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Memorandum

To: Elsa Reclamation and Development Company Ltd.

From: Catherine Henry

CC: Kai Woloshyn

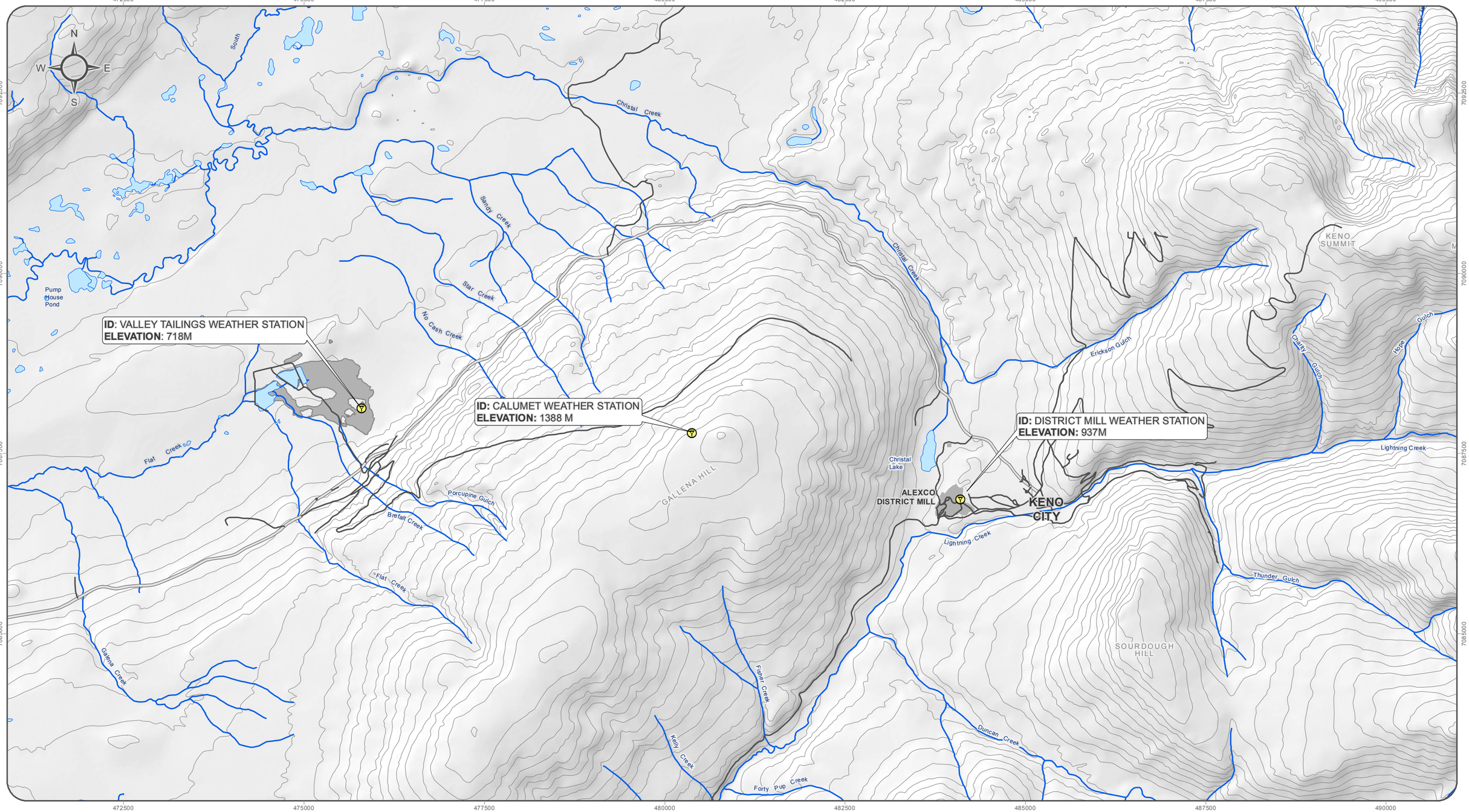
Date: February 11, 2017

Deliverable # 2016-009-9_14

Re: 2016 Meteorological Data Summary, Keno, YT

1. INTRODUCTION

This memo describes the meteorological data collected up to 2016 within the Keno Hill Silver Mining District at the Calumet weather station since 2007, at the District Mill meteorological station since 2011 (installed as part of Alexco's Bellekeno mining operations) and at the Valley Tailings meteorological station since 2012. The locations of the three weather stations are shown on Figure 1.



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Quartz claim boundaries current as of February 24th, 2011. Ownership data current as of December 20th, 2010. Data source: http://geomaticsyukon.ca.

Datum: NAD 83; Map Projection: UTM Zone 8N

1:50,000 (when printed on 11 x17 inch paper)

Kilometers
0 1 2 3

Weather Station

Highway
Road
Contours (100 ft)

Watercourse
Waterbody

ERDC

KENO HILL MINING DISTRICT

FIGURE 1

KENO METEOROLOGICAL STATIONS

JANUARY 2016

D:\Project\AllProjects\ALEX-05-01\gis\mxd\Overview_Maps\SpecifcTopics\Monitoring\Weather Stations\WeatherStations_20160106.mxd
(Last edited by: mducharme; 1/6/2016/15:53 PM)

2. CALUMET WEATHER STATION

An automated Onset HOBO meteorological station (Calumet Weather Station) was installed on Galena Hill above the Hector adit at 1,380 masl in June 2007 (UTM coordinates: 08 V 480377 7087790). See Attachment A for the list of components and a photo.

2.1. OBSERVATIONS AND EQUIPMENT CONDITION

- The station was commissioned on June 15, 2007, and logs air temperature, relative humidity, barometric pressure, rainfall, wind speed and direction at a height of 3 meters, solar radiation, and soil temperature all at a 15-minute interval.

- The wind sensor experiences occasional icing during the winter months; as such, extended periods of zero wind speed were invalidated. Also note that winter wind speeds may occasionally be underestimated due to the presence of ice on the sensor, but these occurrences cannot be detected in the data record.

- No total precipitation gauge or snowfall conversion adaptor is installed at this time, therefore only rainfall is measured. Note that instances of rainfall recorded at temperatures below zero are likely due to snowmelt.

- Datalogger connections for the soil temperature, rainfall and pressure sensors malfunctioned between June 23, 2016 and October 23, 2016, and these data are therefore missing for that period.

2.2. METHODS AND RESULTS

Monthly averages were calculated from 15-minute values recorded by the datalogger (averaged values from a 1 minute sampling interval). Average temperature and total rainfall are presented in Table 1 below.

Table 1 Monthly statistics for average temperature and total rainfall collected at Calumet Station

	Average Temperature (°C)										Total Rainfall (mm)									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
January	-	-17.18	-18.84	-14.08	-16.78[3]	-18.71[4]	-16.90	[6]	-13.22	*-8.34*[12]	-	-	-	-	-	-	-	[6]	0.0	*0.0*[12]
February	-	-16.99	-16.95	-9.09	-15.88[3]	-9.94[4]	-10.81	-15.69	-13.42	-9.32	-	-	-	-	1.8[3]	[9]	-	-	0.2	0.3
March	-	-11.04	-16.39	-9.21	-12.92[3]	-12.92[4]	-14.45	-11.95	-10.69	-5.84	-	-	-	-	0.5[3]	[9]	0.6	-	2.8	2.8
April	-	-4.93	-4.75	-2.01	-3.77[3]	-1.88[4]	-12.32	-4.39	-3.33	-0.43	-	1	-	1.3[3]	2.8[3]	[9]	0.2	6.2	8.6	7.8
May	-	3.31	3.66	5.35	4.41[3]	1.61[4]	n/a	4.17	7.85	5.55	-	25.4	21.8	32.3[3]	15.5[3]	[9]	n/a	17.2	4.0	23.0
June	*11.25*[1]	8.70	9.58	8.68	8.82[3]	7.76[4]	11.59	*7.31*[11]	8.42	10.07	*55.2*[1]	44.6	*11.8*[7]	56.7[3]	121.8[3]	[9]	45.2	*69.8* [11]	45.2	43.0
July	11.80	8.17	12.45	10.50	3.80[3]	7.84[4]	11.11	[11]	9.67	10.60	108.8	108.4	*22.8*[8]	137.7[3]	135.9[3]	*27.8*[10]	39.2	[11]	135.5	[13]
August	9.63	5.54	7.47	9.61	[2]	8.33[5]	10.58	7.95	6.71	9.25	54.8	110.2	89.4	140.0[3]	[9]	45.0	35.6	112.0	97.0	[13]
September	1.12	2.27	3.58	2.40	[2]	3.39	3.33	1.86	*2.17*[12]	2.95	57.6	61.4	50.4	78.0[3]	[9]	17.4	64.6	43.8	*46.4*[12]	[13]
October	-6.53	-7.20	-4.73	-4.86	[2]	-8.16	-2.52	-5.02	[12]	-6.23	-	12.6	-	16.0[3]	[9]	1.6	14.6	15.2	[12]	*0.0*[13]
November	-9.41	-10.17	-11.94	-11.19	-17.39[4]	-18.44	-15.50	-9.87	[12]	-8.87	-	-	-	-	-	0.2	0.0	0.2	[12]	0.0
December	-16.19	-18.34	-11.16	-17.72	-11.78[4]	-18.83	*-14.55*[6]	-10.43	[12]	-15.27	-	-	-	-	-	0.0	*0.0*[6]	0.0	[12]	0.0

Notes:

Values in grey italics indicate a partial month

[1] *Station commissioned June 15, 2007*

[2] *Temperature probe malfunction – no proxy data available*

[3] *Calculated from MAYO A data*

[4] *Sensor occasionally offline but most data complete*

[5] *Sensor replaced August 7*

[6] *The station was down from December 12, 2013 to January 31, 2014.*

[7] *Rainfall gauge malfunction on June 11; total rainfall provided for June 1-11.*

[8] *Rainfall gauge back online; total rainfall provided for July 7-31.*

[9] *Tipping bucket malfunction – no proxy data available.*

[10] *Tipping bucket repaired July 4th; total rainfall provided for July 4-31.*

[11] *Station was down between June 26 and July 31, 2014.*

[12] *Data missing from September 17, 2015 to January 5, 2016.*

[13] *Rainfall data missing from June 23, 2016 to October 23, 2016.*

3. DISTRICT MILL WEATHER STATION

The District Mill Campbell Scientific automated meteorological station is located above the dry stack tailings facility and below the old Keno City dump near Keno, YT (UTM coordinates: 08 V 0484009 7086872, elevation: 936 masl). See Attachment A for the list of components and a photo.

