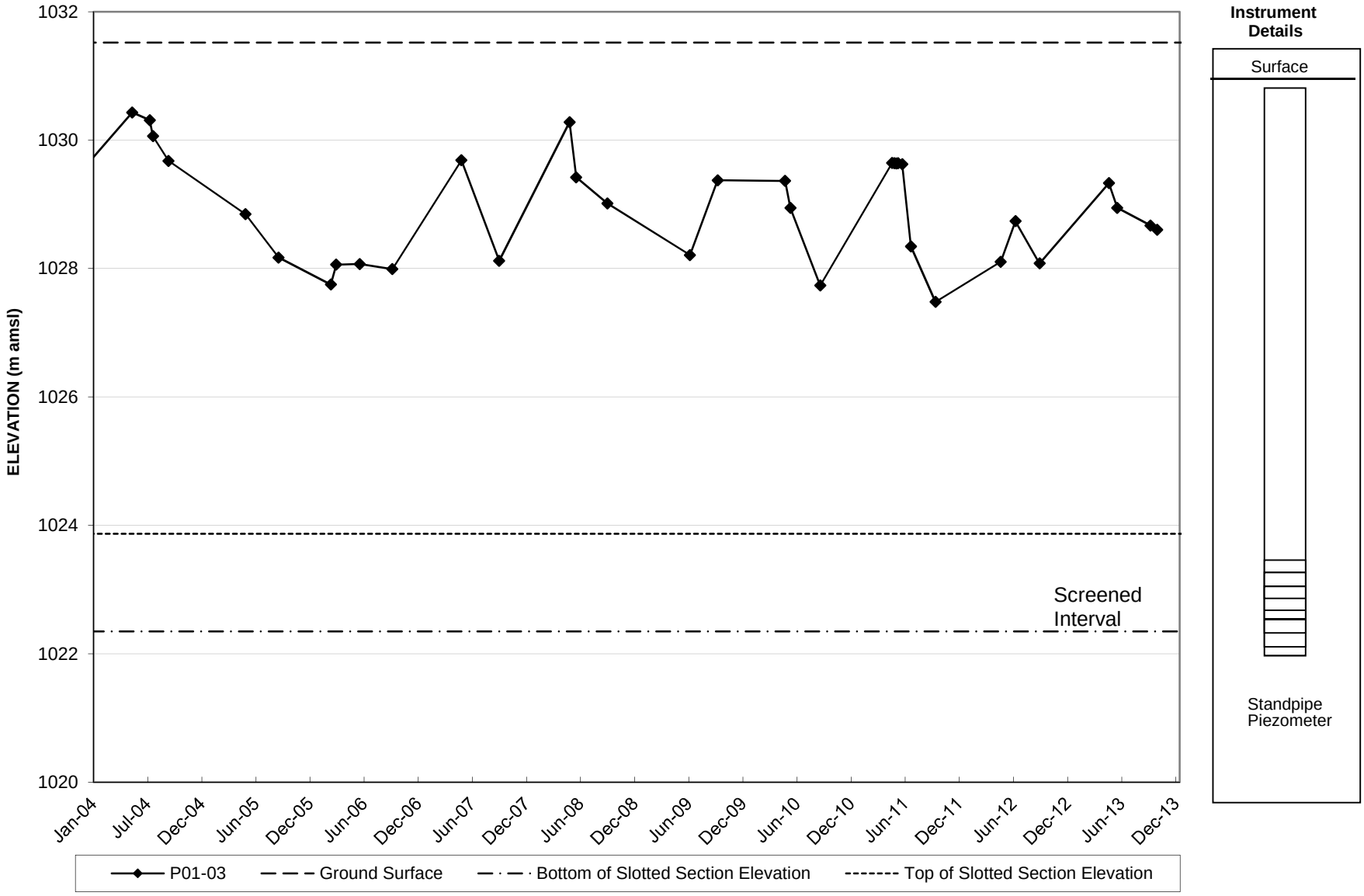


Instrument Details

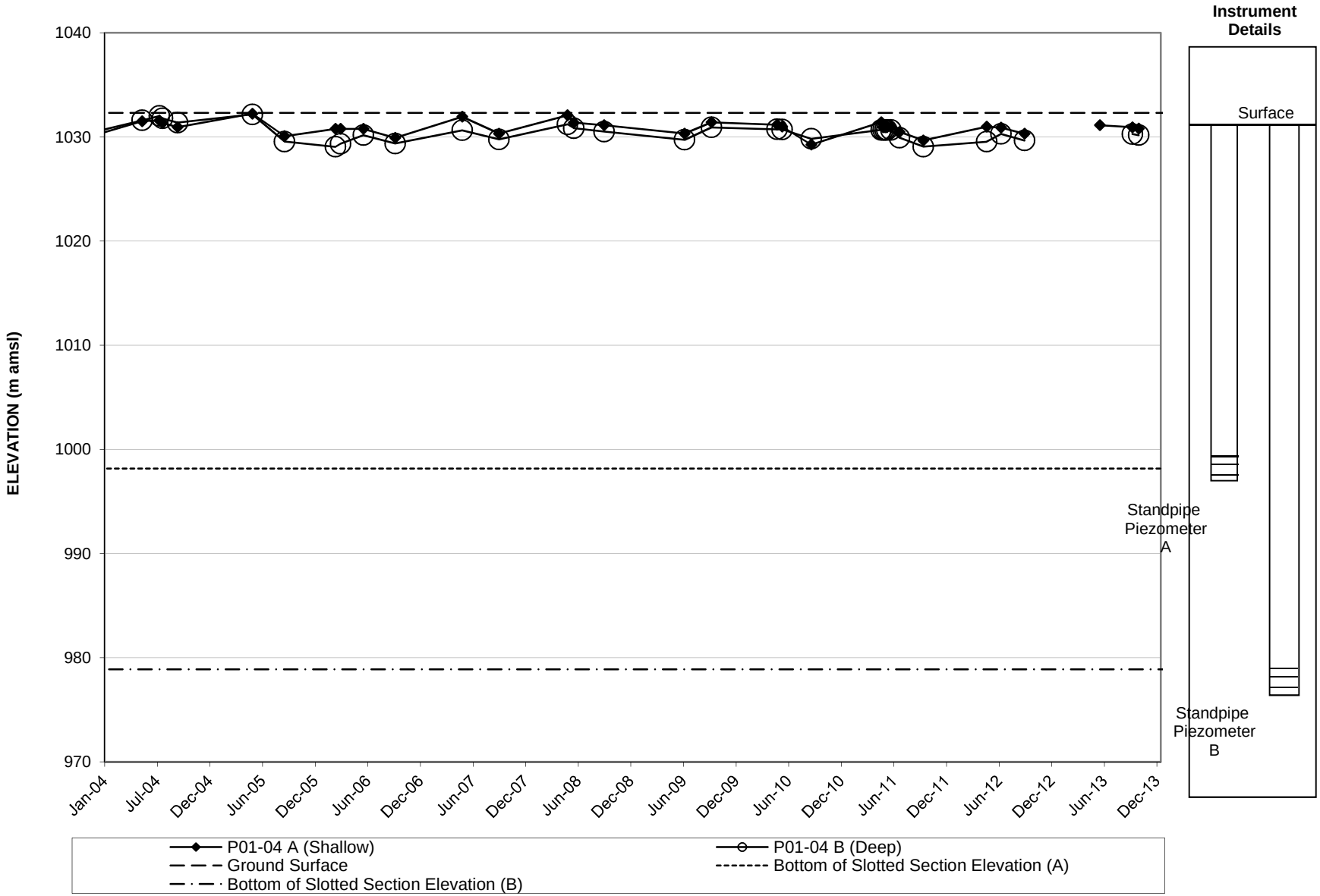
Intermediate Dam
Piezometer BH96-4



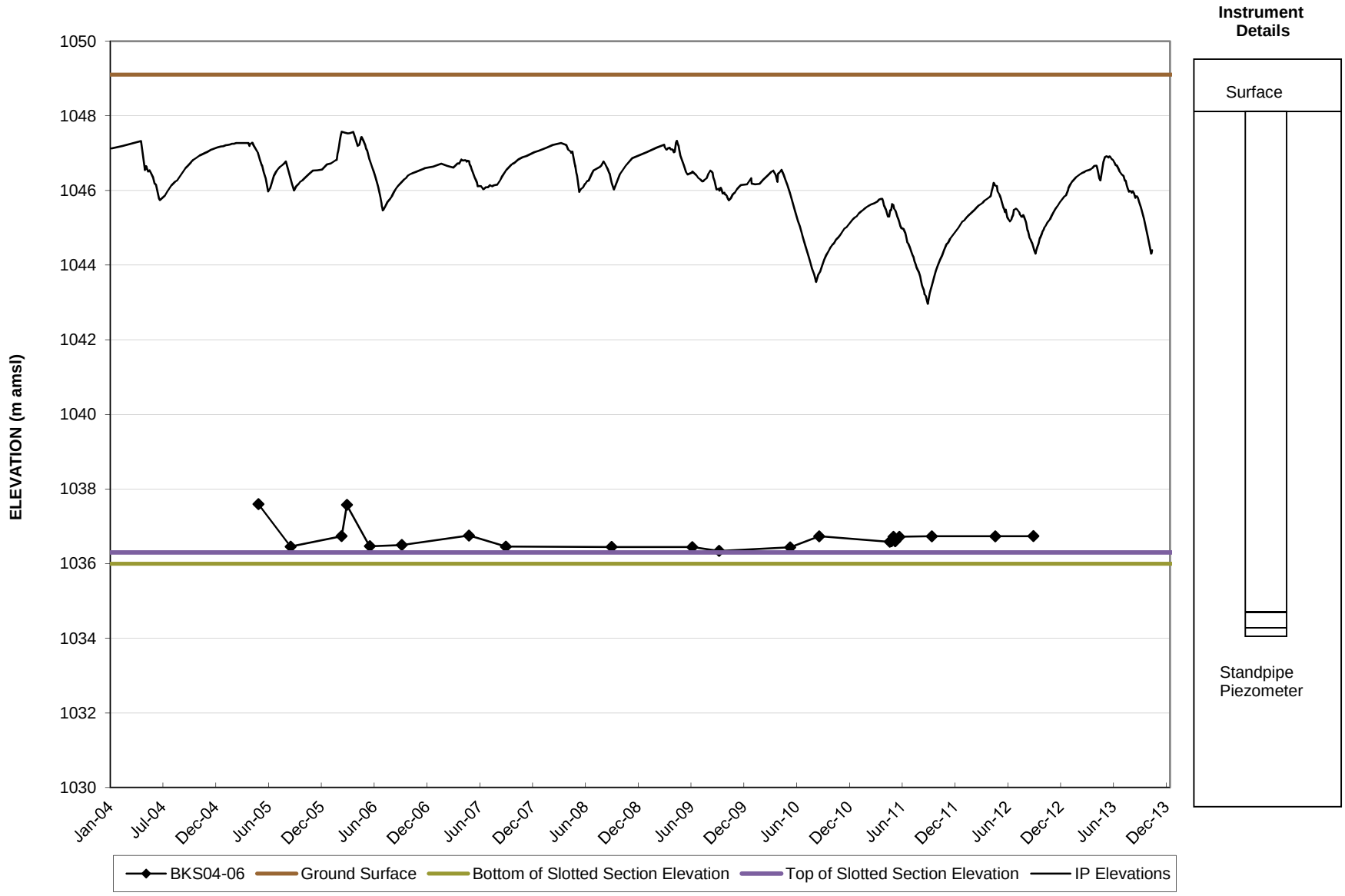
Intermediate Dam
Piezometer P01-03



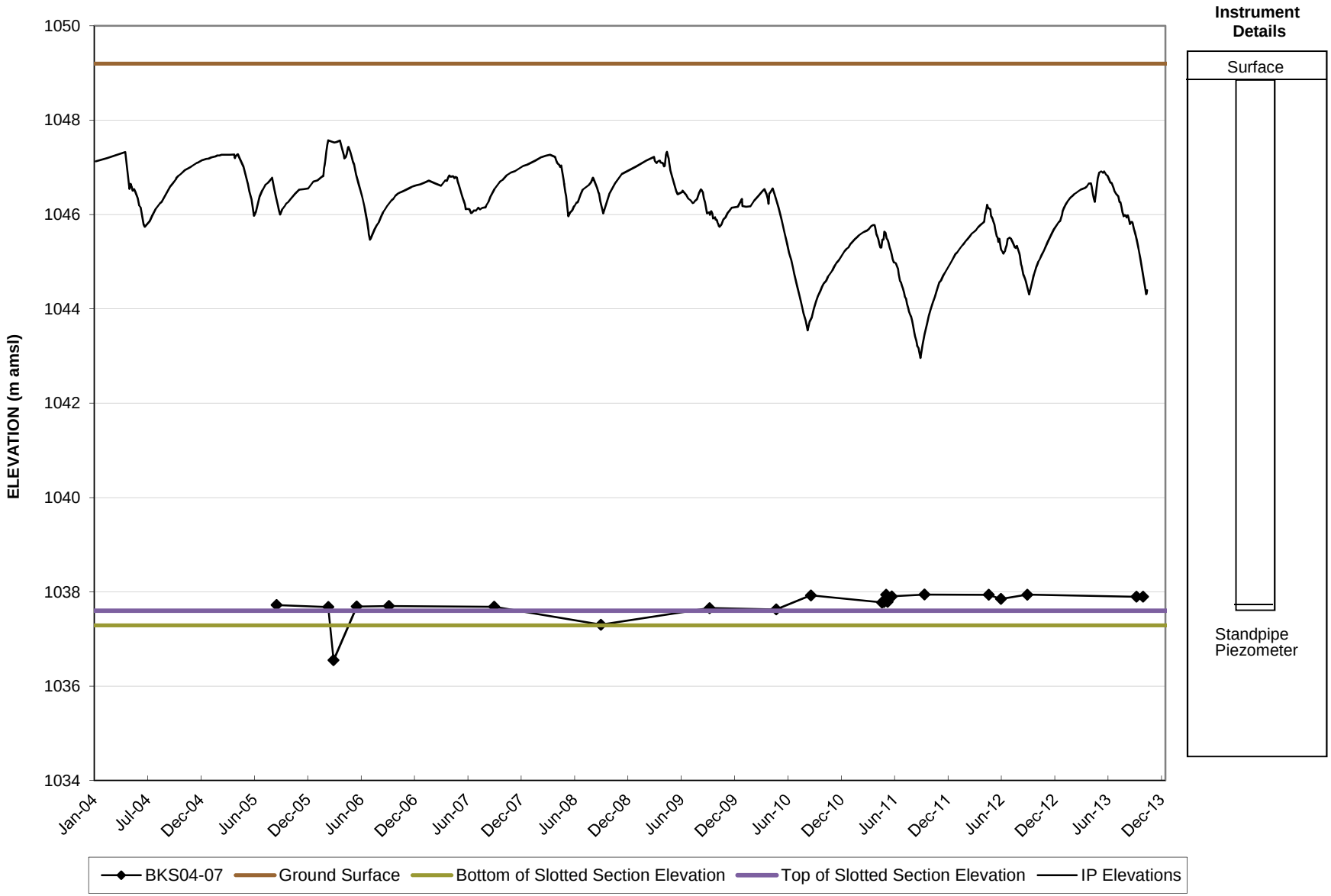
Intermediate Dam
Piezometer P01-04



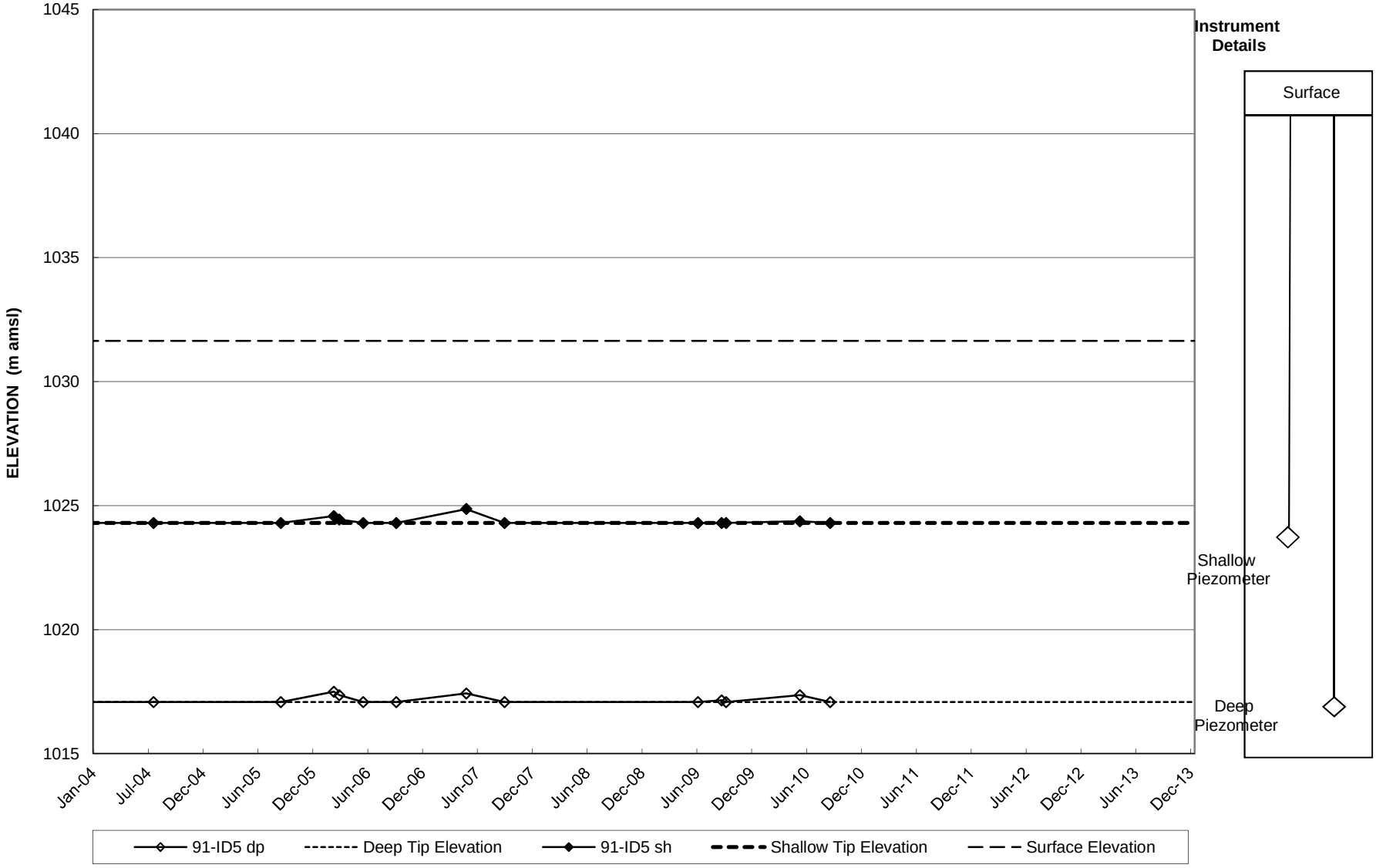
Intermediate Dam
Piezometer BKS04-06



Intermediate Dam
Piezometer BKS04-07



Piezometric Monitoring
BH91-ID5 Pneumatic Piezometer (Both Tips)



APPENDIX II-I

Cross Valley Dam

I.1 – Pond Level (Polishing Pond)

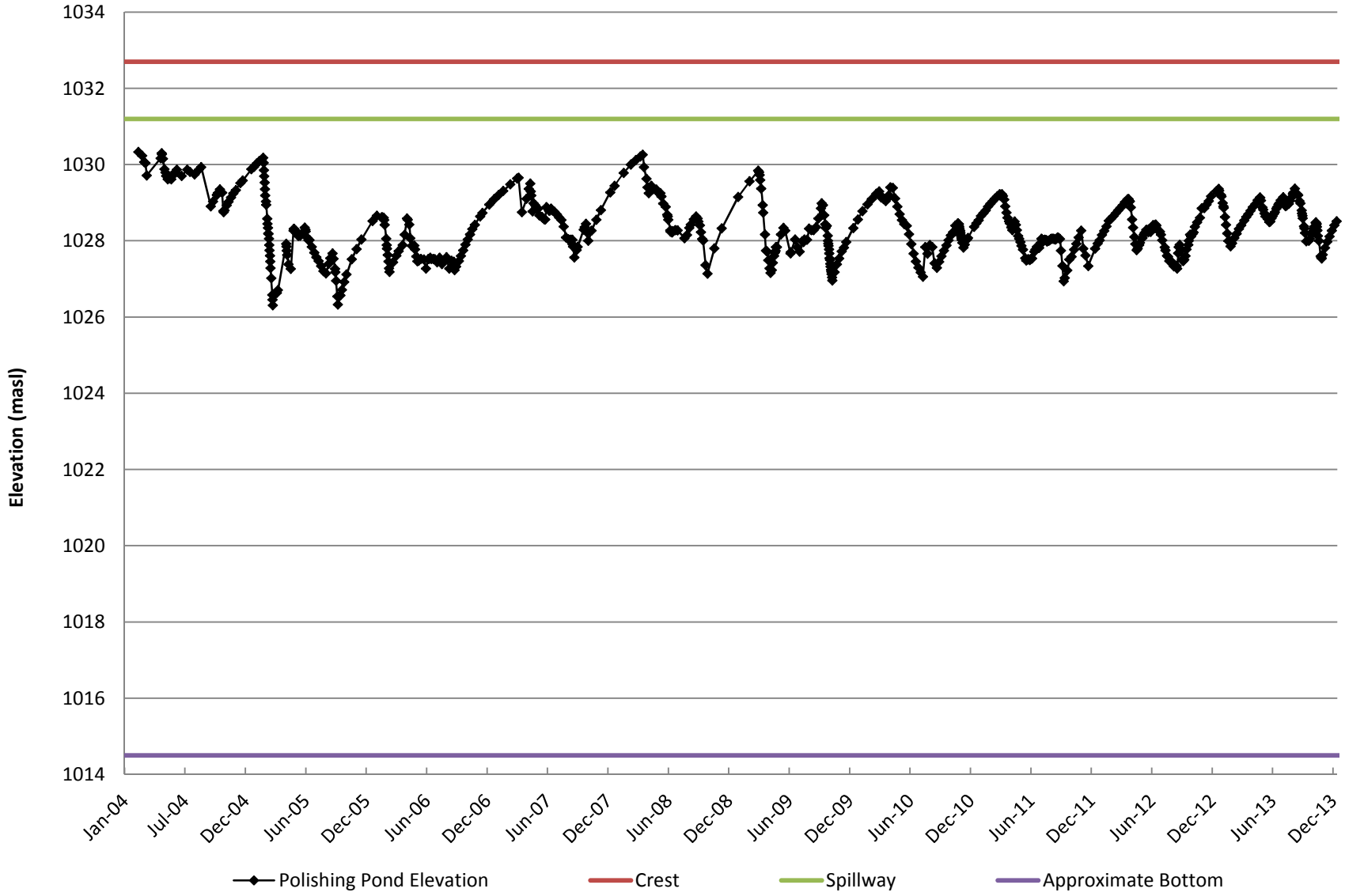
I.2 – Piezometers

I.3 - Thermistors

I.4 – Downstream Weir Flow

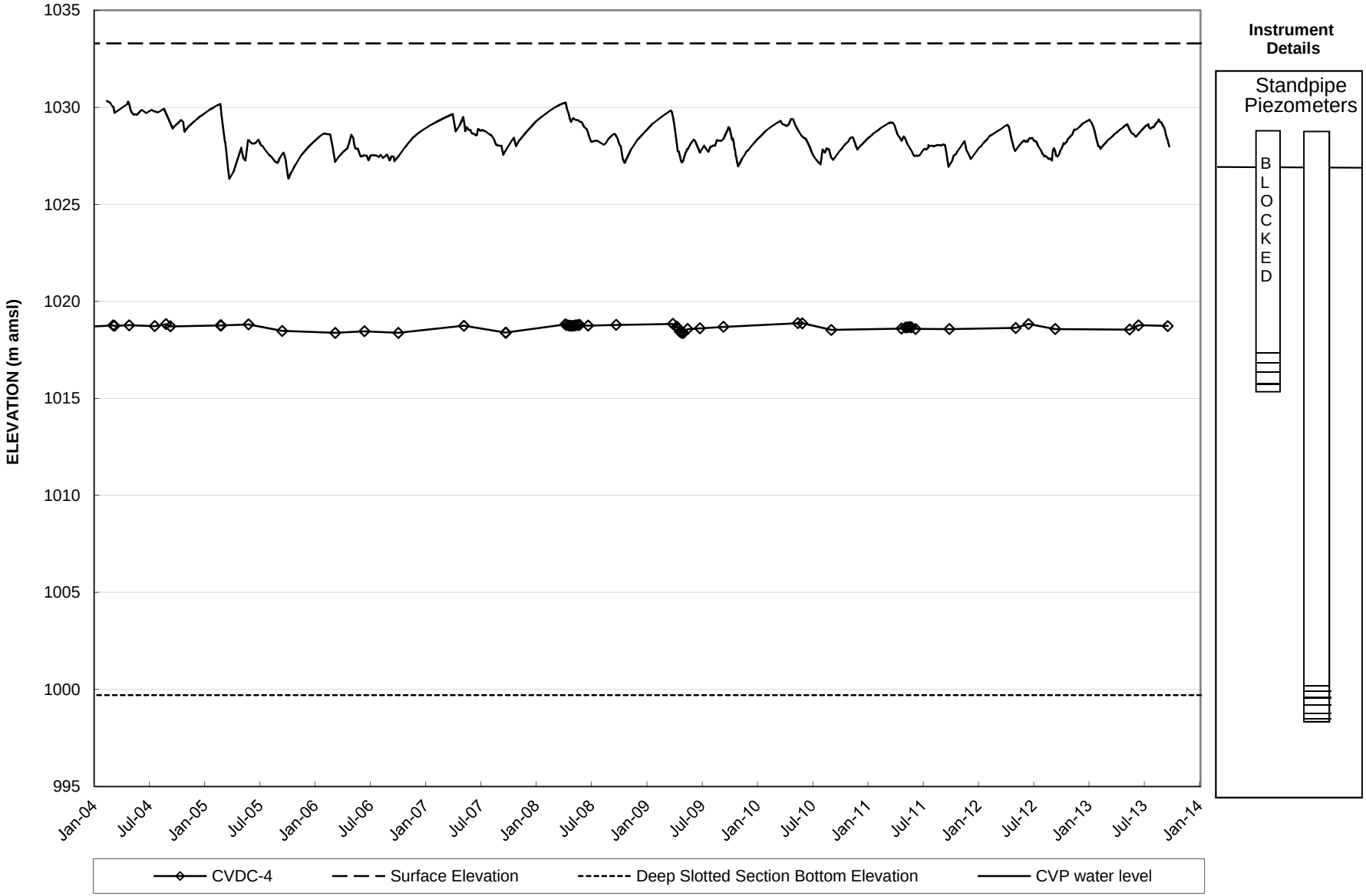
I.1 – Pond Level (Polishing Pond)

