Northeast Air Quality Monitoring Assessment:

Analysis of Results

Prepared by
Eric Taylor
Air Quality Meteorologist
BC Ministry of Environment
December 21, 2017

Executive Summary

Government and industry [1] supported a collaborative study from 2013 to 2017 to measure concentrations of pollutants that are associated with oil and gas development in the Peace region in order to update our knowledge of air quality. Measurements were made by MoE near six rural communities: Blueberry, Doig River, Taylor, Farmington, Rolla and Tomslake. The primary pollutants measured were sulfur dioxide (SO2) and total reduced sulfur (TRS).

Results

- SO2 concentrations remained below BC's hourly air quality objective (70 parts per billion) at all locations.
- TRS concentrations remained below the air quality objective (5 parts per billion) at most locations. Objectives were exceeded about 4% of the time at the Taylor Lone Wolf site and for a brief time at Tomslake. TRS is primarily an odour problem for the public, not a direct health problem.
- Ozone, nitrogen dioxide and PM2.5 were also measured in 2016 and 2017 but did not exceed air quality objectives.

Conclusions

Except for locations close to some oil and gas facilities, this study supports the conclusion that levels of common air pollutants associated with those facilities are generally very low in the Peace region of BC.

Path Forward

In light of the ambient air quality data collected over the life cycle of the project, the NE Air Quality Monitoring Project is shifting from having a full complement of three portable monitoring stations, to leaving one in operation. The portable station to remain in operation will reside in Farmington until further notice. The other two portable monitoring stations that were purchased for the NE Air Monitoring project will operate within the broader BC air monitoring network administered by the provincial government. This scenario is a hybrid of the base case and expanded case governance scenarios for continued operation of the Northeast BC Air Quality Monitoring Network. In addition to the portable station in Farmington, the network will include private sector monitoring data and the BC OGC CAMEL.

The hybrid scenario recommended is premised on the assumption that it is valid to characterize regional air quality in the northeast based on a modest number of monitoring stations and that no new permanent stations were needed at this time beyond the Fort St John AQHI station and the Farmington portable station – that will remain in operation until further notice.

[1] The Northeast Air Monitoring Project has been a collaborative initiative of the BC Ministry of Environment and Climate Change Strategy (MoE), the BC Oil and Gas Commission (OGC), the BC Ministry of Natural Gas Development (MNGD), the Canadian Association of Petroleum Producers (CAPP), Spectra Energy and communities in the Peace region of northeast BC. Funding for this project was provided through the BC Oil and Gas Research and Innovation Society (BC OGRIS)

In the event of a significant shift in gas activities that could be triggered by a positive final investment for a major LNG facility or an upward trend in natural gas prices, the need for additional ambient monitoring in northeast British Columbia would likely be revisited.

Introduction

This is a report on the analysis of air pollutant data measured between December 2013 and June 2017 during the Northeast Air Quality Monitoring project. This project, announced by the BC government in 2012, was developed to address growing public demand for air quality information in Northeast BC. This demand was related to perceived or real impacts on air quality from oil and gas development that could be affecting human health.

The monitoring described in this report occurred at six sites in the Peace region in Phases 1 and 2 of this project and used three monitoring trailers (Fig. 1). This report was preceded by an Airshed Characterization Report (2015) which was an analysis of air quality monitoring data acquired by industry prior to December 2013 in the Peace region as well as air quality modelling provided by the BC Ministry of Health Services. This report will be used as input into determining the future direction of the Northeast Air Quality Monitoring project.

The Northeast Air Monitoring Project has been a collaborative initiative of the BC Ministry of Environment and Climate Change Strategy (MoE), the BC Oil and Gas Commission (OGC), the BC Ministry of Natural Gas Development (MNGD[2]), the Canadian Association of Petroleum Producers (CAPP), Spectra Energy and communities in the Peace region of northeast BC. The project had the "goal of capturing the required air quality data to make the best informed decisions regarding public health, pollution management and impacts to sensitive ecosystems" in areas potentially impacted by oil and gas development[3].

