Physical Monitoring Plan

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Minto Mine
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1 Introduction

The following document describes the instrumentation and monitoring program currently in place at Minto to monitor the stability of mining structures including waste rock, tailings, and water storage facilities. The program consists of two main components: instrumentation to measure ground conditions and deformation, and regular geotechnical inspections. The following sections summarize inspection and data collection frequencies, instrument installation details and locations, and data collection procedures.

Mining and monitoring activities at Minto are licensed under water use license QZ96-006.

Mining structures at Minto are shown in Figure 1-1, and described in the following section.

Figure 1-1: Minto site plan (August 2013)

2 Structures Monitored

Mining structures currently being monitored at Minto include the following (shown in Figure 1-1):

Table 1: Description of Structures Monitored at Minto

Structure	Description	Instrumentation
Area 1 Pit (Main Pit)	Mining in the Area 1 Pit is complete and the pit is now used as a tailings storage facility. As such, no in-pit deformation monitoring is carried out. Instability in the south wall of the pit occurred in 2009 during mining of Stage 3 of the pit, and subsequently a larger failure occurred in 2011 after completion of Stage 5. Continued sloughing and creep movement of the south wall led to the design and construction of a waste rock buttress, known as the **South Wall Buttress**, in the pit along the south wall, completed in 2013. Instrumentation is currently monitored along the south rim of the pit to detect any continued movement of the wall and buttress.	• Survey hubs • Inclinometer
Area 2 Pit	The Area 2 Pit is completed to the extents licensed under Phase IV; the pit will be extended to the south as part of Phase V/VI. As part of Phase IV, a portal was created at the bottom of the pit to access an underground ore zone. Monitoring is therefore ongoing. The highwall crest is monitored via survey hubs to measure large scale stability of the wall. The highwall is monitored by realtime radar-based slope stability measurements, and a program of weekly inspections and prism readings monitors those portions of the wall not actively scanned by the radar.	• Survey hubs • Prisms • Radar
Area 118 Pit	Mining of the Area 118 Pit commenced in January 2014. Survey hubs are monitored along the northeast crest of the pit between Area 118 and Area 2. In-pit monitoring currently consists of regular inspections. Prisms will be installed along catch benches as mining progresses.	• Survey hubs • Prisms
Dry Stack Tailings Storage Facility (DSTSF)	Tailings placement was completed in November 2012; subsequently, a layer of overburden was placed over the stack as part of progressive reclamation activities. The DSTSF began showing deformation in 2009; the movement has been monitored continuously since then via inclinometers, which are typically short-lived due to the rate of deformation, and survey hubs. Ground temperature cables and piezometers have also been installed to better understand foundation conditions and to provide data for analytical work. The deformation is interpreted as primarily horizontal sliding towards the north/northeast on an ice-rich layer in the underlying overburden, several meters above bedrock.	• Survey hubs • Thermistors • Inclinometers • Piezometers
Mill Valley Fill Extension (MFVE)	A waste rock buttress to the north of the DSTSF, constructed from January 2012 to March 2013 in an attempt to prevent or decrease further movement of the DSTSF.	• Survey hubs • Inclinometers
Ice-rich Overburden Dump (IROD)	Originally constructed as a free-standing rockfill structure to contain a volume of ice-rich overburden. It is now entirely surrounded by the Southwest Dump rockfill which extends a minimum 210m down-slope. The crest and contents of the IROD are visually inspected once per year. No instrumentation is installed in the IROD.	None
Mill Water Pond (MWP)	The mill water pond is a small water storage pond used for excess process water and recirculation of mill process water.	• Thermistors
Minto Creek Detention Structure (MCDS)	Detains surface water considered impacted from upstream sub-catchment areas and directs it to the Area 1 pit or water treatment plant. Extensive instrumentation related to the MVFE is near the MCDS; however, no instrumentation specific to the MCDS is installed.	None

Structure	Description	Instrumentation
Reclamation Overburden Dump (ROD)	Received the bulk of the overburden released as part of Phase IV and earlier mining of the Main pit. Due to the nature of the material placed within the dump, small-scale sloughs are expected and have been noted. Annual visual inspections have not noted large tension cracks that could be indicative of differential settlement. The dump is inspected annually, and contains no survey hubs or instrumentation. The material in the ROD is available for use in reclamation of the mine at closure.	None
Southwest Waste Rock Dump (SWD)	The southwest waste rock dump (SWD) is currently the main active waste rock dump at Minto. Design details on the SWD are contained in the report "Waste Rock and Overburden Management Plan" for Phase IV mining.	• Survey hubs • Inclinometers • Thermistors • Piezometers
Water Storage Pond Dam (WSP)	The water storage pond and dam are located east of the mine along Minto Creek. The dam was constructed in 2006 as a clay-core water retention dam for collecting precipitation and surface water runoff at the site. Maximum depth of water at the face of the dam is approximately 15 m.	• Survey hubs • Thermistors • Piezometers
Main Waste Dump (MWD)	This dump stores waste released during the mining of the first three stages of the Main pit. The dump is founded on bedrock. Movement below the toe is monitored by a single inclinometer.	• Inclinometers

3 Design References

Table 2: Design Documents and Monitoring/Inspection Guidance Documents

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Area 1 Pit (Main Pit)	*Area 1 South Wall Buttress Design Report, Minto Mine, Yukon.* EBA File: W141010668.012, July 2011.	-
Area 2 Pit	*Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.* SRK, December 2009. *Review of Minto Area 2 West Wall Stability*. SRK, September 11, 2012. *Review of Minto Area 2 West Wall Stability-April 2013*. SRK, April 18, 2013. *Review of Minto Area 2 West Wall Stability-September 2013.* SRK, September 30, 2013.	*SWP – Area 2 Pit Wall and Crown Pillar Monitoring.* Minto, January 30, 2014.
Area 118 Pit	*Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.* SRK, December 2009.	-
Dry Stack Tailings Storage Facility (DSTSF)	*Geotechnical Design Report, Dry Stack Tailings Storage Facility, Minto Mine, Yukon*. EBA File: 1200173. January 2007.	*Operation, Maintenance, and Surveillance Manual, Dry Stack Tailings Storage Facility, Minto Mine, YT.* Revision 2011-1 EBA File: W14101068.001. January 2011.
Mill Valley Fill Extension (MVFE)	*Waste Rock and Overburden Management Plan, Phase IV Development, Minto Mine YT.* EBA File: W14101068.015. September 9, 2011. *Upstream Water Management for the Mill Valley Fill Expansion and Dry Stack Tailings Storage Facility.* EBA File: W14101168.013. September 14, 2011.	-
Ice-rich Overburden Dump (IROD)	*Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.* EBA file: 1200173. January 2006. *Ice-Rich Overburden Dump Containment Berm Inspection Report, Minto Mine Site, Minto Yukon.* EBA File: 1200173.001. June 19, 2007.	*Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.* EBA file: 1200173. January 2006. EBA, 2007.
Mill Water Pond (MWP)	-	*Construction Quality Assurance Manual for Waste Dumps, Tailings/Water Dam, Mill Water Pond, and Diversion Ditch, Minto Project, Yukon.* EBA File 0201-95-11509. August, 1997.
Minto Creek Detention Structure (MCDS)	*Minto Project: Minto Creek Detention Structure Seepage Monitoring Program.* EBA File: W14101068.001. October 25, 2011.	*Minto Project: Minto Creek Detention Structure Seepage Monitoring Program.* EBA File: W14101068.001. October 25, 2011.
Reclamation Overburden Dump (ROD)	*Geotechnical Design Proposed Reclamation Overburden Dump, Minto Mine, Yukon.* EBA File: W14101068.004. February 2008. *Reclamation Overburden Dump Expansion Geotechnical Design Report.* EBA File: W14101068.0040. June 29, 2010.	*Reclamation Overburden Dump Expansion Geotechnical Design Report.* EBA File: W14101068.0040. June 29, 2010.