Polishing Pond Water Level

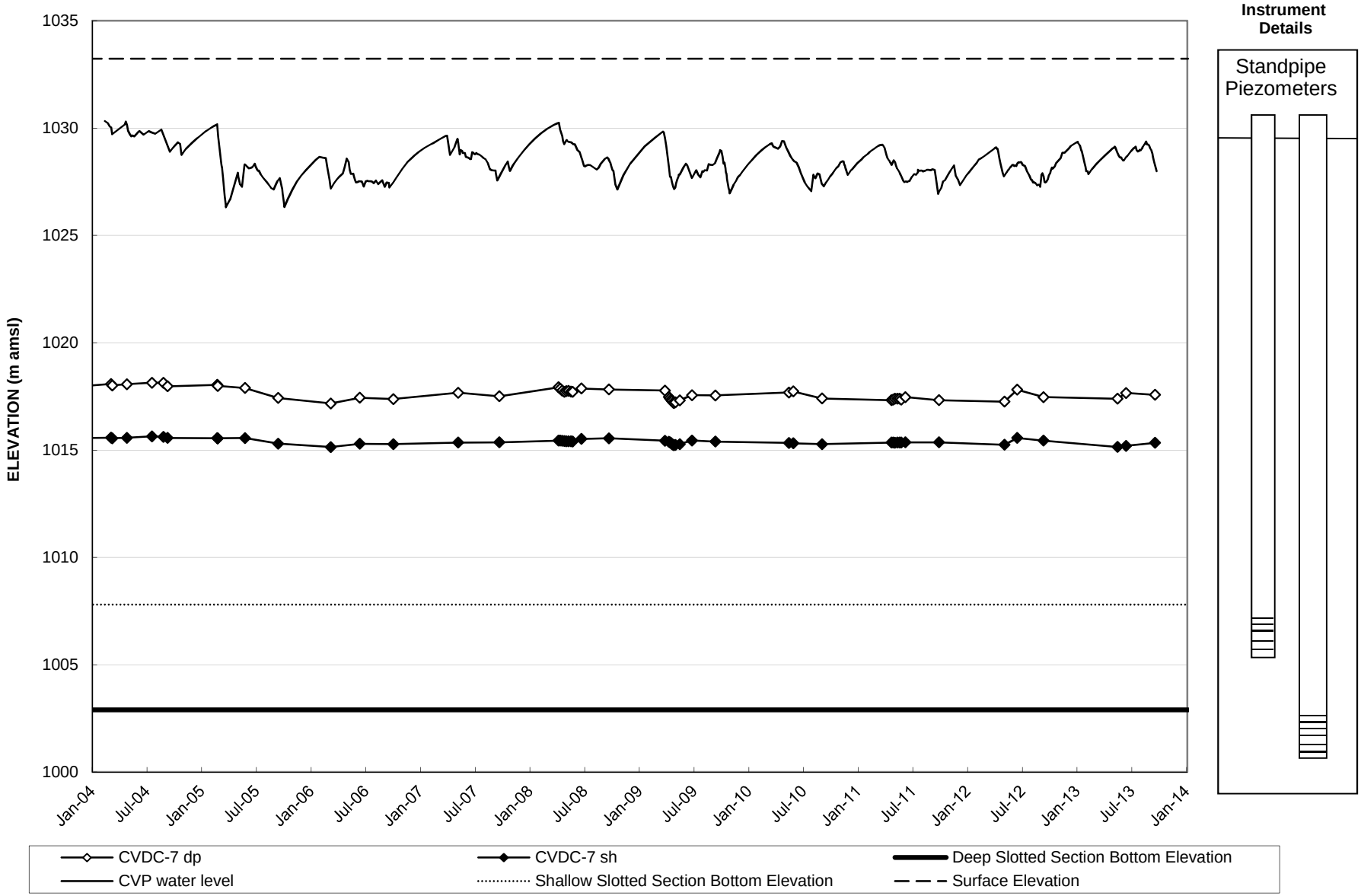


I.2 – Piezometers

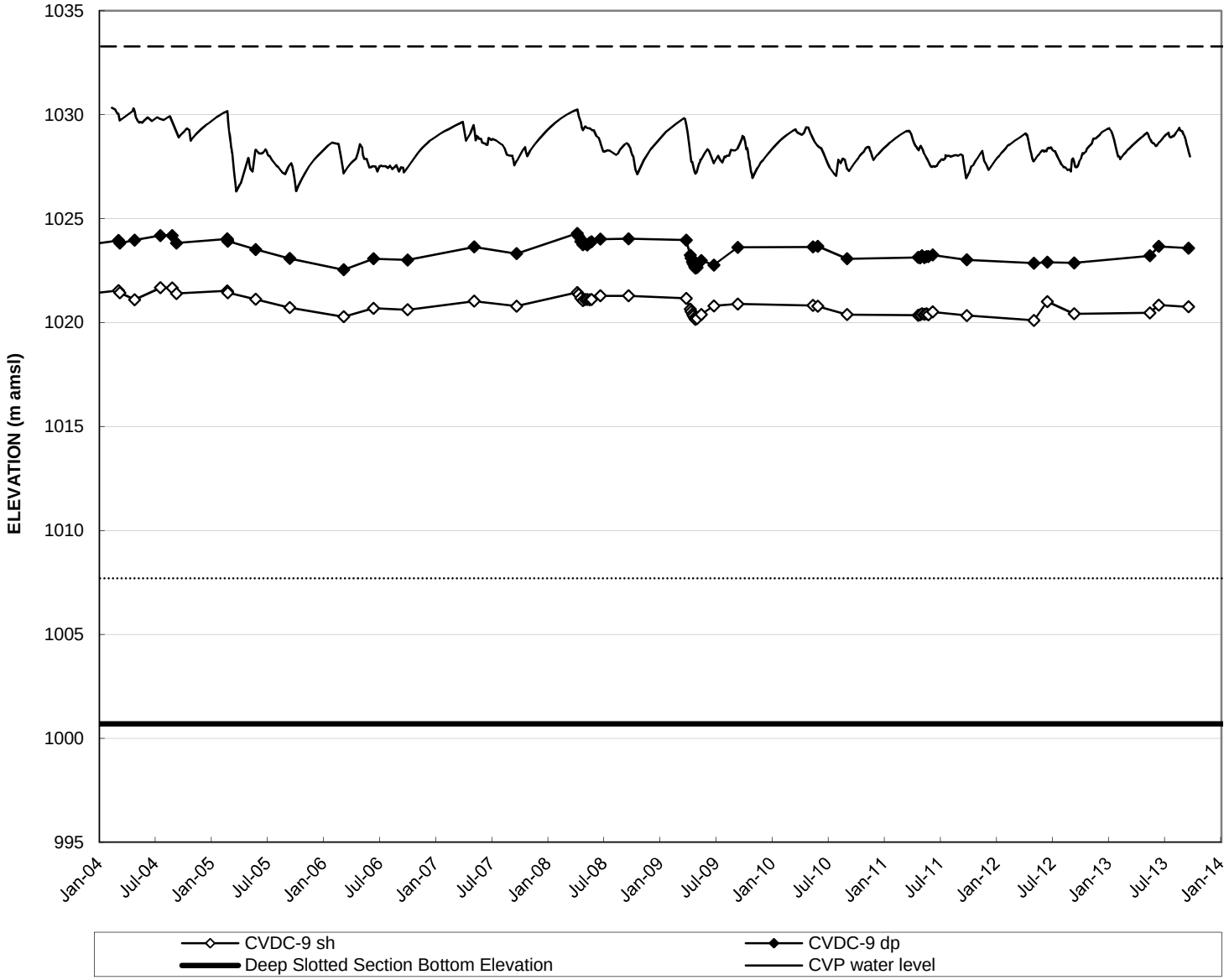
Cross Valley Dam
Piezometer CVDC-4

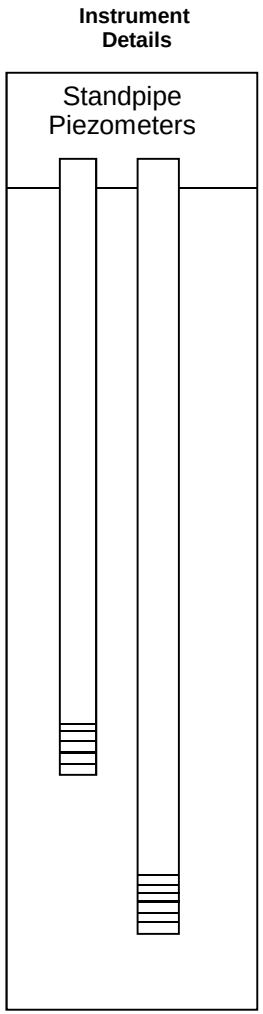


Cross Valley Dam
Piezometer CVDC-7

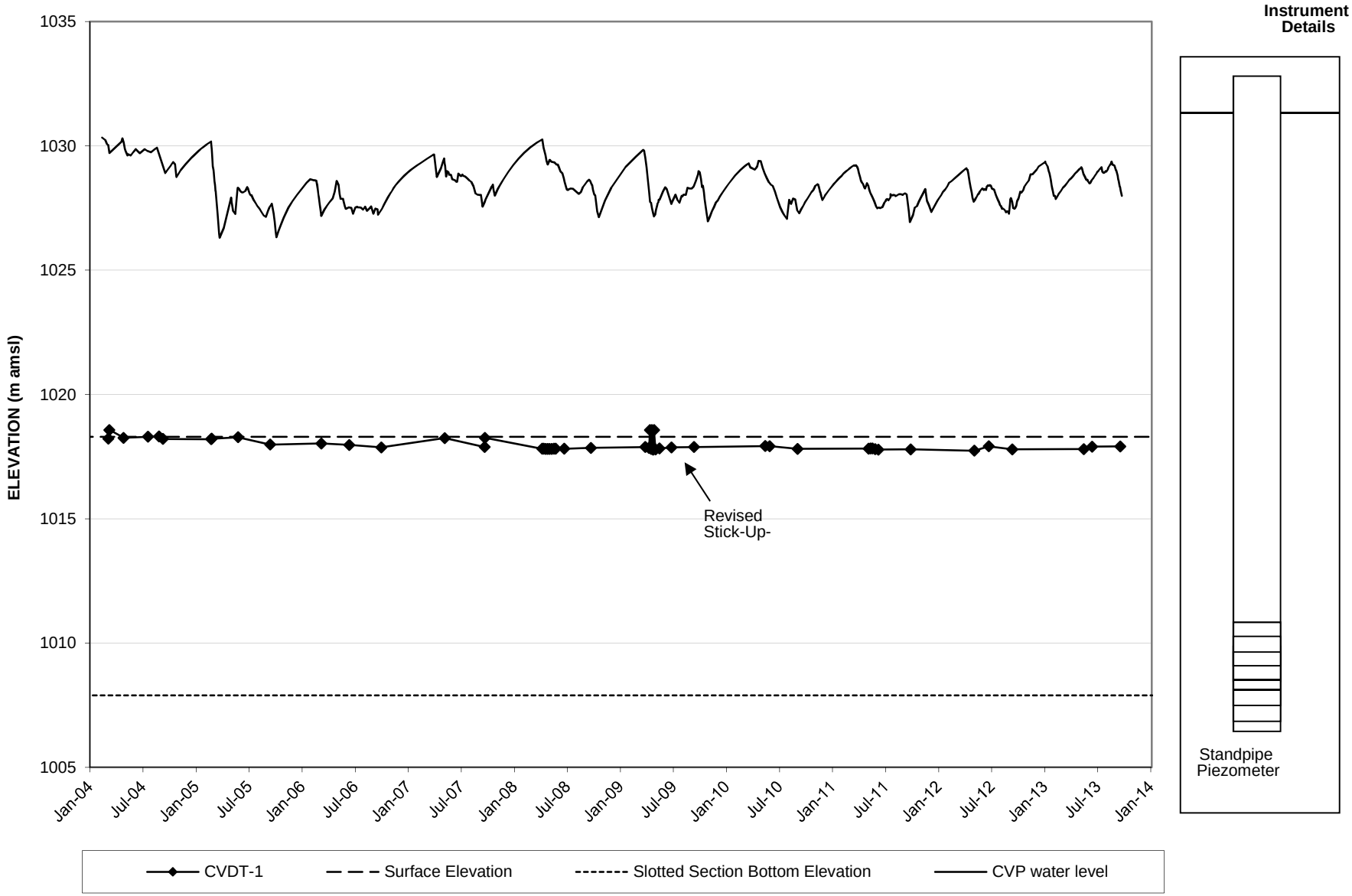


Cross Valley Dam
Piezometer CVDC-9

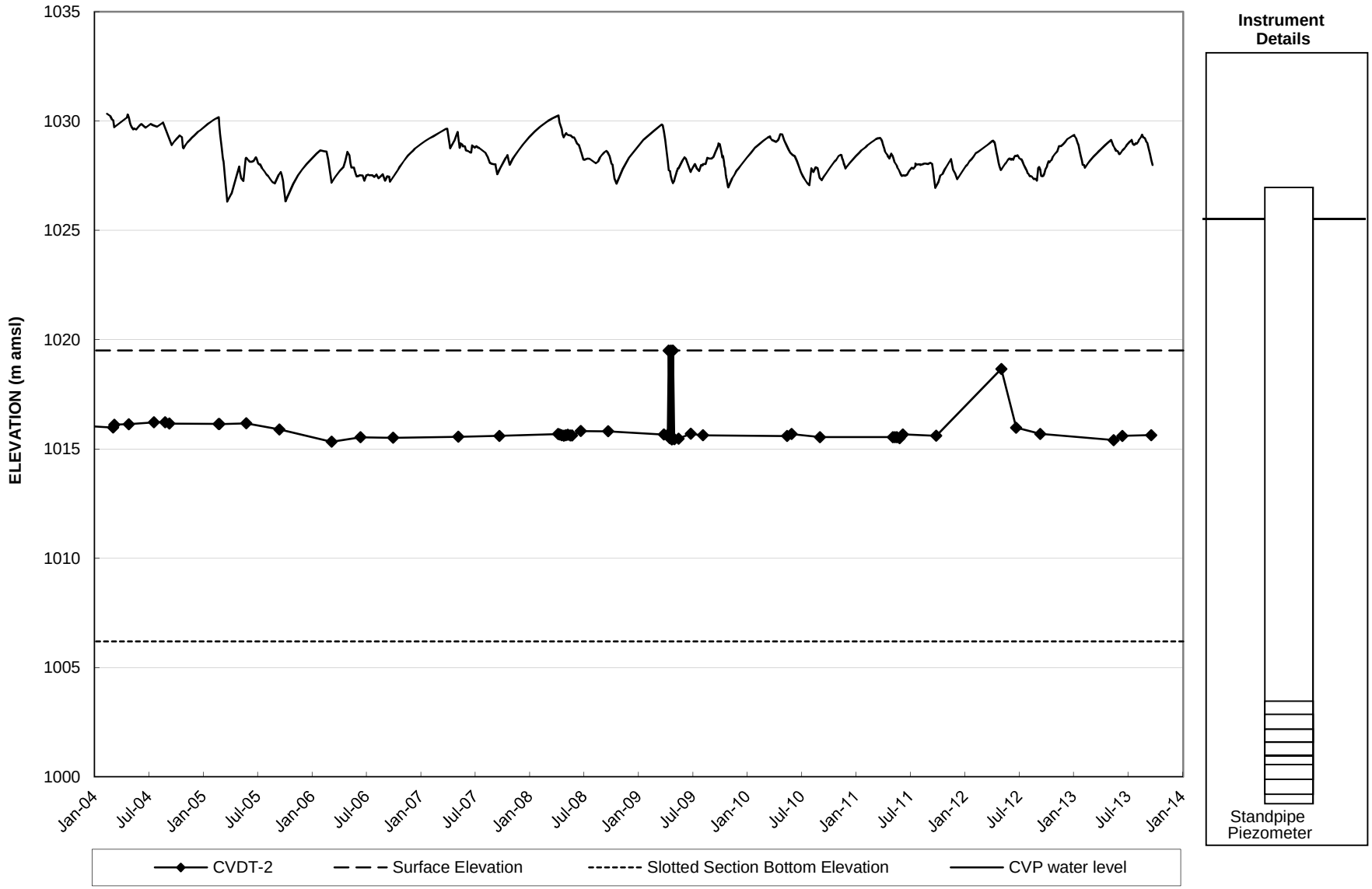




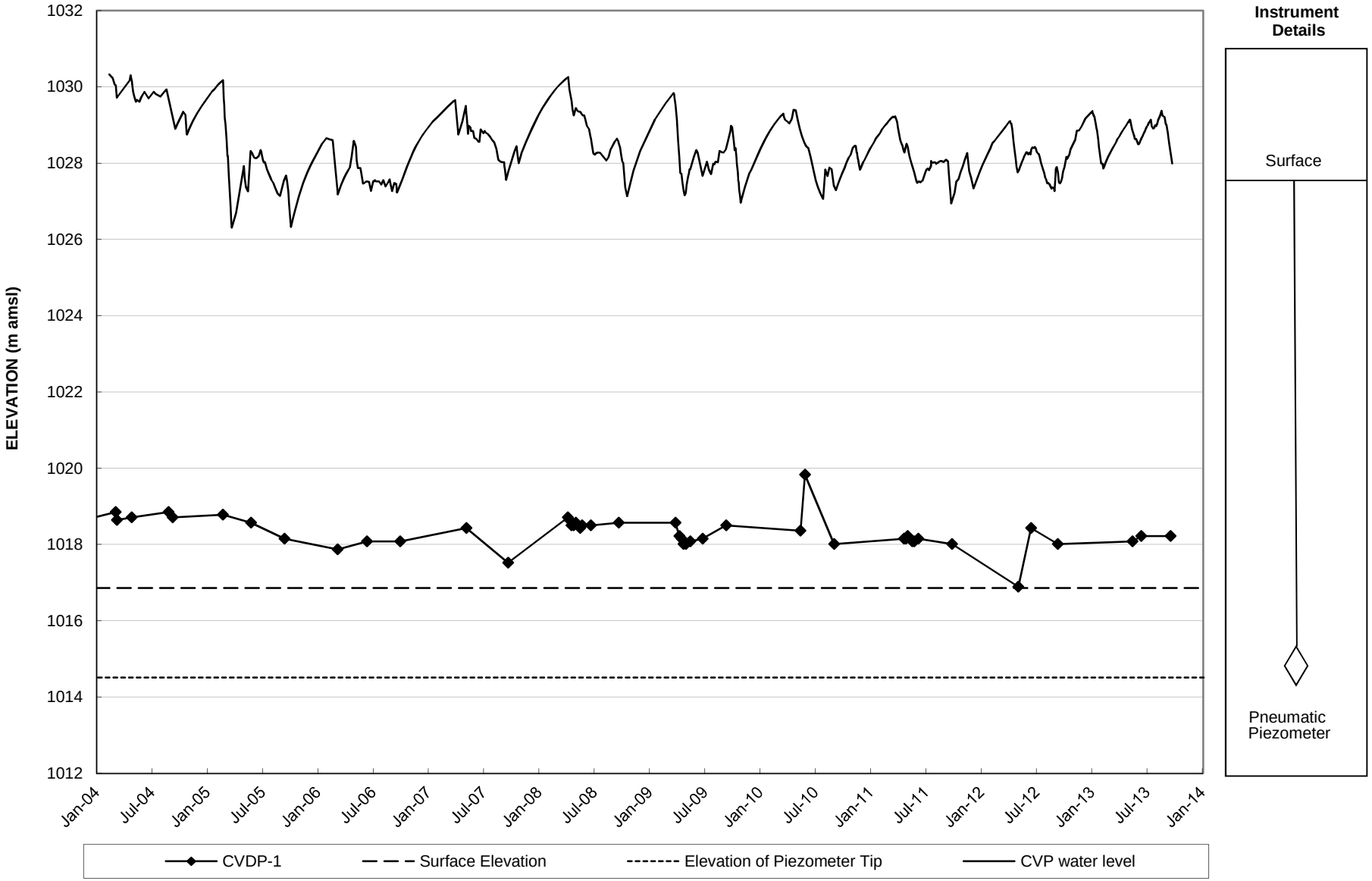
Cross Valley Dam
Piezometer CVDT-1



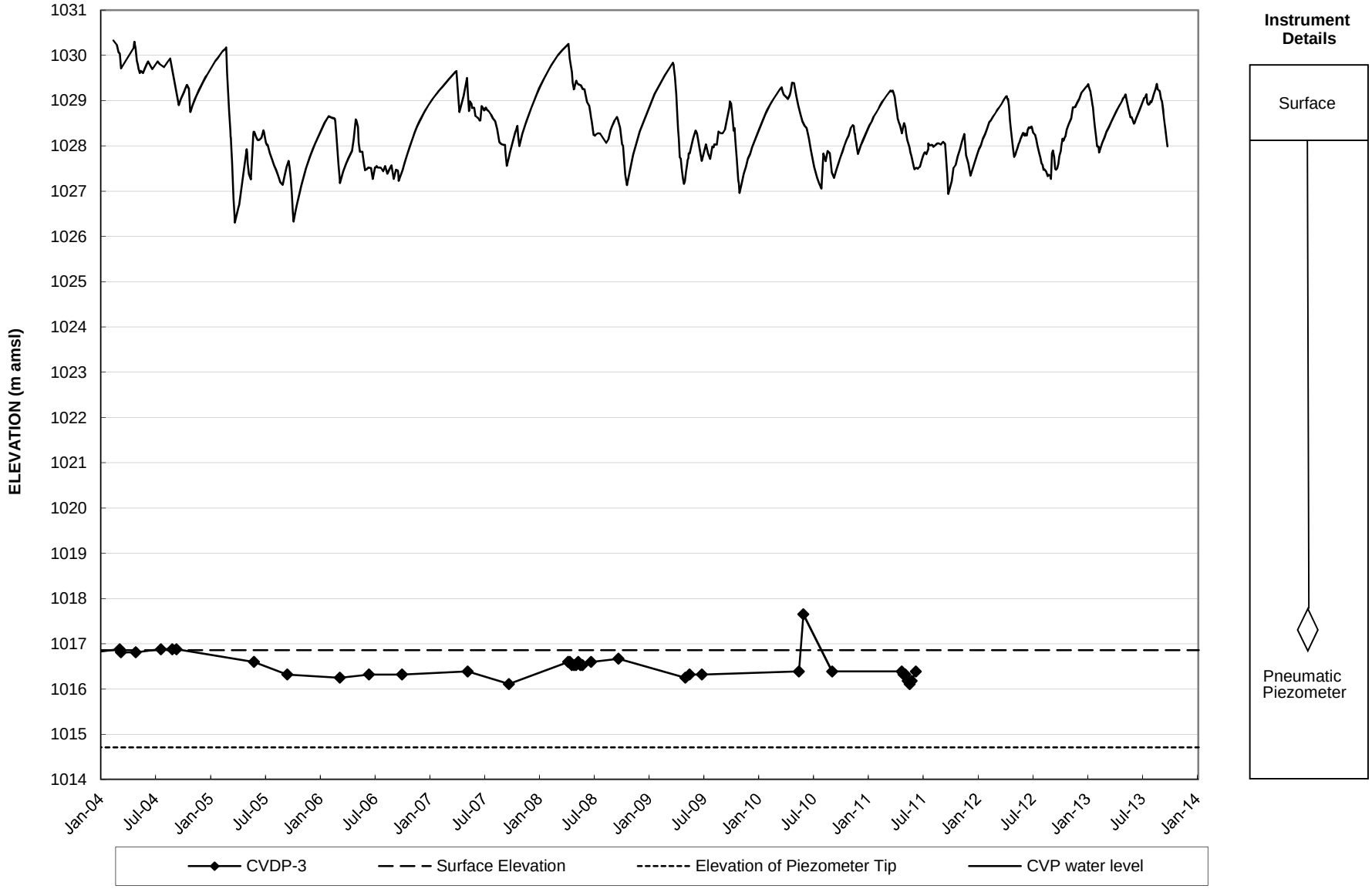
Cross Valley Dam
Piezometer CVDT-2



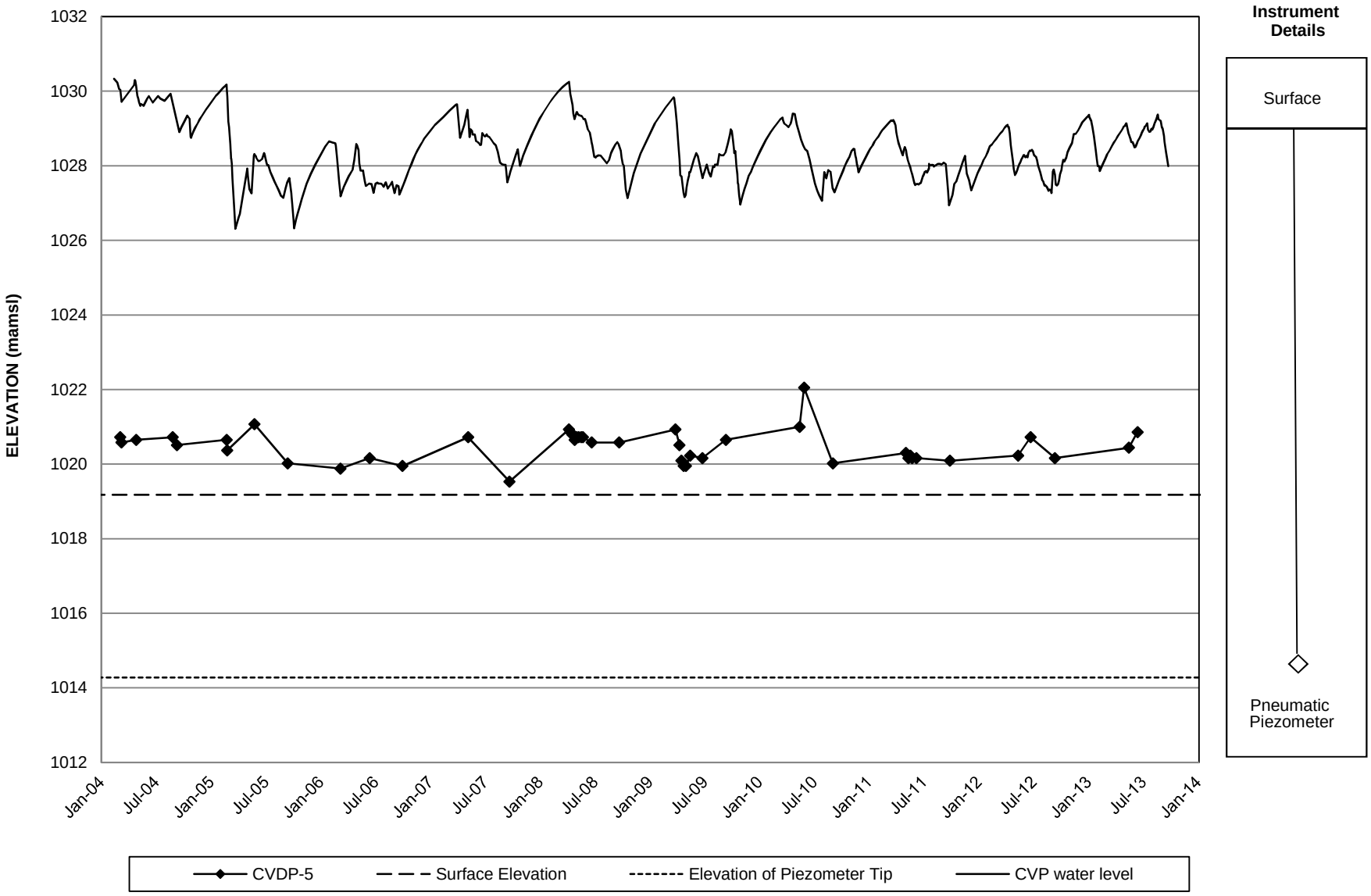
Cross Valley Dam
Piezometer CVDP-1



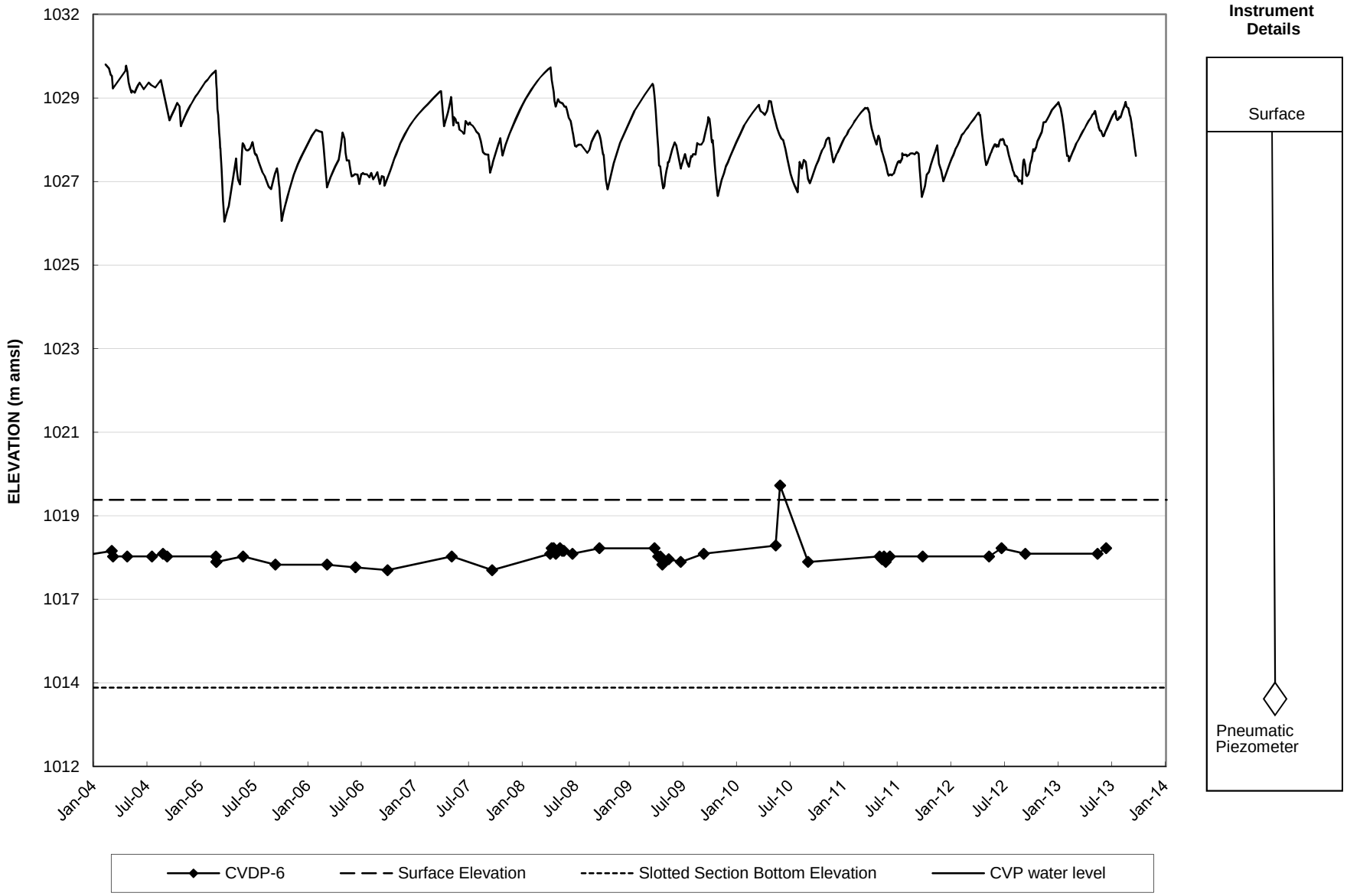
Cross Valley Dam
Piezometer CVDP-3



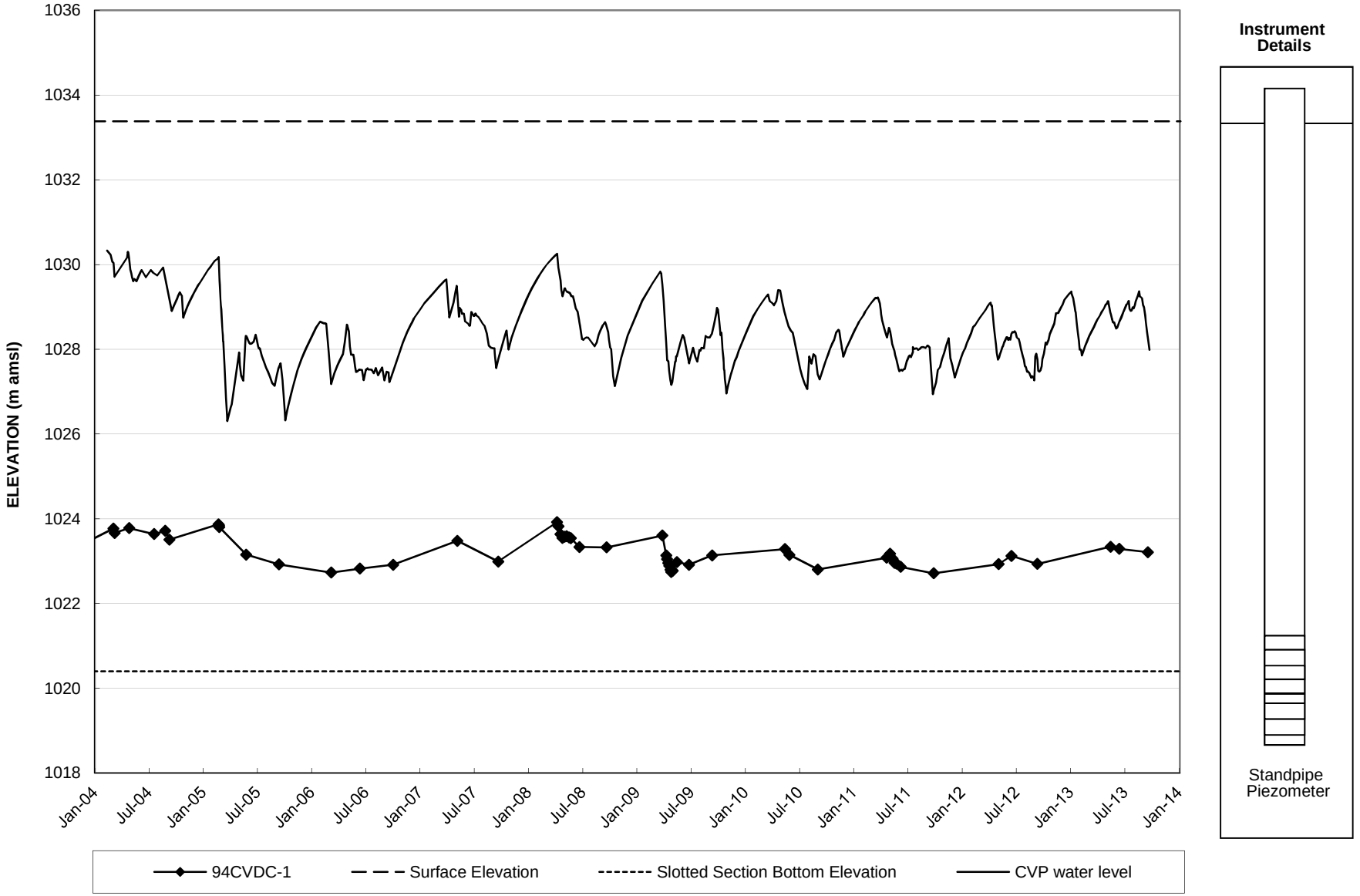
Cross Valley Dam