To achieve this goal, the objectives of the Northeast Air Quality Monitoring Project included:

- monitoring, reporting, and assessing air quality in Northeast BC;
- engaging the local community in this process;
- if necessary, establishing a long-term air monitoring network with a sustainable funding mechanism

Air Quality Monitoring Trailers

The strategy developed for this project included the purchase, outfitting and deployment of three portable air quality monitoring trailers in the Peace region of NE BC. The trailers each monitored concentrations of sulfur dioxide (SO2) and total reduced sulfur (TRS), pollutants associated with oil and gas activity.

SO2 has a pungent, irritating odour and has been shown to trigger health effects above about 35 parts per billion (ppb).

The BC TRS air quality objective is five (5) ppb. H2S, the prime component of TRS, has a rotten-egg odour for some people at this concentration. It is not normally considered a health hazard in outdoor environments far from industrial air pollutant sources. However, it can be dangerous in enclosed or indoor spaces and can cause nausea and headaches above 2000 ppb, respiratory tract irritation at 50,000 ppb and even death at lengthy exposures above 100,000 ppb.

[2] Effective July 2017, the MNDG is part of the Ministry of Energy Mines and Petroleum Resources.
[3] See SCEK (Science and Community Environmental Knowledge Fund) Agreement, January 9, 2014, p 11

The portable monitors were deployed in two phases at the following locations (Fig 1 and Table 1):

Phase 1:

- The Doig River First Nation Cultural Centre
- Tomslake 197 Road
- Farmington Community Hall

Phase 2:

- Rolla 213 Road
- Taylor Lone Wolf golf course
- Blueberry River First Nation School