3.1. OBSERVATIONS AND EQUIPMENT CONDITION

- The Campbell Scientific Meteorological Station was commissioned on June 2, 2011 and includes sensors for the measurement of temperature, relative humidity, rainfall or total precipitation, wind speed and direction at a height of 10 meters, and solar radiation, all at a 1-hour interval.

- Relative humidity readings were invalidated from time of commissioning until May 7, 2012, at which time the problem was corrected by sending a revised program to the datalogger.

- A pyranometer (model SP Lite2) was installed on December 13, 2012, and the datalogger program was revised to incorporate hourly solar radiation readings and an evapotranspiration (ET) instruction. The ET instruction uses temperature, relative humidity, wind speed, solar radiation, latitude, longitude and altitude to calculate an evaporation rate for a short grass crop. This provides an approximation of actual evaporation, which varies locally depending on surface type and micro topography. Note that if one of the parameters listed above is invalid, the ET calculation is also invalidated.

- The wind sensor experiences occasional icing during the winter months and extended periods of zero wind speed were invalidated. Also note that winter wind speeds may occasionally be underestimated due to the presence of ice on the sensor, but these occurrences cannot be detected in the data record.

- The total precipitation gauge or snowfall conversion adaptor was not installed in 2011 or 2012, therefore only rainfall was measured. Note that instances of rainfall recorded at temperatures below zero are likely due to snowmelt. A snowfall converter was installed on October 15, 2013 and now records total precipitation going forward. In 2016, the snowfall conversion adaptor was removed on May 19 and reinstalled on October 22.

- An alter screen was installed around the precipitation gauge on June 3, 2015, to reduce wind induced error in total precipitation measurement.

3.2. METHODS AND RESULTS

Monthly averages were calculated from hourly values recorded by the datalogger (averaged values from a 10 seconds sampling interval) for the following parameters: temperature, daily maximum temperature, daily minimum temperature, relative humidity, wind speed, maximum wind speed and solar radiation. Monthly extreme maximum temperature, extreme minimum temperature, maximum wind speed, total rainfall and total evapotranspiration are also shown in Table 2 below.

Wind data from time of commissioning to December 31, 2016 are also depicted in the wind rose presented in Figure 2, which was produced using WRPLOT View software. This period has a 92.1% data availability.

Table 2 Monthly statistics for meteorological parameters collected at District Mill Station

Month-Year (MMM-YY)	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm)	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
Jun -11[2]	24.72	18.59	11.96	6.30	-2.56	n/a	n/a	1.35	9.14	n/a	n/a
Jul-11	25.67	18.50	12.91	8.00	5.09	n/a	n/a	1.15	8.02	n/a	n/a
Aug-11	22.32	15.58	9.78	5.37	1.93	n/a	n/a	1.18	9.15	n/a	n/a
Sep-11	17.97	11.29	6.07	1.85	-2.47	n/a	n/a	1.43	11.36	n/a	n/a
Oct-11	7.20	0.20	-2.74	-5.41	-9.84	n/a	*2.60*[3]	0.94	13.12	n/a	n/a
Nov-11	-4.23	-16.79	-19.54	-22.47	-34.99	n/a	0.00	0.58	12.05	n/a	n/a
Jan-12	-0.96	-19.10	-23.13	-26.79	-37.32	n/a	0.00	*0.59*	*9.51*	n/a	n/a
Feb-12	2.77	-6.77	-10.00	-13.07	-26.78	n/a	0.10 [4]	*1.38*	*15.62*	n/a	n/a
Mar-12	5.33	-7.69	-13.37	-18.00	-27.80	n/a	0.00	*0.97*	*9.24*	n/a	n/a
Apr-12	9.69	6.13	0.96	-3.87	-15.92	n/a	0.60 [4]	1.37	10.27	n/a	n/a
May-12	17.78	10.73	6.31	1.91	-3.47	*51.81* [5]	18.30	1.78	10.60	n/a	n/a
Jun-12	27.62	18.41	13.46	8.29	4.42	56.35	21.70	1.44	10.26	n/a	n/a
Jul-12	25.14	18.07	12.75	7.73	1.64	69.26	85.80	1.36	12.99	n/a	n/a
Aug-12	21.72	16.31	11.25	6.56	-0.89	67.79	47.00	1.62	9.41	n/a	n/a
Sep-12	20.24	10.33	5.90	2.08	-5.22	69.51	36.40	1.84	14.27	n/a	n/a
Oct-12	7.60	-3.95	-7.35	-10.32	-20.62	79.54	7.60	1.13	10.37	n/a	n/a
Nov-12	-8.98	-19.55	-21.90	-24.32	-33.36	81.43	0.00	0.94	9.36	n/a	n/a
Dec-12	-3.36	-21.30	-23.44	-25.58	-36.32	81.34	0.00	*0.26*	*5.93*	*1.01* [6]	*0.05* [7]
Jan-13	-1.59	-17.06	-20.01	-23.08	-41.48	82.92	0.00	*0.76*	*14.48*	1.06	0.81
Feb-13	1.54	-9.10	-12.52	-15.46	-23.74	88.36	0.30 [4]	*0.85*	*12.25*	10.26	1.27
Mar-13	3.26	-7.52	-13.16	-17.99	-29.96	64.08	3.90	1.59	12.47	95.82	6.33
Apr-13	6.07	-2.76	-7.94	-13.69	-25.07	54.50	8.20	2.44	12.93	190.02	14.48

Month-Year (MMM-YY)	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm)	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
May-13	23.31	10.20	5.27	0.23	-9.46	61.83	39.60	1.77	11.76	215.44	21.70
Jun-13	30.51	19.97	14.27	8.30	1.84	58.72	57.30	1.82	12.87	234.69	29.79
Jul-13	24.93	19.40	14.01	8.60	2.25	62.67	46.90	1.75	16.14	211.00	27.10
Aug-13	27.34	18.54	12.98	8.01	-0.38	66.30	51.90	1.49	11.05	156.25	21.38
Sep-13	16.11	9.69	5.81	2.26	-3.74	77.52	59.70	1.54	10.99	79.69	10.88
Oct-13	8.25	1.61	-1.32	-4.21	-10.10	86.75	44.60	1.11	11.62	35.75	4.26
Nov-13	0.18	-13.41	-16.68	-20.08	-37.96	84.26	10.60	*1.02*	*10.96*	4.93	*1.08*
Dec-13	-1.73	-21.23	-23.91	-26.70	-35.29	78.77	4.90	*0.75*	*9.47*	0.57	*0.62*
Jan-14	3.74	-9.33	-12.16	-15.10	-32.22	89.44	24.9	*0.72*	*10.03*	2.42	*0.641*
Feb-14	-1.93	-15.25	-19.40	-23.02	-33.55	75.20	2.9	0.87	10.85	31.34	1.988
Mar-14	4.57	-5.31	-11.29	-16.16	-26.79	54.77	0.7	1.57	11.98	115.54	9.174
Apr-14	10.93	4.09	-0.96	-5.78	-17.33	57.54	5.1	1.64	12.05	171.28	15.77
May-14	21.30	12.70	7.64	2.03	-3.03	52.18	12.8	2.09	19.21	217.91	29.81
Jun-14	24.93	16.21	11.39	5.95	-0.13	56.14	40.4	1.78	10.43	217.90	28.58
Jul-14	23.44	18.49	13.68	8.73	-0.04	65.01	31.0	1.63	13.38	187.31	23.84
Aug-14	22.09	15.57	10.87	6.93	0.06	74.59	67.7	1.44	11.85	139.84	15.72
Sep-14	17.70	8.76	4.28	0.49	-6.74	70.54	36.4	1.37	11.32	93.38	11.56
Oct-14	7.47	-0.91	-3.79	-6.33	-15.42	88.21	15.7	1.24	12.80	24.83	3.39
Nov-14	-2.21	-12.15	-14.34	-16.59	-30.16	88.64	1.40	*0.59*	*6.27*	3.12	*0.60*
Dec-14	-0.09	-11.05	-13.67	-16.31	-26.66	89.06	1.40 [9]	*0.51*	*8.87*	0.33	*0.40*
Jan-15	-0.34	-13.74	-16.50	-19.13	-34.86	85.85	1.9	*0.49*	*5.488*	1.30	*0.431*
Feb-15	2.87	-12.95	-15.93	-18.78	-39.39	84.95	12.7	0.75	10.36	9.06	0.859
Mar-15	5.54	-4.76	-9.83	-14.37	-28.70	70.52	4.1	1.45	12.6	86.48	6.292