Piezometer CVDP-5



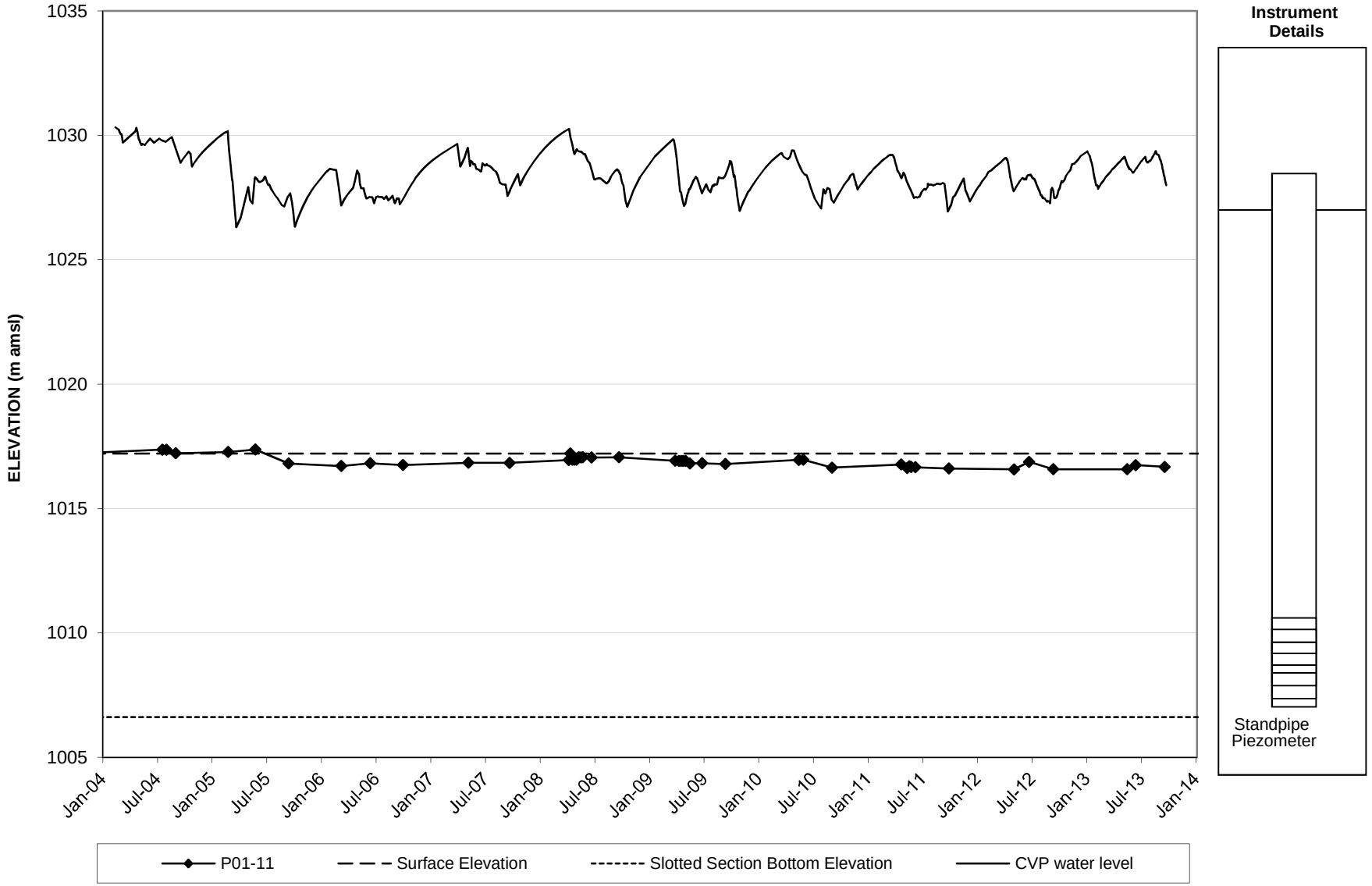
Cross Valley Dam
Piezometer CVDP-6



Cross Valley Dam
Piezometer 94CVDC-1

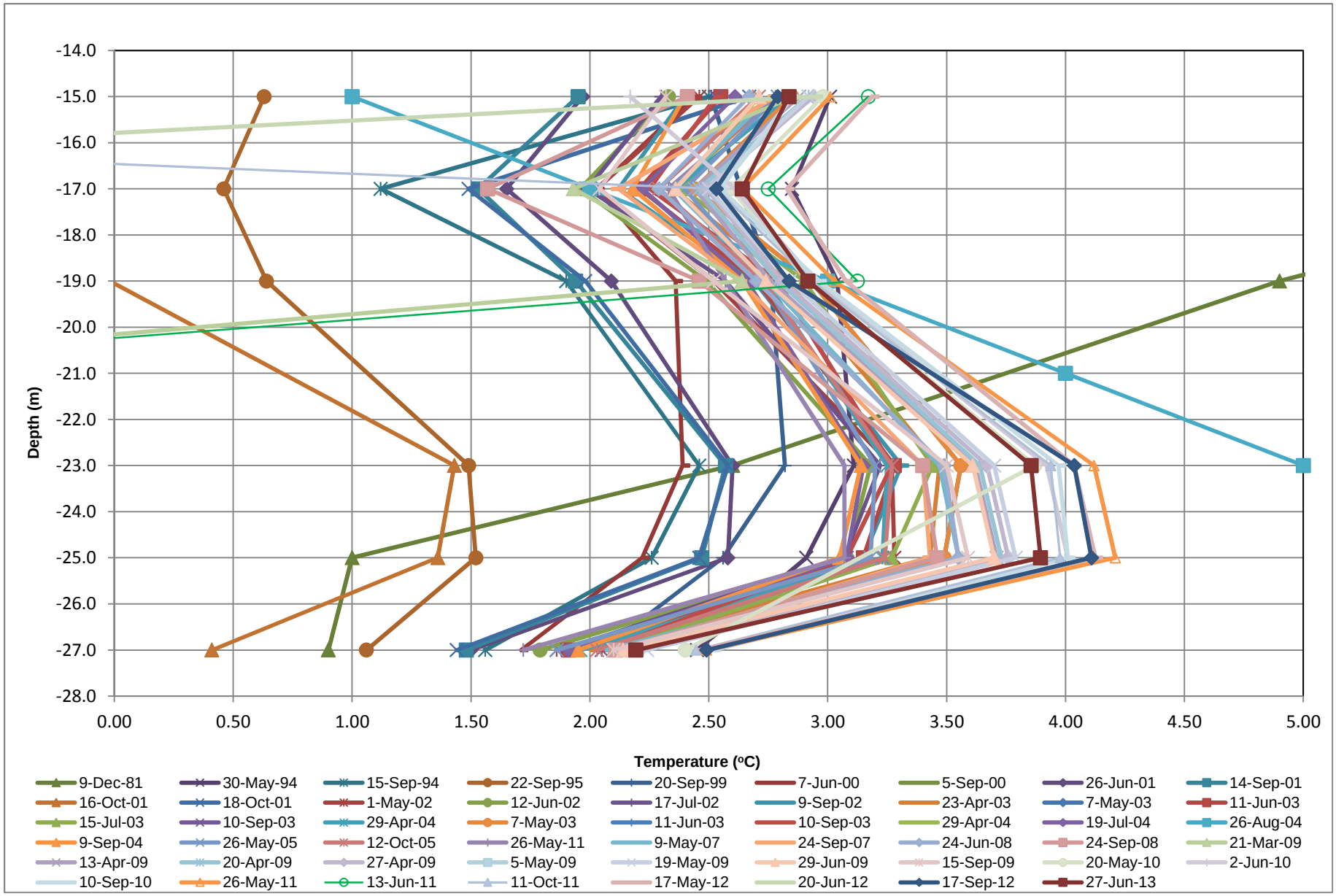


Cross Valley Dam
Piezometer P01-11

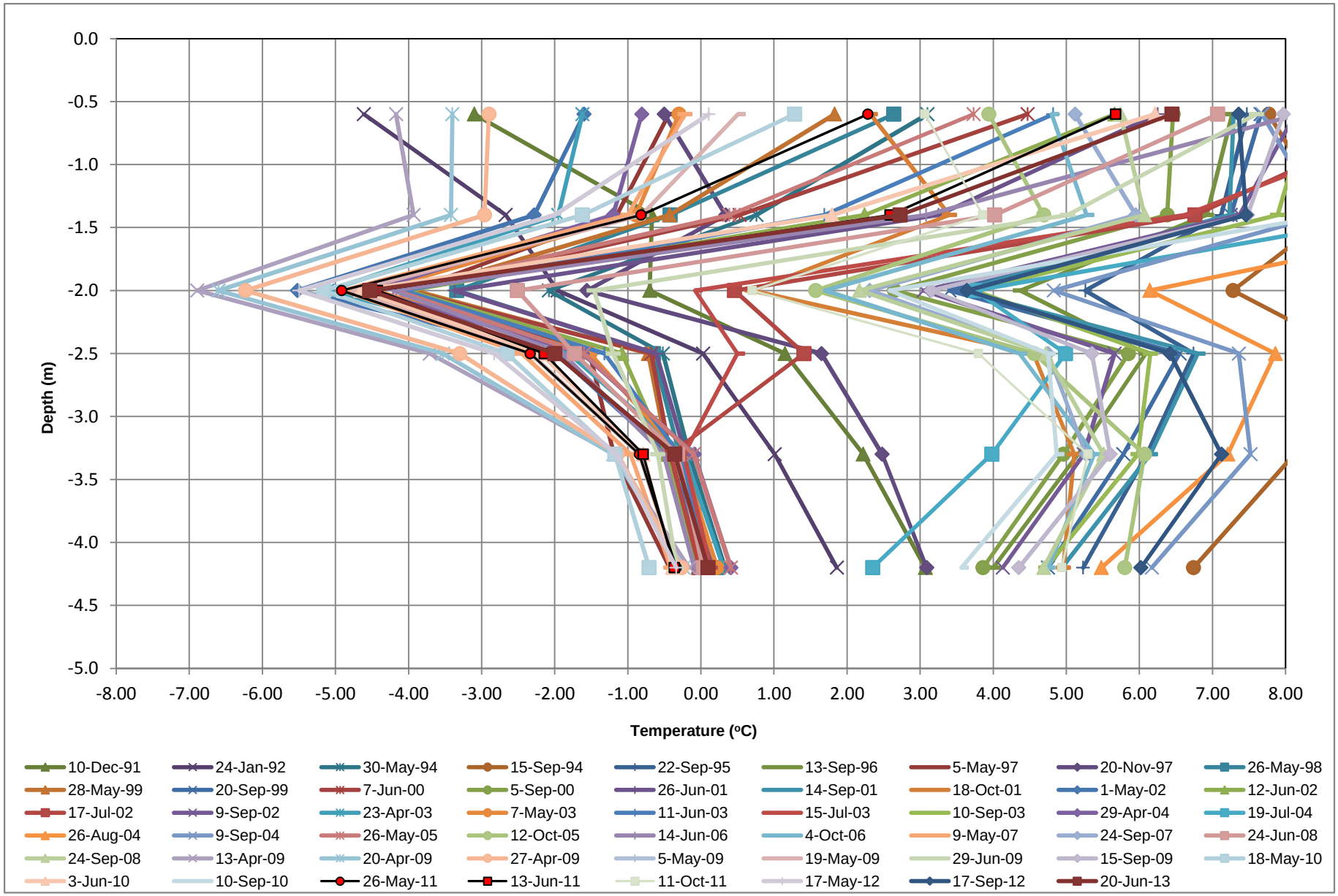


I.3 – Thermistors

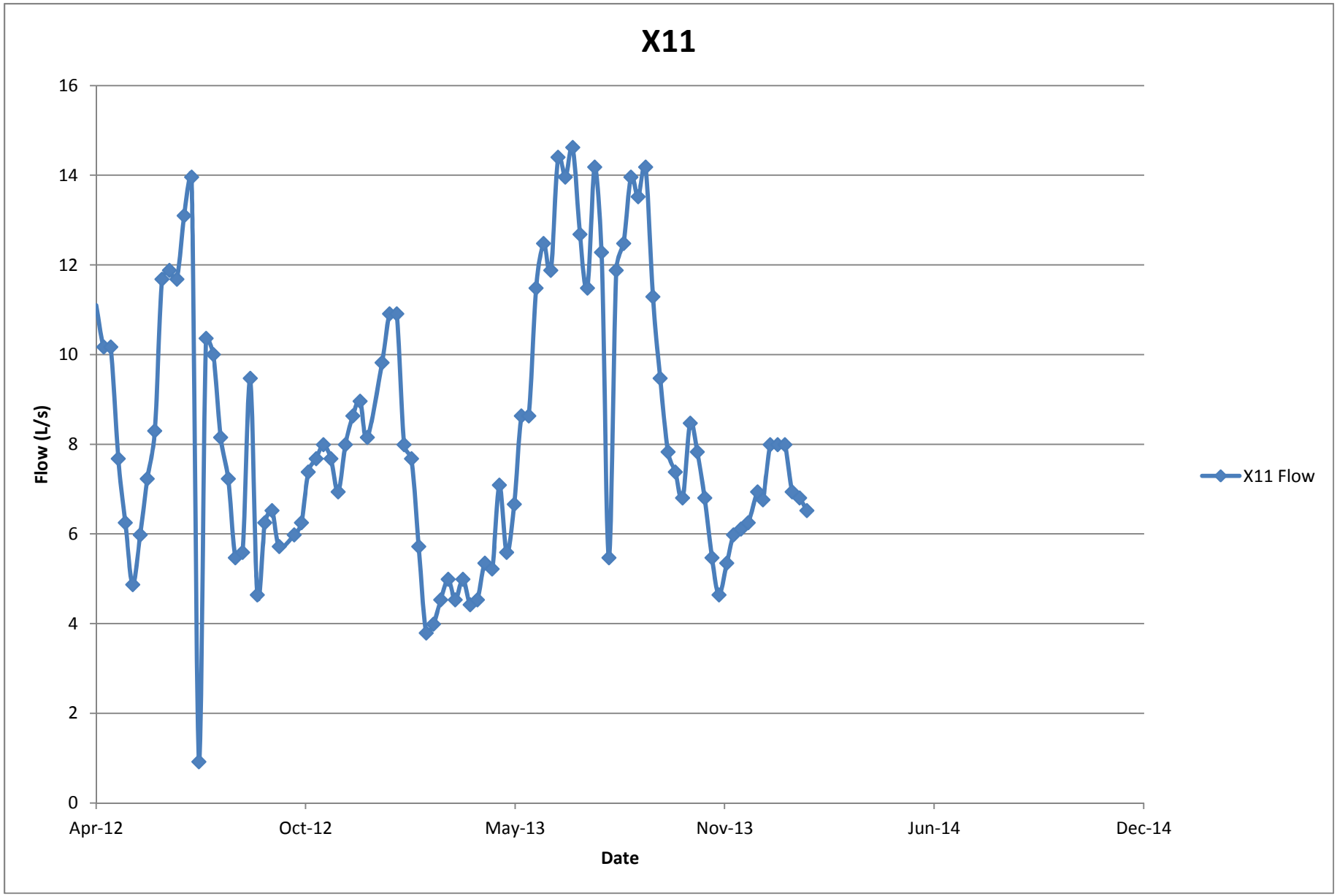
Cross Valley Dam
Thermistor CVDC-6

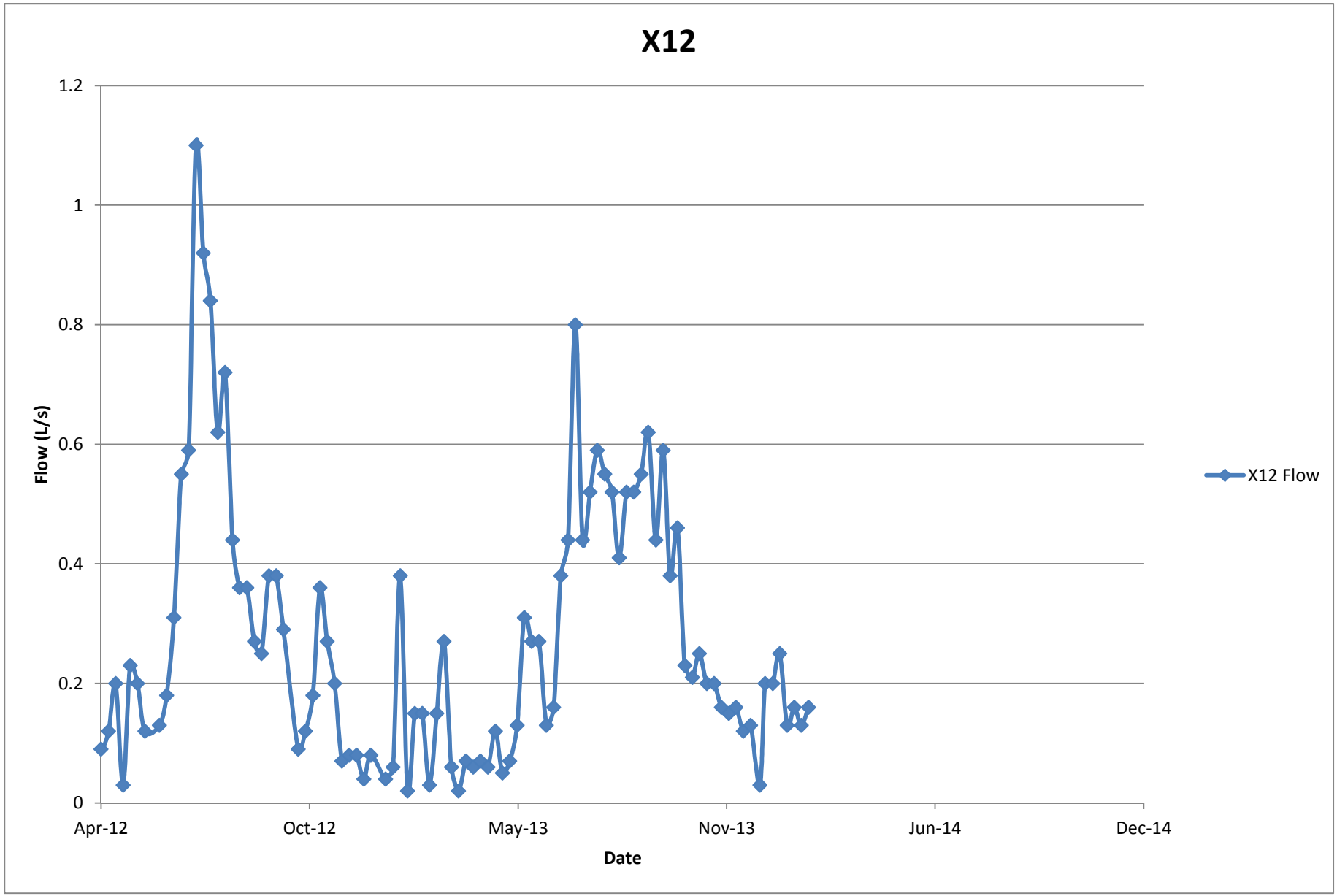


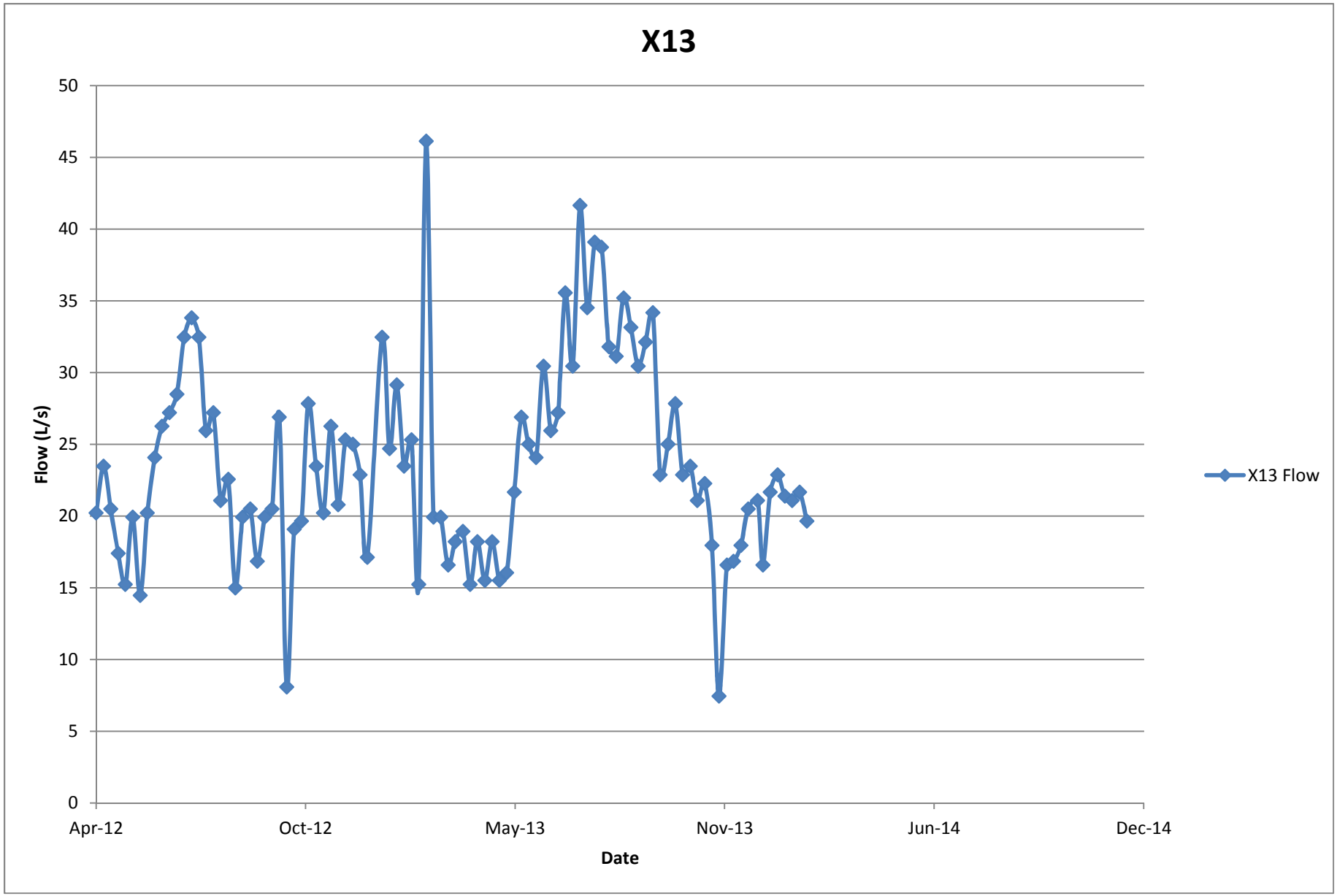
Cross Valley Dam
Thermistor BH88-4

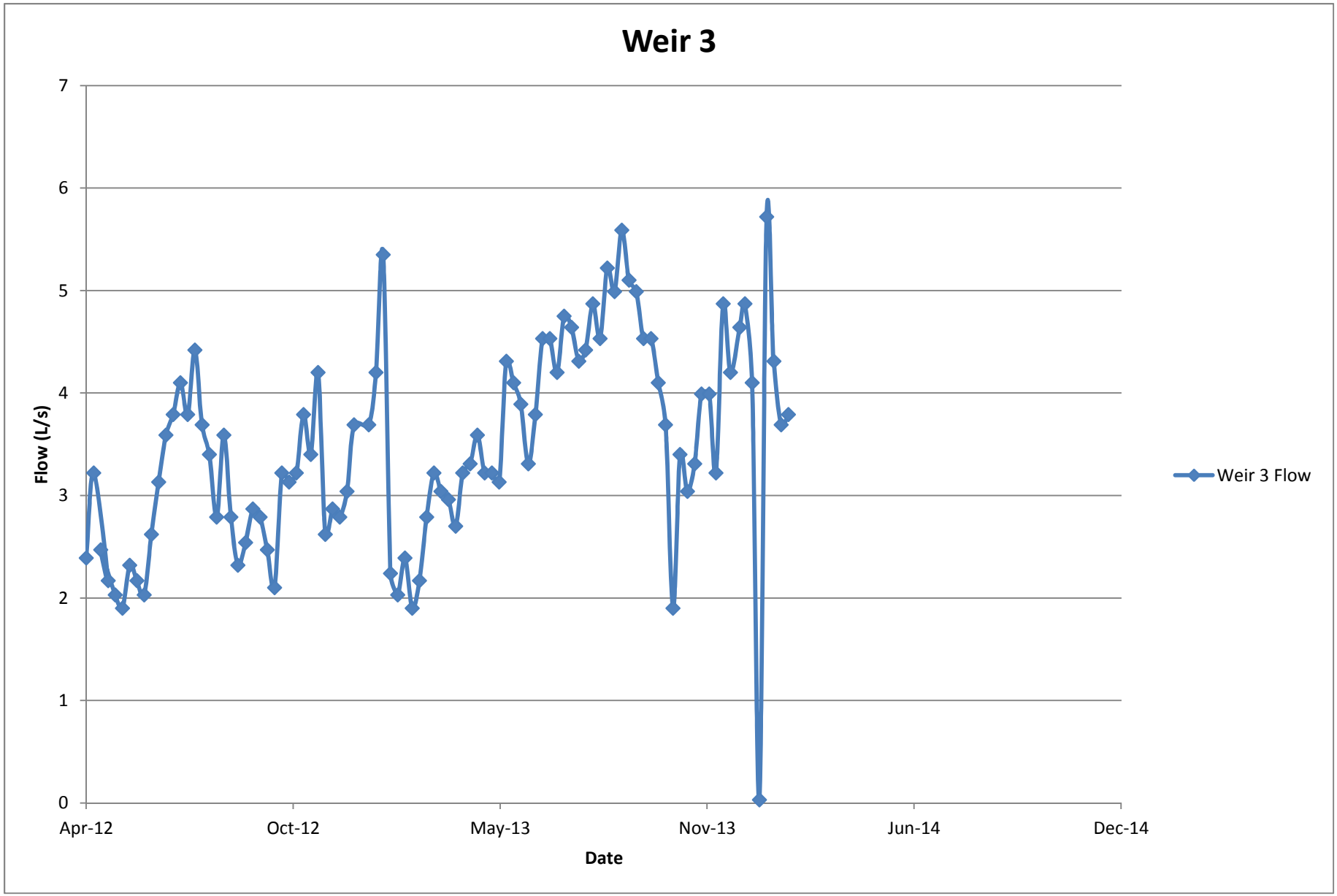


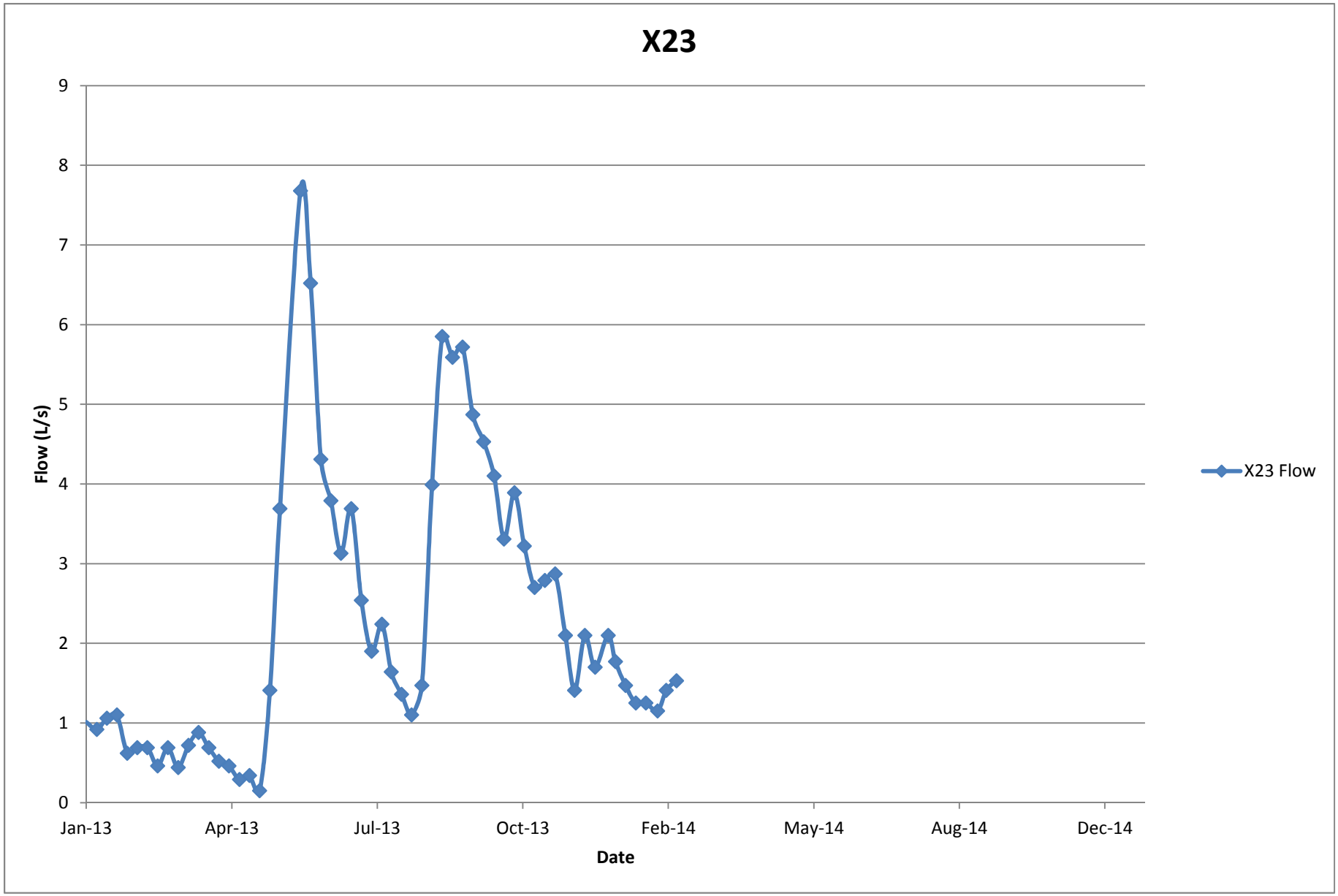
I.4 – Downstream Weir Flow


X11
16
14
12
10
8
6
4
2
0
Flow (L/s)
Apr-12
Oct-12
May-13
Nov-13
Jun-14
Dec-14
Date
X11 Flow


X12
1.2
1
0.8
0.6
0.4
0.2
0
Flow (L/s)
Apr-12
Oct-12
