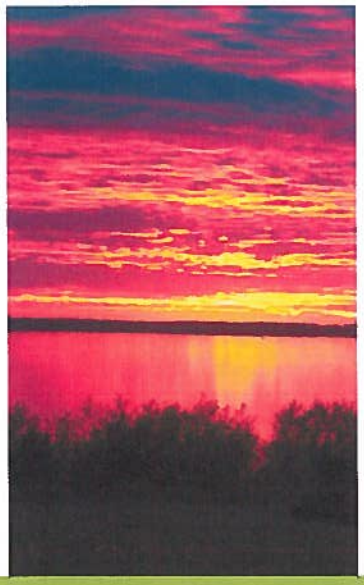
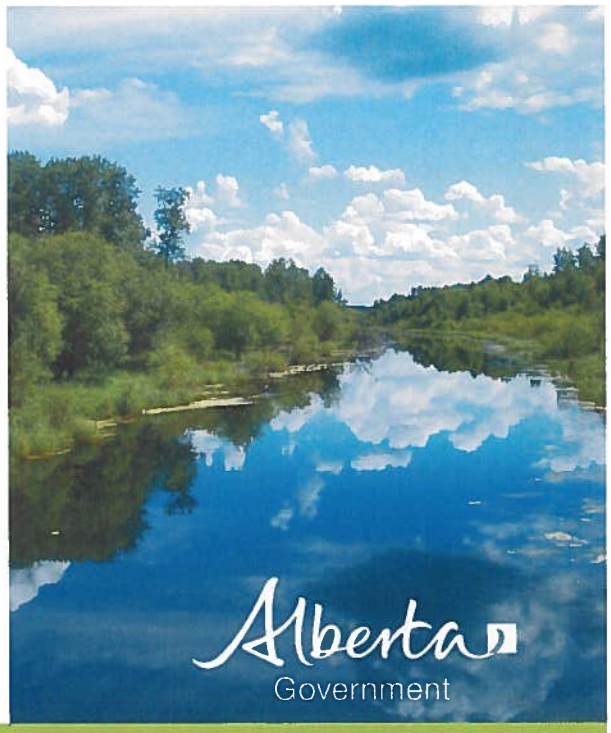
Lower Athabasca Region

Status of Management Response for Environmental Management Frameworks

- Air Quality Management Framework
- Surface Water Quality Management Framework

As of March 2014





Any comments or questions on the content of this report may be directed to:

Alberta Environment and Sustainable Resource Development
LUF Regional Planning Branch, Integrated Resource Management Planning Division
11th floor, Baker Centre
10025-106 Street, Edmonton, Alberta
T5J 1G4
Tel: 780-422-1118
Fax: 780-638-3187

For copies of this report, please contact:

Information Centre
Alberta Environment and Sustainable Resource Development
Phone: 780-427-4976
Email: env.infocent@gov.ab.ca
Website: www.environment.alberta.ca

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Executive Summary

The Government of Alberta is reporting to Albertans on the status of the management response to air and surface water trigger exceedances at monitoring stations in the Lower Athabasca Region for the year 2012. This is done under the *Air Quality Management Framework for Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2)* and the *Lower Athabasca Region Surface Water Quality Management Framework for the Lower Athabasca River* and fulfills a commitment made in the Lower Athabasca Regional Plan to initiate a management response when annual assessments indicate that triggers or limits have been exceeded. The monitoring results are found in the *2012 Status of Ambient Environmental Condition* report.

In 2012, no limits were exceeded for air and surface water quality indicators; however, some triggers were exceeded leading to required management responses. Limits are established as the upper boundaries that are not to be crossed. If a limit is exceeded, the risk to environmental quality is heightened and a mandatory response will be undertaken. Triggers are intended to give advance notice of less favourable conditions or trends, and do not mean that ambient air or water quality concentrations are placing human health or the environment at risk. Rather, they allow sufficient time to engage with stakeholders and to plan and respond proactively to ensure that a limit is not reached.

The management response for 2012 applies to the stations and indicators as follows:

- Ten air monitoring stations (Albian Muskeg River, Mannix, Mildred Lake, Millennium, Syncrude UE1, CNRL Horizon, Fort McMurray Athabasca-Valley, Lower Camp, Buffalo Viewpoint and Fort McKay) for NO_2 and/or SO_2, and
- Three of the 38 water quality indicators (total nitrogen, dissolved uranium, dissolved lithium) at the Old Fort station.

Because triggers were exceeded, the department will undertake a proactive management response. This will begin with an assessment to determine if there is an issue arising and if so, what management actions should occur.

This report presents progress on the management response and some preliminary findings. At this point in time, Environment and Sustainable Resource Development (ESRD) has made progress on the first two steps (verification and preliminary assessment) for both air and water quality, and in the case of air quality has also initiated the third step (investigation) (Figure A). Communication on progress will be ongoing.

The next steps are to continue evaluating the need for action on the trigger exceedances observed. ESRD will determine the need for further investigation to identify potential management actions, and will involve stakeholders in this effort. A further report updating the status of the management response will be made publically available by the end of 2014 on ESRD's website. Any supporting technical reports will be posted to the Oil Sands Information Portal.

Figure A. Steps in Management Response.
In the air quality response ESRD may also provide oversight/delivery of management actions.

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1.0 Introduction

As part of a commitment under the *Lower Athabasca Regional Plan* (LARP), approved in September 2012, a management response must be initiated when a trigger or limit has been determined to be exceeded by the Minister of Environment and Sustainable Resource Development (the Minister). The Minister's Determination confirmed that air quality triggers were exceeded in 2012 and confirmed the assignment of levels described in the 2012 Status of Ambient Environmental Condition Report (2012 Status Report). This signals that a management response will be initiated for the stations and indicators shown in Table 1.

This report provides information on the initial status of the management response to the 2012 air monitoring data collected in support of the *Lower Athabasca Region Air Quality Management Framework* (the Air Quality Framework) and reported in the 2012 Report on Status. As the management response continues, more details will be made publically available. Environment and Sustainable Resource Development (ESRD) is committed to providing another update on the status of the management response within one year.

Table 1. Ambient Levels assigned to air quality stations in the Lower Athabasca Region in 2012 based on triggers established in the Framework for the Annual Average of the Hourly Data and the Upper Range of the Hourly Data for NO_2 and SO_2.

Level	Nitrogen Dioxide (NO_2) Annual Average	Upper Range
2	Exceeded trigger of 16 ppb NO_2 Albian Muskeg River Fort McMurray-Athabasca Valley Millennium	Exceeded trigger of 30 ppb NO_2 Albian Muskeg River Fort McMurray Athabasca-Valley Millennium CNRL Horizon Fort McKay Syncrude UE1
Level	**Sulphur Dioxide (SO_2) Annual Average**	**Upper Range**
3	-	Exceeded trigger of 24 ppb SO_2 Mannix Mildred Lake
2	-	Exceeded trigger of 12 ppb SO_2 Albian Muskeg River Buffalo Viewpoint CNRL Horizon Fort McKay Lower Camp Millennium Syncrude UE1

[1] The station name shown here reflects the information in the CASA Data Warehouse as of October 2013. The "Fort McKay" station has recently been renamed "Bertha Ganter – Fort McKay": www.wbea.org/monitoring-stations-aamp-data/monitoring-stations/fort-mckay-ams-1

[2] The station name shown here reflects the information in the CASA Data Warehouse as of October 2013. The "Syncrude UE1" station has recently been renamed "Fort McKay South": www.wbea.org/monitoring-stations-aamp-data/monitoring-stations/syncrude-ue-1-ams-13

2.0 Management Response

A full description of the management system is found in the Air Quality Management Framework. The management response is a set of steps that must be undertaken (in full or in part) when an ambient air quality trigger or limit is exceeded.

The management response will include verification, preliminary assessment and an investigation to determine the need for management action, as outlined in the Air Quality Framework. The degree of the management response will be tailored to a variety of factors including the type and location of the air monitoring station, averaging time (hourly or annual) and the ambient air quality trigger or limit that was exceeded.