Month-Year (MMM-YY)	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm)	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
Apr-15	10.90	5.36	0.56	-3.89	-10.48	61.71	4.2	1.75	12.37	163.45	16.03
May-15	26.51	16.95	10.96	4.60	-7.00	45.35	1.4	1.89	10.64	246.80	34.67
Jun-15	23.18	16.65	11.37	5.81	0.52	61.05	26.3	1.85	12.62	219.18	26.46
Jul-15	25.43	17.54	12.54	7.72	4.73	68.63	72.4	1.48	12.62	190.74	19.98
Aug-15	24.63	14.03	9.35	5.08	-3.09	75.14	54.9	*1.47*	*9.86*	146.76	*13.87*
Sep-15	13.57	7.07	2.77	-0.72	-7.72	79.33	32.6	1.71	15.64	83.01	10.12
Oct-15	7.32	0.88	-1.78	-4.16	-13.22	89.14	19.4	*1.08*	*10.07*	32.52	*2.92*
Nov-15	0.83	-11.17	-13.75	-17.16	-31.38	89.09	22.8	*0.71*	*12.15*	4.03	*0.60*
Dec-15	0.18	-12.38	-14.60	-16.93	-31.06	89.01	4.0	*4.59*	*14.24*	0.63	*0.13*
Jan-16	1.17	-8.96	-11.14	-13.58	-21.91	88.06	24.9	*0.83*	*15.35*	1.67	*1.45*
Feb-16	2.04	-7.63	-10.94	-14.27	-26.68	82.96	2.3	0.86	9.55	22.80	2.32
Mar-16	12.35	-0.55	-4.96	-8.72	-16.96	73.13	7.1	1.26	8.11	82.81	7.12
Apr-16	13.50	7.12	2.28	-2.23	-12.45	63.20	3.8	1.64	10.66	159.95	15.86
May-16	22.80	13.61	8.44	3.04	-1.59	54.73	14.7	1.89	11.89	210.96	25.97
Jun-16	25.98	18.36	12.88	7.17	2.27	56.52	40.0	1.76	13.37	234.99	29.78
Jul-16	23.73	17.71	13.37	9.07	1.71	73.05	63.4	1.46	12.54	173.59	17.36
Aug-16	24.42	16.67	11.92	7.82	1.22	70.86	42.2	1.50	10.69	152.32	17.72
Sep-16	17.42	10.00	5.01	0.90	-6.18	71.05	28.9	1.50	10.81	100.94	14.02
Oct-16	2.43	-3.20	-7.07	-9.99	-17.15	79.60	11.4	1.12	8.29	50.66	4.15
Nov-16	4.05	-8.20	-10.89	-13.45	-25.46	86.45	7.6	*0.80*	*9.57*	5.70	*1.99*
Dec-16	-4.20	-17.39	-19.62	-21.89	-32.16	83.76	1.3	*0.62*	*8.45*	0.56	*0.51*

Notes: *Values in grey italics indicate a partial month*

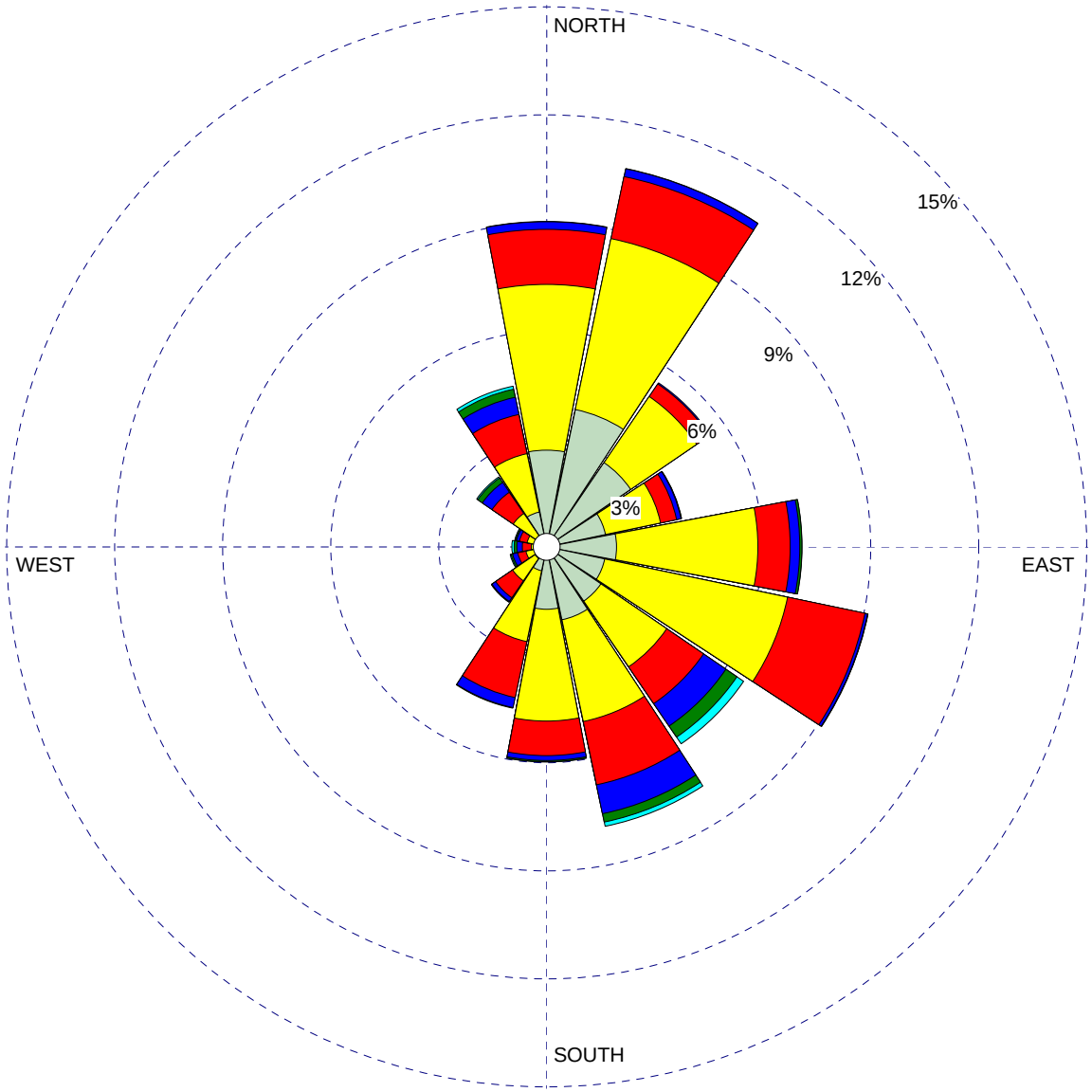
[1]January 2012 has 25 days of complete wind data
February 2012 has 28 days of complete wind data
March 2012 has 30 days of complete wind data
December 2012 has 15 days of complete wind data
January 2013 has 21 days of complete wind data
February 2013 has 26 days of complete wind data
November 2013 has 24 days of complete wind data
December 2013 has 20 days of complete wind data
January 2014 has 9 days of complete wind data
November 2014 has 23 days of complete wind data
December 2014 has 6 days of complete wind data
January 2015 has 24 days of complete wind data
August 2015 has 28 days of complete wind data
October 2015 has 29 days of complete wind data
November 2015 has 9 days of complete wind data
December 2015 has 0 days of complete wind data
January 2016 has 16 days of complete wind data
November 2016 has 23 days of complete wind data
December 2016 has 22 days of complete wind data
[2] June 2011 has 29 days of complete data (station commissioned on June 2)
[3] 16 days of complete rain data
[4] Rainfall recorded at temperatures below zero may be due to snowmelt
[5] 25 days of complete RH data
[6] 18 days of complete solar radiation data
[7] 7 days of complete evapotranspiration data
[8] Evapotranspiration is invalid where wind is invalid
[9]Total precipitation likely underestimated due to partial freezing in snowfall conversion adaptor

WIND ROSE PLOT:

Figure 2 - Keno District Mill Wind Rose
June 2011 - Dec 2016

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Excludes periods of ice affected or missing data.
Anemometer height: 10m

DATA PERIOD:

Start Date: 02/06/2011 - 00:00
End Date: 29/12/2016 - 16:00

TOTAL COUNT:	CALM WINDS:
45100 hrs.	**16.61%**

AVG. WIND SPEED:

1.29 m/s

COMPANY NAME:

MODELER:

DATE:

27/01/2017

PROJECT NO.:

Since the pyranometer was only installed in December 2012, no evapotranspiration data were calculated for 2011 or 2012. Estimates for evapotranspiration were developed previously from the 1996 data set using the computer program WREVAP developed by Environment Canada's National Hydrology Research Institute (Access, 1996). Since 2013, evapotranspiration is calculated in the datalogger program from local meteorological parameters, using the American Society of Civil Engineers (ASCE) standardized reference evapotranspiration equation (Penman-Monteith). Table 3 presents the comparison between the 2013, 2014, 2015, 2016 and the 1996 evapotranspiration data sets. It shows that the 1996 WREVAP evapotranspiration values may overestimate the local evapotranspiration, although more years of local evapotranspiration data will allow a more reliable comparison. It is interesting to note that results for 2013, 2014, 2015 and 2016 are very similar.

Table 3 Evapotranspiration Data Sets Comparison

Month	2013	2014	2015	2016	1996 WREVAP
January	*0.81*	*0.64*	*0.43*	*1.45*	0
February	*1.27*	1.99	0.86	2.32	0
March	6.33	9.17	6.29	7.12	0
April	14.48	15.77	16.03	15.86	10
May	21.70	29.81	34.67	25.97	42
June	29.79	28.58	26.46	29.78	43
July	27.10	23.84	19.98	17.36	44
August	21.38	15.72	13.87	17.72	20
September	10.88	11.56	10.12	14.02	20
October	4.26	3.39	*2.92*	4.15	0
November	*1.08*	*0.60*	*0.60*	*1.99*	0
December	*0.62*	*0.40*	*0.13*	*0.51*	0
Annual Total	**139.70**	**141.47**	**132.35**	**138.24**	**179**

** Values in grey italics indicate a partial month*

4. VALLEY TAILINGS WEATHER STATION

The Valley Tailings Onset HOBO automated meteorological station is located near the Valley Tailings at UTM coordinates: 08 V 0475799 7088130 and at an elevation of 718 masl. See Attachment A for the list of components and a photo.

4.1. OBSERVATIONS AND EQUIPMENT CONDITION

- The HOBO meteorological station was commissioned on October 19, 2012 and includes sensors for the measurement of temperature, relative humidity, rainfall, barometric pressure, soil water content, wind speed and direction at a height of 3 meters.

- The tipping bucket only records rainfall (not total precipitation). As the air temperature started to rise above 0°C in May 2013, it was noted that still no rain was being recorded. This observation triggered an inspection of the tipping bucket and the tipping mechanism was found to be obstructed. The obstruction was removed on May 16, 2013, and the tipping bucket is now functioning properly.

- The wind sensor experiences frequent icing during the winter months and extended periods of zero wind speed in combination with wind gusts of less than 1 m/s were invalidated. Similarly, extended periods with identical wind directions were also invalidated. Also, note that winter wind speeds may be underestimated due to the presence of ice on the sensor, but these occurrences cannot be detected in the data record.