May-13
Nov-13
Jun-14
Dec-14
Date
X12 Flow


X13
50
45
40
35
30
25
20
15
10
5
0
Flow (L/s)
Apr-12
Oct-12
May-13
Nov-13
Jun-14
Dec-14
Date
X13 Flow


Weir 3
Flow (L/s)
0
1
2
3
4
5
6
7
Apr-12
Oct-12
May-13
Nov-13
Jun-14
Dec-14
Date
Weir 3 Flow


X23
9
8
7
6
5
4
3
2
1
0
Flow (L/s)
Jan-13
Apr-13
Jul-13
Oct-13
Feb-14
May-14
Aug-14
Dec-14
Date
X23 Flow

APPENDIX II-J

Grum Pit

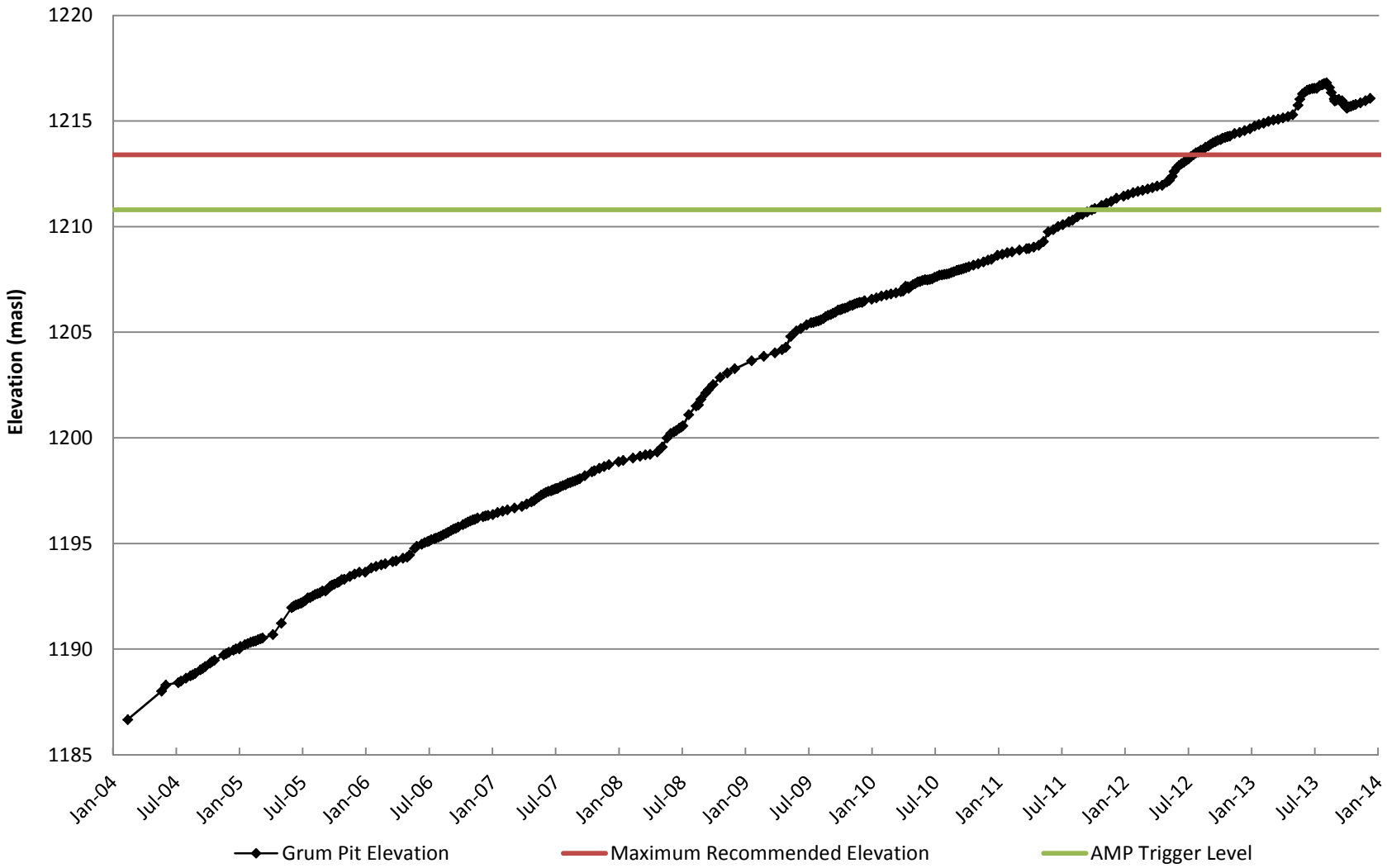
J.1 – Pond Level

J.2 – Displacement Monitoring

J.3 – Piezometers (Cut Slot)

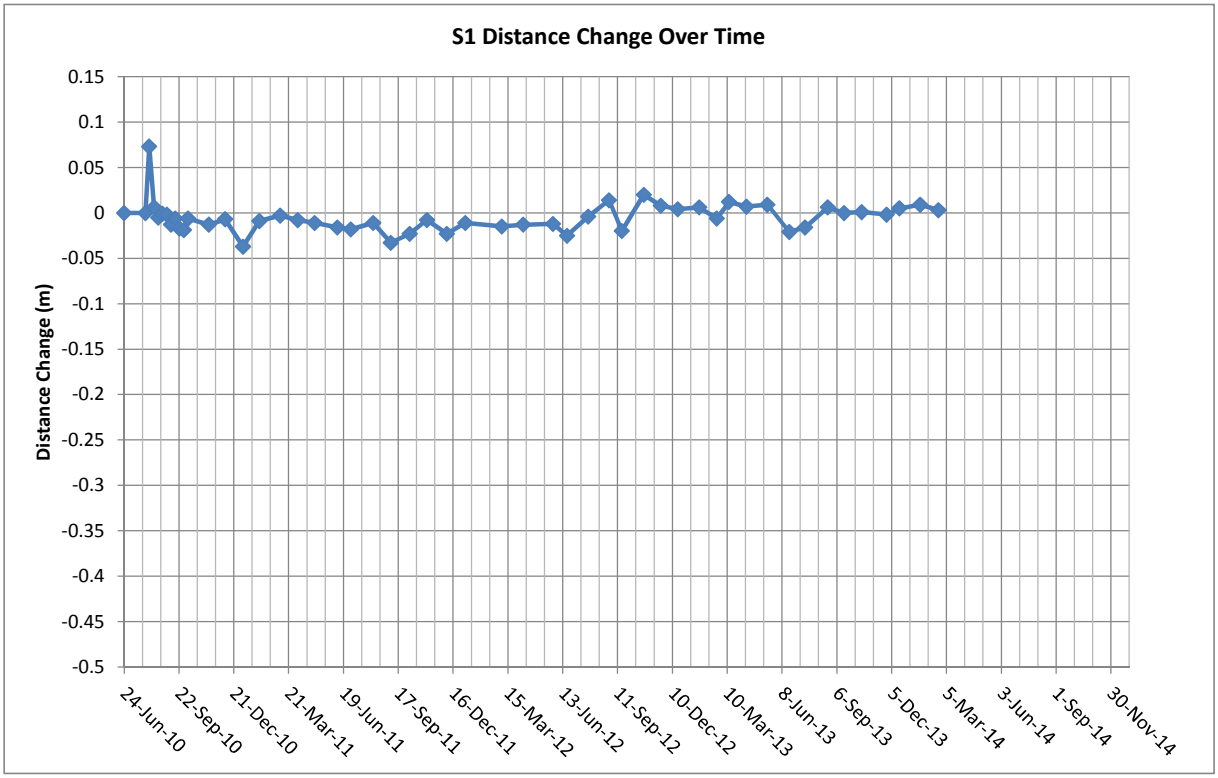
J.1 – Pond Level

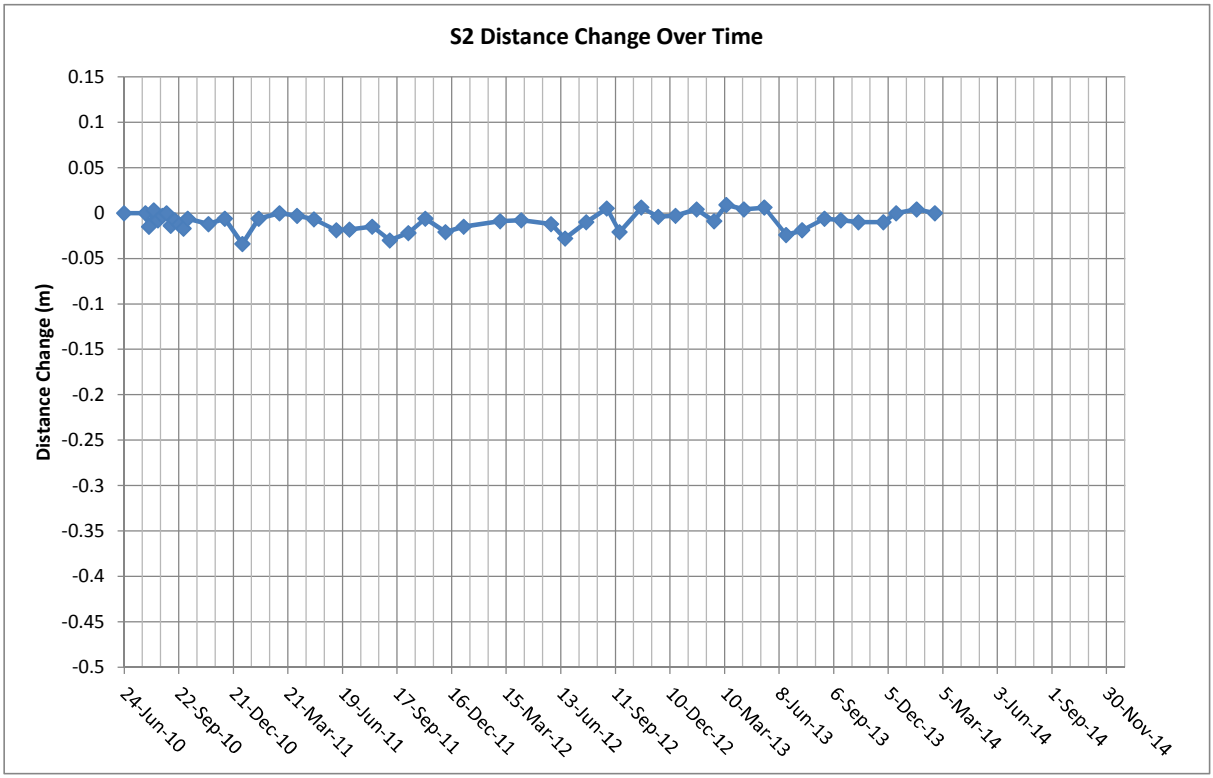
Grum Pit Water Level

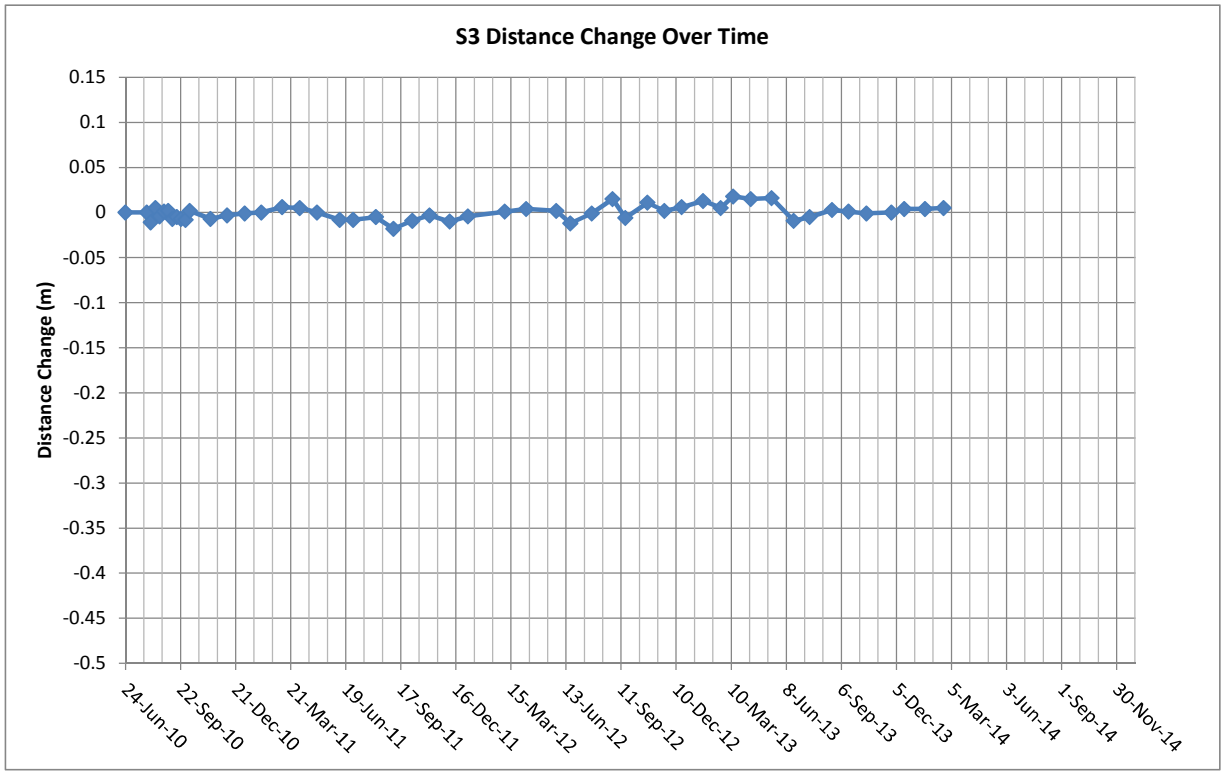


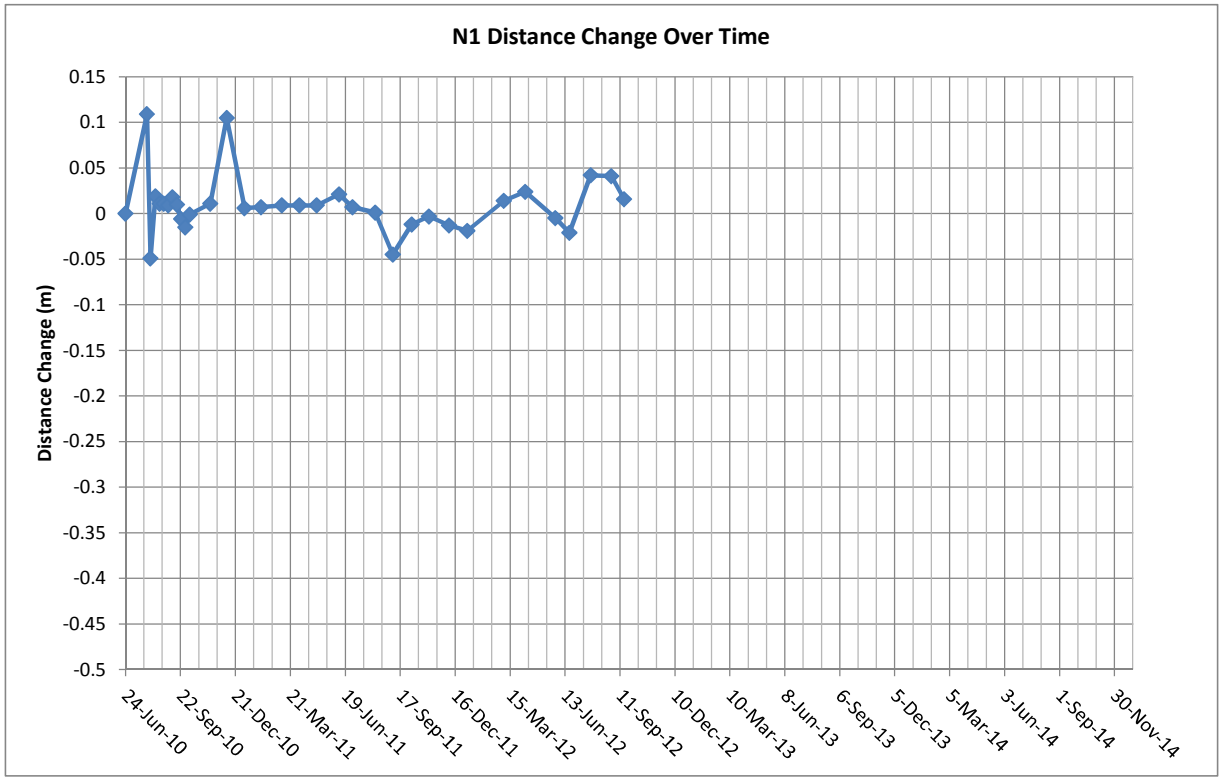
J1. Grum Pit Elevations.xlsx
M09770A03.730