This report presents progress on the status of the management response and some preliminary findings. At this point in time, ESRD has made progress on the first two steps (verification and preliminary assessment) and initiated the third step (investigation).

There are seven steps in the management response:

- Verification
- Preliminary assessment
- Investigation
- Mitigative management actions
- Oversight/delivery of management actions
- Evaluation
- Communication

What does it mean to exceed a trigger for the upper range of hourly data?

If a Level 4 trigger is exceeded, exceedences of the hourly Alberta Ambient Air Quality Objective are likely to have occurred. There should be no or very few exceedances of the hourly AAAQO at the trigger for Level 3. The specific circumstances of maximum hourly values will be reviewed during the annual assessment if a Level 3 or 4 is triggered.

Were there any exceedances of hourly AAAQOs in 2012?

Initial investigation indicates that no hourly AAAQOs were exceeded in 2012.

2.1 Management Response Status

2.1.1 Verification and Preliminary Assessment

ESRD has completed the verification and preliminary assessment of the 2012 air quality monitoring data. This work was predominantly completed in the preparation of the 2012 Status Report (i.e., data were downloaded from the CASA Data Warehouse and the annual average of the hourly data and the upper range of the hourly data (as represented by the 99th percentile of the hourly data) were calculated and compared against triggers and limits). Preliminary investigations suggest that no rare events or natural circumstances (e.g. forest fires) contributed to the trigger exceedances in 2012. However, further analysis will be performed in order to ensure that this is the case.

2.1.2 Investigation

An initial investigation is underway and includes the identification of potential emissions sources and a preliminary analysis of NO_2 and SO_2 at stations in Level 2 and Level 3. In accordance with the Air Quality Framework, the two stations in Level 3 will be prioritized for potential mitigative actions, if required.

Initial steps that were undertaken in the investigation to date include:

1) Locating stations and emissions sources according to the 2011[3] National Pollutant Release Inventory (NPRI) facility-reported data.
2) Performing a statistical analysis of episodes with SO_2 and NO_2 hourly measurements that exceeded the Level 2 and Level 3 trigger for the Upper Range of the Hourly Data to determine the meteorological conditions under which higher concentrations of SO_2 and NO_2 were observed in 2012.
3) Beginning to assess the 2012 levels in the context of previous years through the qualitative analysis of the Annual Average of the Hourly Data and Upper Range of the Hourly Data for 2003 to 2012.
4) Identifying the emissions reduction programs that are currently in place or planned for the future.
5) Identifying future pressures in the region.

What is an air emissions inventory?

An air emissions inventory is an accounting of air pollutant emissions released over a given time. It can include point (e.g. industrial stack), area (e.g. total home heating in the region) and mobile (e.g. cars, trucks, rail) sources.

What is the NPRI facility-reported data?

The NPRI facility-reported data includes emissions estimates from industrial, commercial, institutional, and other facilities that meet certain criteria. This dataset does not include air emissions from many smaller facilities, residences or mobile sources.

[3] Note that the 2011 NPRI facility-reported data was used for this Initial Management Response because the 2012 NPRI data had not been released in a downloadable format at the time of the present study (October 2013).

SO_2

Some key findings to date:

Sulphur Dioxide – Emission Sources: Figure 1 shows the locations of the monitoring stations and their corresponding management level as determined based on the triggers based on the upper range of the hourly data, as well as the major point sources for SO_2 emissions in the area according to the NPRI. Note that ambient air quality can be affected by additional factors that are not captured by air emissions inventories, such as the altitude at which emissions are released and meteorology. All Level 2 and Level 3 stations for SO_2 were located in the mineable oil sands development area and Fort McKay.

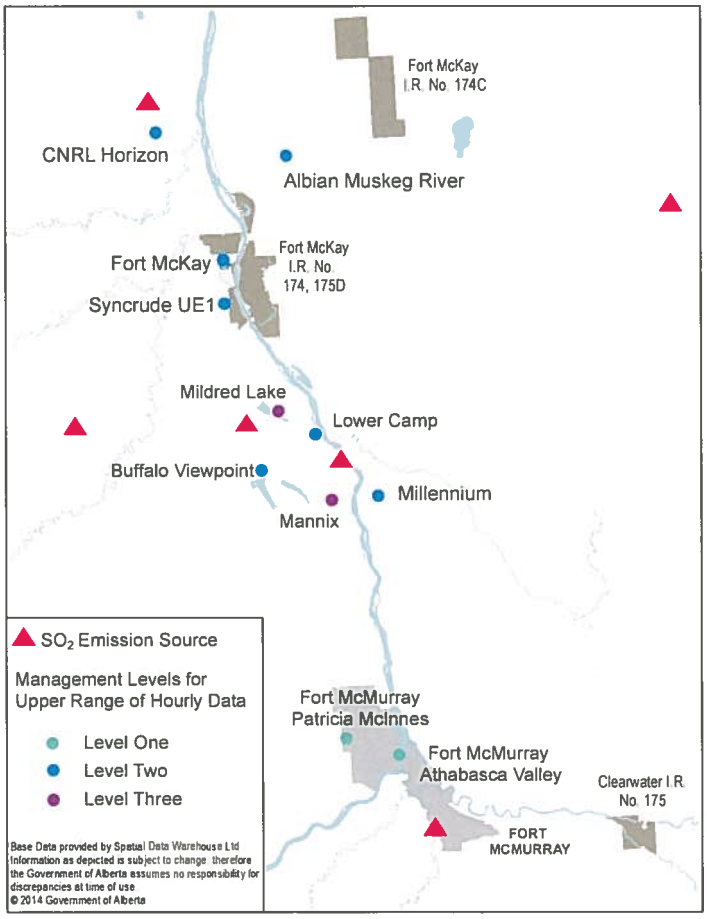

Figure 1. Major SO_2 Emissions sources in the Lower Athabasca Region and location and ambient level of air monitoring stations that measure SO_2.

According to the 2011 NPRI, upgraders make up 90 per cent of SO_2 emissions in the Lower Athabasca Region. Other known sources of SO_2 in the Lower Athabasca Region include sources from diesel-burning equipment (e.g. mine fleets and on-road transportation vehicles) and sources related to in situ oil extraction.

In order to attribute emissions sources to trigger exceedances, a pollution rose analysis was performed at each station at a Level 2 or Level 3. A pollution rose is a graphic tool used by air quality specialists to examine the relationship between air contaminants and the typical wind speed and direction at a station. The results from this analysis are summarized as follows:

- **Level 3: Mannix and Mildred Lake**

  The Mannix and Mildred Lake stations are likely affected by emissions from two upgraders, which are located near these stations.

- **Level 2: Albian Muskeg River, Buffalo Viewpoint, CNRL Horizon, Fort McKay, Lower Camp, Millennium and Syncrude UE1**

  All Level 2 stations appear to be affected by sources in the region near the open pit mining. Possible sources of SO_2 in this area include the local upgraders and mobile emissions from diesel-burning equipment.

Year-to-Year Variations in SO_2

The historical (2003-2012) annual average and upper range of the hourly data for SO_2 are shown in Figures A1-A4. The SO_2 levels in 2012 are consistent with the range of SO_2 levels observed in previous years. At all stations with Level 2 and Level 3 trigger exceedances, the upper range of the hourly data in 2012 is below the largest values observed for 2003-2011.

Current SO_2 Reduction Initiatives

Various initiatives are underway in the region to reduce SO_2 emissions. This includes the installation of flue gas scrubbers and more comprehensive liquid extraction processes, which remove more sulphur compounds than would have previously been emitted to the atmosphere.

NO_2

Some key findings to date:

Nitrogen Dioxide – Emissions Sources: Figure 2 shows the stations that monitor NO_2 in relation to the NO_2 industrial emissions point sources from the 2011 NPRI, which include large sources from the upgraders. Industrial NO_2 emission sources in the region also include mobile sources, such as mine fleets and transportation of employees. Urban sources, such as residential heating and traffic, affect more populated regions like Fort McMurray.

