Peace Project Water Use Plan

Monitoring Program Terms of Reference

GMSMON-18: Williston Dust Control Monitoring

Addendum 4
March 20, 2018

A4 Addendum to GMSMON-18: Williston Dust Control Monitoring

This TOR addendum extends the dust monitoring project for two additional years. There is no change in budget.

A4.1 Addendum Rationale: The Management Question is not answered

From study data to date, it is only possible to infer results to the Management Question. Two additional years of data will better constrain the data to draw conclusions rather than inferences. The rationale is explained further below.

Two additional years of data will improve the statistical power in the analysis

Of the ten-year monitoring study, there are only four years of high quality data for the Regional Monitoring program. The methods and monitoring equipment changed significantly in 2014, following the TOR Addendum 3 to improve the data quality:

- Spatial resolution increased: The number of sites increased from 6-8 sites to 13-18 sites as shown in Appendix A and Appendix B.
- Temporal resolution increased: The first four years (from 2008 to 2011), the program only collected data for a three-week period from late May to early June. In 2012 and 2013, the duration increased from May to October (or 'snow to snow'). However, the frequency of quality data was only collected 1 in 6 days which meant that a number of significant dust events were not included in the data set. In 2014, with a change in equipment at most locations to the E-samplers, air quality data was collected every five minutes for the 'snow to snow' period from May to October.

Extension will allow the capture of a broader span of operational conditions

In the higher quality data set from 2014, three of the last four years have been average or below average dust years—with 2 to 5 dust events compared to the typical of 10 to 15 dust events. Adding two more years is expected to create the opportunity to include a higher than average dust year in the data set with the greater temporal and spatial resolution.

The Management Question has not changed

The Management Question remains the same as follows:

What is the impact of dust mitigation treatments on Aeolian dust emission from the Finlay Reach of Williston Reservoir?

A4.2 Monitoring Program Modifications

To be most cost effective, the monitoring will continue at those sites listed in Appendix B and for time periods that will improve the quality of the GMSMON-18 program data and support addressing the Management Question as described further below.

Extend Regional Monitoring for two additional years at 12 of 18 sites

We propose to stop monitoring at sites where data was low quality or where we capture data from a nearby site. While the number of sites increased to 18 in 2014,

the number of sites reporting has varied. This is due to access problems, equipment failure, or safety issues (e.g., wildlife sightings). After a close review of the data and relationships between monitoring sites, we propose to reduce the number of sites from 18 to 12. We are dropping sites that don't contribute to answering the Management Question. In some cases, we will re-deploy equipment to high-dust beaches to better track the impact of the dust mitigation treatments. We have listed the proposed sites in Appendix B. Note that while these are the planned sites, actual monitoring will depend on the site circumstances.

Extend Reference Monitoring for two additional years at only one site

We propose to extend the Reference Monitoring at Tsay Keh Dene Village only. After five years of Reference Monitoring at the Kwadacha stations, it is clear that reservoir dust does not have impact in this location, so no further monitoring is required.

Limit Regional Monitoring for period of April to July

Since 2012, the program has monitored dust and mitigation from ‘snow to snow’ (typically April to October). Based on results to date, dust is generated after the snow had cleared until the reservoir reaches El. 668.5 m (typically July). By reducing the monitoring effort by three to four months, it will significantly reduce the expected cost of monitoring.

A4.3 Deliverables: Annual reports for added years

There will be an additional two years of annual reports for 2018 and 2019 in addition to the Final Report, which will be prepared in early 2020.