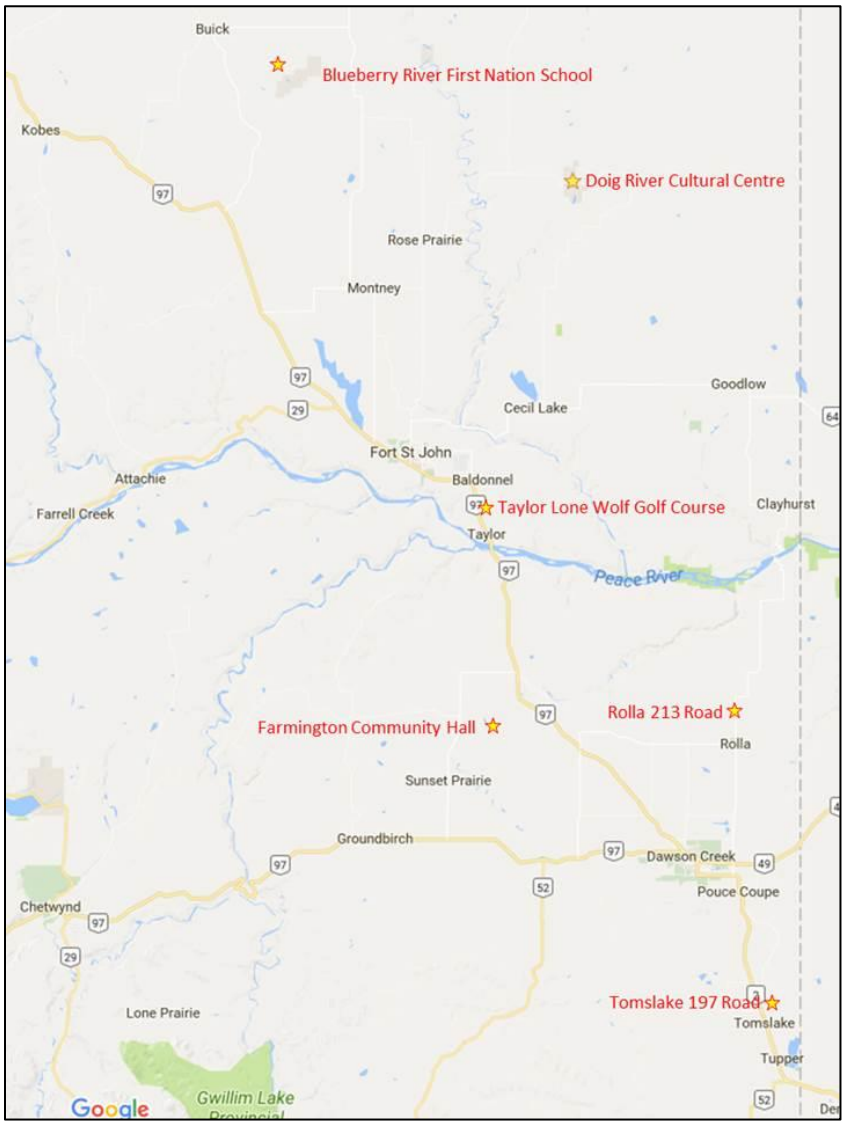

Figure 1 Approximate locations (stars) of the portable air quality monitoring stations during the Northeast BC Air Quality Monitoring Project from late 2013 through mid-2017

Table 1 Maximum hourly and average SO2, TRS and other pollutant concentrations at the six monitoring sites. Units are parts per billion (ppb) for gases and micrograms/m3 for PM2.5. Hourly air quality objectives are: TRS - 5 ppb; SO2 - 70 ppb; NO2 – 100 ppb; O3 – 82 ppb; PM2.5 – 25 µg/m3 (24 hour average objective) and 8 µg/m3 (annual objective).

	Location and Monitoring Period	Pollutant	Maximum hourly concentration	Average conc.
PHASE 1	Tomslake 197 Road. Monitor #1 Dec. 2013 to Nov. 2015	SO2	16.9	0.4
		TRS	7.6	0.4
	Doig River First Nation Cultural Centre. Monitor #2 Dec. 2013 to Dec. 2015	SO2	5.2	0.1
		TRS	1.6	0.1
	Farmington Community Hall. Monitor #3 Jan. 2014 to Apr. 2016	SO2	10.5	0.4
		TRS	3.1	0.2
PHASE 2	Rolla 213 Road. Monitor #1 Dec. 2015 to Jun. 2017	SO2	27.6	0.4
		TRS	4.1	0.6
		NO2	27.5	2.1
		O3	65	28.2
	Taylor Lone Wolf Golf Course. Monitor #2 Jan. 2016 to June 2017	SO2	25	0.4
		TRS	64.5	0.6
		NO2	40.4	3.3
		O3	67.2	24.9
		PM2.5	73.7	4.2
	Blueberry River First Nation School. Monitor #3 June 2016 to June 2017	SO2	18.7	0.5
		TRS	3.9	0.4
		NO2	18.1	1.1
		O3	60.7	26.5

In Phase 2 the three trailers were augmented with additional sensors to monitor nitrogen oxides (NO and NO2), ozone, and, in the case of Taylor Lone Wolf, fine particulate (PM2.5). These monitoring stations continue to monitor pollutant concentrations and post the information to the Ministry of Environment website in real time.

Analysis of air quality during the Northeast Air Quality Monitoring Project

Table 1 summarizes the maximum and average pollution concentrations at each of the six sites. MoE aims to keep hourly concentrations of sulfur dioxide (SO2) below 70 parts per billion (ppb) throughout

the province. As Table 1 shows, the maximum hourly SO2 concentration at all six locations was only 27 ppb, so this goal was achieved.

MoE also aims to keep hourly concentrations of total reduced sulfur (TRS) below 5 ppb. This was achieved at all but 2 stations, where TRS concentrations were occasionally above 5 ppb (up to 4% of the time). These stations were at the Taylor Lone Wolf site, 2 km northwest of the McMahon gas processing plant[4], and, to a lesser extent, Tomslake, 40 km southeast of Spectra gas processing plants. As noted above, TRS is not normally considered a health hazard in outdoor environments. Concentrations of PM2.5 and NO2 were also low at all the six monitoring sites and did not exceed MoE air quality objectives.

