

# Phase 2 Human Health Risk Assessment of Oil and Gas Activity in Northeastern British Columbia



March 2015

Presented by Bart Koppe, Intrinsik Inc.

# Presentation outline

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- Introduction to the study
- Key findings
- Recommendations

# Goals

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1. To assess the health risks associated with oil and gas activity in NE B.C.
2. Where appropriate, provide recommendations to address potential public health risks.

# Overview of Project

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**Phase 1 HHRA.** Identification of health concerns relating to oil and gas development in NE B.C. Completed in 2012.

**Phase 2 HHRA.** Assessment of the potential health risks in NE B.C. (with emphasis on chemical emissions). Completed in 2014.

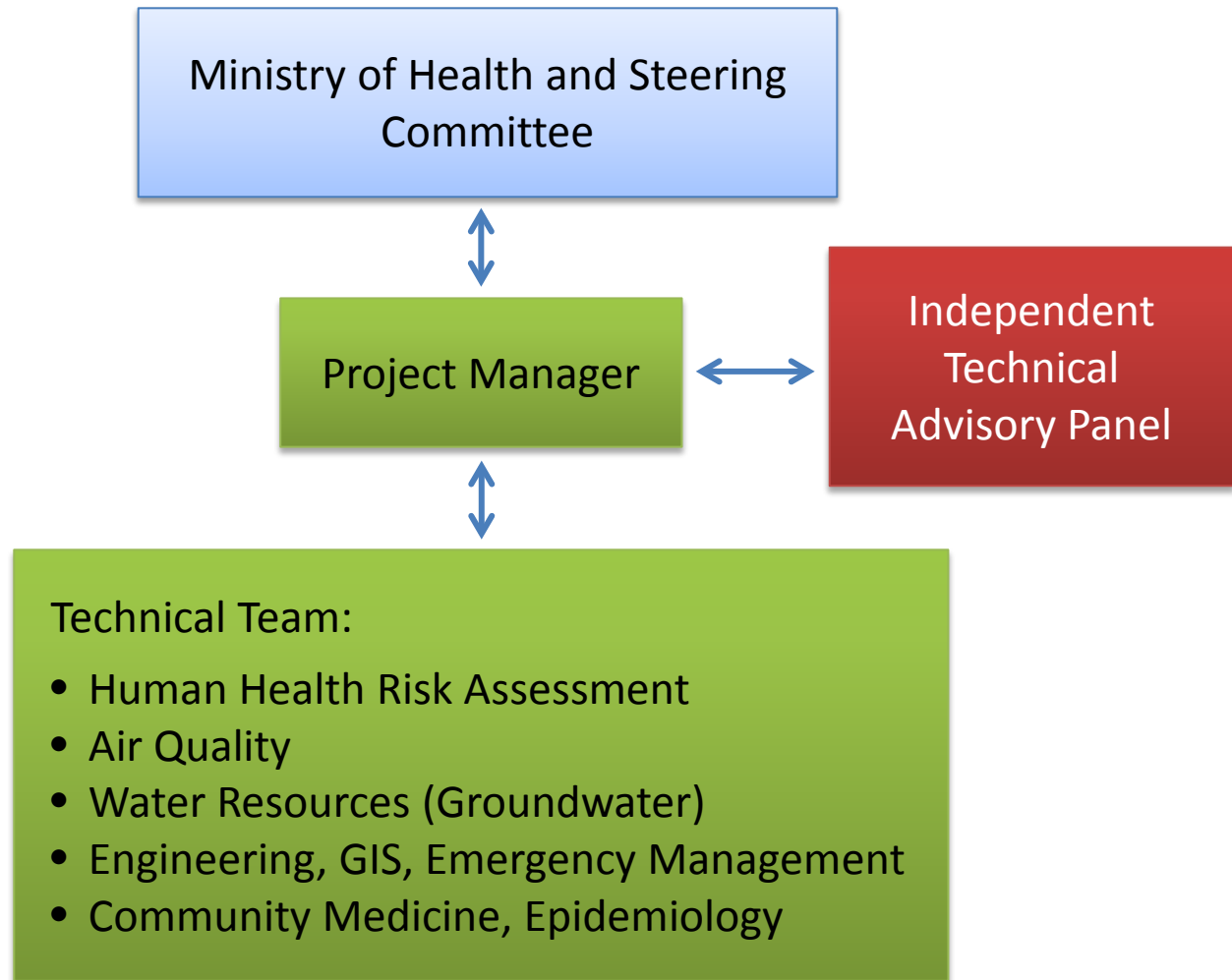
# Phase 2 Deliverables

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Task	Deliverables
1	Phase 2 Direction Document
2	Literature Review of health effects
3	Screening Level Risk Assessment
4	Detailed Human Health Risk Assessment (HHRA)
5	Review of Regulatory Framework
6	Recommendations