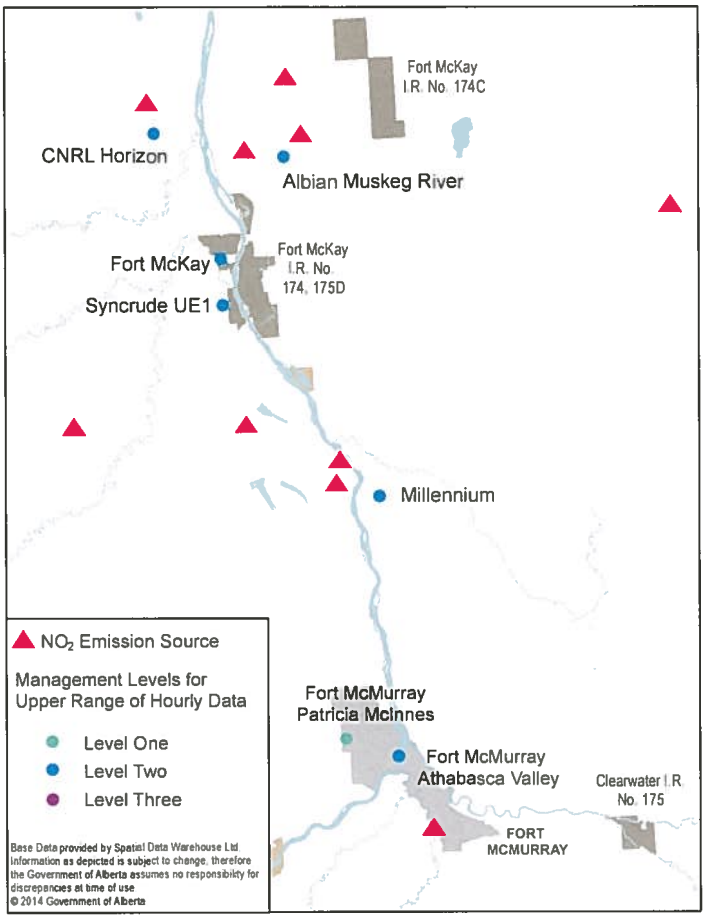

Figure 2. Major NO_2 emissions point sources in the Lower Athabasca Region and location of air monitoring stations that measure NO_2.

- **Level 2: Albian Muskeg River, Fort McMurray Athabasca-Valley, Millennium, CNRL Horizon, Fort McKay, Syncrude UE1**

  At all Level 2 stations, enhanced levels of NO_2 were observed most frequently under low wind-speeds and during the winter months. This suggests that NO_2 accumulates when meteorological conditions are stable and pollutants are not dispersed effectively.

  The variation of NO_2 with time of day was used to infer possible emissions sources. At the Fort McMurray Athabasca-Valley station, elevated levels of NO_2 occur primarily during morning and evening rush hour, suggesting that Level 2 stations may be affected by mobile emissions from local traffic. The Level 2 triggers at Albian Muskeg River, Millennium, CNRL Horizon, Fort McKay, and Syncrude UE1 stations all appear to be affected by 24-hour industrial sources, which could include facility point sources as well as mobile emissions from mine fleets.

Year-to-Year Variations in NO_2

The historical (2003-2012) annual average and upper range of hourly data for NO_2 are shown in Figures A5-A8. At most stations in Level 2, the NO_2 Annual Average of the Hourly Data and Upper Range of the Hourly Data are within the ranges of data from the previous five years.

Current Initiatives to Reduce NO_2 and NO_x

Nitrogen oxides (NO_x) make up a family of gases in the atmosphere that are closely related through chemical reactions. NO_2 is a member of the NO_x family.

ESRD regulations for industry are in place to mitigate nitrogen oxide (NO_x) emissions from large point sources and mine fleets. New boilers, heaters and turbines for the oil sands region are subject to performance targets that represent the approximate level of NO_x emissions achievable by using the best available NO_x control combustion technology economically achievable[4]. Mobile NO_x emissions from the heavy haul mine fleets are regulated by ESRD requirements that they use Tier 4 engines, when they are commercially available, as per the site-specific oil sands mine approvals. In 2018, the federal government will require that new and imported engines be Tier 4[5].

Management of Future Pressures on NO_2 and SO_2 in the Lower Athabasca Region

Ongoing development may add pressure to air quality in the Lower Athabasca Region. This could include, for example, air emissions from new industrial facilities, as well as from vehicles and home heating of growing populations. In the future, air quality in the region will continue to be managed through the Air Quality Management Framework. This work will be supported by scientifically credible, accessible and open information on air quality in the region from the Alberta Environmental Monitoring, Evaluation, and Reporting Agency, which will begin operations in 2014.

[4] Alberta Environment, Approvals Program Interim Policy, OSEMD-00-PP2, 14 December 2007, available at: http://environment.alberta.ca/documents/Oil-Sands_Interim_Emission_Guidelines.pdf

[5] Environment Canada, Off-RoadCompression-Ignition Engine Emission Regulations, SOR/2005-32, available at: www.ec.gc.ca/lcpe-cepa/eng/regulations/detailreg.cfm?intReg=88

3.0
Next Steps

ESRD will work with specific stakeholders whose activities result in air emissions (e.g., industrial emitters and communities/municipalities) to inform the investigation and assist in identifying management actions that may be necessary to address point and non-point source emissions.

Next steps may include:

- Identifying specific periods with enhanced SO_2 at the Level 3 stations and investigating the causes of these individual events. This study could include information on facility upsets and meteorological conditions.
- Performing a detailed assessment of the variation of NO_2 and SO_2 ambient levels since 2003. This study could be performed in the context point source emissions estimates for 2004-2011 from NPRI, population changes in Fort McMurray, the growth and development of industrial facilities, and past implementation of emissions reduction technologies in the oil sands.
- Consulting with subject matter experts to determine whether air quality models could contribute to the understanding of ambient SO_2 levels in the region. This would include the identification of previous modeling studies that may have relevant results as well as the consideration of a new modeling study. If a new modeling study is deemed useful, the resource requirements could be assessed.
- Assessing the need for additional monitoring.

A report updating the status of the management response will be made publically available within one year.

4.0
Appendix A

The long-term or historical data for the air quality monitoring stations in the Lower Athabasca Region are provided here as context for interpreting the 2012 data.

The reader should note that several stations were not part of the regional monitoring network for the entire period shown (2003 to 2012) and may only have a partial time series (e.g. Millennium, CNRL Horizon and Albian Muskeg River). In addition, the Albian Mine Site monitoring station was relocated in 2008 to make room for the mine extension. The new location (Albian Muskeg River) was chosen as the continuous monitoring station for the purpose of the Air Quality Framework.

4.1 SO_2 DATA FROM 2003 TO 2012

The historical (2003 to 2012) Annual Average of the Hourly Data for SO_2 are displayed in two separate graphs based on geographic location to enable the reader to view the data more easily (Figures A1 and A2). Similarly, the historical Upper Range of the Hourly Data are shown in Figures A3 and A4.