- Starting on July 29, 2016, the wind direction data showed very little variability and it is suspected that results are invalid, due to a sensor or connection malfunction. The issue is currently being investigated.

- The logging interval was changed from 10 to 15 minutes on May 16, 2013, as this interval is sufficient for the purposes of this meteorological station and requires less datalogger memory.

4.2. METHODS AND RESULTS

Monthly averages from installation to December 2016 inclusively were calculated from instantaneous 10-minute or 15-minute values recorded by the datalogger for the following parameters: temperature, daily maximum temperature, daily minimum temperature, relative humidity, wind speed, gust speed, barometric pressure and solar radiation. Monthly extreme maximum temperature, extreme minimum temperature, maximum and minimum relative humidity, maximum gust speed and total rainfall are also shown in Table 4 below. Note that the barometric pressure has not been corrected for elevation and therefore represents the absolute pressure.

Table 4 Monthly Statistics for Meteorological Parameters Collected at the Valley Tailings Meteorological Station

Month	Extreme Minimum Temp.(°C)	Average Minimum Temp. (°C)	Average Temp. (°C)	Average Maximum Temp. (°C)	Extreme Maximum Temp. (°C)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Maximum Wind Speed (m/s)[3]	Extreme Maximum Wind Speed (m/s)[3]	Average Barometric Pressure (mbar)	Average Solar Radiation (W/m²)	Soil Average Water Content (%)[4]
Oct-2012[1]	*-23.84*	*-20.12*	*-15.71*	*-9.71*	*-4.05*	*81.92*	*89.16*	*70.76*	n/a	*0.51*	*1.39*	*7.81*	*939.06*	*34.14*	n/a
Nov-2012	-40.71	-27.24	-23.77	-20.42	-8.07	82.04	90.97	69.24	n/a	*0.59*	*1.66*	*7.81*	932.15	7.72	n/a
Dec-2012	-44.20	-29.97	-26.29	-22.98	-3.99	82.75	97.20	71.67	n/a	*0.52*	*1.75*	*6.04*	926.06	1.48	n/a
Jan-2013	-45.56	-25.98	-21.58	-17.72	0.74	84.73	94.43	72.60	n/a	*0.94*	*2.10*	*14.61*	929.62	4.78	n/a
Feb-2013	-24.88	-16.72	-12.96	-8.80	2.40	90.08	96.67	81.42	n/a	*0.90*	*2.09*	*10.83*	919.93	23.70	n/a
Mar-2013	-33.45	-21.40	-13.93	-5.74	5.57	68.05	92.35	53.08	n/a	*0.84*	*2.00*	*13.85*	931.80	93.31	n/a
Apr-2013	-25.05	-14.66	-7.17	-0.87	8.37	53.23	81.57	39.58	n/a	*2.01*	*4.10*	*16.62*	930.07	171.18	n/a
May-2013	-8.36	0.10	6.08	11.66	23.35	62.90	95.00	40.13	*4.80*	*1.42*	*3.26*	*11.84*	928.76	186.87	12.3
Jun-2013	1.64	8.20	15.63	22.00	32.82	58.66	84.24	42.04	46.20	1.50	3.45	22.66	930.76	215.51	8.0
Jul-2013	1.59	8.95	15.68	21.90	29.32	60.65	87.50	38.38	25.40	1.39	3.22	16.12	931.69	194.18	6.9
Aug-2013	-1.90	6.94	13.85	20.49	29.49	68.65	95.18	44.98	43.00	*0.93*	*2.45*	*13.60*	926.92	144.34	9.6
Sep-2013	-2.45	2.00	6.39	10.85	18.06	80.70	98.19	60.89	64.80	*1.19*	*2.83*	*17.38*	921.41	71.21	14.4
Oct-2013	-11.22	-5.32	-1.54	2.56	9.11	91.89	99.04	68.02	49.40	*0.61*	*1.86*	*11.58*	927.19	32.16	12.2
Nov-2013	-42.69	-22.40	-18.25	-14.23	-0.59	88.31	99.71	75.50	0.00	*0.55*	*1.71*	*11.58*	931.23	8.07	n/a
Dec-2013	-40.38	-30.71	-27.25	-23.50	-2.48	83.73	95.83	72.42	0.00	*0.49*	*1.72*	*9.07*	936.80	1.69	n/a
Jan-2014	-37.92	-18.28	-14.50	-10.52	1.67	93.54	99.99	81.10	0.00	*0.17*	*1.96*	*6.30*	926.22	2.73	n/a
Feb-2014	-39.42	-27.88	-22.85	-14.48	-3.33	84.27	91.09	77.57	0.00	*0.34*	*1.43*	*8.31*	933.74	27.52	n/a
Mar-2014	-30.55	-20.48	-12.32	-3.50	5.85	63.32	80.35	46.47	7.00	*0.75*	*2.17*	*9.57*	928.51	103.16	n/a
Apr-2014	-20.69	-6.99	-0.45	6.19	11.52	59.76	87.11	43.10	5.00	*1.34*	*3.20*	*13.09*	923.72	152.86	n/a
May-2014	-3.24	1.34	8.66	14.54	21.94	53.49	74.94	35.74	11.40	*1.39*	*3.41*	*13.35*	931.01	201.57	17.3
Jun-2014	-0.85	6.35	12.79	18.09	28.17	56.74	87.94	38.68	56.80	1.39	3.45	15.61	926.57	206.09	14.0
Jul-2014[5]	*6.86*	*9.96*	*16.01*	*21.50*	*24.85*	*64.71*	*82.34*	*48.07*	*32.20*	*1.30*	*3.24*	*13.35*	*930.01*	*193.02*	*14.0*

Month	Extreme Minimum Temp.(°C)	Average Minimum Temp. (°C)	Average Temp. (°C)	Average Maximum Temp. (°C)	Extreme Maximum Temp. (°C)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Maximum Wind Speed (m/s)[3]	Extreme Maximum Wind Speed (m/s)[3]	Average Barometric Pressure (mbar)	Average Solar Radiation (W/m²)	Soil Average Water Content (%)[4]
Aug-2014 [5]	Station Down – No data														
Sep-2014 [5]															
Oct-2014 [5]	*-17.47*	*-12.34*	*-7.87*	*-4.47*	*-1.47*	*93.68*	*95.52*	*90.51*	*0.00*	*0.69*	*1.93*	*7.05*	*923.44*	*16.88*	n/a
Nov-2014	-35.71	-18.96	-15.69	-12.75	-2.25	89.63	99.47	80.36	0.00	*0.75*	*2.09*	*8.06*	932.50	8.54	n/a
Dec-2014	-29.59	-18.70	-15.22	-12.12	-1.73	92.55	98.58	85.41	0.00	*0.59*	*1.93*	*10.32*	924.68	1.53	n/a
Jan-2015	-41.27	-22.34	-19.15	-15.78	-0.14	90.13	99.54	78.03	0.00	*0.32*	*1.68*	*9.07*	932.43	2.93	n/a
Feb-2015	-41.50	-21.41	-17.51	-12.68	3.85	89.56	99.96	78.51	13.60	*0.46*	*1.80*	*12.34*	935.86	22.75	n/a
Mar-2015	-31.12	-16.89	-10.20	-3.39	6.84	75.01	91.08	58.48	3.20	*1.00*	*2.33*	*13.35*	927.14	84.81	n/a
Apr-2015	-11.15	-4.79	1.23	7.51	12.53	64.06	88.56	50.40	13.80	*1.45*	*3.36*	*12.84*	921.78	153.92	n/a
May-2015	-6.99	3.25	11.76	18.45	27.55	48.65	67.29	33.82	6.00	*1.43*	*3.41*	*17.12*	932.37	235.70	21.4
Jun-2015	1.24	5.77	12.99	19.00	25.82	59.92	81.85	34.81	27.20	1.48	3.49	16.62	929.55	213.66	13.1
Jul-2015	4.14	7.64	13.90	19.65	27.16	69.15	93.72	43.99	82.60	1.05	2.63	10.83	927.71	180.54	17.2
Aug-2015	-2.57	4.53	10.52	15.76	25.84	76.20	95.53	54.67	69.20	*1.01*	*2.48*	*10.83*	927.00	138.77	20.2
Sep-2015	-8.10	-0.86	3.67	8.66	16.03	81.30	93.24	61.31	42.60	*1.29*	*2.97*	*21.40*	923.36	80.01	20.7
Oct-2015	-12.79	-4.25	-1.37	1.63	7.70	91.95	99.99	65.89	14.00	*0.75*	*2.01*	*8.56*	924.77	33.28	8.6
Nov-2015	-36.15	-18.71	-14.44	-10.89	2.64	92.87	99.34	82.48	0.00	*0.40*	*1.71*	*7.05*	921.85	6.59	n/a
Dec-2015	-33.38	-18.58	-15.58	-12.85	3.01	92.73	97.50	83.71	0.00	*0.46*	*2.12*	*11.84*	919.23	1.26	n/a
Jan-2016	-26.91	-16.61	-13.08	-10.02	4.17	91.42	98.22	78.66	0.00	*0.69*	*2.08*	*17.38*	922.28	4.92	n/a
Feb-2016	-34.26	-17.54	-12.62	-7.02	2.96	89.23	97.60	79.77	2.00	*0.49*	*1.71*	*9.82*	924.51	26.62	n/a
Mar-2016	-15.91	-9.95	-4.83	0.67	13.83	76.08	94.59	62.59	4.80	*1.34*	*2.86*	*9.82*	922.88	80.42	n/a
Apr-2016	-10.97	-2.76	2.77	8.43	15.25	65.43	92.00	46.16	3.20	*1.53*	*3.40*	*14.10*	925.77	151.79	6.8
May-2016	-2.10	2.56	9.64	15.44	23.88	56.10	83.81	36.95	16.40	*1.66*	*3.66*	*15.11*	931.02	205.21	25.5
Jun-2016	3.01	7.16	14.43	20.48	27.53	55.89	88.06	36.60	40.40	1.63	3.64	15.11	927.96	233.69	21.6