# Study Team

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# Communication

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- Stakeholder sessions in Fort St. John (January 2013)
- Northern Health session in Fort St. John (October 2013)
- Steering Committee sessions throughout

# Scope of work

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- Developed iteratively through information collection and review, taking into account:
  - Phase 1 findings  
(Fraser Basin Council report)
  - Literature review
  - Input from steering committee
  - Input from advisory panel
  - Professional judgment



# HHRA Approach

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## **Two parts:**

### **Screening level risk assessment (SLRA)**

- Qualitative review of various candidate exposure scenarios, and ranking in terms of relevance/importance/significance.
- Ranking relied on use of a risk matrix (likelihood and consequence).

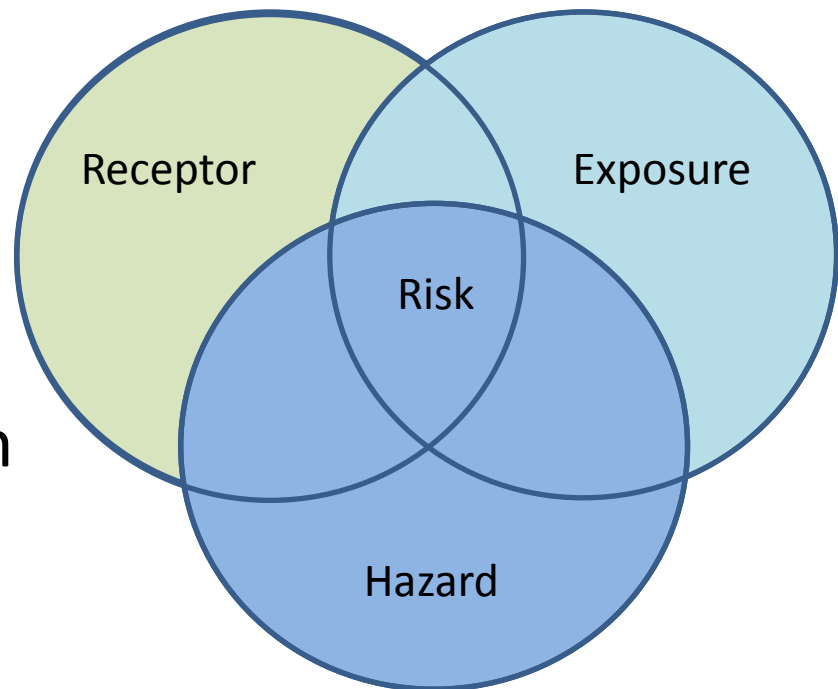
### **Quantitative Human Health Risk Assessment**

- Focused on key exposure scenarios determined from the SLRA.
- Followed a conventional risk assessment paradigm.

# How was the HHRA conducted?

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- Developed by regulatory agencies (Health Canada, US EPA, World Health Organization)
- When in doubt, err on the side of caution.

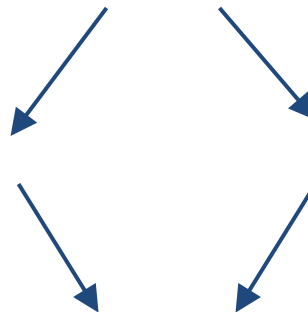


**Problem Formulation**  
Identification of chemicals, exposure pathways and scenarios for assessment, along with people potentially at risk.

**Toxicity Assessment**  
Determination of exposure limits for chemicals of concern.

**Exposure Assessment**  
Prediction of exposures to chemicals of concern.

**Risk Characterization**  
Comparison of predicted exposure to exposure limits, including consideration of chemical interactions.