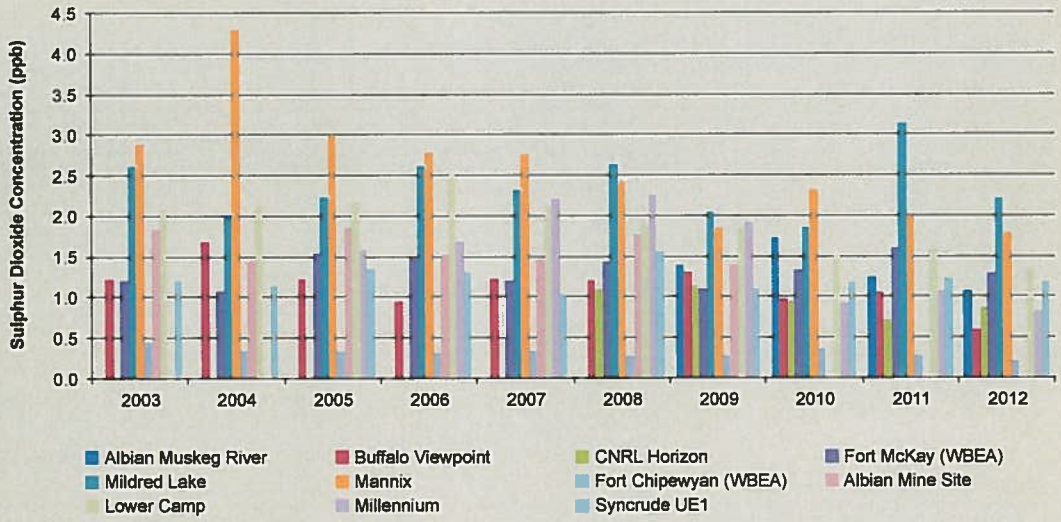

Figure A1: Annual Average of the Hourly Data for SO_2 from 2003–2012 for air monitoring stations located north of Fort McMurray

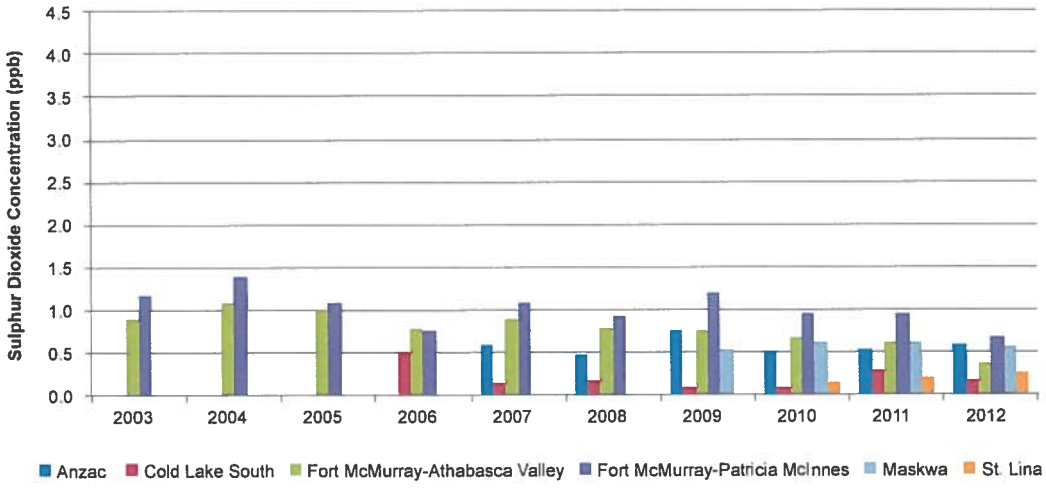

Figure A2: Annual Average of the Hourly Data for SO_2 for 2003-2012 for air monitoring stations located in Fort McMurray and south

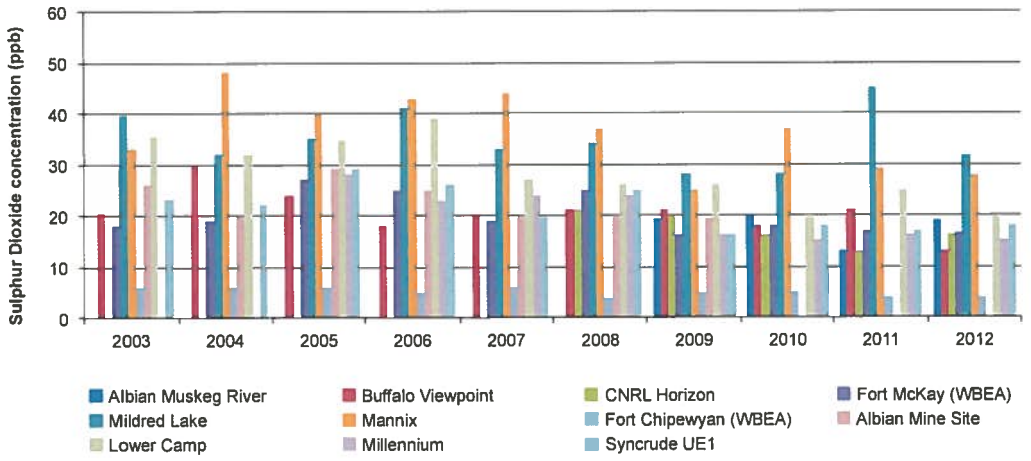

Figure A3: Upper Range of the Hourly Data for SO_2 for 2003–2012 from air monitoring stations located north of Fort McMurray

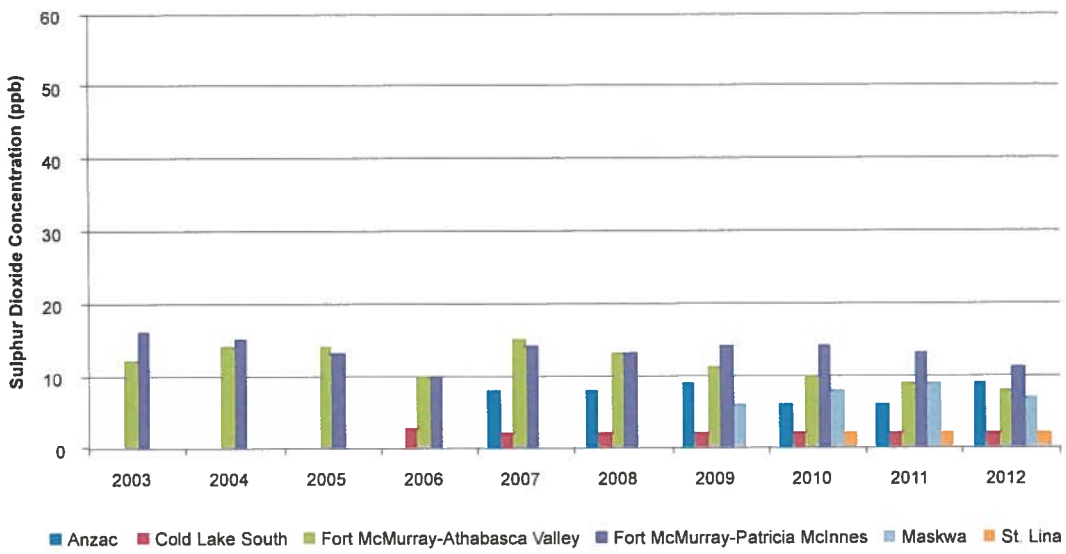

Figure A4: Upper Range of the Hourly Data for SO_2 for 2003-2012 from air monitoring stations located in Fort McMurray and south

4.2 NO_2 DATA FROM 2003 TO 2012

The historical (2003 to 2012) Annual Average of the Hourly Data for NO_2 are displayed in two separate graphs based on geographic location to enable the reader to view the data more easily (Figures A5 and A6). Similarly, the historical Upper Range of the Hourly Data (as represented by the 99th percentile of annual hourly data) are shown in Figures A7 and A8.

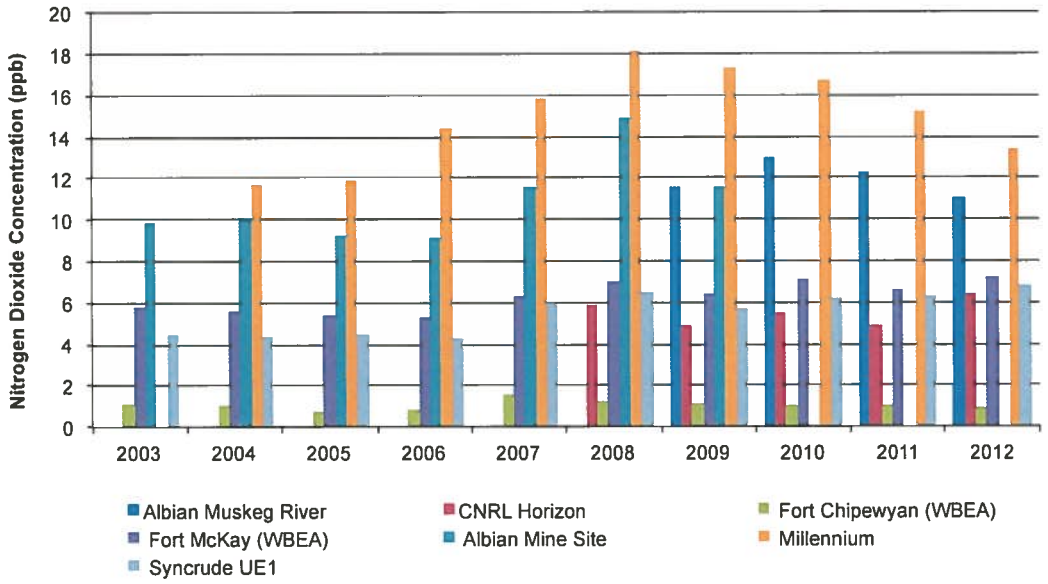

Figure A5: The Annual Average of the Hourly Data for NO_2 for the years 2003–2012 from stations located north of Fort McMurray