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Southwest Waste Rock Dump (SWD)	*Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.* EBA File: W14101068.005. September 2008.	*Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.* EBA File: W14101068.005. September 2008.
Water Storage Pond Dam (WSP)	*Geotechnical Design Tailings/Water Dam, Minto Project, Yukon.* EBA File: 0201-95-11509. Dec. 1995. *As-built Construction Report, Water Retention Dam, Minto Mine, Minto, YT.* EBA File: 1200173.001. April 2008.	*Draft Operation, Maintenance and Surveillance Manual, Water Retention Dam, Minto Mine, Minto, YT.* EBA File: W14101068.002. April 2008.

4 Roles and Responsbilities

The following table lists the roles and responsibilites for physical monitoring on the site.

Table 3: Roles and Responsibilities

Role	Responsibilities
Geotechnical Technicians	• Collect instrumentation data at specified frequencies • Input data into monitoring spreadsheets/databases • Internal reporting of monitoring data • Maintain equipment
Geotechnical Engineers	• QA/QC of data collection • Ensure compliance with license requirements • Monthly, quarterly and annual water use license (WUL) reporting • Visual inspections at specified frequencies • Review and update Physical Monitoring Plan
Environmental Officers	• Compile Monthly, quarterly and annual water use license (WUL) reports
Chief Engineer	• Review annual WUL report • Ensure compliance with license requirements

5 Inspections

Table 4 lists the regular, required inspections for each mining structure.

Table 4: Inspections

Structure	Frequency	Description
Dry stack tailings facility, Mill Valley Fill, Main waste rock dump, Southwest waste dump, Reclamation Overburden dump, Ice-rich overburden dump, Mill water pond, Water storage pond dam, Area 1 Pit, South wall buttress, Mill and Camp, Minto Creek detention structure, Big Creek bridge, South diversion ditch.	May/June and September	Inspection and data review by geotechnical engineer as per QZ96-006 (Clause 11)
Area 2 and Area 118 pit walls	Weekly during active mining	Visual inspection by geotechnical engineer/geologist/mine engineer
Water storage pond dam	Weekly (daily during filling)	Visual inspection and inspection for water seepage flows as per QZ96-006 (Appendix 2)
Mill water pond	Weekly (daily during filling)	Visual inspection and inspection for water seepage flows as per QZ96-006 (Appendix 2)
Waste rock and overburden dumps	Daily	Visual inspection as per QZ96-006 (Appendix 2)
Diversion Ditch	Daily	Visual inspection as per QZ96-006 (Appendix 2)

6 Instrumentation

A map of sitewide active and inactive (damaged or destroyed) instrumentation is shown in Appendix A. Installation information, data collection schedules, procedures, documentation and reporting for active instrumentation are contained in the following sections.

6.1 Location and Installation Information

6.1.1 Inclinometers

Inclinometers are used to measure lateral, differential ground movement in a borehole. Inclinometer stations consist of grouted, slotted PVC pipe into which the inclinometer probe is lowered and deflection is measured at 0.5m intervals. The current probe used on site is an RST digital MEMS inclinometer system.

Table 5: Inclinometers

ID	Area	Northing (m)	Easting (m)	Elevation (m)	A0 Azimuth	Hole Depth (m)	Date Installed	Reading Frequency
A2I-1	Dry Stack Tailings	6944164.73	385298.95	822.46	302	55.5	2013-04-26	Quarterly
DSI-10	Dry Stack Tailings	6944926.43	386114.98	780.13	-	85	2010-11-12	Bi-monthly
DSI-14	Dry Stack Tailings	6945107.35	385579.80	768.23	62	53	2013-04-08	Bi-weekly
DSI-16	Dry Stack Tailings	6944843.36	385919.57	792.51	354	92.5	2013-04-15	Bi-weekly
DSI-17	Dry Stack Tailings	6945034.51	385963.96	764.53	352	57	2013-04-09	Bi-weekly
DSI-18	Dry Stack Tailings	6945090.95	386132.08	764.60	322	101.5	2013-04-08	Quarterly
DSI-19	Dry Stack Tailings	6945218.17	386262.61	747.76	321	43.5	2013-04-08	Quarterly
DSI-20	Dry Stack Tailings	6944989.60	385394.56	780.47	35	32.5	2013-04-19	Bi-weekly
DSI-21	Dry Stack Tailings	6944587.73	385679.34	793.15	22	27	2013-04-21	Bi-weekly
MDI -2	Area 1 Pit/Main Waste Dump	6945013.08	384217.20	858.67	93	50.5	2010-02-10	Monthly
SDI - 1	Southwest Dump	6944770.08	384174.61	836.46	0	59.5	2010-02-10	Bi-weekly
SDI - 3	Southwest Dump	6944591.11	383966.00	847.42	90	46.5	2010-02-11	Bi-weekly
SDI - 5	Southwest Dump	6944328.87	383823.17	860.57	-	59.5	2011-10-24	Bi-weekly

6.1.2 Survey Hubs

Survey hubs are used to monitor surface movement of structures and are comprised of steel posts cemented into waste rock or bedrock and equipped with a threaded base to which a high precision RTK-corrected GPS instrument is attached. The GPS currently used on site is a Trimble R8.