Month	Extreme Minimum Temp.(°C)	Average Minimum Temp. (°C)	Average Temp. (°C)	Average Maximum Temp. (°C)	Extreme Maximum Temp. (°C)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Maximum Wind Speed (m/s)[3]	Extreme Maximum Wind Speed (m/s)[3]	Average Barometric Pressure (mbar)	Average Solar Radiation (W/m²)	Soil Average Water Content (%)[4]
Jul-2016	0.63	9.33	14.84	20.11	26.92	73.54	93.34	54.86	67.20	1.08	2.67	11.84	929.36	173.57	23.9
Aug-2016	-1.47	7.05	12.77	18.13	24.80	73.62	94.25	58.18	45.80	1.15	2.75	15.11	932.57	146.43	23.6
Sep-2016	-6.14	0.03	5.67	11.48	18.11	73.70	94.96	34.79	39.40	*0.96*	*2.56*	*14.86*	927.36	98.46	23.4
Oct-2016	-22.37	-11.82	-7.27	-1.85	5.00	84.13	97.87	63.33	0.60	*0.57*	*1.77*	*9.32*	929.65	47.00	5.2
Nov-2016	-32.83	-17.19	-13.41	-9.77	5.62	90.97	99.91	74.28	6.80	*0.49*	*1.84*	*10.83*	919.86	6.43	1.0
Dec-2016	-39.74	-25.23	-21.84	-18.83	-3.42	87.07	96.70	76.06	0.00	*0.43*	*1.68*	*6.55*	931.27	1.78	0.2

Notes: *Values in grey italics indicate a partial month*

[1] Station was commissioned on October 19 so October 2012 has 12 days of complete data

[2] May2013 has 14 days of compete rain data

[3] October 2012 has 2 days of complete and 11 days of partial wind data
November 2012 has 5 days of complete and 24 days of partial wind data
December 2012 has 2 days of complete and 16 days of partial wind data and
January 2013 has 5 days of complete and 16 days of partial wind data
February 2013 has 2 days of complete and 26 days of partial wind data
March 2013 has 4 days of complete and 27 days of partial wind data
April 2013 has 14 days of complete and 16 days of partial wind data
May 2013 has 15 days of complete and 16 days of partial wind data
June 2013 has 29 days of complete and 1 day of partial wind data
August 2013 has 29 days of complete and 2 days of partial wind data
September 2013 has 15 days of complete and 15 days of partial wind data
October 2013 has 6 days of complete and 25 days of partial wind data
November 2013 has 1 day of complete and 28 days of partial wind data
December 2013 has 2 days of complete and 23 days of partial wind data
January 2014 has 0 days of complete and 12 days of partial wind data
February 2014 has 0 days of complete and 13 days of partial wind data
March 2014 has 1 days of complete and 30 days of partial wind data
April 2014 has 10 days of complete and 20 days of partial wind data
May 2014 has 21 days of complete and 10 days of partial wind data
December 2014 has 3 days of complete and 12 days of partial wind data
January 2015 has 0 days of complete and 14 days of partial wind data

February 2015 has 1 day of complete and 17 days of partial wind data
March 2015 has 5 days of complete and 26 days of partial wind data
April 2015 has 12 days of complete and 18 days of partial wind data
May 2015 has 27 days of complete and 4 days of partial wind data
August 2015 has 29 days of complete and 2 days of partial wind data
September 2015 has 14 days of complete and 16 days of partial wind data
October 2015 has 12 days of complete and 19 days of partial wind data
November 2015 has 1 day of complete and 23 days of partial wind data
December 2015 has 0 day of complete and 9 days of partial wind data
January 2016 has 4 days of complete and 19 days of partial wind data
February 2016 has 2 days of complete and 17 days of partial wind data
March 2016 has 8 days of complete and 23 days of partial wind data
April 2016 has 22 days of complete and 4 days of partial wind data
May 2016 has 30 days of complete and 1 day of partial wind data
September 2016 has 22 days of complete and 8 days of partial wind data
October 2016 has 4 days of complete and 27 days of partial wind data
November 2016 has 3 days of complete and 11 days of partial wind data
December 2016 has 0 day of complete and 18 days of partial wind data

[4] *Negative values reported from Oct 2012 to April 2013, from Nov 2013 to Apr 2014, from Oct 2014 to Apr 2015 and from Nov 2015 to March 2016 were invalidated – soil assumed to be frozen*

[5] *Station was down between July 16 and October 26, 2014*

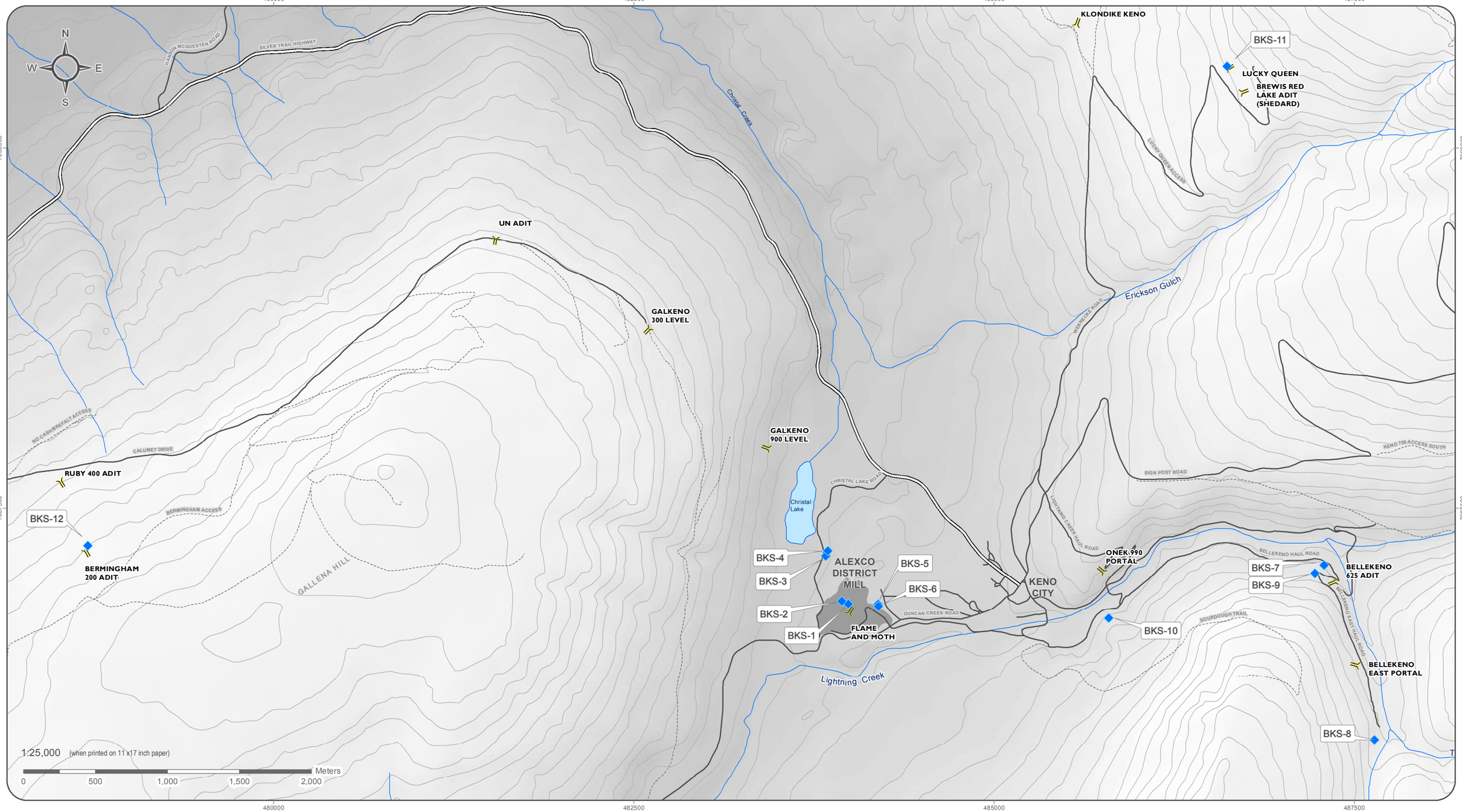
5. SNOW SURVEYS

Alexco has been conducting manual snow surveys since 2011 at ten monitoring stations in order to adequately represent the varying snow conditions as a function of aspect, elevation, etc. In 2016, surveys were conducted on January 30, March 2 and April 5. Snow water equivalent (SWE) results are presented in Table 5 below and the station locations are shown of Figure 3. Figure 4 presents the average snow water equivalent (SWE) across all stations.

Table 5 Snow Survey SWE Results (cm)

Station	Description	Jan 2011	Feb 2011	Mar 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	Feb 2015	Mar 2015	Apr 2015	Feb 2016	Mar 2016	April 2016
BKS-1	tall spruce up hill near dry stack	7.6	7.6	5.1	6.0	16.1	18.7	8.7	7.3	11.3	13.0	15.0	12.3	14.0	12.3	9.7	8.0	9.3	8.7	4.0	8.7	7.7
BKS-2	log pile near dry stack	7.6	7.6	7.6	12.2	13.6	9.3	20.8	9.3	10.7	11.7	13.8	10.3	10.7	10.0	7.7	9.0	10.3	9.0	8.0	11.0	10.3
BKS-3	Between 1 and 2 marker on CLR road	7.6	10.2	7.6	9.6	12.5	4.4	7.7	7.3	10.0	14.3	14.7	13.0	12.3	11.0	9.7	9.3	7.0	10.7	8.0	9.3	10.7
BKS-4	down road from BKS 3, closer to #2 CLR marker	7.6	7.6	7.6	8.5	17.6	12.3	8.8	9.3	11.7	18.3	14.3	12.7	12.0	11.7	7.3	3.7	8.7	7.3	10.0	8.7	12.3
BKS-5.0	Keno dump area. Near scrub trees	5.1	7.6	5.1	13.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BKS-5.1	Keno dump area. Near scrub trees	-	-	-	-	11.3	12.2	9.6	6.7	9.7	13.3	13.0	11.0	12.0	10.7	8.7	8.3	10.7	12.0	10.0	8.7	10.7
BKS-6	Keno dump area. On sloping hillside	2.5	2.5	0	11.2	12.6	14.8	19.8	6.7	9.2	12.0	11.3	10.7	10.3	8.7	8.3	7.3	8.7	9.0	8.0	8.0	8.3
BKS-7	Uphill from Bellekeno treatment pond	7.6	10.2	7.6	12.5	13.6	4.8	8.5	6.7	11.0	10.3	13.7	13.3	13.0	13.0	10.0	9.0	12.7	14.0	7.3	7.0	11.3
BKS-8	Far end of Bellekeno East. Nr explosive storage shed	7.6	7.6	5.1	9.9	13.8	17.6	19.5	8.0	10.0	18.5	19.7	9.3	12.7	12.7	10.7	6.7	17.0	12.3	7.3	9.3	-
BKS-9	At BKR 16 marker. Slightly up on hillside	7.6	10.2	10.2	12.4	13.3	17.1	0.00	7.3	10.0	15.0	14.0	12.3	11.7	11.3	9.0	7.7	10.7	8.3	7.3	7.0	0.0