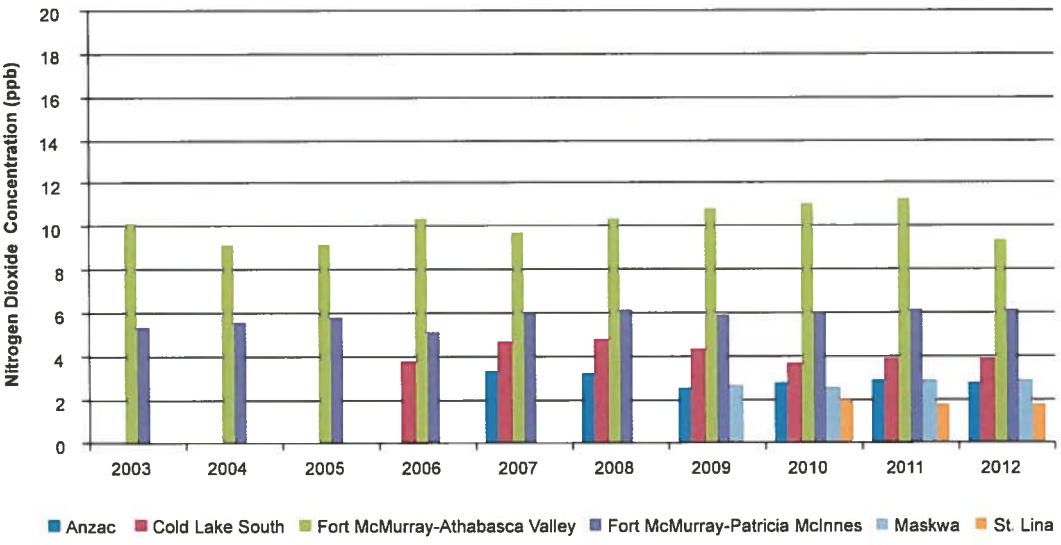

Figure A6: The Annual Average of the Hourly Data for NO_2 for the years 2003–2012 from stations located in Fort McMurray and south

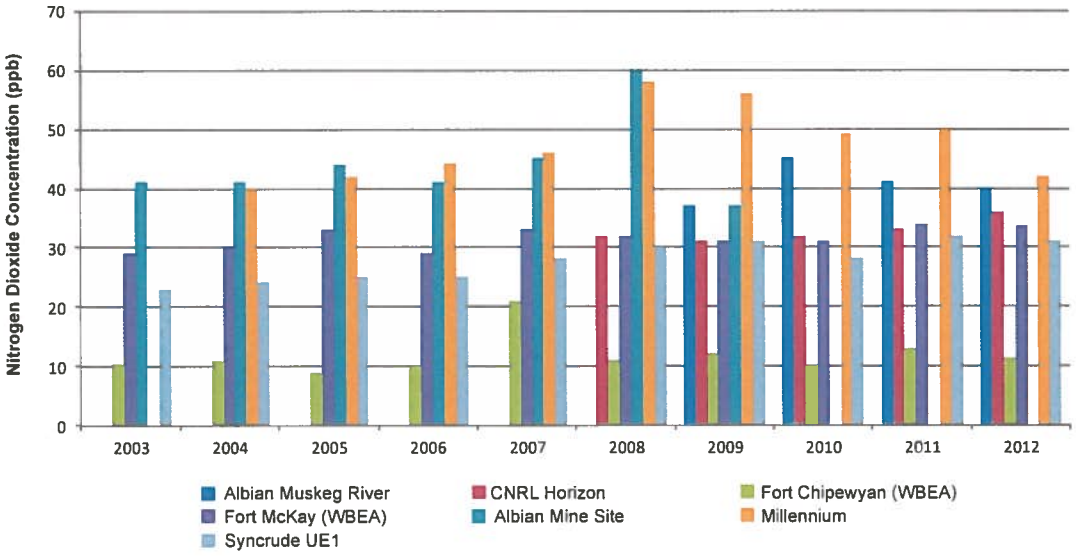

Figure A7: The Upper Range of the Hourly Data for NO_2 for the years 2003–2012 from stations located north of Fort McMurray

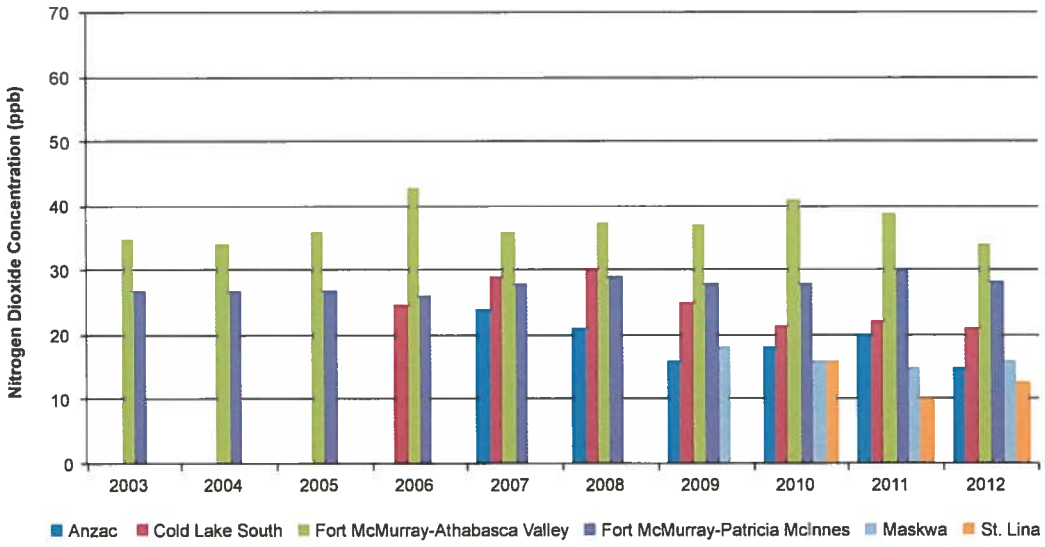

Figure A8: The Upper Range of the Hourly Data for NO_2 for the years 2003-2012 from stations located in Fort McMurray and south

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Status of Surface Water Quality Management Response

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1.0 Introduction

As part of a commitment under the *Lower Athabasca Regional Plan* (LARP), approved in September 2012, a management response must be initiated when a trigger or limit has been determined to be exceeded by the Minister of Environment and Sustainable Resource Development (the Minister). The Minister's Determination confirmed that ambient surface water quality triggers were exceeded in 2012 and confirmed the assignment of levels described in the *2012 Status of Ambient Environmental Condition Report* (2012 Status Report). This signals that a management response must be initiated for the indicators shown in Table 1.

This report provides information on the initial status of the management response to the 2012 surface water quality monitoring data collected in support of the *Lower Athabasca Region Surface Water Quality Management Framework for the Lower Athabasca River* (the Surface Water Quality Framework) and reported in the 2012 Status Report. As the management response continues, more details will be made publically available. Environment and Sustainable Resource Development (ESRD) is committed to providing another update on the status of the management response within one year.

Table 1. Management Levels Assigned to Surface Water Quality Indicators at the Athabasca River at Old Fort Station in 2012.