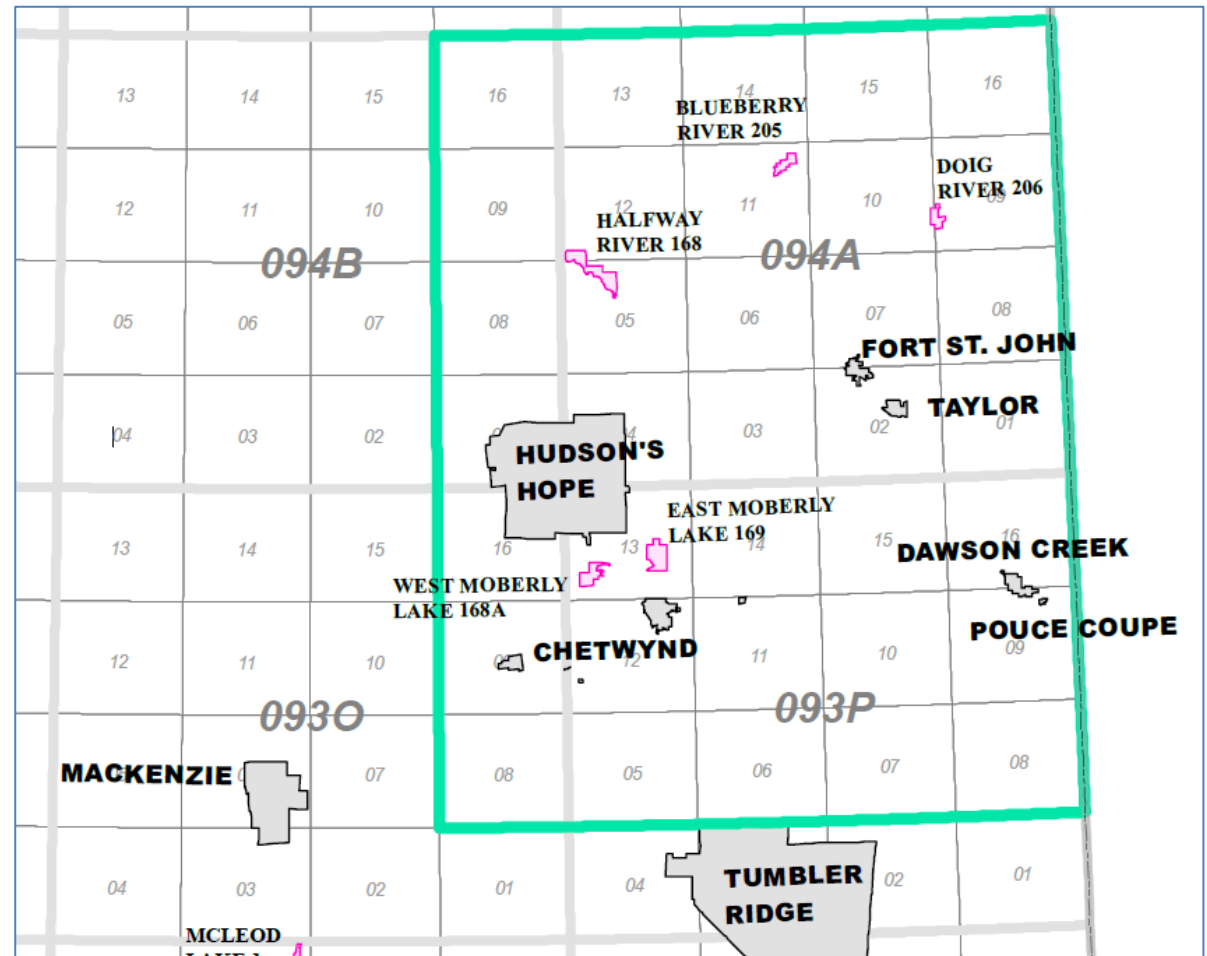
# Selected HHRA Study Area

Area:

~175 x 150 km

Includes:

- Highest population density
- Highest emission density
- Greatest variety of emission sources
- First Nations
- Represents “worst-case conditions”