Table 6: Survey Hubs

ID	Area	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Reading Frequency
A210	Area 2 Pit – south crest	6944268.42	384934.69	861.28	2011-07-01	Weekly
A211	Area 2 Pit – south crest	6944257.41	384891.47	869.88	2011-07-01	Weekly
ASH05	Airport road	6944280.52	385830.65	850.16	2011-03-07	Monthly
ASH06	Airport road	6944331.73	385623.79	824.17	2011-03-07	Monthly
DSSH-06	Dry Stack Tailings	6944971.61	385553.16	773.83	2010-04-06	Weekly
DSSH-10	Dry Stack Tailings	6944992.62	385807.51	763.12	2010-04-06	Weekly
DSSH-12	Dry Stack Tailings	6944933.16	385704.30	773.99	2010-04-06	Weekly
DSSH-14	Dry Stack Tailings	6944920.27	385606.55	782.88	2012-04-21	Weekly
DSSH-15	Dry Stack Tailings	6944942.65	385503.43	782.61	2012-04-21	Weekly
DSSH-17	Dry Stack Tailings	6944980.74	385896.26	772.07	2012-04-21	Weekly
DSSH-18	Dry Stack Tailings	6945069.81	385522.12	771.39	2014-02-28	Weekly
DSSH-19	Dry Stack Tailings	6945085.22	385642.14	769.16	2014-02-28	Weekly
DSSH-20	Dry Stack Tailings	6945137.83	385730.25	765.83	2014-02-28	Weekly
DSSH-21	Dry Stack Tailings	6945074.87	385735.67	767.74	2014-02-28	Weekly
DSSH-22	Dry Stack Tailings	6945023.66	385710.13	770.65	2014-02-28	Weekly
DSSH-23	Dry Stack Tailings	6944599.38	385491.13	797.40	2014-02-28	Weekly
DSSH-24	Dry Stack Tailings	6944757.90	385712.10	792.07	2014-02-28	Weekly
DSSH-25	Dry Stack Tailings	6944753.94	385894.65	793.38	2014-02-28	Weekly
M73	Area 1 Pit – south wall/buttress	6944723.57	384312.30	840.77	2011-05-23	Semi-weekly
M74	Area 1 Pit – south wall/buttress	6944670.85	384401.18	838.65	2011-05-23	Semi-weekly
M75	Area 1 Pit – south wall/buttress	6944639.43	384475.64	837.55	2011-05-23	Semi-weekly
M76	Area 1 Pit – south wall/buttress	6944623.10	384560.12	835.27	2011-05-23	Semi-weekly
M79	Area 1 Pit – south wall/buttress	6944846.97	384208.90	847.66	2011-09-04	Semi-weekly
M80	Area 1 Pit – south wall/buttress	6944931.70	384256.33	842.06	2011-09-04	Semi-weekly
M81	Area 1 Pit – south wall/buttress	6944971.63	384890.13	806.83	2012-05-08	Semi-weekly
SWD01	Southwest Dump	6944760.85	384077.86	859.07	2011-03-07	Monthly
SWD01A	Southwest Dump	6944762.95	384187.87	837.49	2011-03-07	Monthly
SWD02	Southwest Dump	6944570.23	383884.64	870.82	2011-03-07	Monthly
SWD02A	Southwest Dump	6944741.35	384108.95	840.78	2011-03-07	Monthly
SWD03A	Southwest Dump	6944510.77	383917.28	850.16	2011-03-07	Monthly
SWD04A	Southwest Dump	6944161.48	383793.96	861.32	2011-03-07	Monthly

ID	Area	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Reading Frequency
SWD05A	Southwest Dump	6943939.94	383837.70	869.16	2011-03-07	Monthly
WSP1	Water Storage Pond Dam	6945613.04	386480.98	723.31	2011-06-09	Monthly
WSP2	Water Storage Pond Dam	6945644.59	386545.46	724.42	2011-06-09	Monthly
WSP3	Water Storage Pond Dam	6945551.85	386548.62	719.73	2011-06-09	Monthly
WSP4	Water Storage Pond Dam	6945531.56	386555.22	719.93	2011-06-09	Monthly
WSP5	Water Storage Pond Dam	6945504.74	386560.23	721.02	2011-06-09	Monthly

6.1.3 Thermistors

Thermistor strings are used to measure ground temperature profiles in boreholes, and in particular permafrost conditions at Minto. Thermistor strings consist of multiple temperature sensor nodes distributed along a single multi-conductor cable, installed within or attached to the outside of grouted PVC pipe. EBA and RST thermistor strings have been installed on site. EBA thermistors are read using a basic ohmmeter and RST thermistors are read using a RST TH2016B readout unit.

Table 7: Thermistors

ID	Area	Northing (m)	Easting (m)	Elevation (m)	Thermistor String No.	Nodes	Hole Depth (m)	Date Installed	Reading Frequency
A2T-1	Area 2 Pit	6944162.01	385305.61	822.39	3491	16	63.4	2013-04-21	Monthly
DST-10	Dry Stack Tailings	6944584.06	385489.49	797.13	3492	16	63.4	2013-04-17	Monthly
DST-11	Dry Stack Tailings	6944899.64	385538.89	787.66	3494	16	86.9	2013-04-05	Monthly
DST-13	Dry Stack Tailings	6945014.60	386271.29	777.01	3495	16	101.5	2013-04-02	Monthly
DST-14	Dry Stack Tailings	6944769.09	385713.42	791.47	3497	16	66.5	2013-04-12	Monthly
DST-15	Dry Stack Tailings	6945033.78	385958.17	764.51	3493	16	64.0	2013-03-25	Monthly
MWPT1	Mill Water Pond	6944992.23	385062.50	784.12	2070	16	23.8	2007-11-02	Quarterly
MWPT2	Mill Water Pond	6945015.72	385113.61	784.22	2071	16	23.8	2007-11-02	Quarterly
MW11-01A	Mill Water Pond	6945010.90	385097.00	784.50	2320	11	101.70	2011-11-20	Quarterly
MW11-02	Ridgetop	6943887	385118	861.4	2322	7	30.79	2011-11-21	Quarterly
MW11-03	Ridgetop	6943730	385159	868.2	2321	7	30.79	2011-11-21	Quarterly
WDT - 1	Water Storage Pond	6945523.08	386550.83	720.03	2072	16	42.49	2007-11-16	Monthly
WDT - 2	Water Storage Pond	6945532.89	386574.77	713.66	2073	6	44.50	2007-11-07	Monthly
WDT - 3	Water Storage Pond	6945544.10	386544.43	719.78	2074	16	49.42	2007-11-11	Monthly
WDT - 4	Water Storage Pond	6945534.98	386547.90	719.85	2075	16	49.42	2007-11-10	Monthly
WDT - 5	Water Storage Pond	6945504.57	386557.50	721.03	2076	16	35.13	2007-11-13	Monthly
WDT - 6	Water Storage Pond	6945505.55	386556.32	721.03	2077	16	33.72	2007-11-13	Monthly
WDT - 7	Water Storage Pond	6945504.65	386556.39	721.08	2078	16	33.92	2007-11-13	Monthly
WDT - 8	Water Storage Pond	6945532.89	386574.77	713.66	2079	16	34.14	2007-11-07	Monthly
SDT-1	Southwest Dump	6944766.71	384779.13	836.36	2220	16	59.1	2010-02-04	Monthly
SDT-2	Southwest Dump	6944595.06	383971.30	847.11	2221	16	14.6	2010-01-31	Monthly
SDT-3	Southwest Dump	6944333.87	383824.67	860.17	2222	16	15.8	2010-01-28	Monthly
SDT-4	Southwest Dump	6944163.62	383783.54	860.99	2223	16	13.1	2010-01-30	Monthly

6.1.4 Vibrating Wire Piezometers

Vibrating wire piezometer strings are used to measure pore water pressure profiles in boreholes. They consist of mutltiple vibrating wire sensors installed on PVC pipe in grouted boreholes. RST vibrating wire piezometers are installed on site and data is collected with an RST VW2106 readout unit.