Station	Description	Jan 2011	Feb 2011	Mar 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	Feb 2015	Mar 2015	Apr 2015	Feb 2016	Mar 2016	April 2016
BKS-10	Near BKR 8 pull out. Up on hillside	10.1	7.6	5.1	13.3	16.5	27.7	10.7	9.3	10.0	12.3	14.3	14.0	15.7	14.3	7.0	10.0	10.0	12.0	10.7	6.0	11.7
BKS-11	Lucky Queen, upslope of the pond	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.3	20.7	15.0
BKS-12	East of Bermingham 200 adit, Upslope of road	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.3
Mean	-	7.1	7.9	6.1	10.9	14.1	13.9	11.4	7.8	10.4	13.9	14.4	11.9	12.4	11.6	8.8	7.9	10.5	10.3	8.1	8.4	9.8



- Snow Monitoring Station
- Adit
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Contours (100 ft)
- Watercourse
- Waterbody

ERDC

AEG

ENVIRONMENTAL CONDITION REPORT

FIGURE 3

SNOW SURVEY STATIONS LOCATION

JANUARY 2017

D:\Project\AllProjects\ALEX-05-01\gis\mxd\Overview_Maps\SpecifcTopics\Monitoring\Snow Monitoring\SnowMonitoring_20170126.mxd
(Last edited by: mducharme; 1/26/2017/07:54 AM)

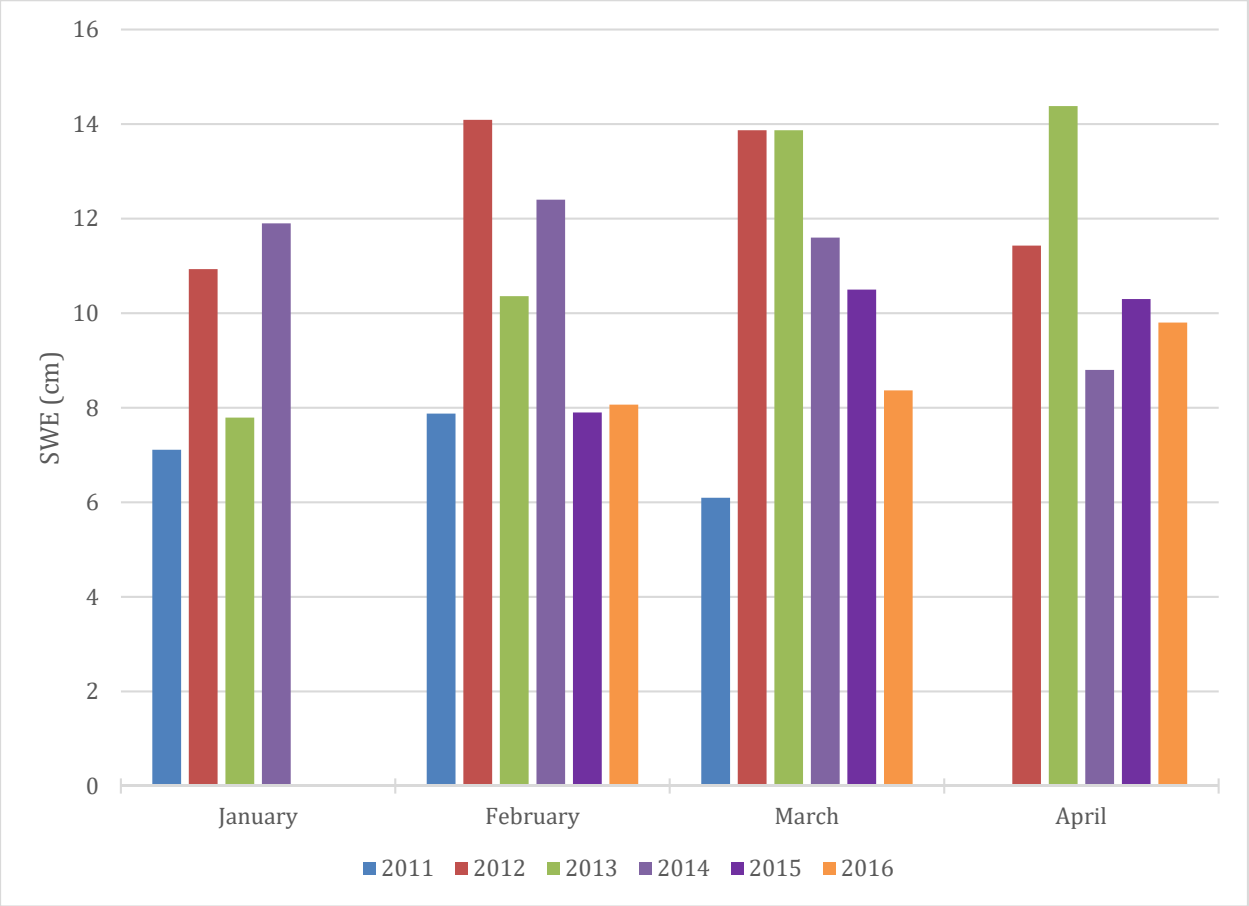


Figure 4 Average Snow Water Equivalent across all Snow Survey Stations

6. MEAN ANNUAL PRECIPITATION (MAP)

Mean annual precipitation (MAP) within a mountainous region typically increases with increasing elevation. The significant relief over which the Keno Hill area spans is well represented by two historical weather stations with Elsa at 814 masl and the Keno Hill weather station at 1472 masl. In 1996, Clearwater Consultants Ltd. used data from these two stations as well as from Environment Canada's station located at Mayo airport (504 masl.) to derive a relationship between MAP and elevation. Assuming a linear relationship, a line was fitted to the data of these stations (see Figure 5) (Access, 1996). The slope of this line indicates that MAP increases by an average of 27 mm for every 100 m of ascent, a value not too dissimilar from that observed in other regions of the Yukon interior.

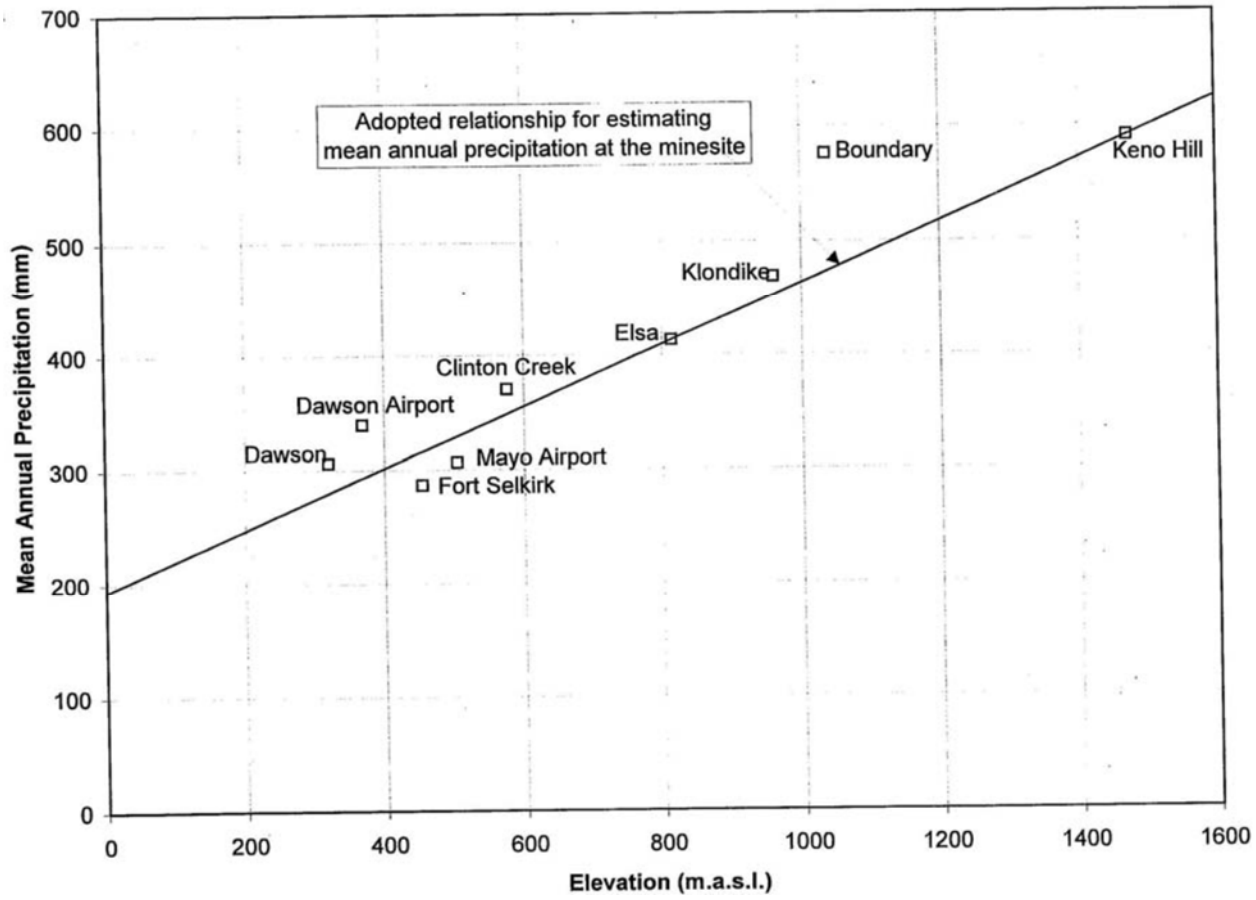


Figure 5 Mean Annual Precipitation as a Function of Elevation

As with MAP, the seasonal distribution is influenced by elevation. To demonstrate this influence, the seasonal distributions for Mayo Airport, Elsa, and Keno Hill have been plotted on Figure 6, as part of the same assessment conducted by Clearwater Consultants in 1996. The proportion of total precipitation which falls as rain decreases as elevation increases (60% of total precipitation at Mayo Airport, 53% at Elsa, and 41% at Keno Hill). Again, a simple linear relationship can be derived and the slope indicates that the proportion of total precipitation that falls as rain decreases by about 2% for every 100 m ascent.