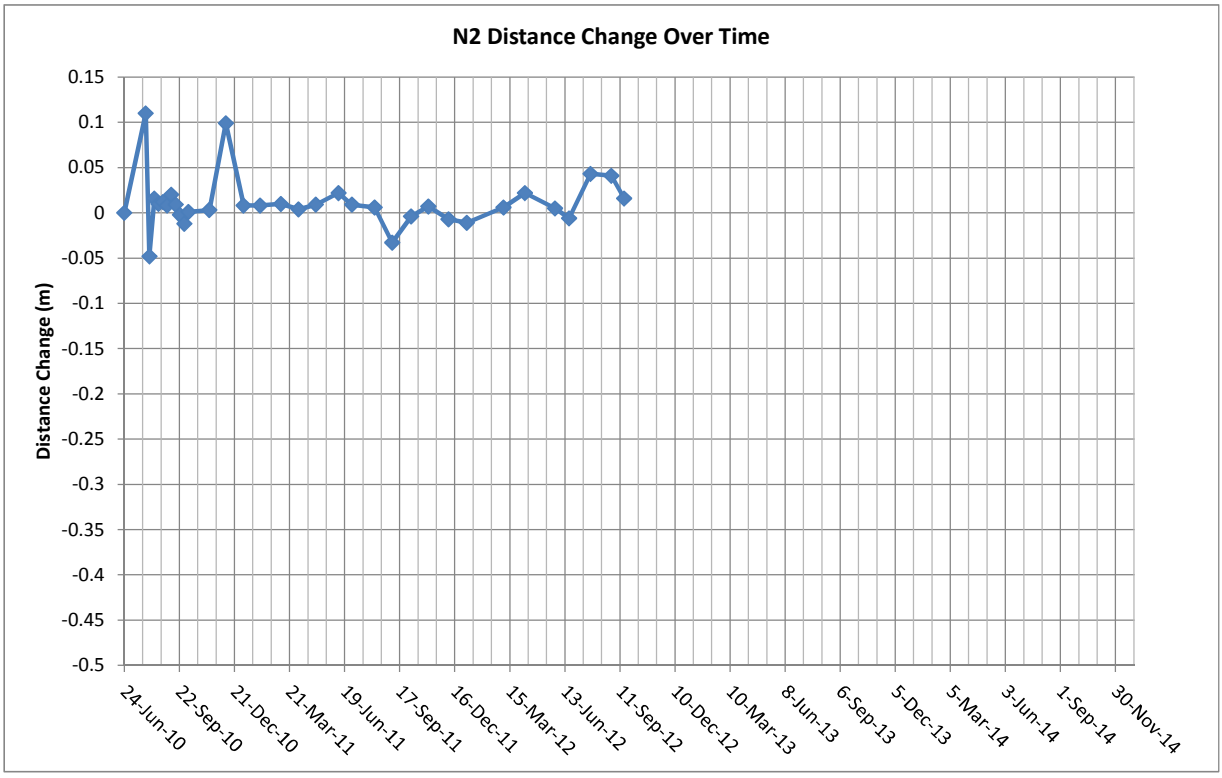
J.2 – Displacement Monitoring

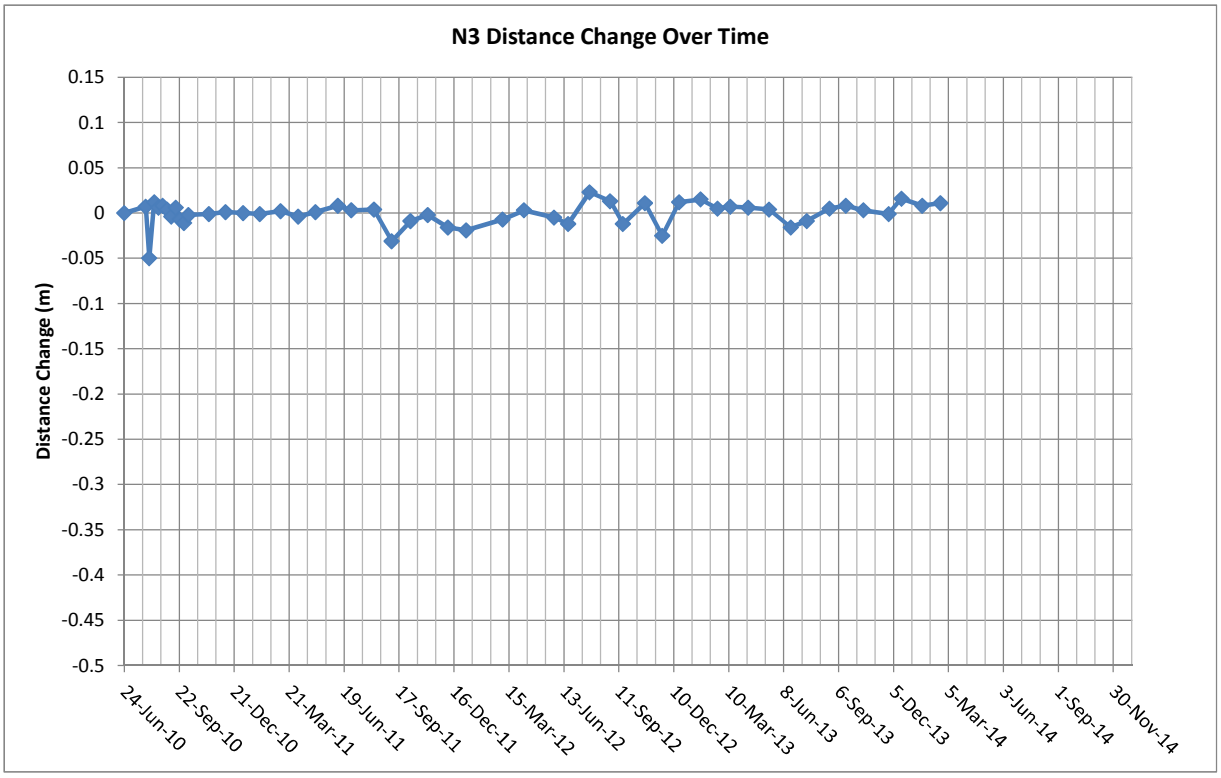

S1 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14

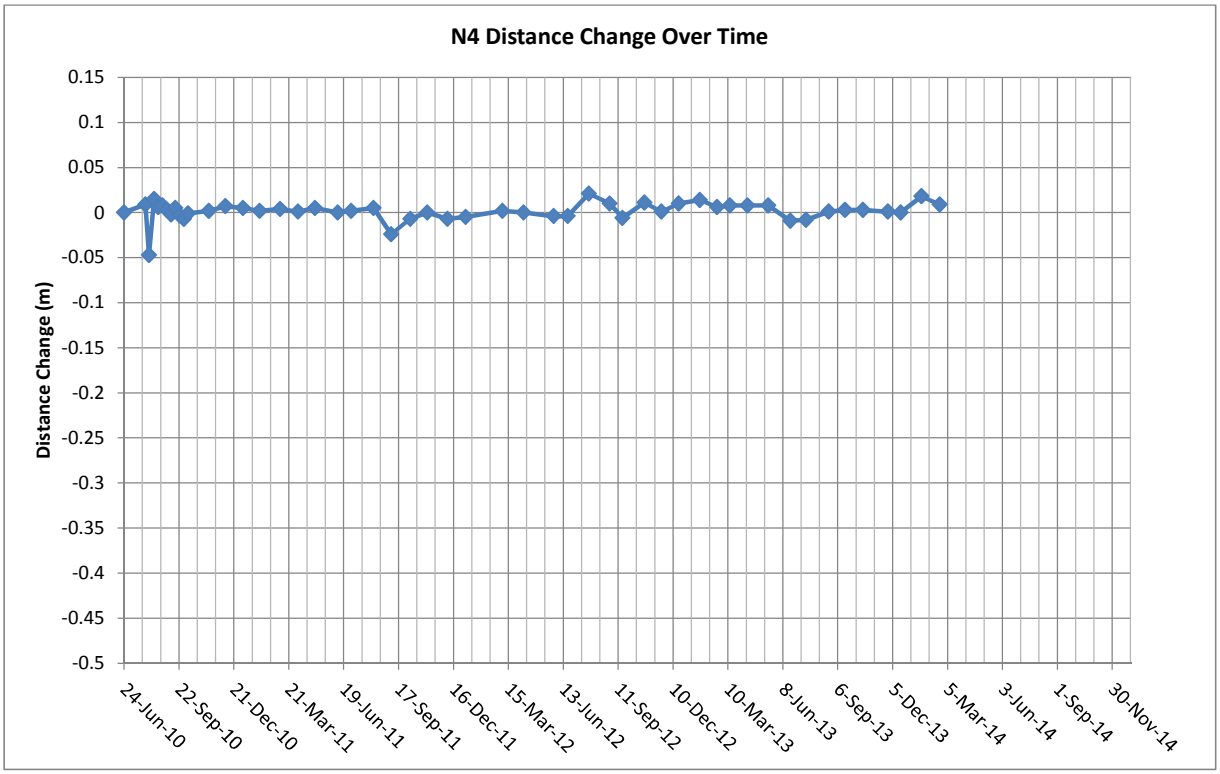

S2 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14

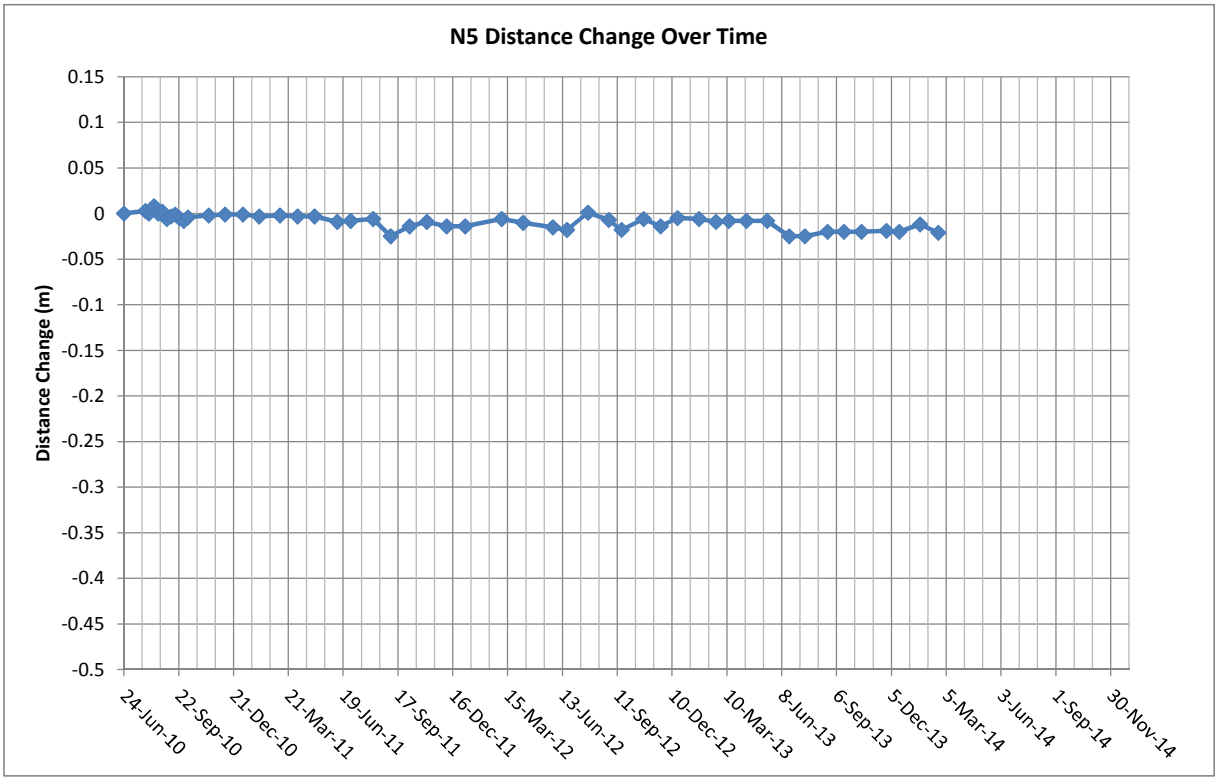

S3 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14


N1 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14


N2 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
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3-Jun-14
1-Sep-14
30-Nov-14

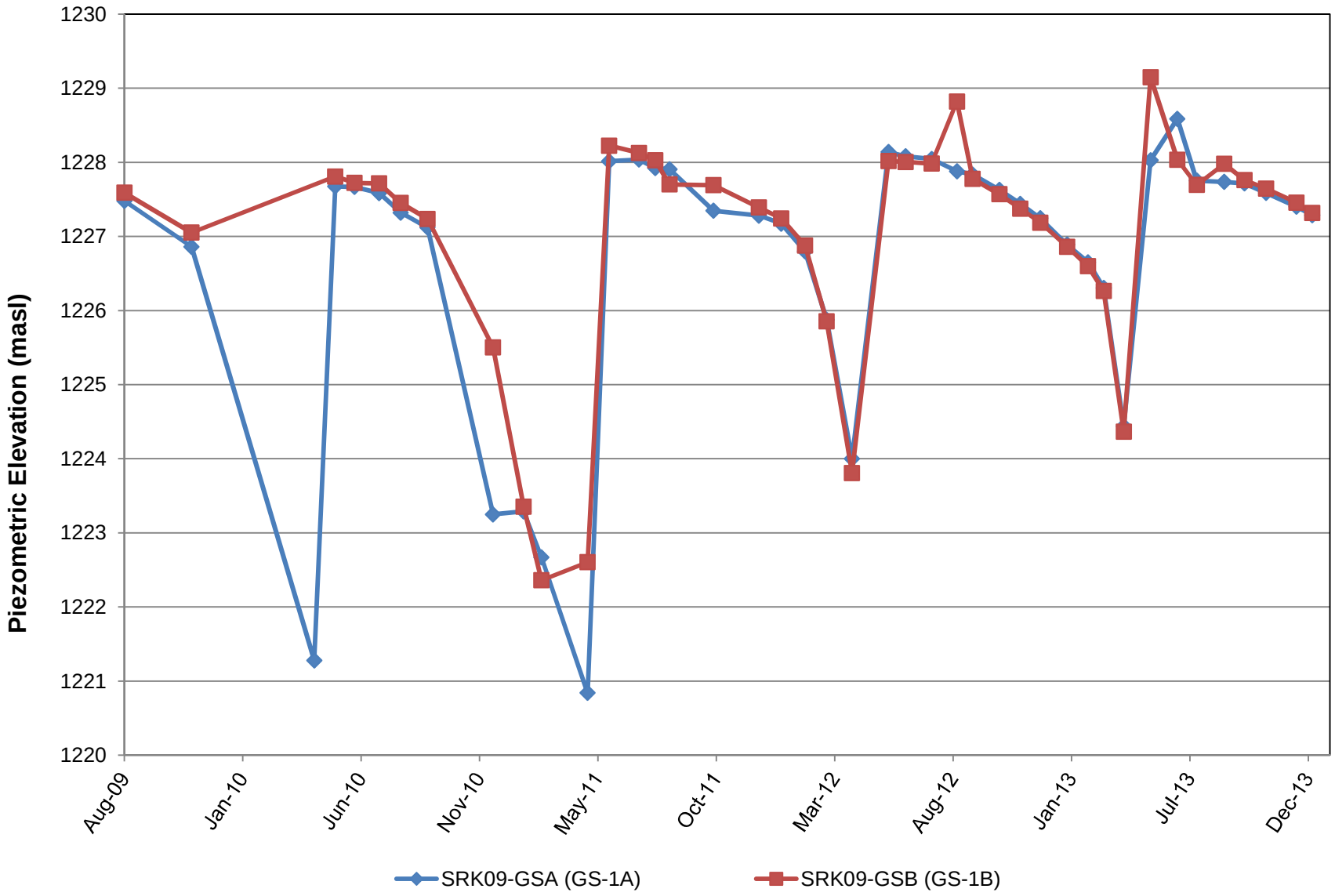

N3 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14


N4 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14


N5 Distance Change Over Time
Distance Change (m)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
24-Jun-10
22-Sep-10
21-Dec-10
21-Mar-11
19-Jun-11
17-Sep-11
16-Dec-11
15-Mar-12
13-Jun-12
11-Sep-12
10-Dec-12
10-Mar-13
8-Jun-13
6-Sep-13
5-Dec-13
5-Mar-14
3-Jun-14
1-Sep-14
30-Nov-14

J.3 – Piezometers (Cut Slot)

Water Elevations - Grum Slot Cut Piezometers



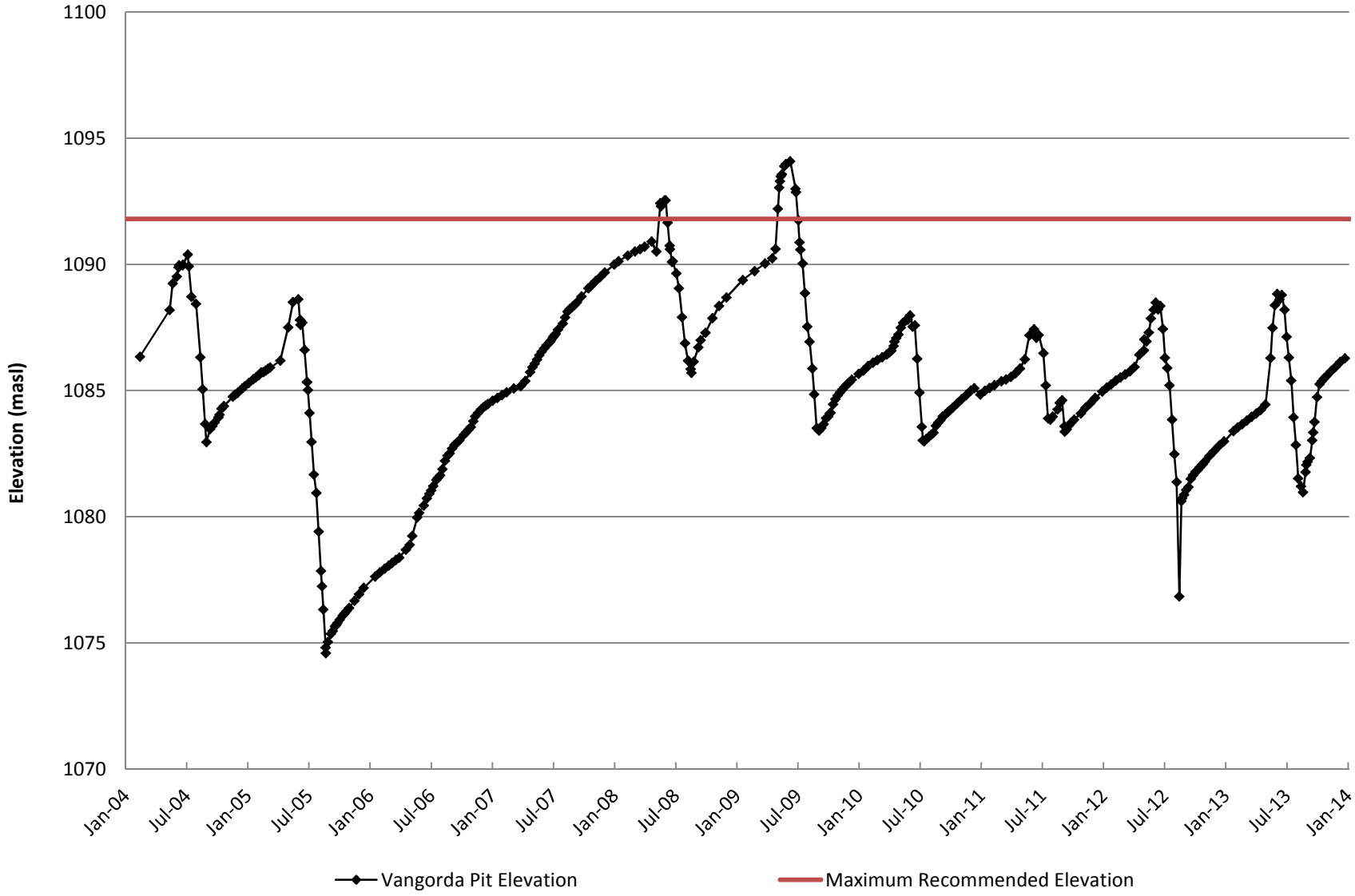
APPENDIX II-K

Vangorda Pit

K.1 – Pond Level

K.1 – Pond Level

Vangorda Pit Water Level



APPENDIX II-L

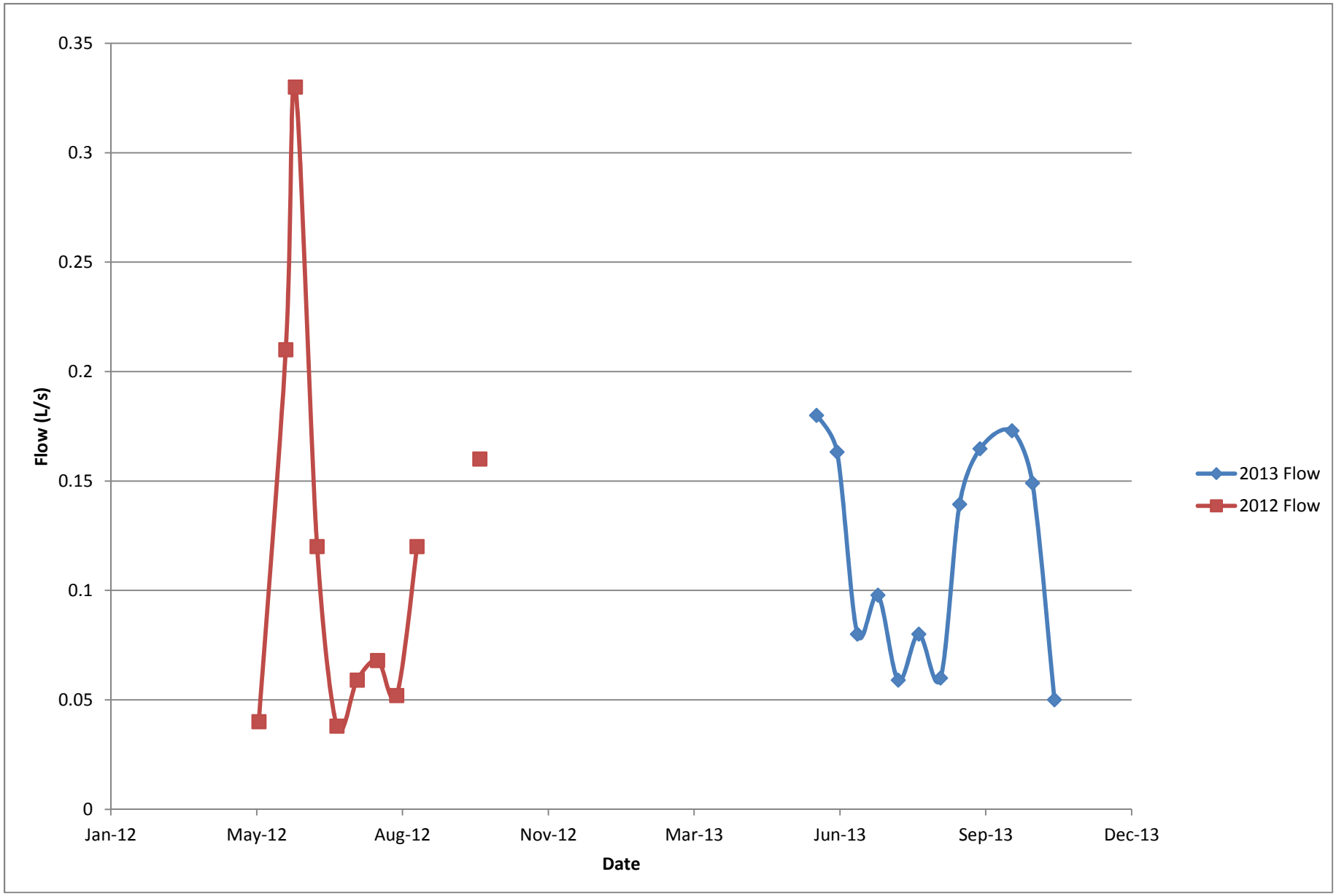
Vangorda Waste Rock Dump

L.1 – Weir Flow Measurement

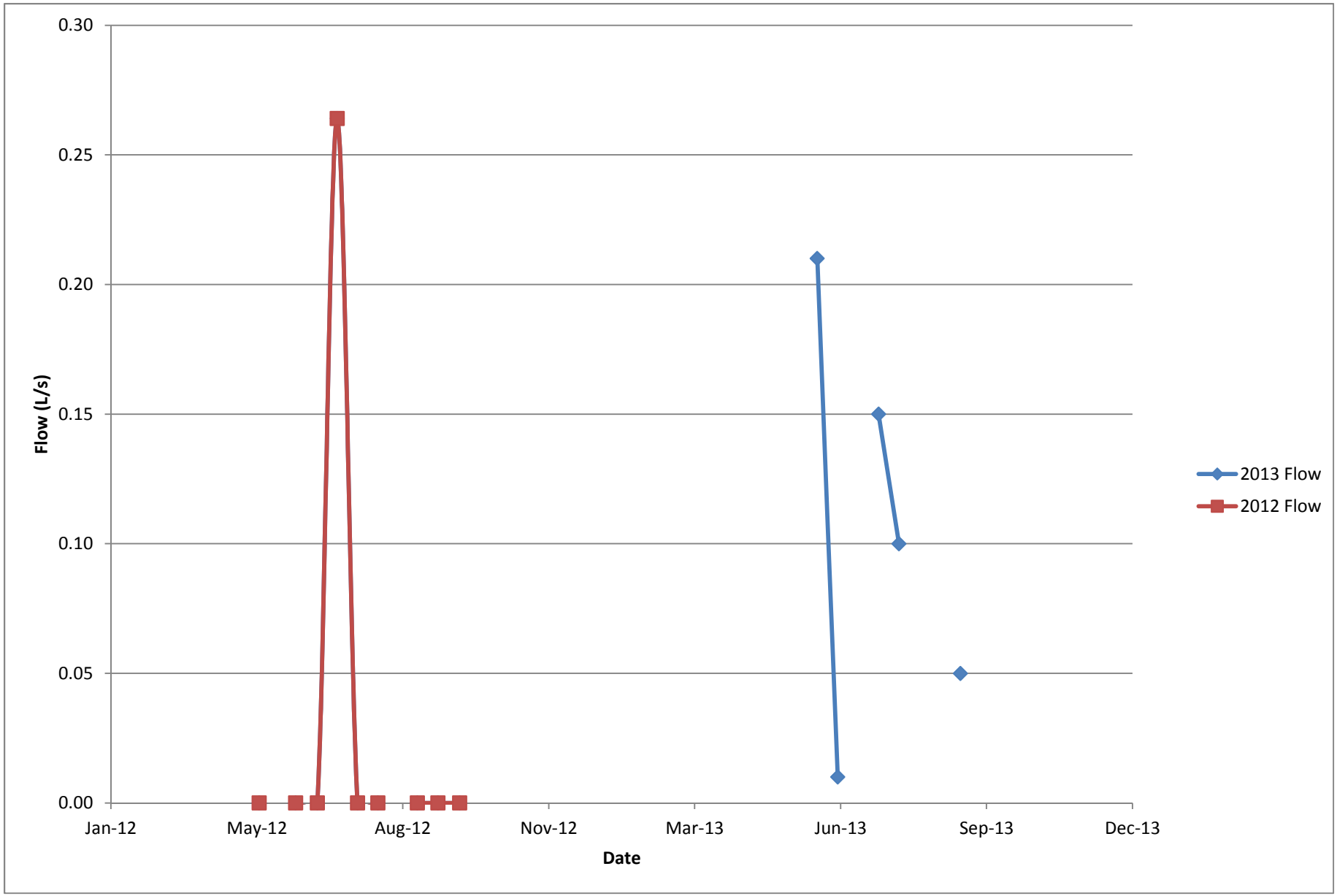
L.2 – Piezometers

L.1 – Weir Flow Measurement

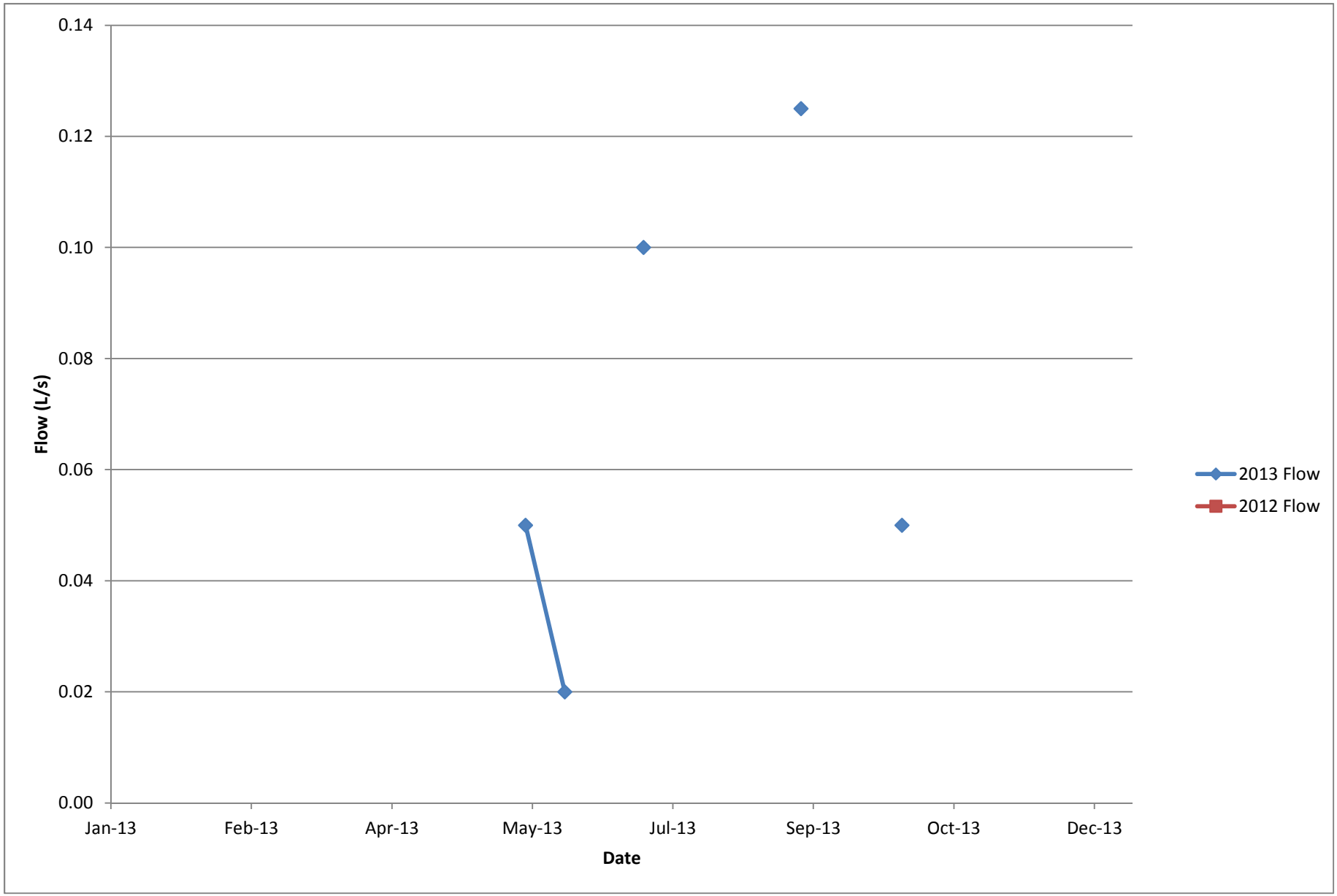
V30


0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Flow (L/s)
Jan-12
May-12
Aug-12
Nov-12
Mar-13
Jun-13
Sep-13
Dec-13
Date
2013 Flow
2012 Flow