By comparison, larger exceedances of the one hour TRS objective in 2016 occurred in other BC communities, including Prince George (14% of the time), Harmac pulp mill (10%) and Powell River (3.8%). As noted above, TRS has a strong annoying odour but is not generally considered a health hazard in the outdoors far from industrial pollutant sources.

Ozone was occasionally elevated but did not exceed MoE air quality objectives. Ozone occurs naturally and is only partially dependent on emissions from oil and gas activity.

The maximum concentrations of TRS and SO2 in Table 2 provide some information on the monthly variation of pollutant concentrations at each of the six sites. In general, pollutant concentrations were highest in fall and winter and lowest in July and August, reflecting the relatively unfavourable dispersion conditions in cold, atmospherically stable months.

[4] Forty-seven tonnes of TRS were emitted to the atmosphere from the McMahon plant in 2012. This plant may have contributed to the TRS exceedances at the Taylor Lone Wolf site during Phase 2 of this project.

Figure 2 An air quality monitoring trailer at Doig River, north of Fort St. John, one of three portable monitoring trailers operated as part of in the Northeast BC Air Quality Monitoring project from 2013 through 2017 .

The most significant exceedances were for TRS (total reduced sulphur) which occurred at the Taylor Lone Wolf Golf Course monitoring site for 3.7% of the time, most often in the cold months when sluggish, stable conditions in the lower levels of the atmosphere limited dispersion. These exceedances were likely due to emissions from the industrial area of Taylor that is a few kilometres southeast of the monitoring site.

Table 2 Monthly maximum hourly concentrations of Total Reduced Sulfur (TRS) and Sulfur Dioxide (SO2) in parts per billion (ppb) measured at six rural locations in the Peace region of NE BC between December 2013 and June 2017. "Time above objective" is the percent of total hours that exceeded the hourly concentration objectives of H2S (5 ppb) and SO2 (70 ppb)

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Time above objective	Approximate Valid hours
Blueberry River TRS	1.2	1	3.9	0.8	1.1	3.2	0.7	0.9	0.6	0.5	1.5	1.1	0%	7091
Doig River TRS	1.2	0.5	0.6	1.6	0.5	0.6	0.6	0.5	0.5	0.5	0.7	1.1	0%	15922
Farmington TRS	3.1	0.9	1	1.5	0.9	1.2	1.3	1.1	1.1	0.9	1.7	1.4	0%	16959
Rolla 213 Road TRS	3.7	4.1	0.9	1.2	1.9	1.1	1.1	0.8	0.8	0.9	1.2	1.7	0%	10660
Taylor Lone Wolf TRS	64.5	40.8	28.8	24.7	29.2	14.7	7.9	11.5	15.9	39.1	57.6	34.4	3.7%	11264
Tomslake 197 Rd TRS	2.1	2.6	1	1.2	7.6	1	0.7	0.9	1.5	1.1	0.8	5.8	0.02%	14975
Blueberry River SO2	NA	0.6	2.6	18.7	4.2	15.4	2.1	1.2	10.9	9.1	16.9	NA	0%	6111
Doig River SO2	1.7	3.6	2.3	5.2	1.2	1.6	4.8	2.5	3.6	2.1	1.5	1.7	0%	15955
Farmington SO2	5.5	7.5	10.5	4.4	3.4	5.8	2.7	1.5	2.4	3.2	4.6	6.3	0%	17459
Rolla 213 Rd SO2	10.5	13.4	27.6	18.8	2.5	13.5	3.8	1.6	5.2	4.2	3.9	4	0%	11219
Taylor Lone Wolf SO2	15.1	9	13.2	8.7	17.2	20.9	12.2	5.5	25	7.4	13.5	14.8	0%	11268
Tomslake 197 Rd SO2	6.4	6.9	15	16.9	5	5.1	4.6	3.3	2.2	5	12.3	4	0%	14761

BC Oil and Gas Commission air quality data analysis

The BC Oil and Gas Commission (OGC) also collects air quality data in the Peace Region to assess the possible impacts on health from oil and gas development. An OGC air monitoring trailer (the Commission Air Monitoring Environmental Laboratory or CAMEL) is similar to the MoE monitoring trailers, but it measures a wider suite of pollutants. Since November 2013, the CAMEL has operated at Taylor, Fort St. John, Dawson Creek, Tumbler Ridge, Chetwynd, Buick Creek and is currently on location in Pouce Coupe.