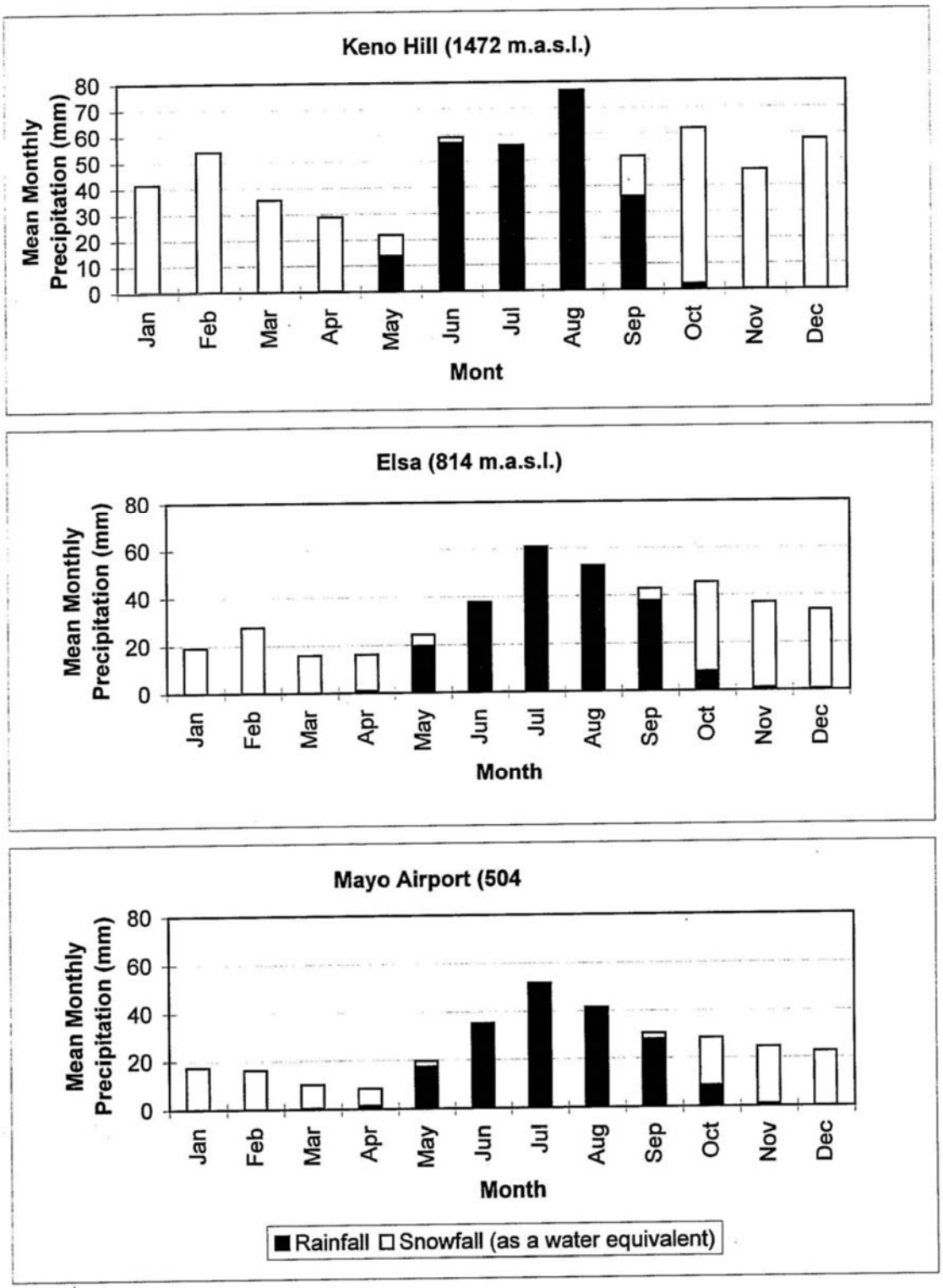


Figure 6 Mean Monthly Precipitation

Recent precipitation data from Mayo A, Calumet, District Mill and the Valley Tailings weather stations were used to verify the empirical relationships presented above. Validated precipitation data at Mayo A are available until the end of 2016, with the exception of the year 2013, which is missing, therefore, the common periods with Calumet station (2007-2016), with the District Mill station (2012-2016) and the valley Tailings (2014-2016) were used for this comparison. Mayo A reports both rain and total precipitation, while Galena Hill and the Valley Tailings weather stations record rainfall only. The District Mill weather station recorded rainfall only in 2012 and 2013 and total precipitation in 2014 and 2015. Table 6 presents the proportion of total precipitation that fell as rain for the 2007-2016 period at Mayo A.

Table 6 Annual Precipitation at Mayo A, 2007-2015

	Total Rain (mm)	Total Snow (cm)	Total Precipitation (mm)	% rain
2007	217.2	188.4	345.8	62.8
2008	309.3	157.8	429.3	72.0
2009	186.9	181.6	304.3	61.4
2010	198.1	129.8	293.7	67.4
2011	329.5	164.9	452.9	72.8
2012	171.7	158.4	276.1	62.2
2013	n/a			
2014	259.4	69.4	376.3	68.9
2015	133.9	123.5	393.4	34.0
2016	245.5	124.2	316	77.7
AVG	**227.9**	**144.2**	**354.2**	**64.4**

For this 9-year period, the average proportion of total precipitation that fell as rain was 64.4%, which is slightly higher than the original estimate of 60%. Since the value of 60% was estimated using data collected between 1974 and 1982, it is possible that the proportion of total precipitation falling as rain has increased with the warming temperature trend. Figure 7 shows the temperature trend at Mayo A since 1925; maximum, minimum and mean temperatures recorded over the 1925 to 2010 time period all show an increasing trend.

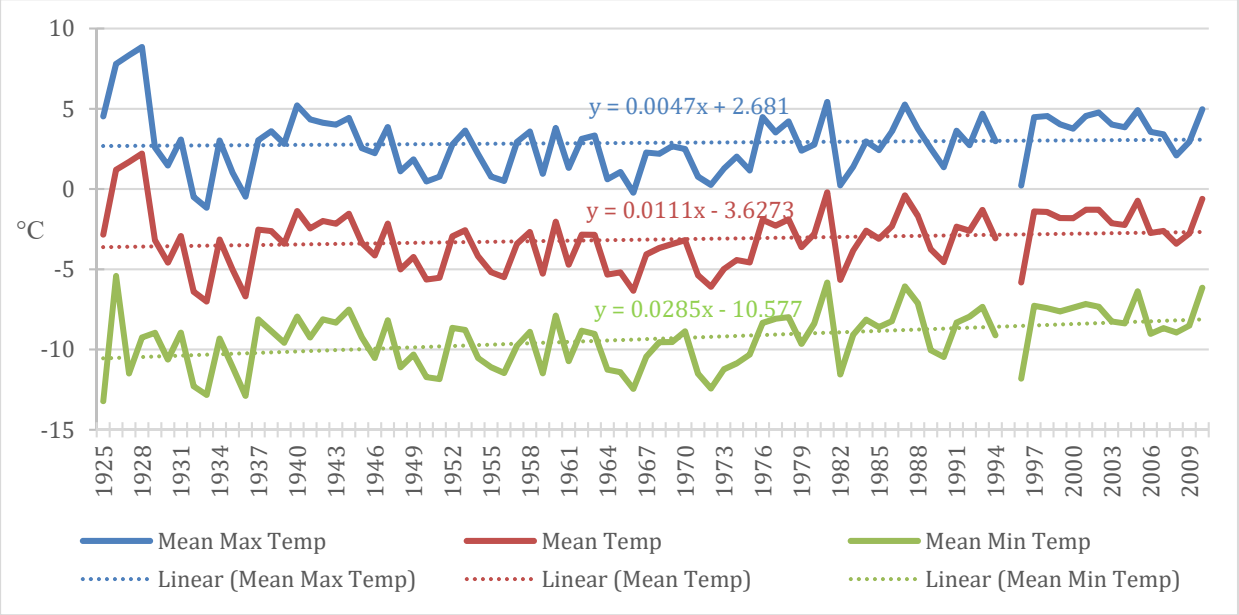


Figure 7 Mayo A Annual Temperatures, 1925-2010

Assuming the empirical linear relationship where the proportion of total precipitation that falls as rain decreases by about 2% for every 100 m ascent, it is expected that 45.2% of total precipitation falls as rain at Calumet, 54.1% at the District Mill and 58.4% at the Valley Tailings station. Since total precipitation was not measured at Galena Hill, Valley Tailings nor at the District Mill in 2012, this assumption was used to verify the linear relationship between MAP and elevation developed by Clearwater. Based on Mayo A annual total precipitation from 2007 to 2016 (Table 6), predicted total rainfall is compared to total rainfall measured at Galena Hill and the District Mill (Table 7). Note that Galena Hill observed rainfall data for 2016 are largely incomplete (see Table 1 for details) and that year was therefore not included in the comparison below.