A4.4 Schedule: Extended to 2019

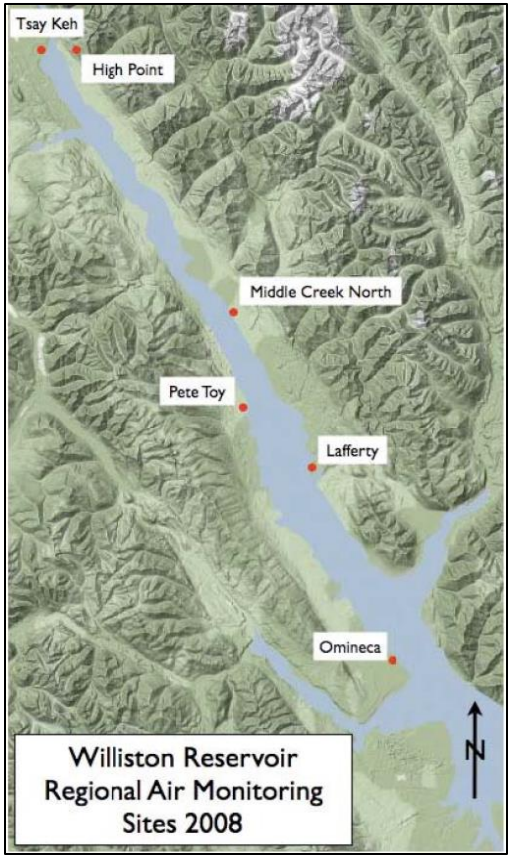
Monitoring will occur in 2018 and 2019 after the snow has cleared (typically April) until July or when reservoir levels reach El. 668.5 m (2193 ft) whichever is sooner.

A4.5 Budget: No change to approved budget

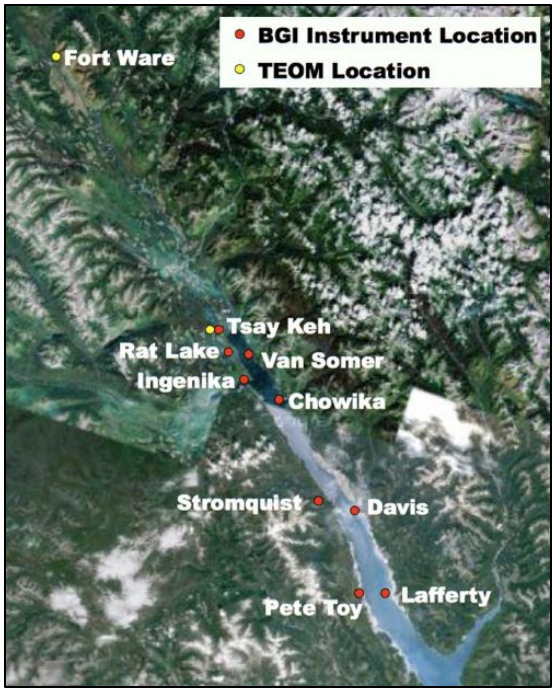
Total Program Cost: $5,621,243.