Table 8: Vibrating Wire Piezometers

ID	Area	Northing (m)	Easting (m)	Elevation (m)	Sensor	No.	Sensor Elevation (m)	Date Installed	Reading Frequency
DSP-5	Dry Stack Tailings	6944769	385713	791.47	DSP-5A	VW24851	765.47	2013-04-16	Monthly
					DSP-5B	VW24853	761.47		
DSP-6	Dry Stack Tailings	6944900	385539	787.66	DSP-6A	VW24850	769.56	2013-04-05	Monthly
					DSP-6B	VW24852	765.56		
WDP-2	Water Storage Pond	6945632	386545	701.67	WDP-2	VW7212	701.67	2007-11-04	Monthly
WDP-3A	Water Storage Pond	6945618	386498	712.62	WDP-3A	VW7557	712.62	2007-11-28	Monthly
WDP-3	Water Storage Pond	6945609	386500	712.60	WDP-3	VW7202	712.60	2007-11-12	Monthly
WDP-4	Water Storage Pond	6945609	386500	702.60	WD -4	VW7210	702.60	2007-11-14	Monthly
WDP-5	Water Storage Pond	6945605	386526	712.35	WDP-5	VW7204	712.35	2007-11-20	Monthly
WDP-6	Water Storage Pond	6945605	386526	701.50	WDP-6	VW7214	701.50	2007-11-20	Monthly
WDP-7	Water Storage Pond	6945605	386526	689.20	WDP-7	VW7208	689.20	2007-11-20	Monthly
WDP-8	Water Storage Pond	6945554	386542	693.10	WDP-8	VW7200	693.10	2007-11-18	Monthly
WDP-9	Water Storage Pond	6945554	386542	687.93	WDP-9	VW7206	687.93	2007-11-18	Monthly
WDP-10	Water Storage Pond	6945554	386542	676.17	WDP-10	VW7211	676.17	2007-11-18	Monthly
WDP-11	Water Storage Pond	6945523	386551	712.96	WDP-11	VW7201	712.96	2007-11-16	Monthly
WDP-12	Water Storage Pond	6945523	386551	694.64	WDP-12	VW7209	694.64	2007-11-16	Monthly
WDP-13	Water Storage Pond	6945533	386578	684.55	WDP-13	VW7205	684.55	2007-11-07	Monthly
SDP-2	Southwest Dump	6944595.06	383971.30	843.41	SDP-2A	VW12912	843.414	2010-01-31	Monthly
					SDP-2B	VW12911	842.714		
SDP-3	Southwest Dump	6944333.87	383824.67	854.27	SDP-3A	VW12906	854.266	2010-01-28	Monthly
					SDP-3B	VW12907	853.566		
SDP-4	Southwest Dump	6944163.62	383783.54	858.49	SDP-4A	VW12908	858.494	2010-01-30	Monthly
					SDP-4B	VW12909	857.794		

7 Procedures and Documentation

7.1 Data Collection Schedule

Data is collected by geotechnical technicians in the mine technical department. A regular schedule is followed and is used for tracking compliance with license requirements. The schedule is stored in the following location:

X:\Mine Technical\03 – Monitoring\Monitoring To Do Frequency.xlxs

7.2 Data Collection Procedures

Data collection manuals for all monitoring devices are included in Appendix B.

7.3 Documentation

After collection, data is input into a series of spreadsheets and databases used for storing, tracking and plotting instrumentation data. Instructions for data input are contained in the instrumentation manuals in Appendix B.

Data input files are stored in the following location:

X:\Mine Technical\03 - Monitoring

8 Quality Assurance/Quality Control

Task observations are routinely performed on monitoring technicians to verify data collection is consistent with the designed procedures. These reviews are documented as Job Observations.

Data collection equipment is returned to the manufacturers as per their recommended calibration schedules, typically annually.

All data is reviewed and summarized by the Geotechnical Engineer monthly as part of the monthly Water Use Licence submission.

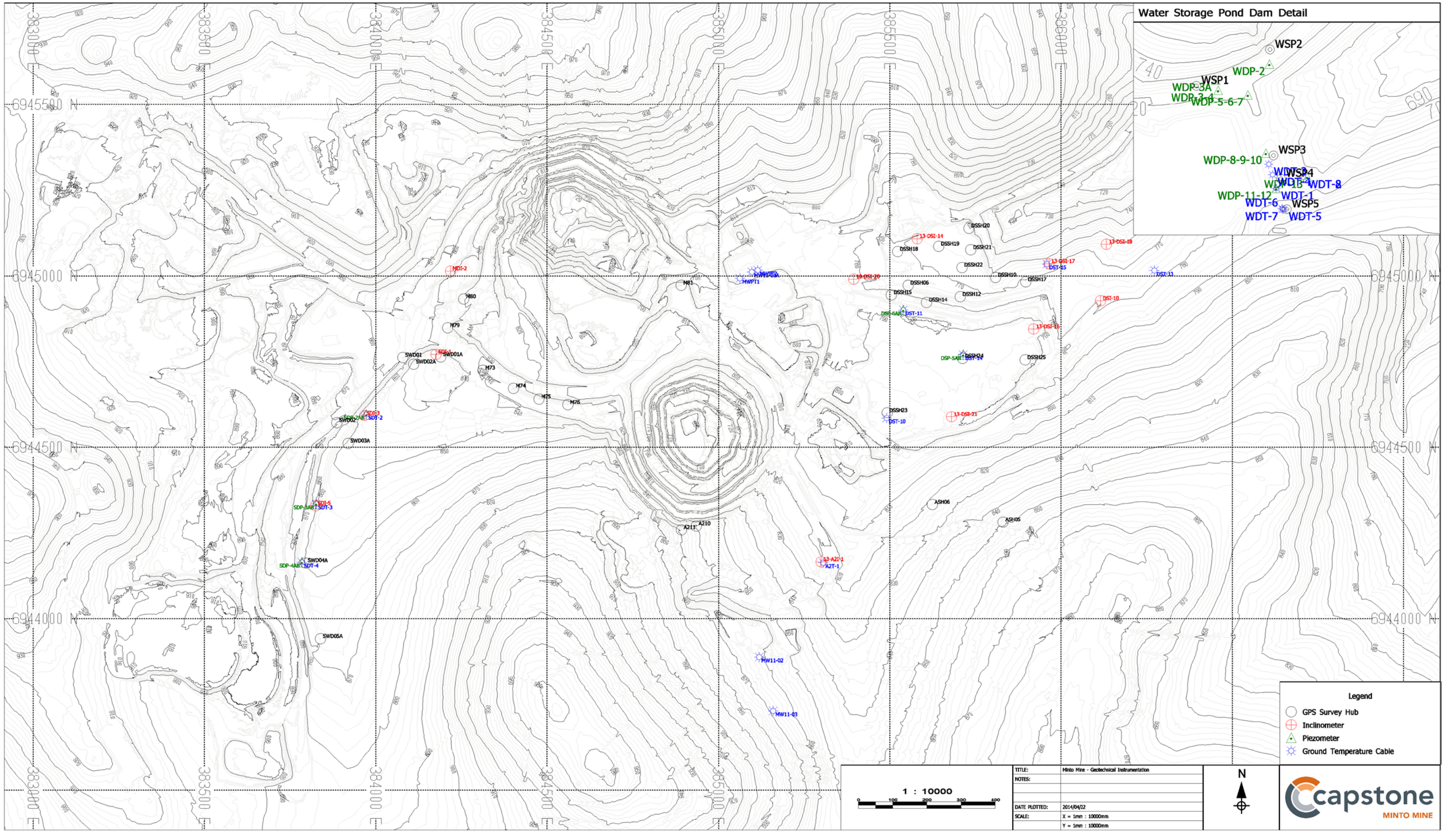
9 Reporting

Regular processing and review of monitoring data is completed and presented in the following documents, as mandated in QZ96-006, Amendment 8.