Level	Description	Management Intent	2012 Status of Indicators
2	Exceedance of water quality triggers.	Proactively maintain water quality below limits. Improve knowledge and understanding of trends.	Triggers were exceeded for 3 indicators. Mean triggers were exceeded for: • Total nitrogen • Dissolved uranium Peak triggers were exceeded for: • Dissolved lithium • Dissolved uranium

2.0 Management Response

A full description of the management system is found in the Surface Water Quality Framework. The management response is a set of six steps that must be undertaken (in full or in part) when an ambient surface water quality trigger or limit is exceeded.

The management response will include verification, preliminary assessment and if required, an investigation to determine the need for mitigative management actions, as outlined in the Surface Water Quality Framework.

There are six steps in the management response:

- Verification
- Preliminary assessment
- Investigation
- Mitigative management actions
- Evaluation
- Communication

This report presents progress on the status of the management response and some preliminary findings. At this point in time, ESRD has made progress on the first two steps: verification and preliminary assessment.

2.1 Management Response Status

2.1.1 Verification

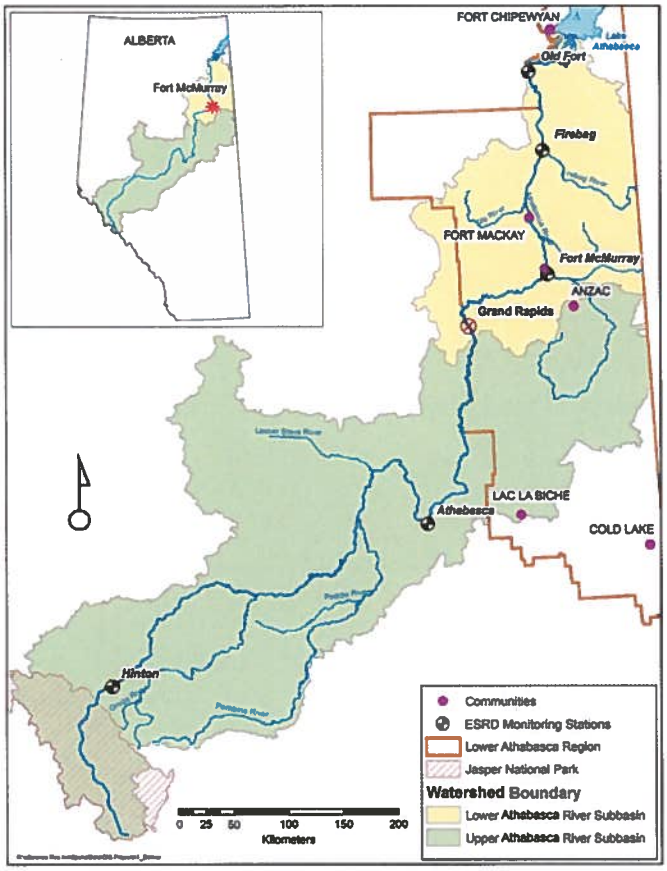
ESRD has verified the 2012 surface water quality data and calculated the water quality metrics used to assess ambient water quality conditions against triggers and limits. This work was completed in the preparation of the 2012 Status Report.

2.1.2 Preliminary Assessment

The first step of the preliminary assessment was completed and is described in the 2012 Status Report. The Minister's Determination confirmed that surface water quality triggers were exceeded for three indicators at the Athabasca River at Old Fort monitoring station (Table 1). The next step is to determine if an investigation is required for the indicators that exceeded a surface water quality trigger.

Initial steps taken to evaluate the need for an investigation include:

1) Comparing the 2012 data to the historical dataset to put the 2012 trigger in context.
2) Examining the monitoring data from the Athabasca River upstream of Fort McMurray station (approximately 200 km upstream of the Old Fort station; Figure 1), to determine if similar patterns in the indicators are evident.



What does it mean to exceed an ambient surface water quality trigger?

The triggers serve as an early warning system.

They are calculated from the historical data for each indicator and are meant to flag unusual ambient environmental conditions.

Figure 1. Alberta Environment and Sustainable Resource Development Surface Water Quality Monitoring Stations in the Athabasca River Basin

Some key findings to date:

Total Nitrogen – Mean Trigger Exceedance (Level 2)

A statistically significant increase in the annual mean (compared to the historical mean) was found for total nitrogen at the Athabasca River at Old Fort monitoring station in 2012. Mean total nitrogen concentration in 2012 was 0.751 mg/L, which is 26 per cent higher than the mean trigger (i.e., the historical mean; 0.597 mg/L). The same per cent increase was observed at the Athabasca River upstream of Fort McMurray monitoring station during the same time period (Table 2 and Figure 2).

Examination of the historical dataset for total nitrogen at the Athabasca River at Old Fort station revealed that the 2012 annual mean was higher than all other annual means in the dataset with the exception of 1997, when the annual mean was 0.778 mg/L. This indicates that although the magnitude of the 2012 total nitrogen mean is unusual, it is not unprecedented. Examination of the historical dataset for

total nitrogen at the Athabasca River upstream of Fort McMurray station supports a similar conclusion. The 2012 annual mean (0.713 mg/L) was higher than most annuals means in the historical dataset for that station, with the exception of 1993 and 1994 (0.792 and 0.955 mg/L, respectively).

The pattern in total nitrogen concentrations between the two stations has been variable over time (Figure 3). From 1988-1999 the annual means were higher 58 per cent of the time at the Athabasca River upstream of Fort McMurray station. However, since 2000, the annual total nitrogen means have been consistently higher at the Athabasca River at Old Fort station. This pattern suggests either decreases in total nitrogen loading upstream of Fort McMurray in recent years, or increases in nitrogen loading downstream of Fort McMurray since 2000.

Table 2: Comparison of Total Nitrogen at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical Mean and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station

	u/s Fort McMurray				Old Fort			
Indicator	**2012 Mean**	**Historical Mean (1998-2009)**	**Direction of Change**	**% Change**	**2012 Mean**	**Historical Mean* (1998-2009)**	**Direction of Change**	**% Change**
Total Nitrogen (mg/L)	0.713	0.567	increase	26	0.751	0.597	increase	26

* For the Athabasca River at Old Fort station, the historical mean is also the mean trigger.

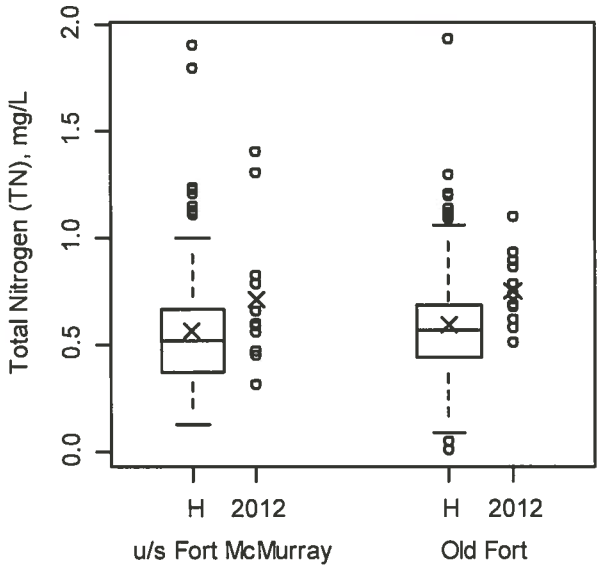


Figure 2. Graphical Presentation of Total Nitrogen Concentrations at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical Mean and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station

Note: Historical data (H) are summarized with boxplots while all the 2012 data are shown. Crosses are means of the historical and 2012 data, while boxes are the 95th percentile of the historical data.