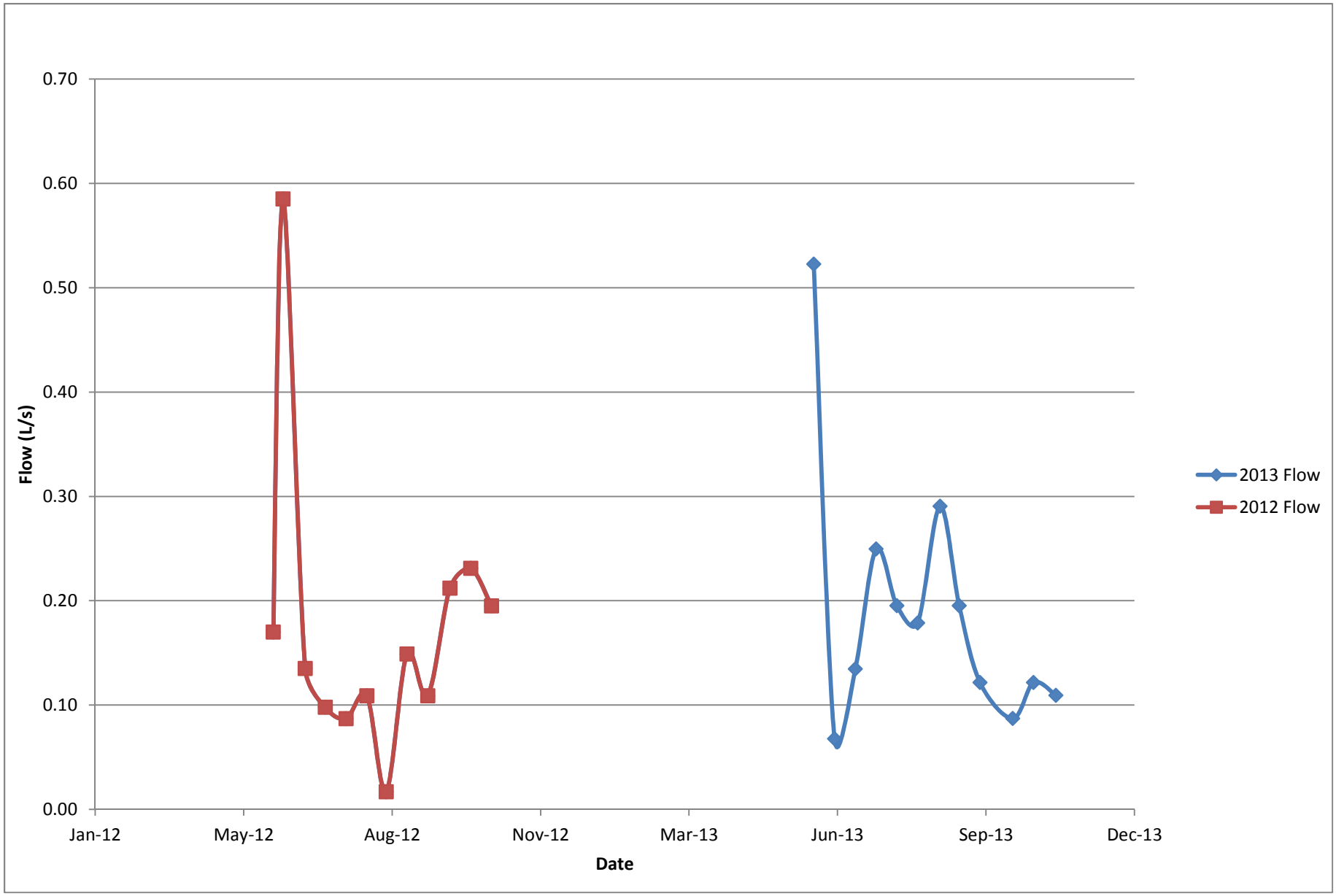
V31


0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (L/s)
Jan-12
May-12
Aug-12
Nov-12
Mar-13
Jun-13
Sep-13
Dec-13
Date
2013 Flow
2012 Flow

V32

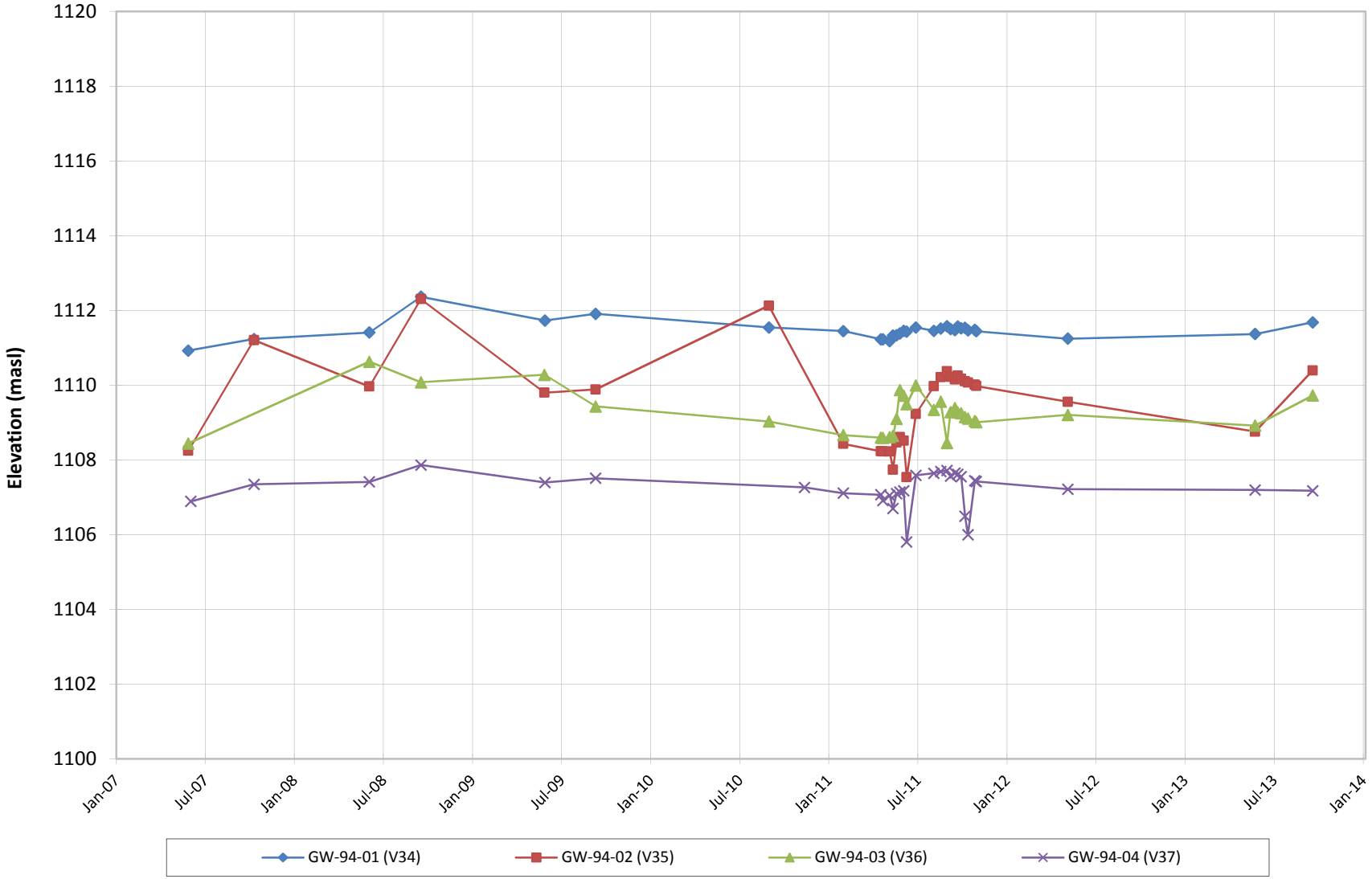

0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Flow (L/s)
Jan-13
Feb-13
Apr-13
May-13
Jul-13
Sep-13
Oct-13
Dec-13
Date
2013 Flow
2012 Flow

V33

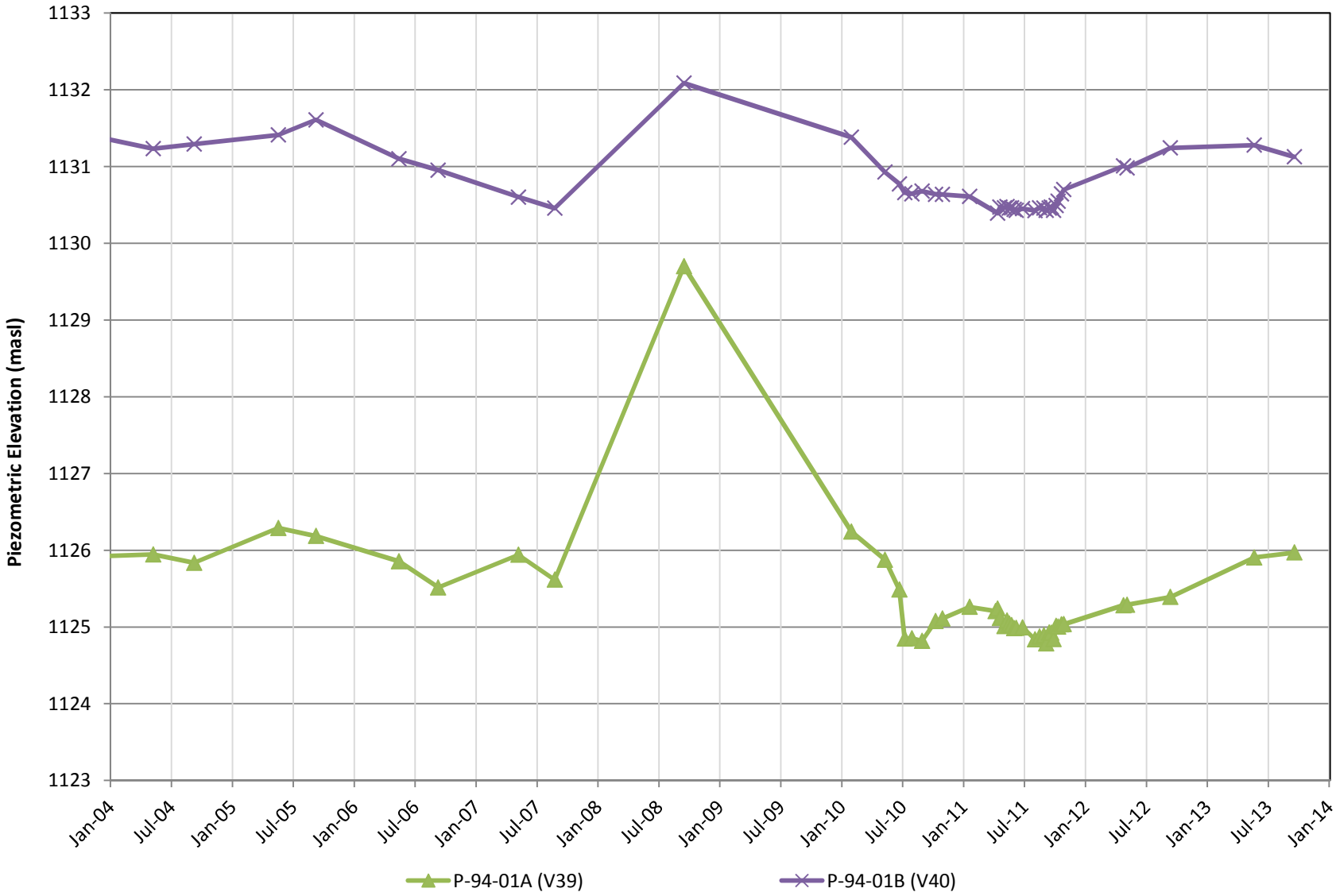

0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Flow (L/s)
Jan-12
May-12
Aug-12
Nov-12
Mar-13
Jun-13
Sep-13
Dec-13
Date
2013 Flow
2012 Flow

L.2 – Piezometers

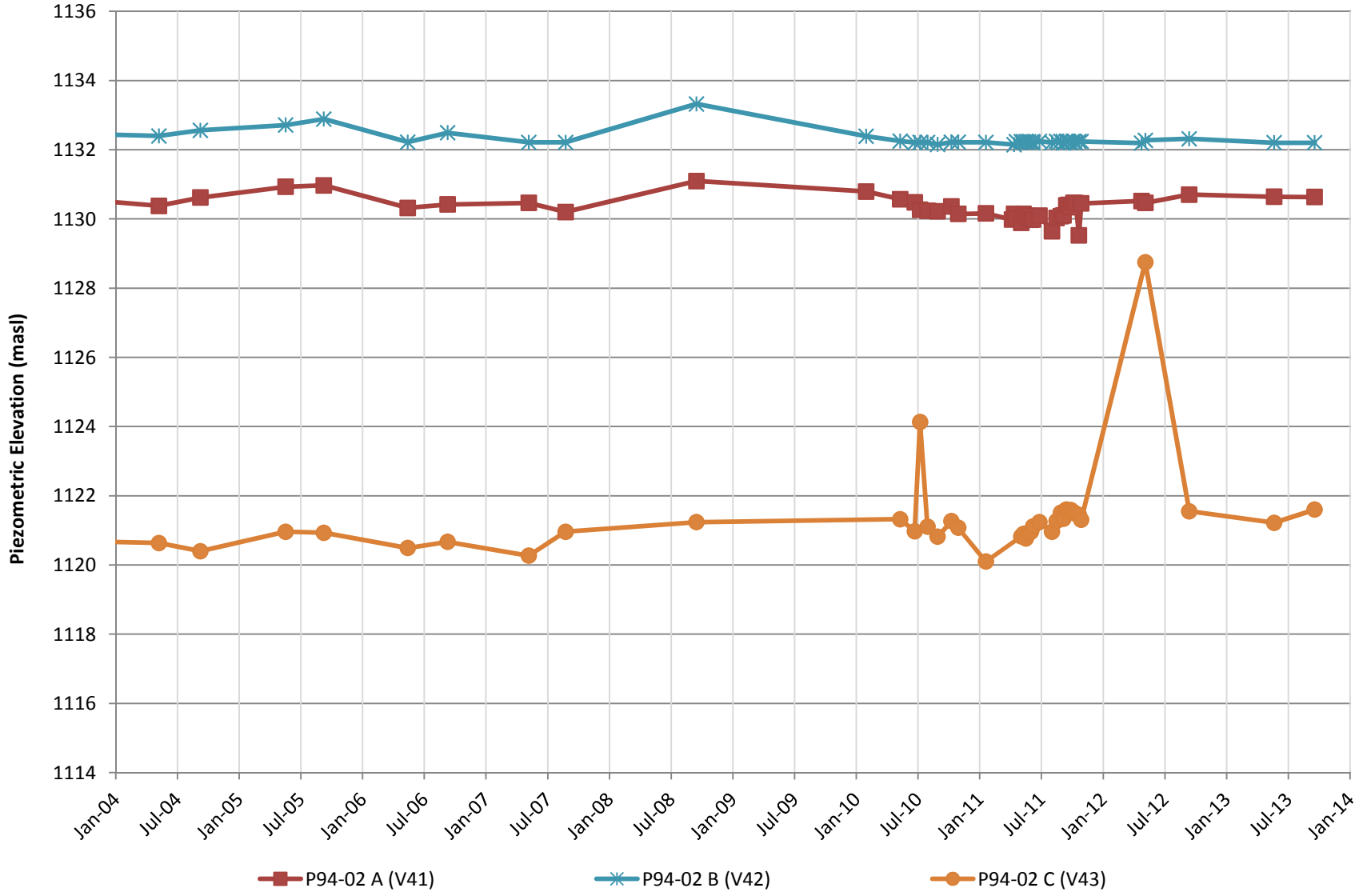
Vangorda Dump Toe Groundwater Elevations
GW-94-01 (V34), GW-94-02 (V35), GW-94-03 (V36), GW-94-04 (V37)



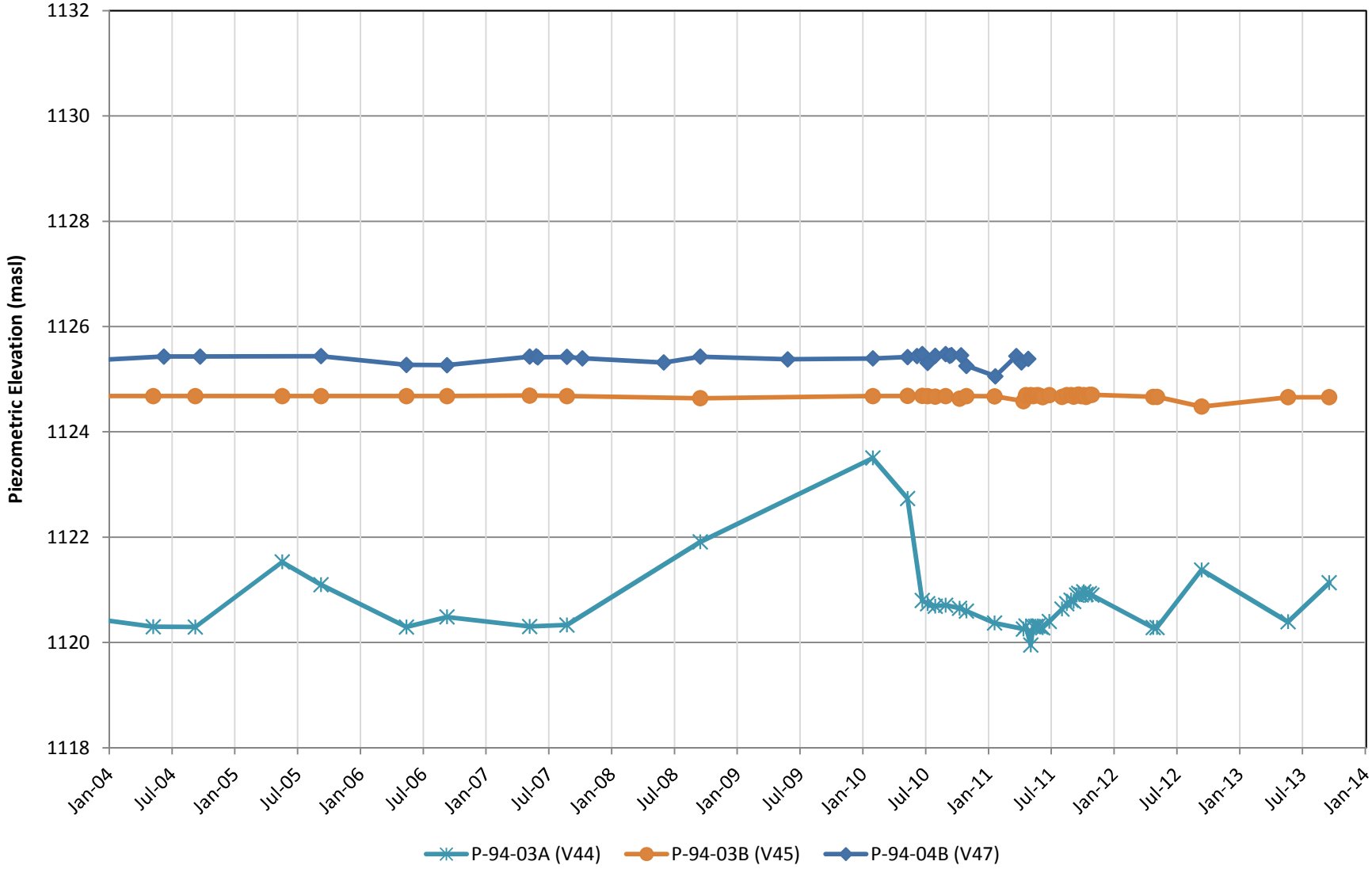
Vangorda Waste Rock Dump
Piezometric Elevations
P94-01A (V39)
P94-01B (V40)



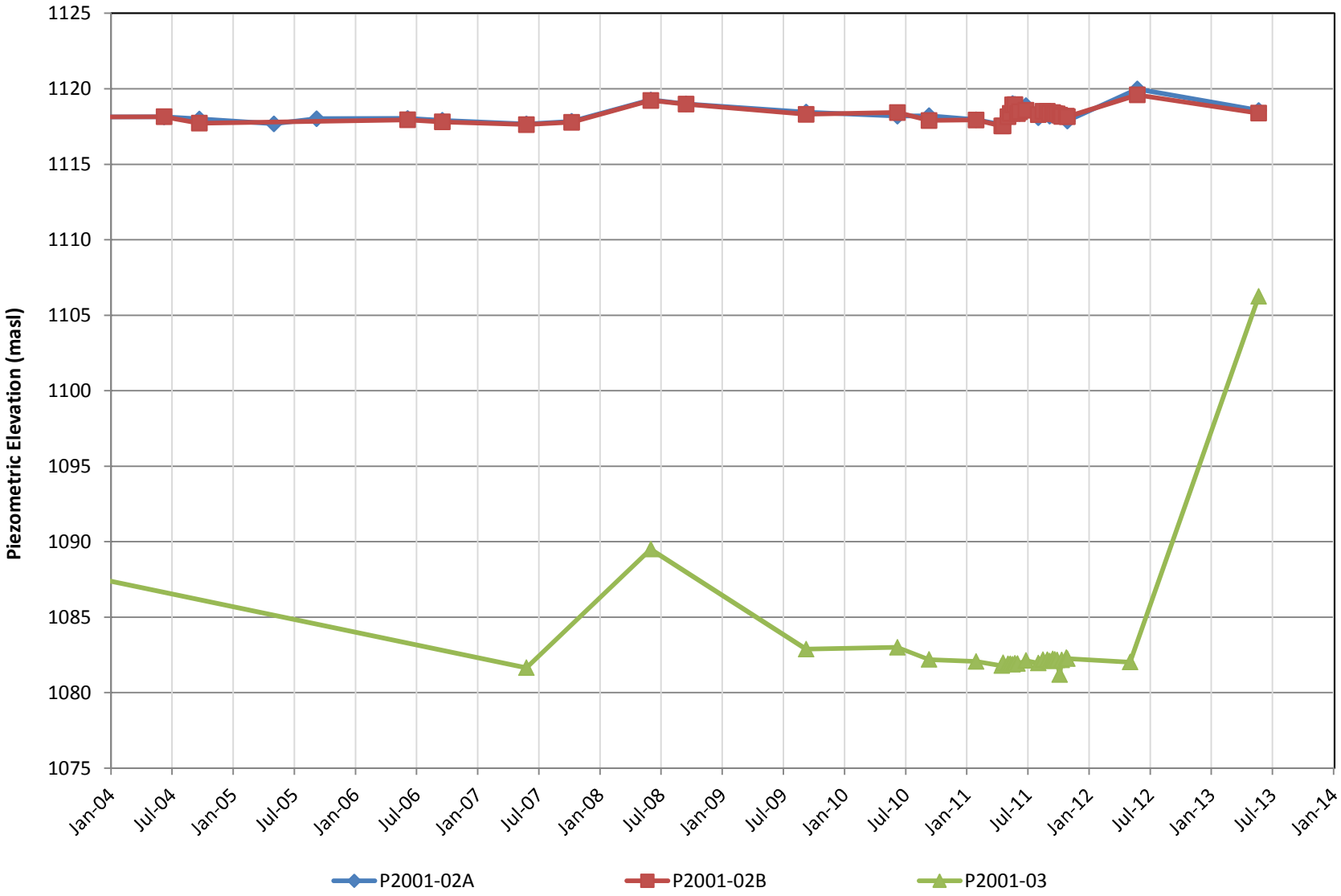
Vangorda Waste Rock Dump
Piezometric Elevations
P-94-02A (V41), P-94-02B (V42), P-94-02C (V43)