Table 7 Predicted Versus Measured Total Rain (mm)

Year	Predicted Annual Total Precipitation (mm)	Predicted Total Rain (mm)	Measured Total Rain (mm)	Actual – Predicted (mm)	Difference (%)
Calumet (1380 masl)					
2007	582.3	263.1	*276.4*	13.3	4.8
2008	665.8	300.8	363.6	62.8	17.3
2009	540.8	244.3	*196.4*	-48.0	-24.4
2010	530.2	239.6	462.2	222.7	48.2
2011	689.4	311.5	*305.5*	-6.0	-2.0
2012	512.6	231.6	*137.0*	-94.6	-69.0
2013	n/a				
2014	612.8	276.9	264.4	-12.5	-4.7
2015	629.9	284.6	*339.7*	55.1	16.2
AVG	**595.5**	**269.0**	**293.1**	**24.1**	**-1.7**

Year	Predicted Annual Total Precipitation (mm)	Predicted Total Rain (mm)	Measured Total Rain (mm)	Actual – Predicted (mm)	Difference (%)
District Mill (936 masl)					
2012	419.5	226.8	217.5	-9.3	-4.3
2013	n/a				
2014	519.7	n/a	292.6**	-227.1	-77.6
2015	536.8	n/a	296.9**	-239.9	-80.8
2016	459.4	n/a	277.7**	-181.7	-65.4
AVG	**483.8**	**226.8**	**271.2**	**-164.5**	**-57.0**
Valley Tailings (718 masl)					
2014	460.8	269.2	*112.4*	-156.8	-139.5
2015	477.9	279.2	272.2	-7.0	-2.6
2016	400.5	234.0	226.6	-7.4	-3.3
AVG	**446.4**	**260.8**	**203.7**	**-57.1**	**-48.4**

**Values in grey italics indicate a partial total*
*** Measured total precipitation, corrected for winter undercatch and wind defelction*

Note that some years have incomplete rain data at Calumet (refer to Table 1 for specific details) and Valley Tailings, and this could explain the negative difference between actual and predicted rainfall in 2009 and 2012 at Calumet and 2014 at the Valley Tailings. In other cases however, the difference is positive even though the Calumet data set in incomplete (e.g. 2015). For the three years where the Calumet dataset is complete, the difference between actual and predicted total rainfall is positive for 2008 and 2010, and negative for 2014. The average difference between actual and predicted for those three years is positive (20.2%), implying that the linear relationship between MAP and elevation developed by Clearwater might underestimate total precipitation increase with elevation. A confounding factor is the assumed relationship between the proportion of total precipitation that falls as rain and elevation, which may also need to be refined. At the Valley Tailings station, the 2015 and 2016 dataset are complete and actual versus predicted rainfall are relatively similar (-2.6% and -3.3% difference respectively).

In the case of the District Mill, there is good agreement between predicted and measured total rain for the year 2012. In 2014, 2015 and 2016 however, comparison is made for total precipitation since a snowfall conversion adaptor was installed in 2013. In that case, the measured amount is considerably less than the predicted amount, indicating probable under catch of the snowfall conversion adaptor. Literature reports a cumulative winter catch efficiency of 0.66 for a Campbell Scientific TE525 tipping bucket gauge with a CS705 snow fall adaptor and alter screen (MacDonald and Pomeroy, 2007). Total precipitation data (2014-2016) from October through April were therefore corrected using this factor. Also, because the use of an alter screen for wind deflection has a documented improvement of 10 to 16% in snow collection efficiency and 6% to 10% for all types of precipitation (Belfort Instrument, 2013), average correction factors of 8% and 13% for summer and winter months respectively were applied to precipitation data collected prior to the installation of the alter screen in June 2015. Corrected total precipitation data are still below the values predicted from the MAP-elevation relationship, suggesting that the snowfall undercatch might be greater at this site than the average value reported in the literature, or that there is uncertainty in the MAP-elevation relationship. Refinement of the MAP-elevation relationship derived by Clearwater will be possible as more years of data

become available at Galena Hill and at the District Mill, and as total precipitation data become available at the District Mill weather station.

7. REFERENCES

Access Mining Consultants Ltd., 1996a. United Keno Hill Mines Limited, Site Characterization Report, Report No. UKH96/01. Prepared for United Keno Hill Mines Limited.

Belfort Instrument. 2013. Reducing Precipitation Gauge Inconsistencies Using Modern Wind Deflection Methodologies.

MacDonald, Jimmy P. and John W. Pomeroy. 2007. Gauge Undercatch of Two Snowfall Gauges in a Prairie Environment. 64th Eastern Snow Conference. St. John's, Newfoundland, Canada, 2007.

ATTACHMENT A: METEOROLOGICAL STATIONS COMPONENTS

Galena Hill HOBO Meteorological Station

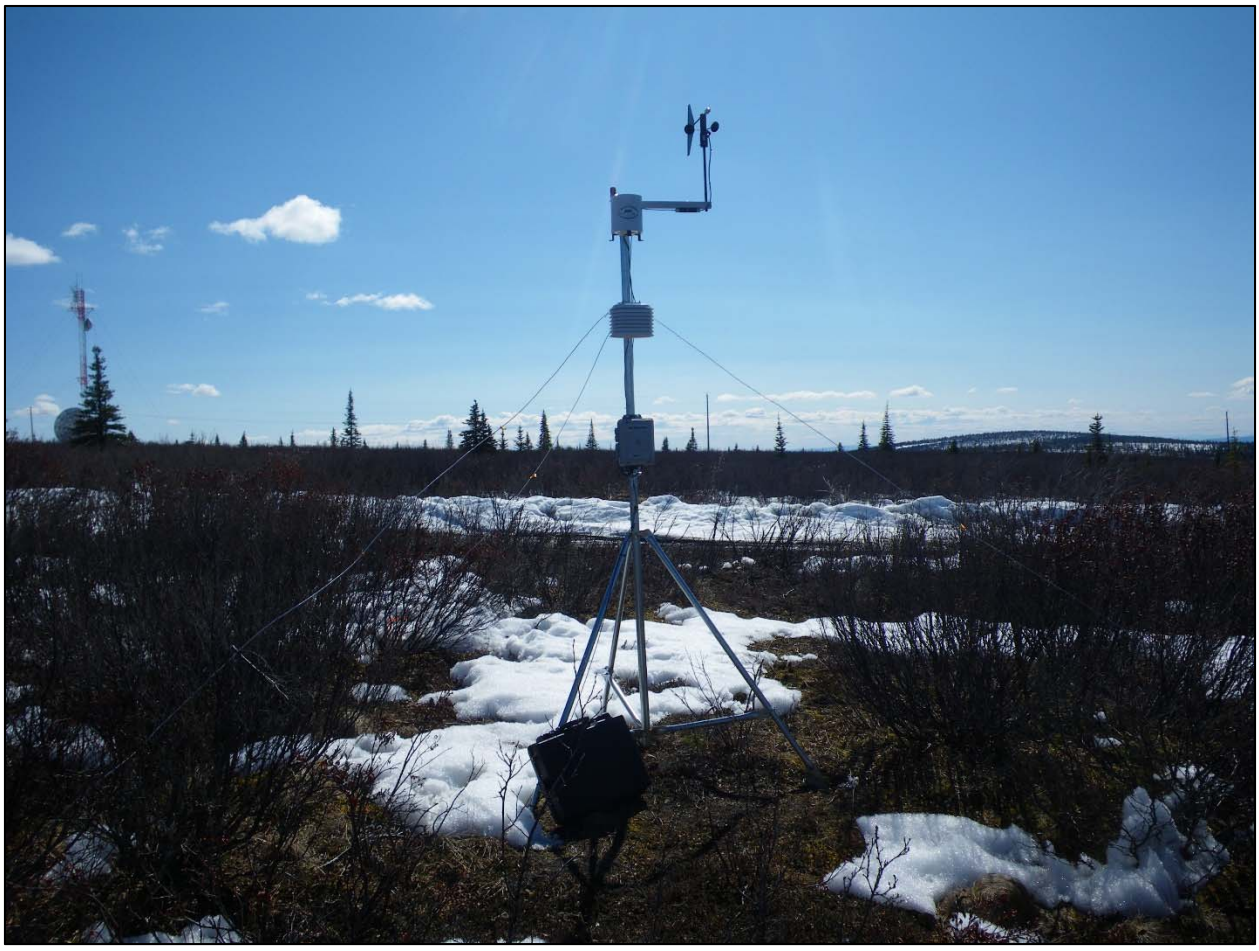
Component	Model	Serial Number
Datalogger	HOBO Weather Logger	1153440
Temp & RH Sensor	S-THB-XXXX	10064003
Soil Temp Sensor	S-TMB-XXXX	985390
Pyranometer	S-LIB-XXXX	1048627
Rain Gauge	S-RGB-M002	1017667
Wind Speed & Direction Sensor	S-WCA-XXXX	1254995
BP Sensor	S-BPA-XXXX	1037089

District Mill Campbell Scientific Meteorological Station

Component	Model	Serial Number
Air Temperature and Relative Humidity Sensor	HMP45C212	n/a
Tipping Bucket Rain Gauge	TE525M	45303-910
Wind Speed and Direction Sensor	05103AP-10-L	WM105907
Solar Panel	SX320J	T21008289B30EC8
Datalogger	CR800	16119
Battery	PS-12120 F2	06299-HC
Pyranometer	SP Lite2	125766

Valley Tailings HOBO Meteorological Station

Component	Model	Serial Number
Datalogger	U30 NRC	10231016
Input Expander kit		
Solar Panel	6W	
AC Power Adaptor	120V - 60Hz	
HOBOware	Pro	2580 2976 6309 4793
Temp & RH Sensor	THB-M002	10220040
Solar Radiation Shield	RS3	
Pyranometer	LIB-M003	10191222
Rain Gauge	RGB-M002	10222664
Light Sensor Bracket	LBB	
Light Sensor Level	LLA	
Wind Speed & Direction Sensor	WSET-A	10233230
Full Cross Arm	CAA	
BP Sensor	BPB-CM50	10212093
Soil Moisture Sensor	SMC-M005	10225679
Tripod	TPA-KIT 3m	



Galena Hill HOBO Meteorological Station

District Mill Campbell Scientific Meteorological Station

Valley Tailings HOBO Meteorological Station