Table 9: Reporting

Report	Frequency	Submission
Pit Wall Inspection Report	Weekly	Submitted internally every Sunday
Minto Mine Water Licence QZ96-006 Monthly Report (Clause 11)	Monthly	Submitted to Yukon Water Board maximum 30 days following each month
Minto Mine Water Licence QZ96-006 Quarterly Report (Clause 15)	Quarterly	Submitted to Yukon Water Board maximum 90 days following each quarter
Minto Mine Water Licence QZ96-006 Annual Report (Clause17)	Annually	Submitted to Yukon Water Board by March 31 each year
Semi-Annual Geotechnical Review Report (Clause 82)	Semi-annually, after spring melt (May/June) and before freeze-up (September)	Submitted to Yukon Water Board within 45 days of inspections

Appendix A: Instrumentation Map



Appendix B: Data Collection and Input Manuals

Inclinometer Measurements

Please refer to RST MEMS Digital Inclinometer System Instruction Manual for complete instruction.

System Overview:

Figure 1 – System Overview

1. Soft Shell Case
2. Digital Inclinometer Probe (w/ protective end cap)
3. Reel Battery Charger
4. 70mm/2.75" OD Cable Grip
5. 85mm/3.34" OD Cable Grip
6. Ultra-Rugged Field PC
7. 12V DC car adapter for Reel Battery Charger or Ultra-Rugged Field PC
8. Spare Reel Battery
9. Silicone Lubricant (for use on connectors)
10. USB Cable for Ultra-Rugged Field PC
11. AC Adapter (110-240V) for Reel Battery Charger
12. AC Adapter (110-240V) for Ultra-Rugged Field PC
13. Cable Reel with Wireless Communication System and protective end cap
14. Reel Carrying Case

1. Make sure the battery for the reel and the Field PC are charged.
2. Lift up protective box with two hands and put it on side as a work bench.

3. Remove cap from inclinometer casing and look for A_0 marking (black mark).

4. Remove excess water inside the probe and the cable connector.
   Probe is very sensitive and susceptible to vibration. **DO NOT BANG THE PROBE**. Use a paper towel to wipe it.

5. Apply silicon lubricant to probe and cable connector when needed.

6. Connect the inclinometer cable to the probe by aligning the keyways and threading the connector onto the probe. Turn the threaded ring, but not the cable.

7. Turn on the power of the reel. A green light indicates that the power is on. This energizes the accelerometers and makes them less susceptible to shock.

8. Check the depth of the hole. Turn on Field PC and select the hole you are going to measure.

9. Always start with **UPPER** Wheel in the A_0 direction.

10. Lower the probe gently and carefully. When it gets close to the bottom lower it very gently to avoid bouncing the probe off the bottom of the hole. The cable has aluminum sleeve marks which are spaced at 0.5m and it has a red measure mark with label every 5m.

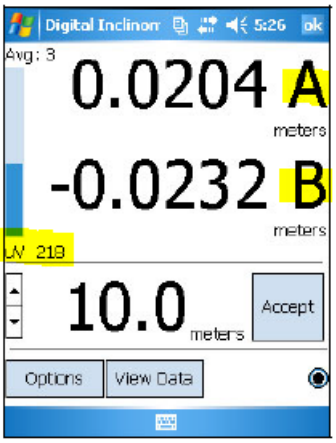
11. Lower the probe gently to ensure the bottom of the hole is encountered. (Slightly passed the designated depth). Double check your correct depth by pulling out reel to the next 5m mark and counting back each 0.5m for each increment.

12. Place the cable grip on top of the casing and hang the cable by the aluminum crimps.

13. Connect the Field PC to the reel. Use the pen attached to the field PC and press "*Connections".*

14. Once connected, hit "*Readings*".

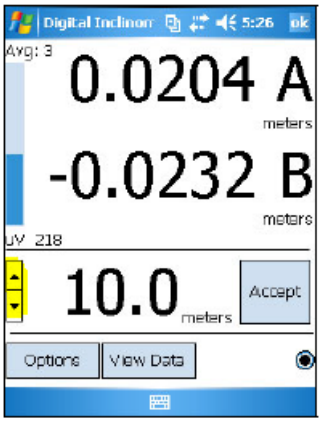

15. At each depth allow the A and B readings as well as the noise level become stabilized before you accept the readings. Ideally noise level should be at or below 30 µV.



16. Wear gloves as the Envirobind inside the inclinometer casing can be sticky and irritable. Pull up gently to the next marker and let the aluminum crimp to sit on the metal grip. Wait for the readings and noise level to stabilize and then hit *"Accept"*.


17. If you accidentally pull the probe too far (more than an inch), lower the probe back down to the previous bead then pull up to the bead you want to measure. This will ensure that the readings remain consistent.

18. At each 5m mark, check that you are at the right location. If you miss or overpass a reading, go back to the previous 5m depth. For examples, if something goes wrong at 41.5m, go back to 45m and drop the cable to 45.5m. Then gently pull up to 45m and hit *"Accept"* again. There are arrow keys on the Field PC which allow you to adjust your depth.



19. Once the last reading (0.5m) is taken, gently take out the probe and turn it 180° so that the **Lower** wheel is now in the A_0 direction.

20. Go back gently to the bottom of hole and take the second set of readings.

21. During the measurement of the second set of readings, checksum data will appear in a smaller font below the current readings. Checksum should be reasonably small and consistent. Ideally it should be somewhere between -0.0035m to +0.0045m.

22. If the checksum is large (> 0.01m) and inconsistent, check the following:
    - Is the probe at the right depth?
    - Is the probe in the correct direction?
    - Lower the probe to the previous depth and retake the reading again.

    It is possible that checksum is high due to differential pressure in the ground. In that case continue measurement and keep monitoring checksum.

23. Once readings are completed, take out the probe and wipe away the Envirobind gently. Put the caps back onto the probe and connector.

Data Input

Note: Windows Mobile Device Center must be installed on the computer in order to collect the readout unit to the computer.

1. Connect the USB cable from the readout unit to the computer and turn the power on.
2. Open DMM for Windows

3. *File – Open – Project Database*
   The database for all inclinometer data is stored here:
   X:\Mine Technical\03 - Monitoring\! Inclinometers\Master Database

4. *File – Import – Import RPP file*
   Navigate to the mobile device and select the .rpp file for the appropriate monitoring station and date. The data will then import and save in the database automatically.