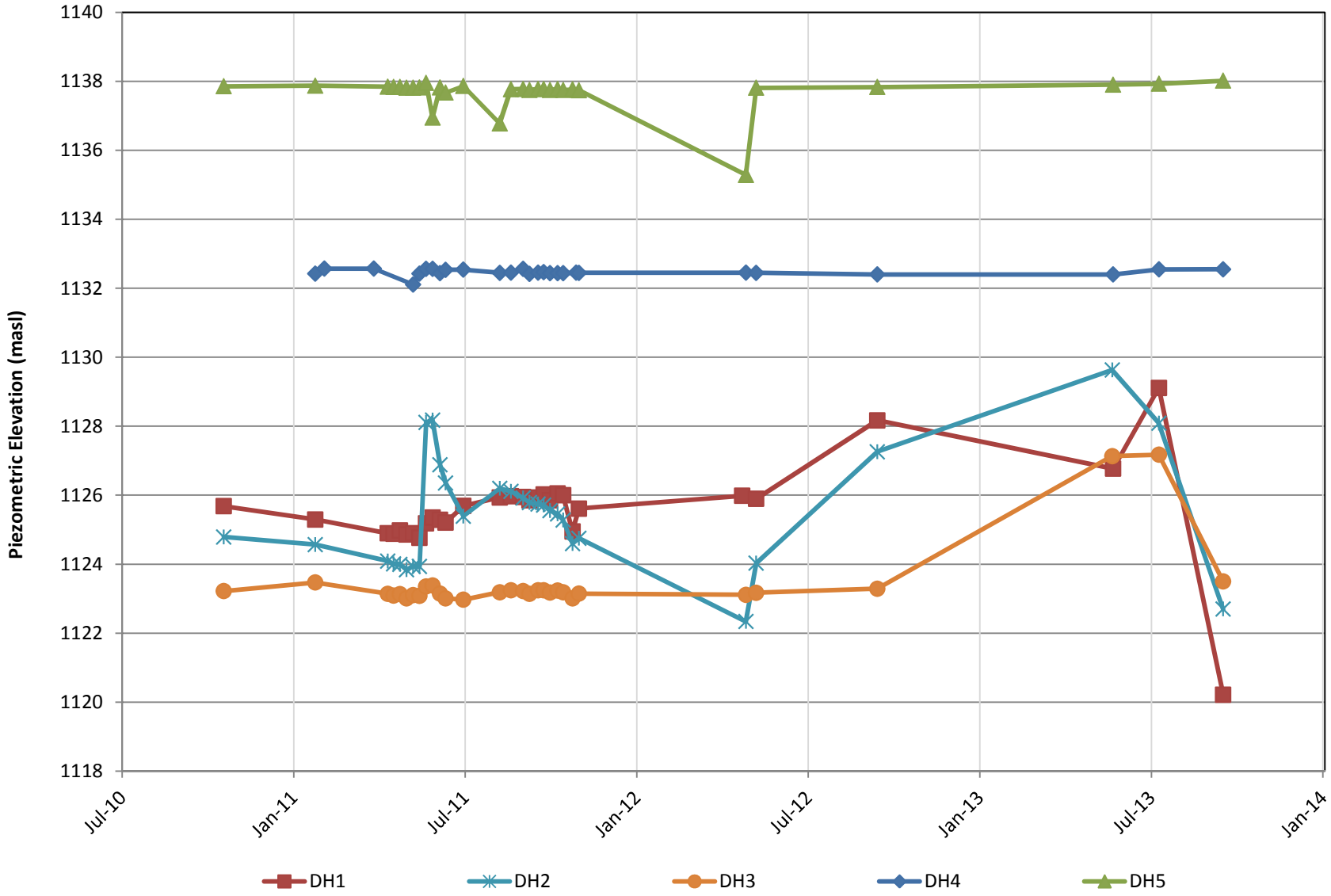
Vangorda Waste Rock Dump
Piezometric Elevations
P94-03A (V44)
P94-03B (V45)
P94-04B (V47)



Vangorda Waste Rock Dump
Piezometric Elevations
P2001-02A, P2001-02B, P2001-03



Vangorda Waste Rock Dump
Piezometric Elevations
PW-10-01 (DH1), PW-10-02 (DH2), PW-10-03 (DH3), PW-10-04 (DH4), PW-10-05 (DH5), PW-10-06 (DH6)



APPENDIX II-M

Little Creek Dam

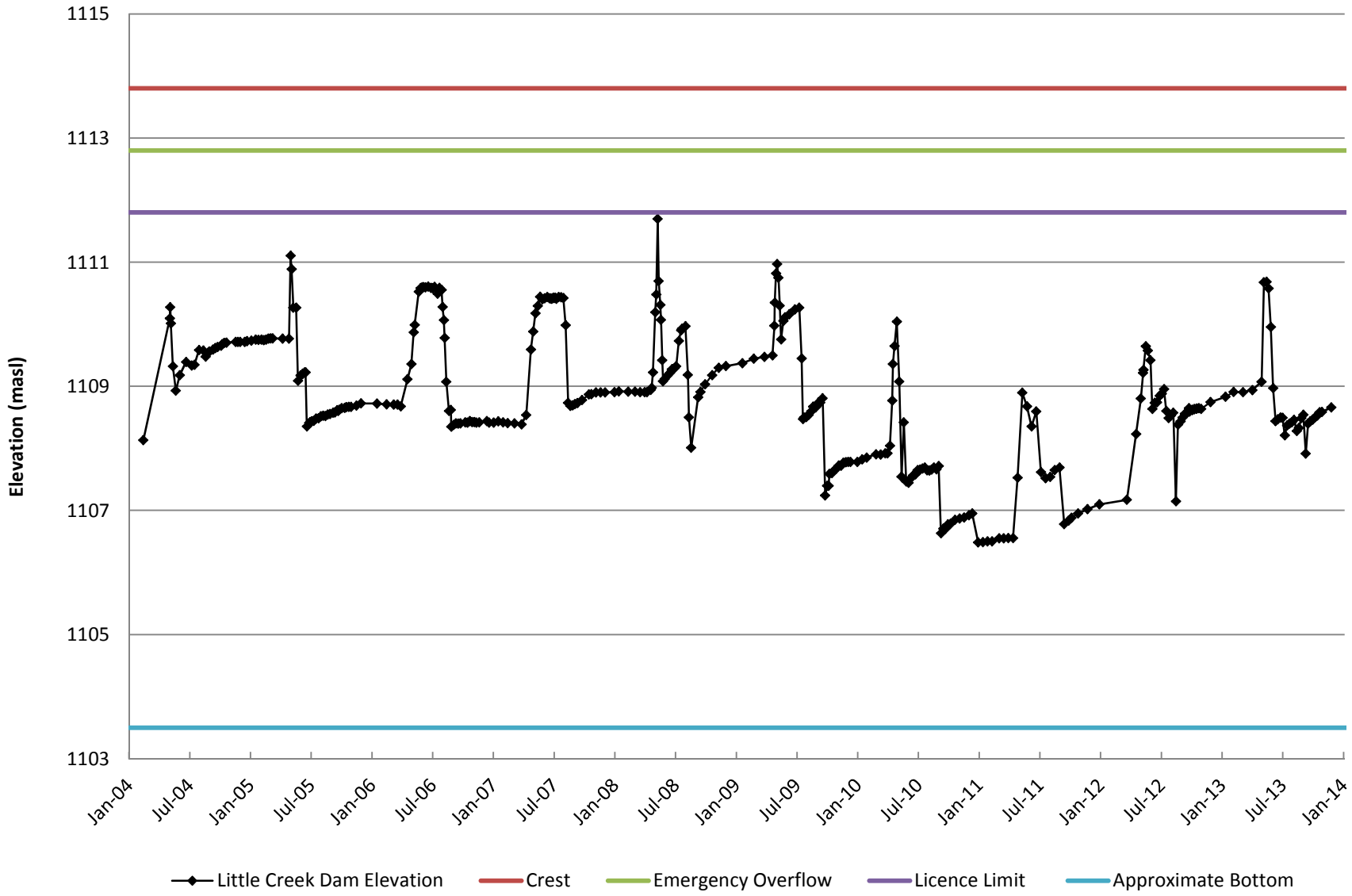
M.1 – Pond Level

M.2 – Piezometers

M.3 - Thermistors

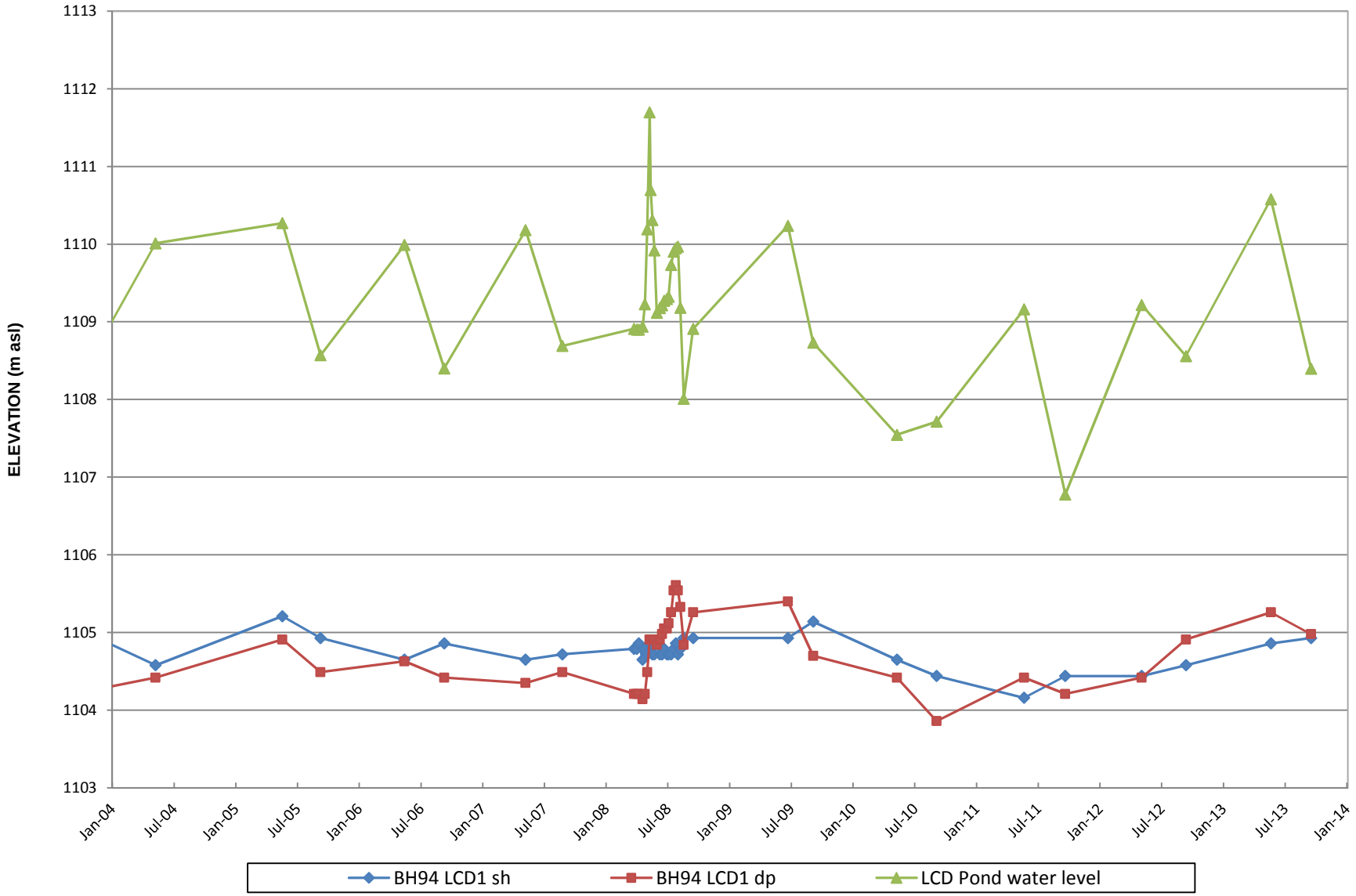
M.1 – Pond Level

Little Creek Dam Pond Water Level

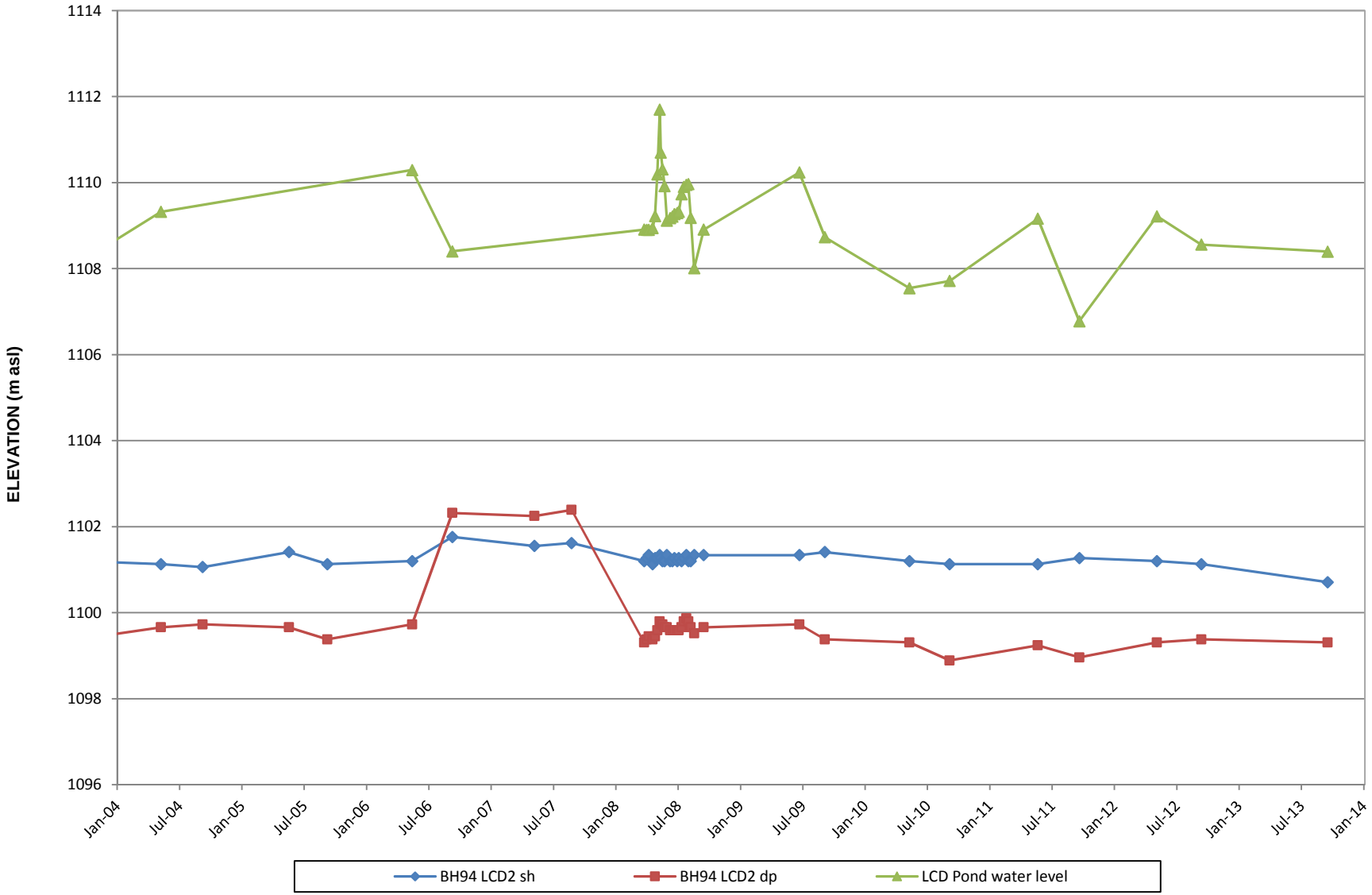


M.2 – Piezometers

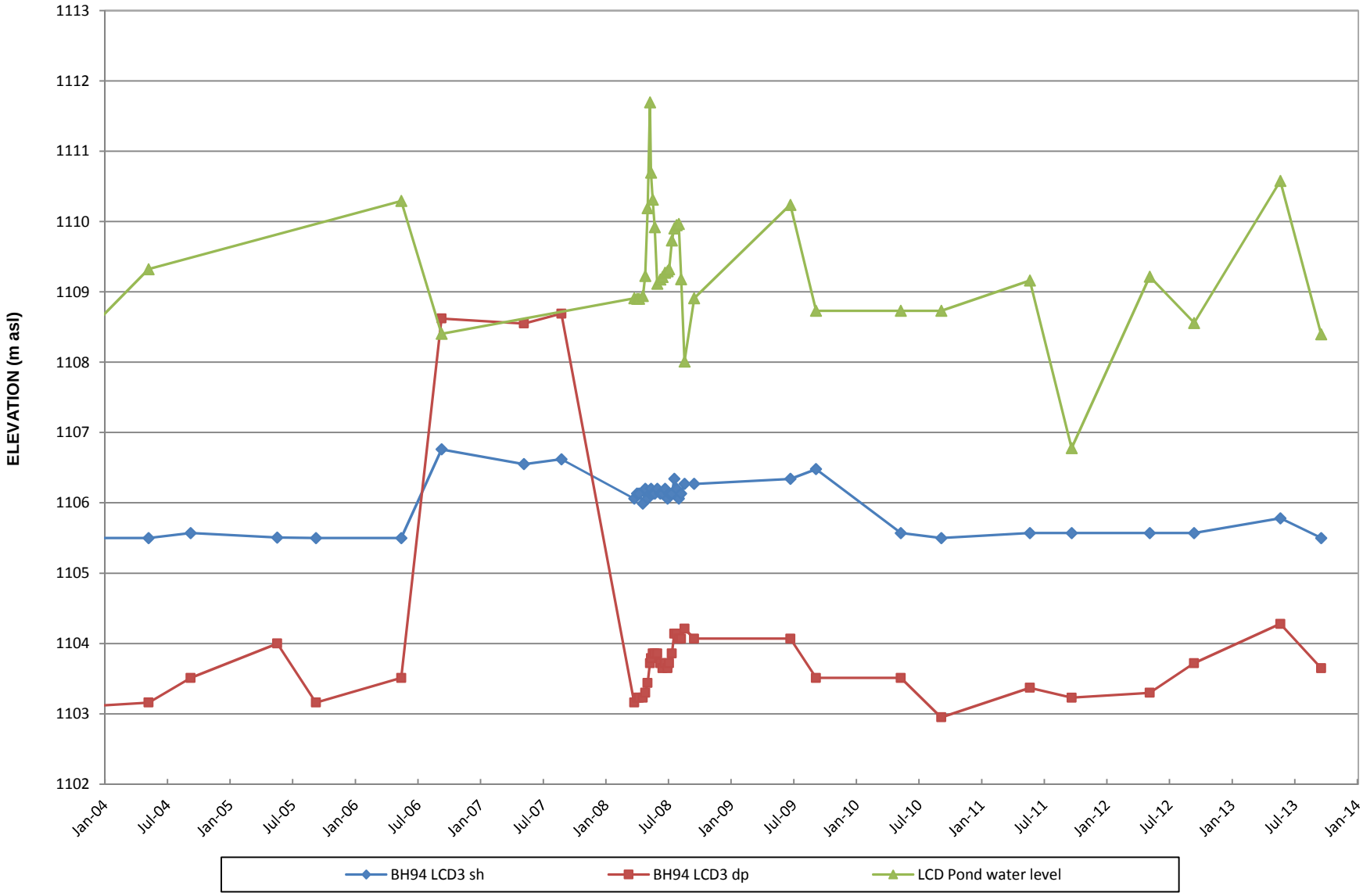
Little Creek Dam - Dam Crest
Piezometer BH94 LCD1



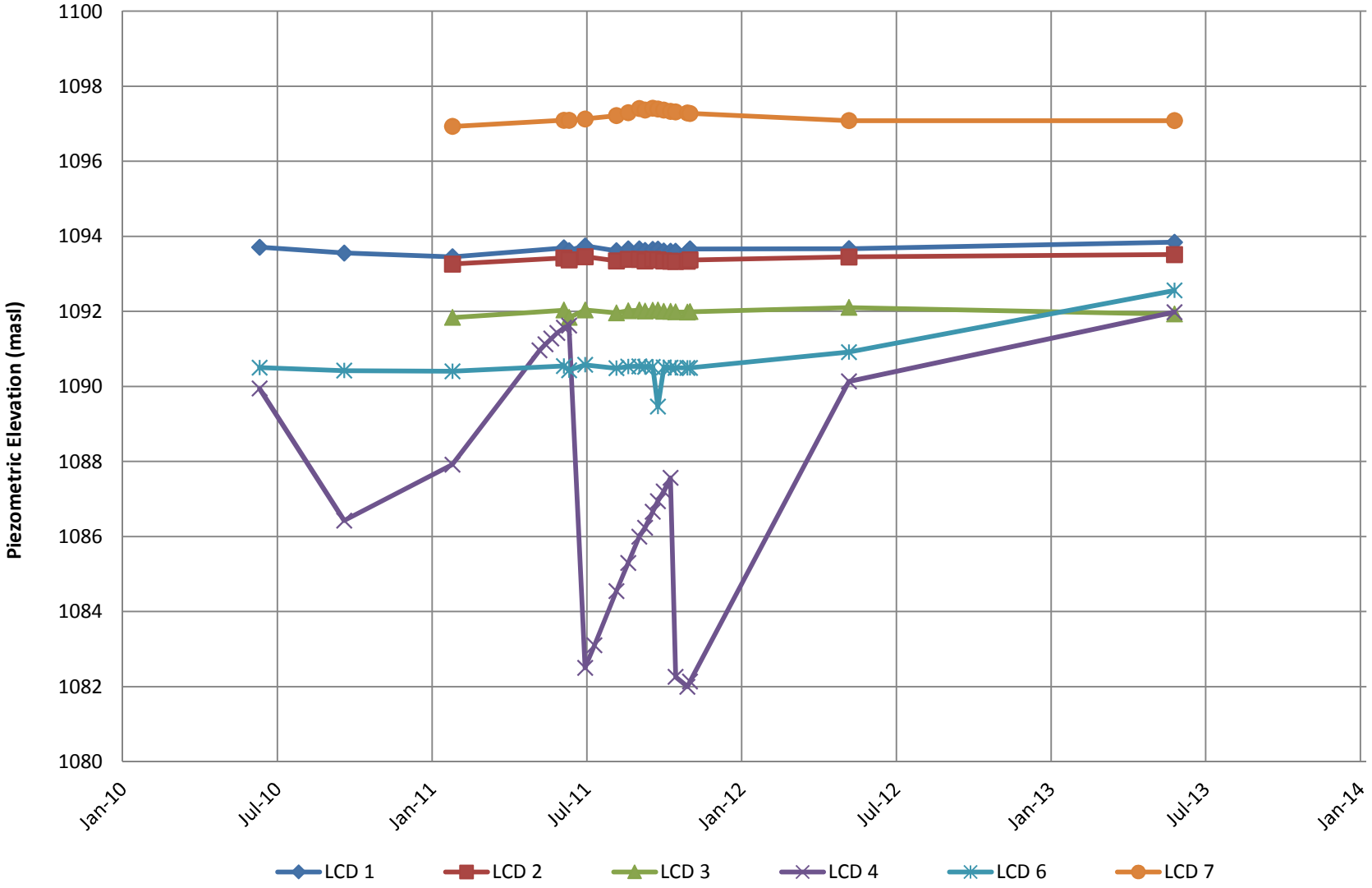
Little Creek Dam
Piezometer BH94 LCD2



Little Creek Dam
Piezometer BH94 LCD3

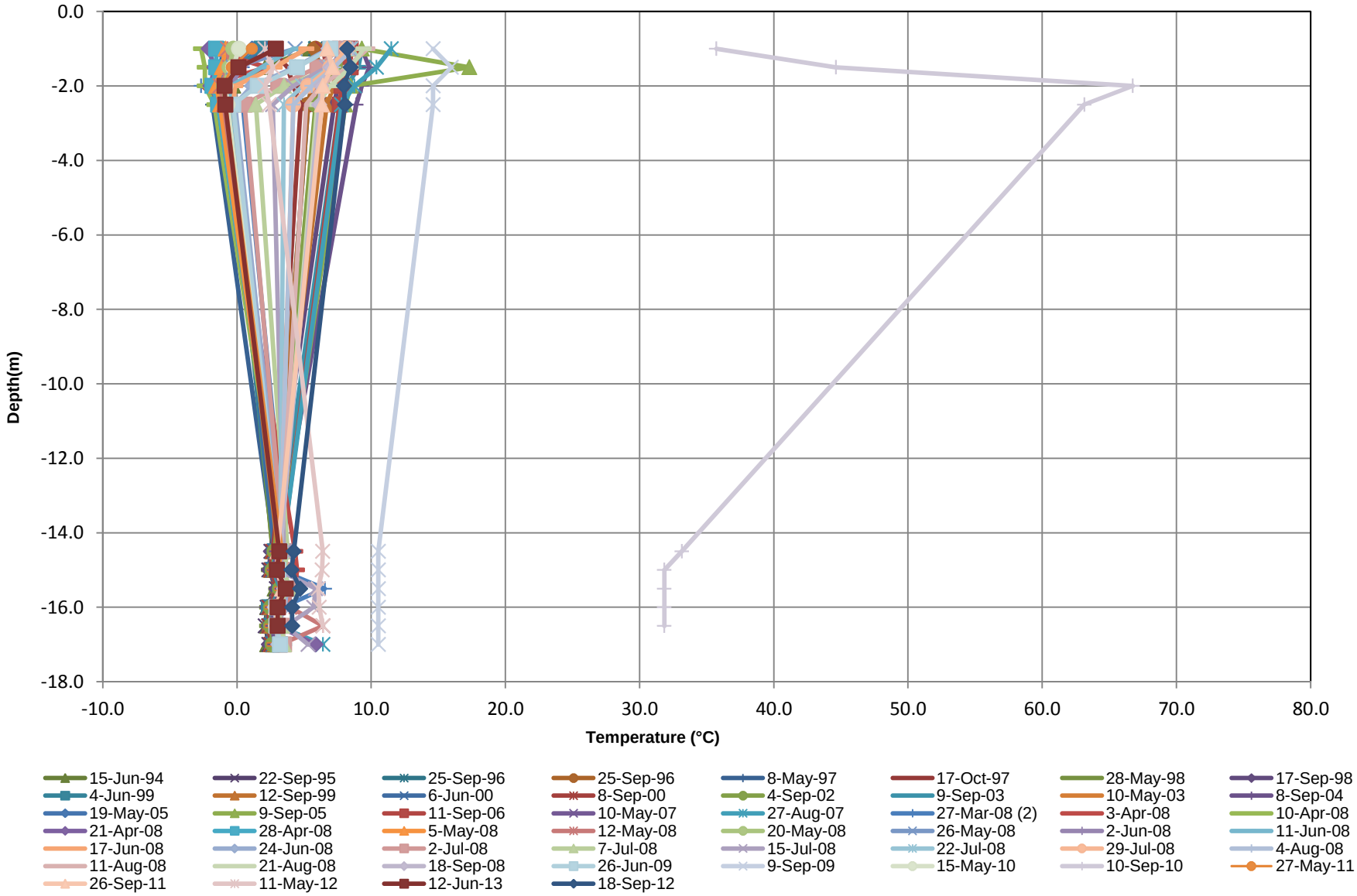


Little Creek Dam - Dam Toe
Piezometric Elevations
P09-LCD1, LCD2, LCD3
P09-LCD4, LCD6, LCD7