A preliminary analysis of the CAMEL ambient air quality data (all locations except Pouce Coupe[5]) suggests consistency with the MoE monitored data. For the following contaminants, measured values were well below applicable BC and Alberta ambient air quality objectives:

- Carbon monoxide
- Nitrogen dioxide
- Sulphur dioxide
- Toluene
- Ethylbenzene/BTEX
- Total Xylene

Except for elevated particulate recordings in Tumbler Ridge, Chetwynd and Buick Creek, and TRS recordings for Taylor, the other pollutants measured by CAMEL are almost always at concentrations below provincial air quality objectives, with only sporadic exceedances of BC and Alberta air quality objectives:

- Ozone – single exceedances of the one hour and eight hour objective in Buick Creek.

[5] Results for Pouce Coupe will be available after monitoring has concluded.

- TRS – minor exceedances of the one hour objective in Fort St. John, Dawson Creek, Chetwynd and Buick Creek for 0.1% or less of the time; and minor exceedance of the 24 hour objective in Tumbler Ridge for 1.4% of the time and Chetwynd for 6.5% of the time.
- Benzene – two one hour exceedances in Tumbler Ridge and a single one hour exceedance in Buick Creek.

There were elevated fine particulate ($PM_{2.5}$) recordings in Tumbler Ridge and Chetwynd that are likely due to forest fires and residential wood heating. In Buick Creek there were elevated course particulate (PM_{10}) recordings, likely from wind blown dust. It is extremely unlikely that these would be associated with oil and gas activity.

TRS measured by CAMEL in Taylor clearly exceeds the BC odour-based objective, as has been shown in previous studies [6] and is consistent with the exceedances reported by MoE at the Taylor Lone Wolf site. OGC intends to publish a more detailed report on CAMEL data in the near future.

Results

1. No exceedances of the one hour objective of 70 ppb for sulfur dioxide (SO2) were observed at any of the six stations (Blueberry River First Nation School, Doig River First Nation Cultural Centre, Farmington Community Hall, Rolla 213 Rd, Taylor Lone Wolf Golf Course or Tomslake 197 Rd) for the monitoring period from December 2013 to June 2017.

2. No exceedances of the one hour objective of 5 ppb for Total Reduced Sulfur (TRS) were measured at Blueberry River, Doig River, Farmington or Rolla during the monitoring period. Consistent with the Air Quality Characterization of the Peace region of Northeast BCS concentrations in the vicinity of Taylor were elevated. Exceedances of the one hour objective of TRS at Taylor Lone Wolf Golf Course (2 km from the McMahon Gas Plant) occurred 3.7% of the time and at Tomslake 197 Road for 0.02% of the time. TRS can be lethal at high concentrations, though it is not normally considered a health hazard outdoors far from its sources.

3. During the Phase 2 monitoring period, no exceedances of the one hour objective of NO2 or ozone were reported at Rolla, Taylor Lone Wolf or Blueberry. No exceedances of the 24 hour objective for PM2.5 were reported at Taylor Lone Wolf.

4. Except for fine particulate and TRS, CAMEL recorded data shows sporadic exceedances of ambient air quality objectives for Ozone, TRS and Benzene. Fine particulate data recorded is likely attributed to wildfires and residential wood heating. TRS recordings for Taylor are consistent with other recording in this area.

Conclusion

Ambient concentrations of pollutants associated with oil and gas development in the Peace region appear to be generally well below BC air quality objectives, and are unlikely to be impacting human health in areas well away from industrial activity. There is therefore little evidence that all three MoE

[6] Air Quality Characterization of the Peace region of Northeast BC, July 2015

air quality monitoring trailers should remain operating in northeast BC, particularly since the OGC CAMEL station continues to operate.