Thermistor Readings

Two different types of thermistors are currently installed on site – RST and EBA thermistors.

To read RST thermistors:

1. Connect adapter cord to the TH2016B Readout Box.
2. Record the resistivity (Ohms) for each thermistor node on paper or store the data in the readout box with the following steps:
    a. Scroll with the Up/Down arrows to the ***Memory*** screen and press enter (arrow key)

    b. Scroll with the Up/Down arrows to the ***Store Data*** screen and press enter

    c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading

    d. The data is now stored and the readbox can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.

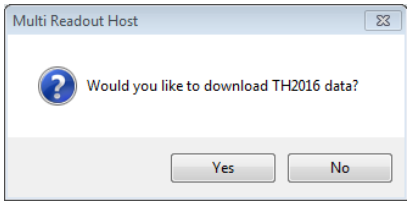
To read EBA thermistors:

1. Connect the EBA 16 Point Ground Temperature Dial into the thermistor cable.
2. Connect the multi-meter to the EBA 16 Point Ground Temperature Dial.
3. Record on paper the resistance in Ohm's (Ω) for each point.

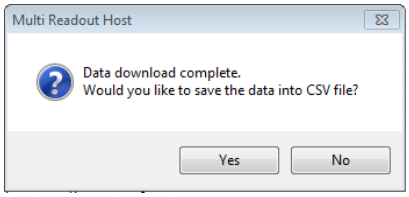
Data Downloading

1. Connect USB cord from computer to the readout box.
2. Open the software Multi Readout Host.

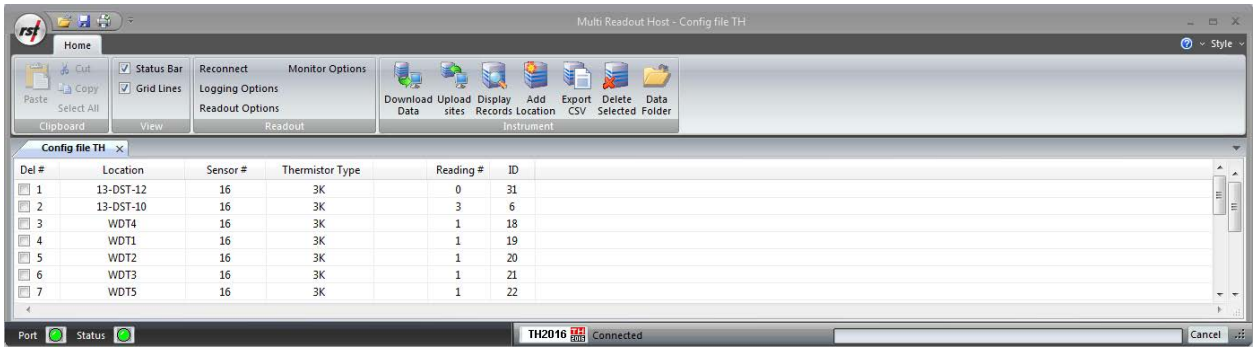
3. Turn on the power on the readout box.
4. The software will recognize the readout unit and prompt to download data. Choose “Yes” to download the data from the readout unit.



5. Once data is downloaded you will have the option to save all data as .csv file. Choose “Yes” and the data will be stored in My Documents in a folder named “TH2016data”.



6. The software can be used to setup new locations or view data but no further steps are required.

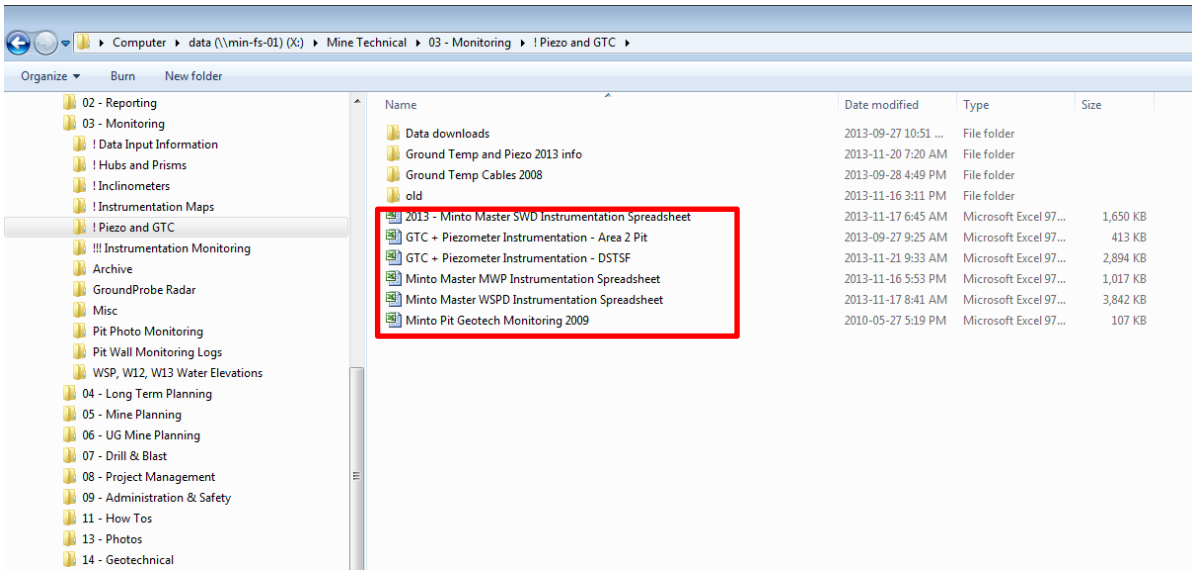


Data Input

Spreadsheets for piezometer data input and tracking are stored here:

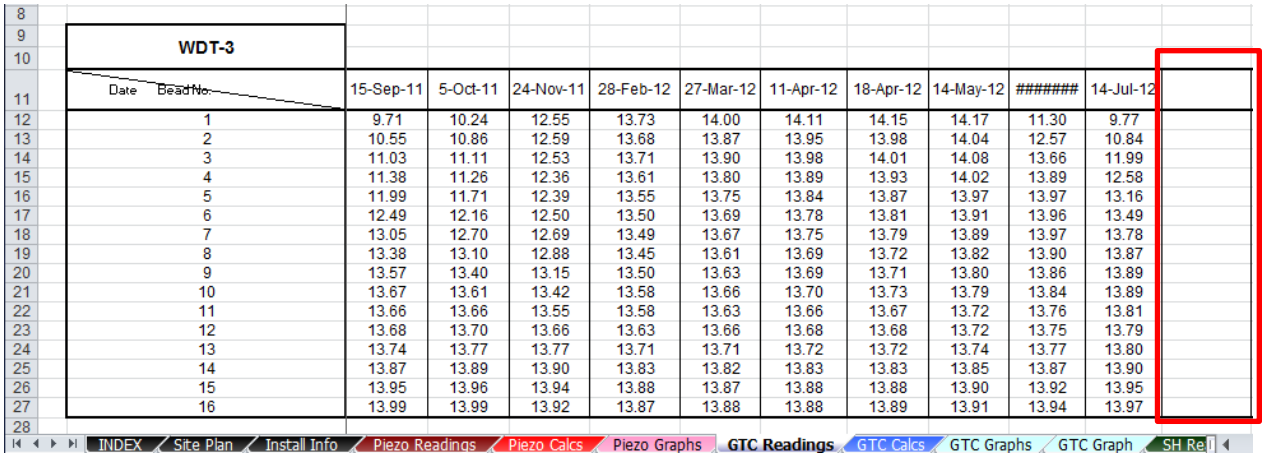
X:\Mine Technical\03 - Monitoring\! Piezo and GTC

1. Open the spreadsheet for the area monitored



2. Open the tab “GTC Readings”

3. In a new column enter the date and copy the resistivity data (Ohms) from the paper records, or from the .csv file saved in either “TH2016data” or “VW2016data” saved in My Documents.