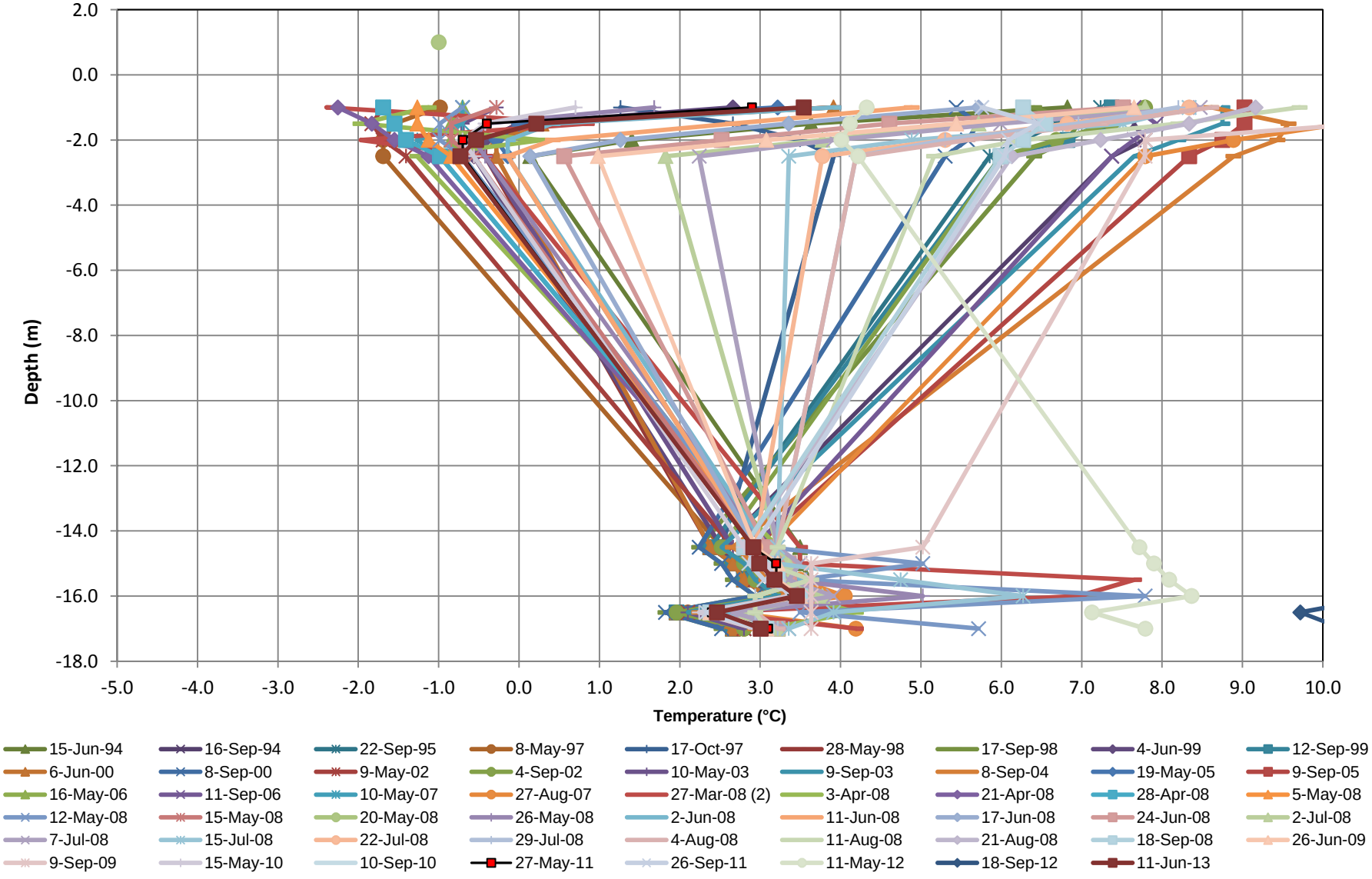


M.3 – Thermistors

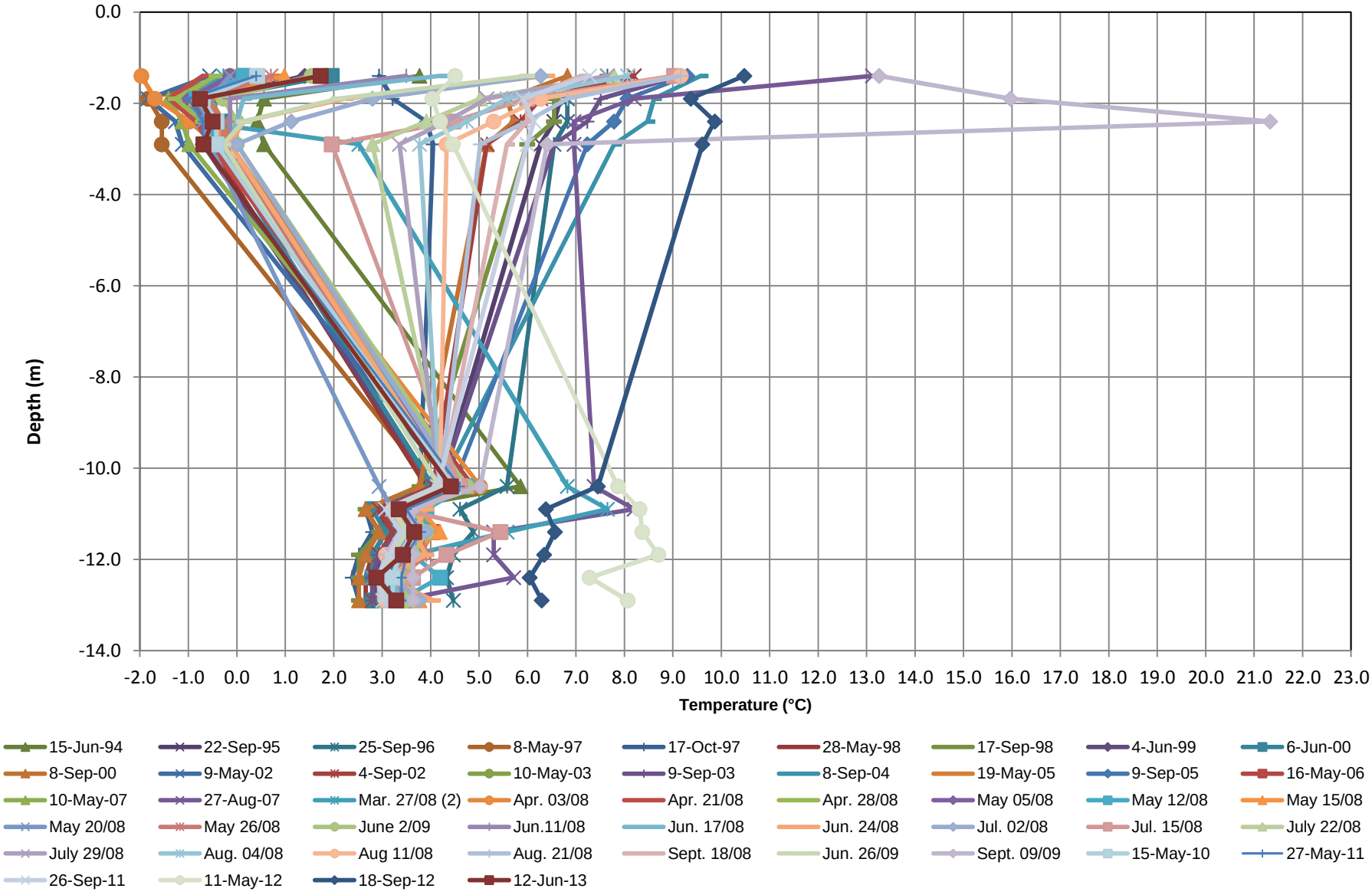
Little Creek Dam
Thermistor BH94 LCD-4



Little Creek Dam
Thermistor BH94 LCD-5



Little Creek Dam
Thermistor BH94 LCD-6

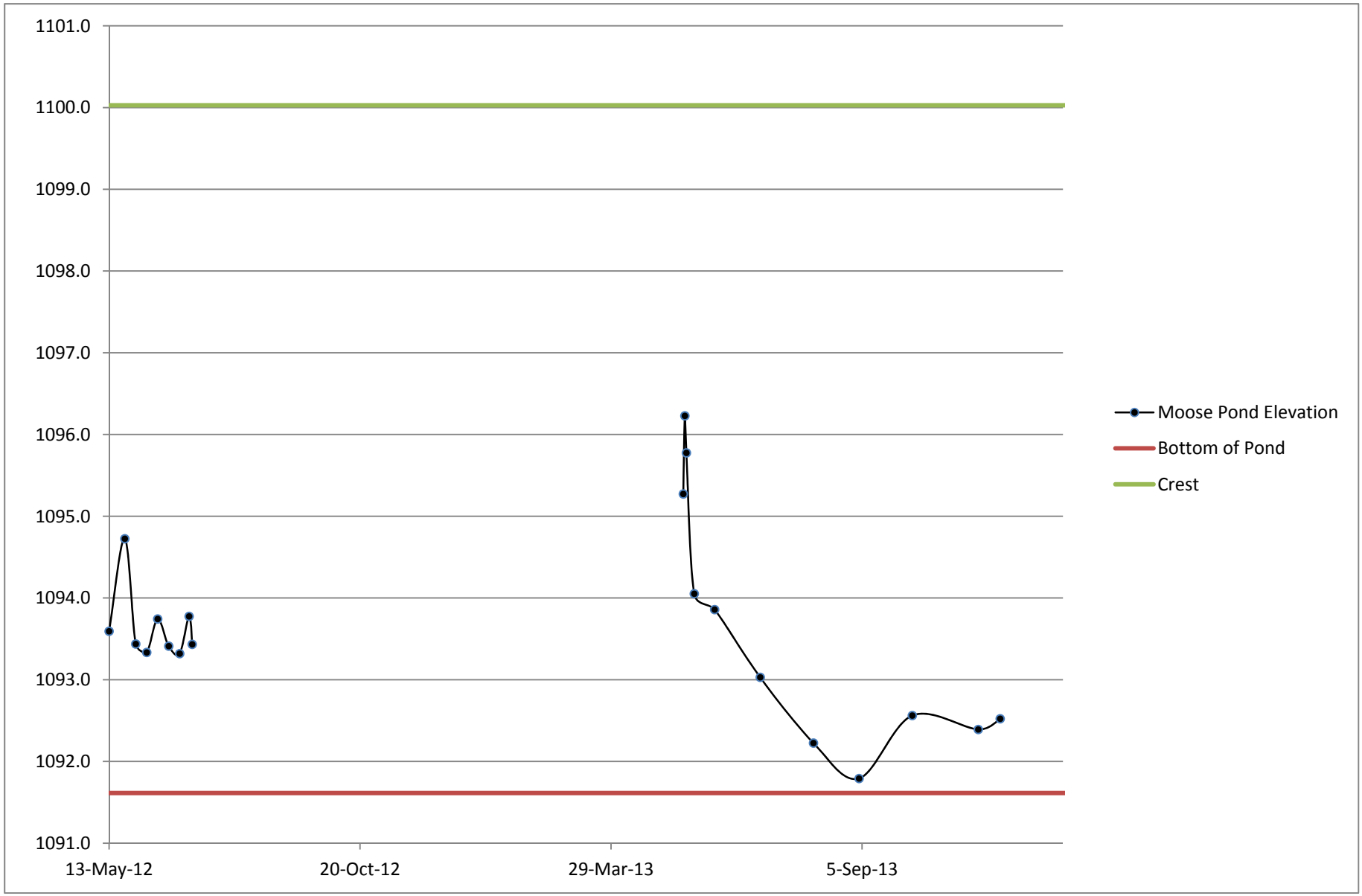


APPENDIX II-N

Moose Pond

N.1 – Pond Level

N.1 – Pond Level


1101.0
1100.0
1099.0
1098.0
1097.0
1096.0
1095.0
1094.0
1093.0
1092.0
1091.0
13-May-12
20-Oct-12
29-Mar-13
5-Sep-13
Moose Pond Elevation
Bottom of Pond
Crest

APPENDIX III

Instrumentation Status and Monitoring Schedule

Appendix IIII
Instrumentation Status and Monitoring Schedule

III-1 SUMMARY

Appendix III summarizes the current status of instrumentation monitored by TEES for the annual geotechnical review program. Table III.1 presents a summary of instrumentation monitored in 2013 at various structures and corresponding reference tables given in the main text and recorded data presented in Sections of Appendix II. Table III.2 shows the 2013 monitoring schedule followed by TEES as recommended by BGC (2010). Table III.3 shows the monitoring schedule proposed for 2014.

III-2 RATIONALE FOR PROPOSED CHANGE IN MONITORING SCHEDULE

Our proposed changes apply only to the following:

- thermistors for the Canal Dyke associated with the Rose Creek Diversion Channel, Cross Valley Dam and Little Creek Dam; inclinometers for the Canal Dyke;
- K8 Rock Drain; and
- Vangorda Creek Diversion Trash Rack at Headworks.

Golder (1981) discussed the purpose for monitoring ground temperature is to check the progress of potential thawing of permafrost present at these structures during the design and construction stages. Moreover, inclinometers were installed to track potential slope movement in the thawed out permafrost region along the Canal Dyke. We observed that no permafrost is present now in the monitored region and no stability issue has been encountered at the Cross Valley Dam and Little Creek Dam. Similar situation was observed along some reach of the Canal Dyke. Thus we recommend to discontinue reading those thermistors located in these areas as shown in Tables III.1 and III.3, and preserve the thermistors for potential use in future.

The available thermistors data along the Backslope of the Rose Creek Diversion Channel and some reach of the Canal Dyke also appear to indicate that permafrost may be still present at depth in the monitored locations. These thermistors should continue be monitored annually as shown in Tables III.1 and III.3.

We also noticed that no instrumentation readings were taken along the Backslope in recent years probably due to restrictions by regulators. However, we believe that it is critically important to continue monitoring the thermistors, piezometers and inclinometers installed along the Backslope to confirm that the hillside slope stability is not impacted by potential thawing of remaining permafrost at depth. The longitudinal cracks and slope slumps that occurred in the spring of 2013 as shown in Photos 21 to 24 in Appendix I are in the vicinity of BS-10 thermistors and inclinometer. Thus, it is important to get access to the hillside slope in the period of no snow cover to conduct detailed

examination of the deformed slope as well as to obtain readings of ground temperature and slope deformation profile in order to assess the slope stability condition in the distressed region.

The monthly observations for the K8 Rock Drain and the Vangorda Creek Diversion Trash Rack at Headworks have been revised to require observations during the spring freshet period.

Table III.1 Status of Instrumentation Monitoring

Structure	Type of Instrument	Instrument Status - Table in Main Text	2013 Data - Section in Appendix II	Comments Regarding 2014 Monitoring Schedule
Faro Pit[1]	Lake Level	Table 2.1	Section II-A.1	As required by YG[2]
	Brim Displacement	-	Sections II-A.2 and II-A.3	Reference Bars - May, September; Prisms - Yearly
Grum Pit[1]	Lake Level	-	Section II-J.1	As required by YG[2]
	Brim Displacement	Table 3.1	Section II-J.2	Reference Rods - Monthly
	Piezometer	-	Section II-J.3	As required by YG[2]
Vangorda Pit[1]	Lake Level	-	Section II-K.1	As required by YG[2]
Faro Creek Diversion	Staff Gauge	Table 2.1	Section II-B.1 and II-B.2	Twice monthly - April to October
Rose Creek Diversion / Canal Dyke	Staff Gauge	Table 2.3	Section II-D.1 and II-D.2	Daily - April to September
	Piezometers	Table 2.4	Section II-E.1	Three times yearly - May, June, September
	Inclinometers	Table 2.4	Section II-E.3	Once yearly - all inclinometers (repeat until correct readings taken, critical in Back Slope)
	Thermistors	Table 2.4	Section II-E.2	Once yearly - all thermistors in Back Slope and the following thermistors for Canal Dyke: CD-10, CD-15, CD-21, SP-2, SP-3 and SP-5. Preserve remaining thermistors for potential use in future.
North Valley Interceptor	Flow Measurement	Table 2.2	Section II-C.1	As required by YG[2]
North Fork Rock Drain	Water Level	Table 2.5	Section II-F.1	As required by YG[2]
Secondary Tailings Dam	Piezometers	Table 2.6	Section II-G.1	Three times yearly - May, June, September
Intermediate Dam	Pond Level	Table 2.7	Section II-H.1	As required by YG[2]
	Piezometers	Table 2.7	Section II-H.2	Three times yearly - May, June, September
Cross Valley Dam / Polishing Pond	Pond Level	Table 2.8	Section II-I.1	As required by YG[2]
	Piezometers	Table 2.8	Section II-I.2	Three times yearly - May, June, September
	Thermistors	-	Section II-I.3	Preserve thermistors for potential use in future
	Weirs	-	Section II-I.4	As required by YG[2]
Little Creek Dam	Pond Level	Table 3.4	Section II-M.1	As required by YG[2]
	Piezometers	Table 3.4	Section II-M.2	Twice yearly - May, September
	Thermistors	-	Section II-M.3	Preserve thermistors for potential use in future
Moose Pond	Pond Level	-	Section II-N.1	As required by YG[2]
Vangorda Waste Dump	Piezometers	Table 3.2	Section II-L.2	Twice yearly - May, September
	Weirs	Table 3.3	Section II-L.1	Twice monthly - April to October

Notes: 1. Photos of Instability Zones in Faro Pit East Wall and Grum Pit East Wall and Vangorda Northwest Wall to be taken at same vantage points, see Appendix I and Golder (2013).
2. No proposed schedule adjustment is made in Table III.3 for those instrumentations commented with "As Required by Yukon Government (YG)".

Table III.2 2013 Faro Mine Complex Geotechnical - Hydrotechnical Monitoring Program (BGC 2010)

	January	February	March	April	May	June	July	August	September	October	November	December
Rose Creek Diversion Canal												
Thermistors												
Canal Dyke: CD-15, CD-21, BGC05-04, BGC05-07, CD-26					Monthly	Monthly			Monthly			
Spoil Pile: SP-3, SP-5						Monthly						
Backslope: BS-5, BS-9, BS-10, BS-12	Not read in 2012 - Read every second year											
Slope Indicators	If blocked in May attempt in June											
Canal Dyke: CD-10, CD-15, CD-19, CD-21, BH94CD-1, BH91-CD1, BGC05-05, BGC05-08					Monthly				Monthly			
Spoil Pile: SP-2, SP-5						Monthly						
Backslope: BS-5, BS-9, BS-10	Not read in 2012 - Read every second year											
Piezometers												
Canal Dyke: CD-13, CD-15, CD-21, BGC05-02, BGC05-03, BGC05-06, CD-26					Monthly	Monthly			Monthly			
Backslope: BS-5, BS-9	Not read in 2012 - Read every second year											
Staff Gauges												
RCDC-4				Daily	Daily	Daily	Daily	Daily	Daily			
Cross Valley Dam												
Thermistors												
CVDC-6, BH88-4					Monthly	Monthly			Monthly			
Piezometers												
CVDC-4, CVDC-7, CVDC-9, CVDT-1, CVDT-2, CVDP-1, CVDP-3, CVDP-5, CVDP-6, 94 CVDC-1					Monthly	Monthly			Monthly			
Weir Flows												
X11, X12, Weir 3	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
X13	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
Elevations												
Polishing Pond	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
Intermediate Dam												
Piezometers												
91ID-4, 91-ID-6, 91-ID-7, 94-IDC-1, 96-1, 96-2, 96-3, 96-4, P01-03, P01-04, BKS04-06, BKS04-07					Monthly	Monthly			Monthly			
914-ID3					Monthly	Monthly		Monthly	Monthly			
Observations												
Seepage observations near south abutment					Monthly	Monthly		Monthly	Monthly			
Elevations												
Intermediate Pond	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
Secondary Tailings Dam												
Piezometers												
P81-6, P81-7, P81-8, P03-01, P03-02, P03-03					Monthly	Monthly			Monthly			
North Fork Rock Drain												
Data loggers												
NFRD23				Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly		
Staff Gauges												
NFRD23, X2				Daily	Daily	Daily	Weekly	Weekly	Weekly	Weekly		
Elevations												
NF1, NF2					Weekly	Weekly	Weekly	TAM	TAM			
Observations												
NF1, NF2	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Faro Creek Diversion Channel												
Staff Gauges												
FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	TAM	TAM	TAM	TAM	TAM		
Flows												
FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	TAM	TAM	TAM	TAM	TAM		
Faro Pit												
Regression Measurements												
15356, 15717, 15355, 15737, 15354, 15742, 13908, 15352, 15351					Monthly				Monthly			
Observations												
Faro Pit	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Haul Road												
Observations												
K8 Rock Drain									Monthly	Monthly	Monthly	Monthly
Grum Pit												
Slope Stability Measurements												
GP-S1, GP-S2, GP-S3, GP-S4, GP-N1, GP-N2, GP-N3, GP-N4, GP-N5, GP-N6	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Observations												
Grum Pit Wall	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Piezometers												
SRK09-GSA, SRK09-GSB	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Vangorda Pit												
Observations												
Vangorda Pit Wall	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Vangorda Waste Rock Dump												
Observations												
V28, V29, V30, V31, V32, V33					Monthly	Monthly	Monthly	Monthly	Monthly	Monthly		
Drainage Ditch						Monthly						
Northeast Dump Crest						Monthly						
Flows												
V29, V30, V31, V32, V33					TAM	TAM	TAM	TAM	TAM	TAM		
Piezometers												
V39, V40, V41, V42, V43, V44, V45, V46, V47, PW-10-01, PW-10-02, PW-10-03, PW-10-04, PW-10-05					Monthly				Monthly			
Data loggers												
PW-10-01, PW-10-02, PW-10-03, PW-10-5					Monthly				Monthly			
Little Creek Dam												
Piezometers												
BH94 LCD-1, BH94 LCD-2, BH94 LCD-3					Monthly				Monthly			
Thermistors												
BH94 LCD-4, BH94 LCD-5, BH94 LCD-6					Monthly				Monthly			
Observations												
Dam Crest						Monthly						
Inlet of Culvert Spillway						Monthly						
Vangorda Creek Diversion												
Observations												
Trash Rack at Headworks						Monthly						
Seepage Collection Pond						Monthly						
Sideslopes Above Plume						Monthly						
Sludge Pond Embankment												
Observations												
Downstream slopes and Embankments						Monthly						
Grum Settling Pond												
Observations												
Spillway from Grum Settling Pond to Grum Inteceptor Ditch						Monthly						
Grum Interceptor Ditch and Sheep Pad Pond												
Observations												
Outlets / Inlets to Ditch						Monthly						
Sheep Pad Pond Dyke						Monthly						

Table III.3 Proposed 2014 Faro Mine Complex Geotechnical - Hydrotechnical Monitoring Program

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rose Creek Diversion Canal													
Thermistors	Canal Dyke: CD-10[2], CD-15[2], CD-21[2], BGC05-04, BGC05-07, CD-26						M						
	Spoil Pile[2]: SP-2, SP-3, SP-5						M						
	Backslope[2]: BS-5, BS-9, BS-10, BS-12						M			M			
Slope Indicators	Canal Dyke: CD-10, -15, -19, -21. BH94CD-1. BH91-CD1. BGC05-05, -08.					One successful reading for all inclinometers							
	Spoil Pile: SP-2, SP-5					One successful reading for all inclinometers							
	Backslope: BS-5, BS-9, BS-10					Two successful readings for all inclinometers:							
						one set in spring/summer, the other in fall							
Piezometers	Canal Dyke: CD-13, -15,-21. BGC05-02, -03, -06. CD-26.					M	M			M			
	Backslope: BS-5, BS-9					M	M			M			
Staff Gauges	RCDC-4				Daily	Daily	Daily	Daily	Daily	Daily			
Cross Valley Dam													
Thermistors	CVDC-6, BH88-4												
Piezometers	CVDC-4, -7, -9. CVDT-1, -2. CVDP-1, -3, -5, -6. 94 CVDC-1.					M	M			M			
Weir Flows	X11, X12, Weir 3	M	M	M	M	M	M	M	M	M	M	M	M
	X13	W	W	W	W	W	W	W	W	W	W	W	W
Elevations	Polishing Pond	W	W	W	W	W	W	W	W	W	W	W	W
Intermediate Dam													
Piezometers	91ID-4, -6, -7. 94-IDC-1, 96-1, -2, -3, -4. P01-03, -04. BKS04-06, -07.					M	M			M			
	91-ID3					M	M		M	M			
Observe	Seepage observations near south abutment					M	M		M	M			
Elevations	Intermediate Pond	W	W	W	W	W	W	W	W	W	W	W	W
Secondary Tailings Dam													
Piezometers	P81-6, P81-7, P81-8, P03-01, P03-02, P03-03					M	M			M			
North Fork Rock Drain													
Data loggers	NFRD23				M	M	M	M	M	M	M		
Staff Gauges	NFRD23, X2				Daily	Daily	Daily	W	W	W	W		
Elevations	NF1, NF2					W	W	W	TAM	TAM			
Observe	NF1, NF2	M	M	M	M	M	M	M	M	M	M	M	M
K8 Rock Drain													
Observe						M	M	M					
Faro Creek Diversion Channel													
Staff Gauges	FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	TAM	TAM	TAM	TAM	TAM		
Flows	FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	TAM	TAM	TAM	TAM	TAM		
Faro Pit													
Measure	15356, 15717, 15355, 15737, 15354, 15742, 13908, 15352, 15351					M				M			
Observe	Faro Pit	M	M	M	M	M	M	M	M	M	M	M	M
Haul Road													
Observe	K8 Rock Drain					M	M	M					
Grum Pit													
Measure	GP-S1, -S2,-S3, -S4. GP-N1, -N2, -N3, -N4, -N5, -N6.	M	M	M	M	M	M	M	M	M	M	M	M
Observe	Grum Pit Wall	M	M	M	M	M	M	M	M	M	M	M	M
Piezometers	SRK09-GSA, SRK09-GSB	M	M	M	M	M	M	M	M	M	M	M	M
Vangorda Pit													
Observe	Vangorda Pit Wall	M	M	M	M	M	M	M	M	M	M	M	M
Vangorda Waste Rock Dump													
Observe	V28, V29, V30, V31, V32, V33					M	M	M	M	M	M		
Observe	Drainage Ditch						M						
Observe	Northeast Dump Crest						M						
Flows	V29, V30, V31, V32, V33					TAM	TAM	TAM	TAM	TAM	TAM		
Piezometers	V39, 40, 41, 42, 43, 44, 45, 46, 47. PW-10-01, -02, -03, -04, -05.					M				M			
Data loggers	PW-10-01, PW-10-02, PW-10-03, PW-10-5					M				M			
Little Creek Dam													
Piezometers	BH94 LCD-1, BH94 LCD-2, BH94 LCD-3					M				M			
Thermistors	BH94 LCD-4, BH94 LCD-5, BH94 LCD-6												
Observe	Dam Crest						M						
Observe	Inlet of Culvert Spillway						M						
Vangorda Creek Diversion													
Observe	Trash Rack at Headworks					M	M	M					
Observe	Seepage Collection Pond						M						
Observe	Sideslopes Above Flume					M	M	M					
Sludge Pond Embankment													
Observe	Downstream slopes and Embankments						M						
Grum Settling Pond													
Observe	Spillway from Grum Settling Pond to Grum Inteceptor Ditch						M						
Grum Interceptor Ditch and Sheep Pad Pond													
Observe	Outlets / Inlets to Ditch						M						
	Sheep Pad Pond Dyke						M						

Notes: 1. M means monthly, W means weekly and TAM means twice a month

2. It is critical to take readings of thermistors located in Back Slope and Spoil Pile as well as Thermistors CD-10, CD-15 and CD-21 in 2014.