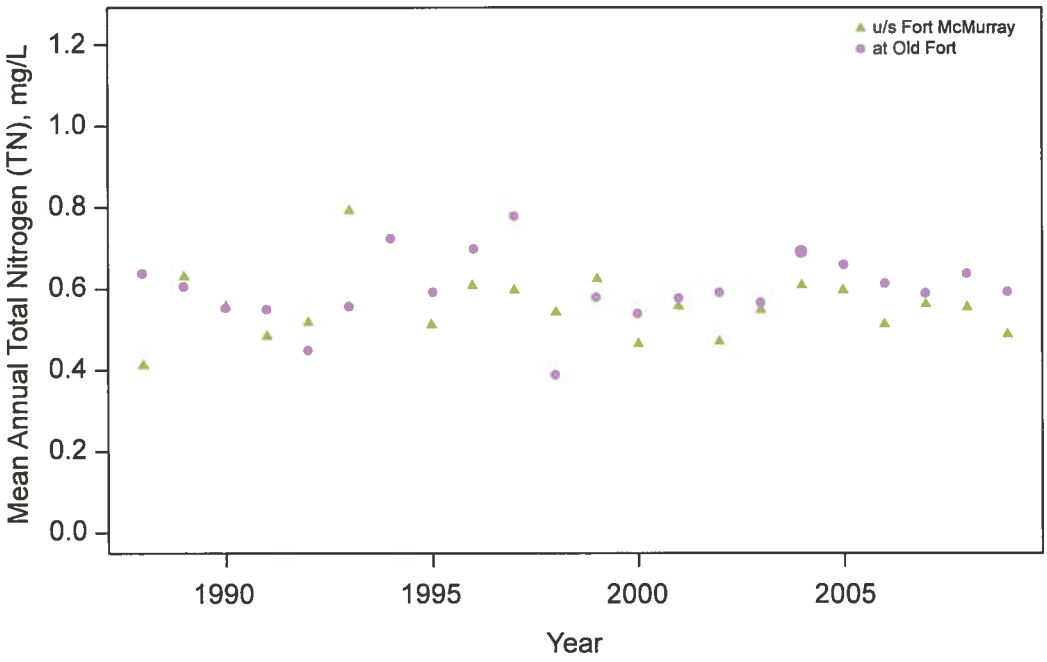


Figure 3. Plot of the Annual Total Nitrogen Means at the Athabasca River at Old Fort Monitoring Station and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station for the Historical Datasets

Dissolved Uranium – Mean Trigger Exceedance (Level 2)

A statistically significant increase in the annual mean (compared to the historical mean) was found for dissolved uranium at the Athabasca River at Old Fort monitoring station in 2012. Mean dissolved uranium concentration in 2012 was 0.359 µg/L, which is 15 per cent higher than the mean trigger (i.e., the historical mean; 0.313 µg/L). Similarly, the 2012 mean was 12 per cent higher than the historical mean at the Athabasca River upstream of Fort McMurray monitoring station (Table 3 and Figure 4).

Examination of the historical dataset for dissolved uranium at the Athabasca River at Old Fort station revealed that the 2012 annual mean was higher than all other annual means in the dataset. This indicates that the 2012 annual mean was quite unusual; however, the historical dataset for this indicator is relatively short (2003-2009). Analysis of the historical dataset at the Athabasca River upstream of Fort McMurray station showed that the 2012 annual mean (0.509 µg/L) was also higher than most annuals means in the historical dataset, with the exception of 2006 and 2009 (0.516 and 0.518 µg/L, respectively).

The pattern in dissolved uranium concentrations between the two stations has been consistent over time (Figure 5). Without exception, the annual means for dissolved uranium have been higher at the Athabasca River upstream of Fort McMurray station than at the Athabasca River at Old Fort station. This suggests that significant sources of dissolved uranium are not present downstream of Fort McMurray, however this notion needs to be examined in more detail.

Table 3: Comparison of Dissolved Uranium at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical Mean and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station

	u/s Fort McMurray				Old Fort			
Indicator	2012 Mean	Historical Mean (2002-2009)	Direction of Change	% Change	2012 Mean	Historical Mean* (2003-2009)	Direction of Change	% Change
Dissolved Uranium (µg/L)	0.509	0.456	increase	12	0.359	0.313	increase	15

* For the Athabasca River at Old Fort station, the historical mean is also the mean trigger.

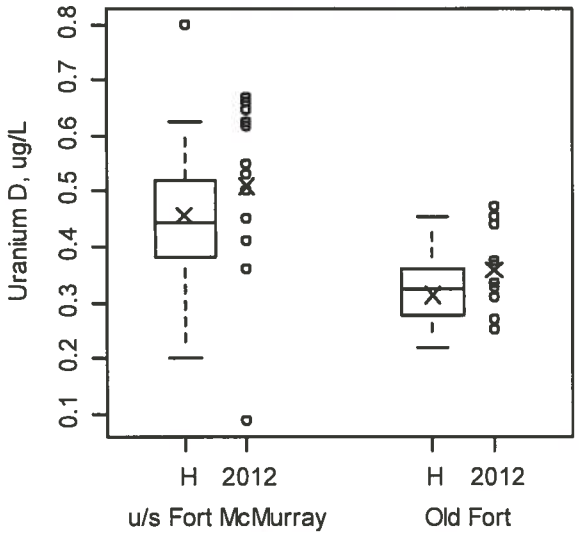


Figure 4. Graphical Presentation of Dissolved Uranium Concentrations at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical Mean and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station
Note: Historical data (H) are summarized with boxplots while all the 2012 data are shown. Crosses are means of the historical and 2012 data. D=dissolved.

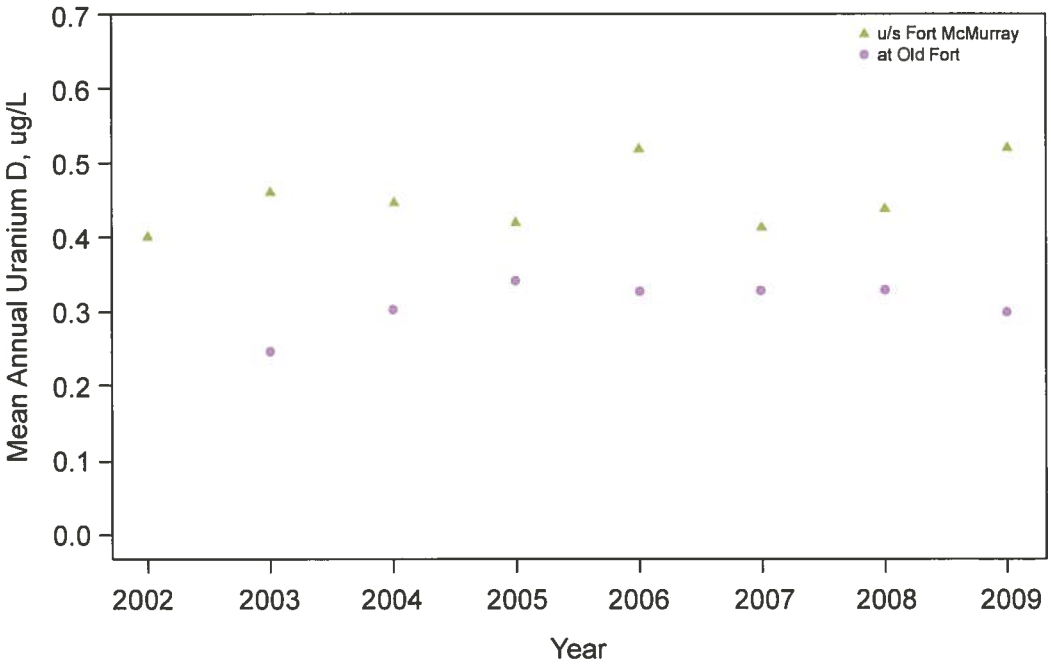


Figure 5. Plot of the Annual Dissolved Uranium Means at the Athabasca River at Old Fort Monitoring Station and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station for the Historical Dataset D=dissolved

Dissolved Uranium – Peak Trigger Exceedance (Level 2)

A statistically significant peak trigger exceedance was found for dissolved uranium at the Athabasca River at Old Fort monitoring station (three out of 12 samples above the historical 95th percentile). Similarly, five out of 12 samples were above the historical 95th percentile for dissolved uranium at the Athabasca River upstream of Fort McMurray station in 2012 (Table 4 and Figure 6).