WDT-3											
Date / Bead No.	15-Sep-11	5-Oct-11	24-Nov-11	28-Feb-12	27-Mar-12	11-Apr-12	18-Apr-12	14-May-12	########	14-Jul-12	
1	9.71	10.24	12.55	13.73	14.00	14.11	14.15	14.17	11.30	9.77	
2	10.55	10.86	12.59	13.68	13.87	13.95	13.98	14.04	12.57	10.84	
3	11.03	11.11	12.53	13.71	13.90	13.98	14.01	14.08	13.66	11.99	
4	11.38	11.26	12.36	13.61	13.80	13.89	13.93	14.02	13.89	12.58	
5	11.99	11.71	12.39	13.55	13.75	13.84	13.87	13.97	13.97	13.16	
6	12.49	12.16	12.50	13.50	13.69	13.78	13.81	13.91	13.96	13.49	
7	13.05	12.70	12.69	13.49	13.67	13.75	13.79	13.89	13.97	13.78	
8	13.38	13.10	12.88	13.45	13.61	13.69	13.72	13.82	13.90	13.87	
9	13.57	13.40	13.15	13.50	13.63	13.69	13.71	13.80	13.86	13.89	
10	13.67	13.61	13.42	13.58	13.66	13.70	13.73	13.79	13.84	13.89	
11	13.66	13.66	13.55	13.58	13.63	13.66	13.67	13.72	13.76	13.81	
12	13.68	13.70	13.66	13.63	13.66	13.68	13.68	13.72	13.75	13.79	
13	13.74	13.77	13.77	13.71	13.71	13.72	13.72	13.74	13.77	13.80	
14	13.87	13.89	13.90	13.83	13.82	13.83	13.83	13.85	13.87	13.90	
15	13.95	13.96	13.94	13.88	13.87	13.88	13.88	13.90	13.92	13.95	
16	13.99	13.99	13.92	13.87	13.88	13.88	13.89	13.91	13.94	13.97	

INDEX | Site Plan | Install Info | Piezo Readings | Piezo Calcs | Piezo Graphs | GTC Readings | GTC Calcs | GTC Graphs | GTC Graph | SH Re

Vibrating Wire Piezometer Readings

1. Connect adapter cord to the VW2106 Readout Box.
2. Connect the coloured wires to the correct wire clips on the extension cable. Make sure the wires do not touch each other.
3. Record the **DATE** and **TIME** as barometric pressure will be needed to calibrate the water level.
4. Record the measurement (between 7000B to 9000B) and the temperature (°C) for each piezometer. The piezometer ID should be labeled on the wire (eg. P5a and P5b).

5. Alternatively the data can be stored in the readout box:

    a. Scroll with the Up/Down arrows to the ***Memory*** screen and press enter (arrow key)

    b. Scroll with the Up/Down arrows to the ***Store Data*** screen and press enter

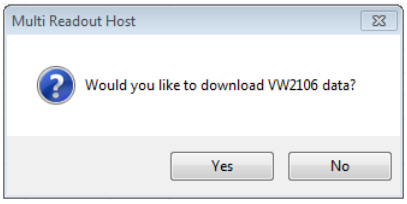
c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading

d. The data is now stored and the readout box can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.

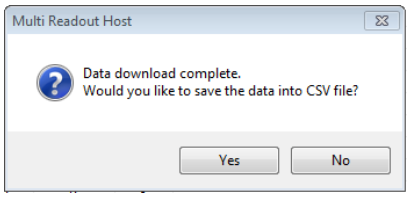
Data Downloading

7. Connect USB cord from computer to the readout box.
8. Open the software Multi Readout Host.

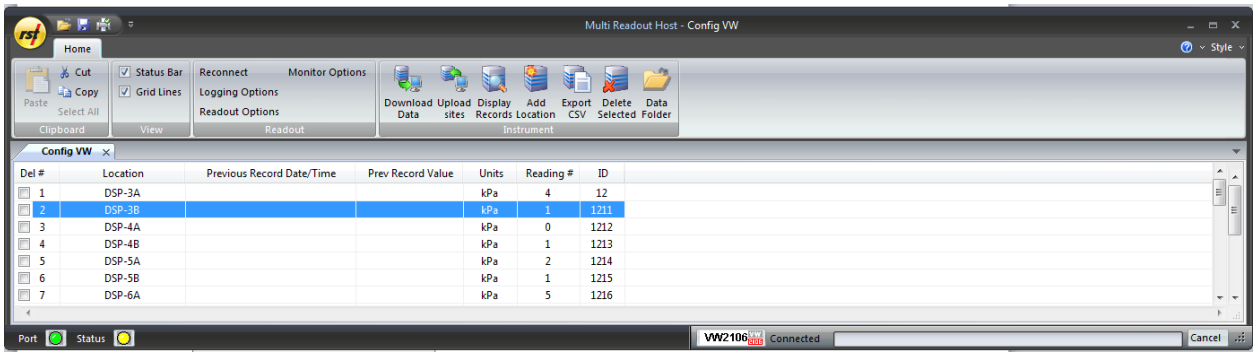
9. Turn on the power on the readout box.
10. The software will recognize the readout unit and prompt to download data. Choose “Yes” to download the data from the readout unit.



11. Once data is downloaded you will have the option to save all data as .csv file. Choose “Yes” and the data will be stored in My Documents in a folder named “VW2016data”.