Appendix A: Locations of monitoring stations under GMSMON-18

2008-2010



2011-2013



2014-2017 with stations not continued for 2018-2019*

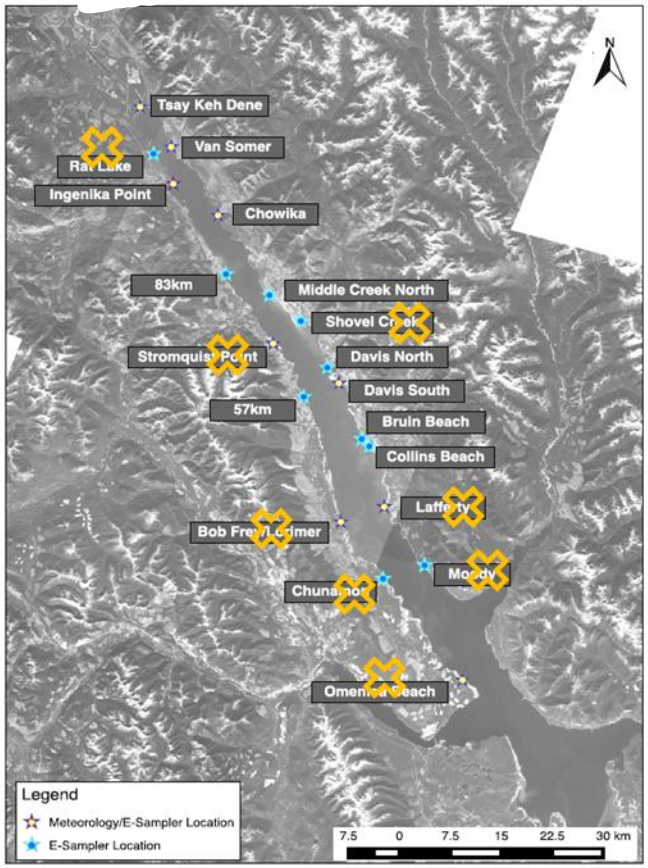


Figure 1: Map of Regional Monitoring Network Sampling Locations

*Pete Toy/Corless/35km location not shown

Appendix B: Monitoring locations under GMSMON-18

Table 1: Regional Monitoring by location, type of equipment, sampling frequency and sampling date range

Location	2008	2009-2010	2011	2012-2013	2014-2017	2018-2019 Planned
# sites	6	9	6	9	14-18	12
Equipment	Partisol 2025-D			BGI	E-Sampler	E-Sampler
Sampling Frequency	AQ: 1/day, 24Hr Avg. Met: 15 min Avg.			BGI: 1 in 6 day 24hr	AQ: 5 min Avg. Met: 5 min Avg.	AQ: 5 min Avg. Met: 5 min Avg.
Van Somer		E sampler May 20 - June 6		End May to Mid Oct	April/May to Sept (only 2014)	April to July
High Point	May 22 - June 6	May 20 - June 6	May 12- June 6			
Chowika		E sampler May 20 - June 6		End May to Mid Oct	April/May to Sept	April to July
Tsay Keh Dene Beach	May 22 - June 6	May 20 - June 6	May 12-Aug 30	End May to Mid Oct	April/May to Sept	April to July
Ingenika				End May to Mid Oct	April/May to Sept	April to July
Middle Creek North					April/May to Sept	April to July
Middle Creek South	May 22 - June 6					
Stromquist		May 20 - June 6	May 20 - June 6	End May to Mid Oct		
Pete Toy/35KM (Corless)	May 22 - June 6	May 20 - June 6	May 20 - June 6	End May to Mid Oct	April/May to Sept for 2014 & 2015);	April to July
Lafferty	May 22 - June 6	May 20 - June 6	May 20 - June 6	End May to Mid Oct (2012 only)	April/May to Sept (2014 & 2015 only)	
Omnica	May 22 - June 6	E sampler May 20 - June 6			April/May to Sept	Excessive travel times and low quality data
Bob Frey /Lorimar					April/May to Sept (2017 only)	Excessive travel times and low quality data
Shovel Creek					April/May to Sept	Continued wildlife encounters and damage to equipment

Location	2008	2009-2010	2011	2012-2013	2014-2017	2018-2019 Planned
# sites	6	9	6	9	14-18	12
Equipment	Partisol 2025-D			BGI	E-Sampler	E-Sampler
Sampling Frequency	AQ: 1/day, 24Hr Avg. Met: 15 min Avg.			BGI: 1 in 6 day 24hr	AQ: 5 min Avg. Met: 5 min Avg.	AQ: 5 min Avg. Met: 5 min Avg.
Davis North		May 20 - June 6	May 20 - June 6		April/May to Sept	April to July
Davis South				End May to Mid Oct	April/May to Sept	April to July
Collins Beach					April/May to Sept	April to July
Moody Beach					April/May to Sept	Excessive travel times and low quality data
Bruin Beach					April/May to Sept	April to July
57KM					April/May to Sept	April to July
83KM					April/May to Sept	April to July
Chunamon					April/May to Sept (2014 & 2015; bridge removed site inaccessible)	Site inaccessible
Rat Lake				End May to Mid Oct	April/May to Sept	Proximity to Ingenika, low quality data

Table 2: Reference Monitoring by location and type of equipment (Annual measurement)

Location	2008-2011	2012-2013	2014-2017	2018-2019 Planned
Fort Ware (Kwadacha)		TOEM	TOEM	
Tsay Keh Dene Village		TOEM /BGI/	TOEM /BGI/ Esampler	TOEM / Esampler