Examination of the historical dataset for dissolved uranium at the Athabasca River at Old Fort station revealed that one monthly 2012 sample exceeded the previous maximum concentration observed at this station (0.455 µg/L in 2005) by 4 per cent. The historical maximum value was not exceeded at the Athabasca River upstream of Fort McMurray station in 2012.

Table 4: Comparison of Dissolved Uranium at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical 95th Percentile and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station

	u/s Fort McMurray		Old Fort	
Indicator	**Historical 95th Percentile (2002 - 2009)**	**# of 2012 Samples Above Historical 95th Percentile**	**Historical 95th Percentile* (2003 - 2009)**	**# of 2012 Samples Above Historical 95th Percentile**
Dissolved Uranium (µg/L)	0.615	5	0.381	3

* For the Athabasca River at Old Fort station, the historical 95th percentile is also the peak trigger.

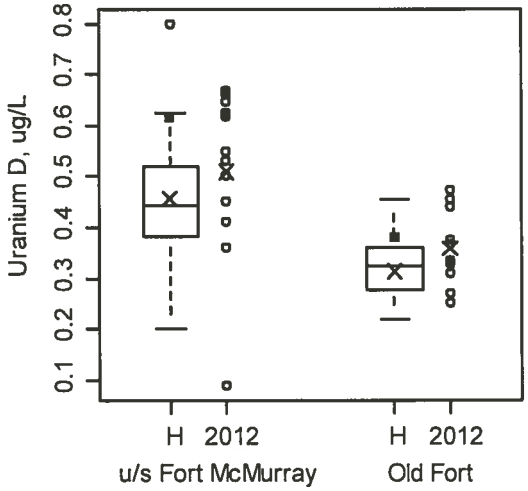


Figure 6. Graphical Presentation of the Dissolved Uranium Data at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical 95th Percentile and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station
Note: Historical data (H) are summarized with boxplots, while all the 2012 data are shown. Crosses are means of the historical and 2012 data respectively, while boxes are the 95th percentile of the historical data. D=dissolved.

Dissolved Lithium – Peak Trigger Exceedance (Level 2)

A significant peak trigger exceedance was found for dissolved lithium at the Athabasca River at Old Fort monitoring station (three out of 12 samples higher than the historical 95th percentile). In comparison, none of the 2012 samples were above the historical 95th percentile at the Athabasca River upstream of Fort McMurray station (Table 5 and Figure 7).

Examination of the historical dataset for dissolved lithium at the Athabasca River at Old Fort station revealed that none of the 2012 values exceeded the historical maximum concentration observed at this station (11 µg/L in 2002). However, compared to past years it was unusual to have three sampling occasions with concentrations above the 95th percentile. In the historical dataset (1999 to 2009), only four observations exceeded the 95th percentile.

The pattern in dissolved lithium concentrations between the two stations has been relatively consistent over time (Figure 8). With the exception of 2002, the annual means for dissolved lithium have been higher at the Athabasca River upstream of Fort McMurray station.

Table 5: Comparison of Dissolved Lithium at the Athabasca River Old Fort Monitoring Station in 2012 Relative to the Historical 95th Percentile and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station

	u/s Fort McMurray		Old Fort	
Indicator	**Historical 95th Percentile (2002 - 2009)**	**# of 2012 Samples Above Historical 95th Percentile**	**Historical 95th Percentile* (2003 - 2009)**	**# of 2012 Samples Above Historical 95th Percentile**
Dissolved Lithium (µg/L)	11	0	9	3

* For the Athabasca River at Old Fort station, the historical 95th percentile is also the peak trigger.

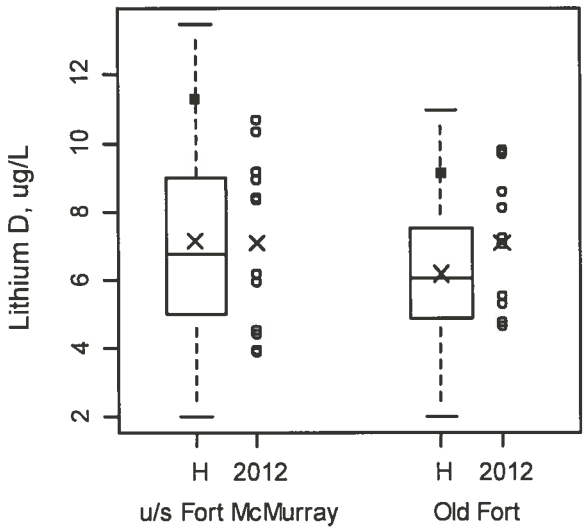


Figure 7. Graphical Presentation of the Dissolved Lithium Data at the Athabasca River at Old Fort Monitoring Station in 2012 Relative to the Historical 95th Percentile and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station

Note: Historical data (H) are summarized with boxplots while all the 2012 data are shown. Crosses are means of the historical and 2012 data respectively, while boxes are the 95th percentile of the historical data. D=dissolved.

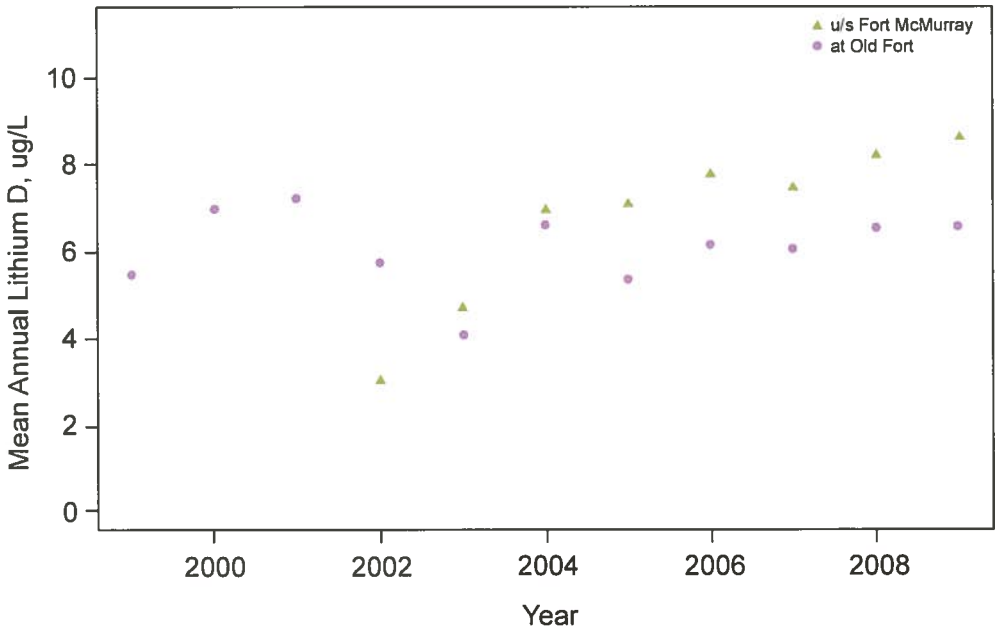


Figure 8. Plot of the Annual Dissolved Lithium Means at the Athabasca River at Old Fort Monitoring Station and the Athabasca River Upstream (u/s) of Fort McMurray Monitoring Station for the Historical Dataset D=dissolved

3.0 Next Steps

ESRD will continue to conduct exploratory analyses as part of the preliminary assessment step to determine if an investigation is required. In addition to the work done to date, these analyses will include:

- Initiating an assessment of the flow data for the lower Athabasca River to evaluate the potential influence of 2012 hydrological conditions on the triggers observed. Seasonal patterns will also be examined in more detail as part of this assessment.
- Conducting statistical trend assessments for the three indicators in Level 2 exceedances at the Athabasca River at Old Fort station to see if undesirable trends are developing over time. Trend assessment may also extend to the Athabasca River upstream of Fort McMurray station to better understand patterns in upstream loading over time.
- Examining potential sources of total nitrogen, dissolved uranium, and dissolved lithium to the lower Athabasca River.

Once these analyses are complete, ESRD will be in a better position to determine what level of investigation, if any, is required.

A report updating the status of the Management Response will be made publically available within one year.