12. The software can be used to setup new locations or view data but no further steps are required.

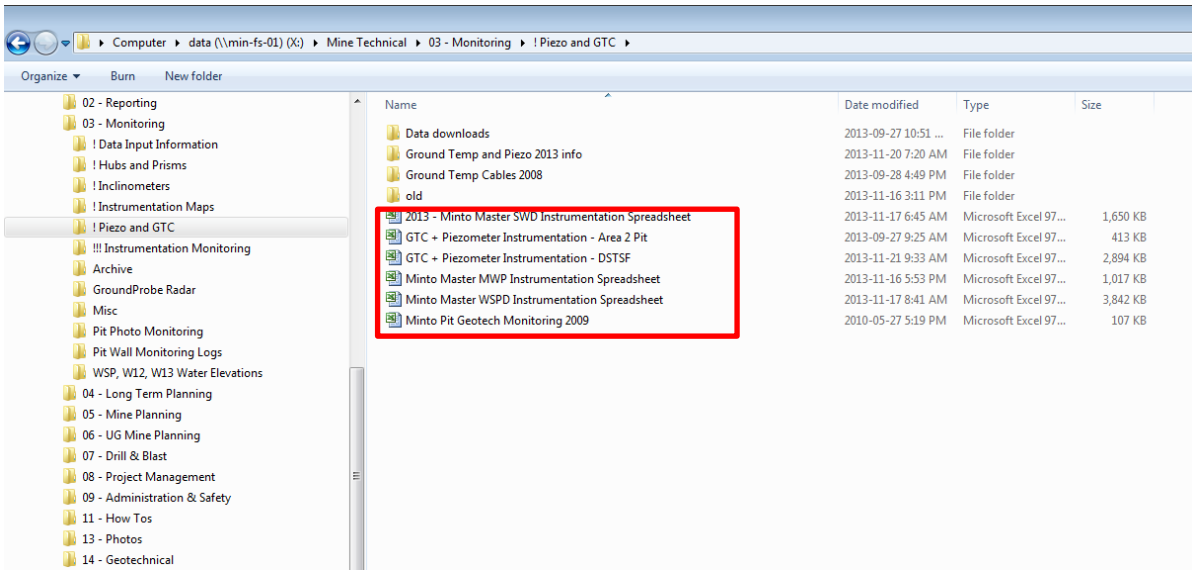


Data Input

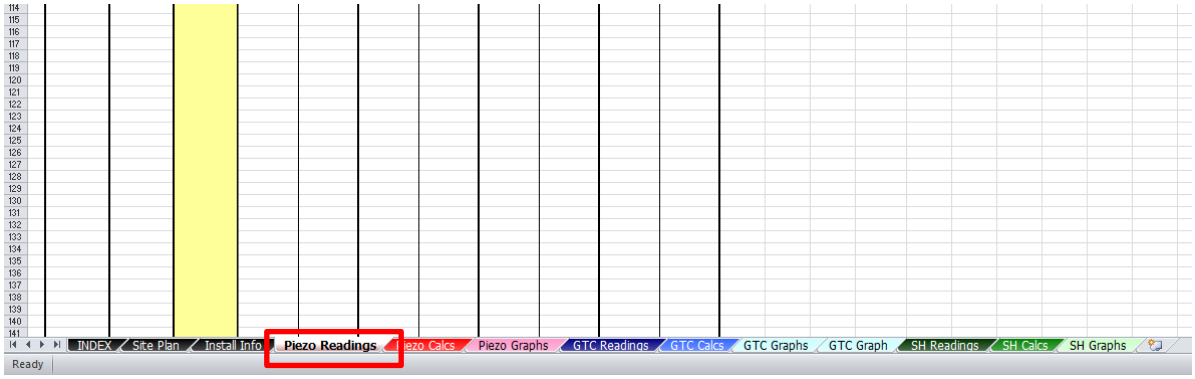
Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

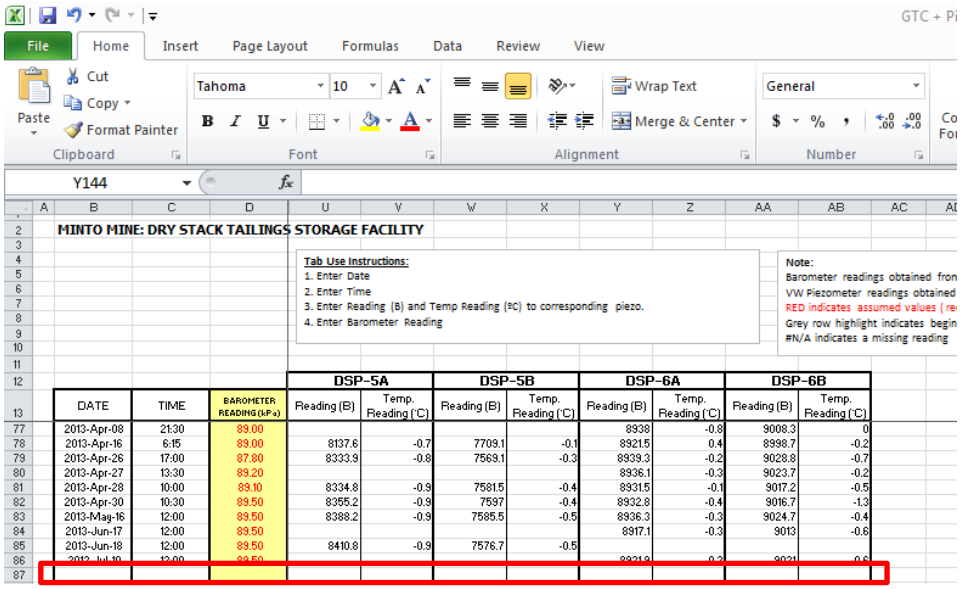
4. Open the spreadsheet for the area monitored



5. Open the tab “Piezo Readings”



6. In a new row, input the date, time, barometric pressure, B-unit and temperature readings for each instrument.



MINTO MINE: DRY STACK TAILINGS STORAGE FACILITY

Tab Use Instructions:
1. Enter Date
2. Enter Time
3. Enter Reading (B) and Temp Reading (ºC) to corresponding piezo.
4. Enter Barometer Reading

Note:
Barometer readings obtained fron
VW Piezometer readings obtained
RED indicates assumed values (re
Grey row highlight indicates begin
#N/A indicates a missing reading

	DSP-5A		DSP-5B		DSP-6A		DSP-6B	
DATE	TIME	BAROMETER READING (kPa)	Reading (B)	Temp. Reading (˚C)	Reading (B)	Temp. Reading (˚C)	Reading (B)	Temp. Reading (˚C)	Reading (B)	Temp. Reading (˚C)
2013-Apr-08	21:30	89.00					8938	-0.8	9008.3	0
2013-Apr-16	6:15	89.00	8137.6	-0.7	7709.1	-0.1	8921.5	0.4	8998.7	-0.2
2013-Apr-26	17:00	87.80	8333.9	-0.8	7569.1	-0.3	8939.3	-0.2	9028.8	-0.7
2013-Apr-27	13:30	89.20					8936.1	-0.3	9023.7	-0.2
2013-Apr-28	10:00	89.10	8334.8	-0.9	7581.5	-0.4	8931.5	-0.1	9017.2	-0.5
2013-Apr-30	10:30	89.50	8355.2	-0.9	7597	-0.4	8932.8	-0.4	9016.7	-1.3
2013-May-16	12:00	89.50	8388.2	-0.9	7585.5	-0.5	8936.3	-0.3	9024.7	-0.4
2013-Jun-17	12:00	89.50					8917.1	-0.3	9013	-0.6
2013-Jun-18	12:00	89.50	8410.8	-0.9	7576.7	-0.5				

Barometric pressure can be obtained from the site's weather monitoring stations. Data is stored here:

X:\Environmental\Environmental Monitoring Program\1_MASTER LOGS\Meteorology Station Data\Met Station 1 and 2 Data Summary.xlsx

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