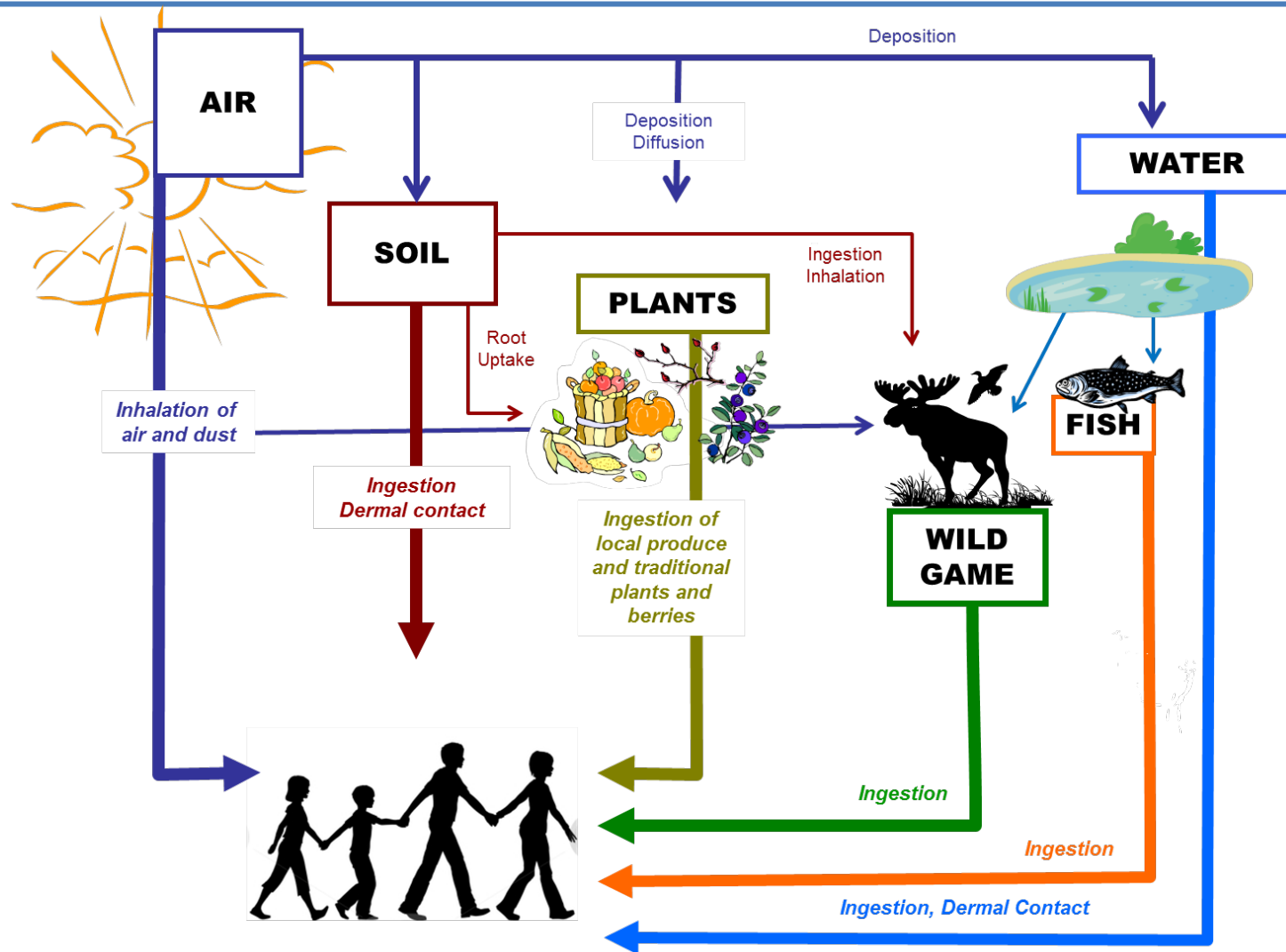


# Two Assessment Scenarios

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- **Oil and Gas Scenario:** Includes all ongoing air emissions from gas processing plants and various production facilities (e.g., compressor stations, fugitive emissions from tank storage).
- **Cumulative Scenario:** Includes air emissions from oil and gas, other industries, transportation and community sources.

# HHRA: Conceptual Model



# Chemicals of Potential Concern

Criteria Air Contaminants	Volatile Organic Compounds	Polycyclic Aromatic Hydrocarbons	Sulphur Compounds
SO <sub>2</sub>	Benzene	Benzo(a)pyrene	H <sub>2</sub> S
NO <sub>2</sub>	Toluene	Benzo(a)anthracene	
PM <sub>2.5</sub>	Ethylbenzene	Benzo(b)fluoranthene	
O <sub>3</sub>	Xylenes	Benzo(k)fluoranthene	
	1,3-butadiene	Chrysene	
	Acrolein	Fluoranthene	
	Acetaldehyde	Indeno(1,2,3-cd)pyrene	
	Cyclohexane	Phenanthrene	
	Formaldehyde		
	n-hexane		
	Isopropylbenzene (cumene)		
	Naphthalene		
	n-pentane		
	Trimethylbenzenes		

# HHRA: Inhalation Results

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Risks were interpreted based on:

- Source of the emissions.
- Spatial extent of the exceedances.
- Likelihood of exceedances.
- Degree of conservatism incorporated into the assessment.

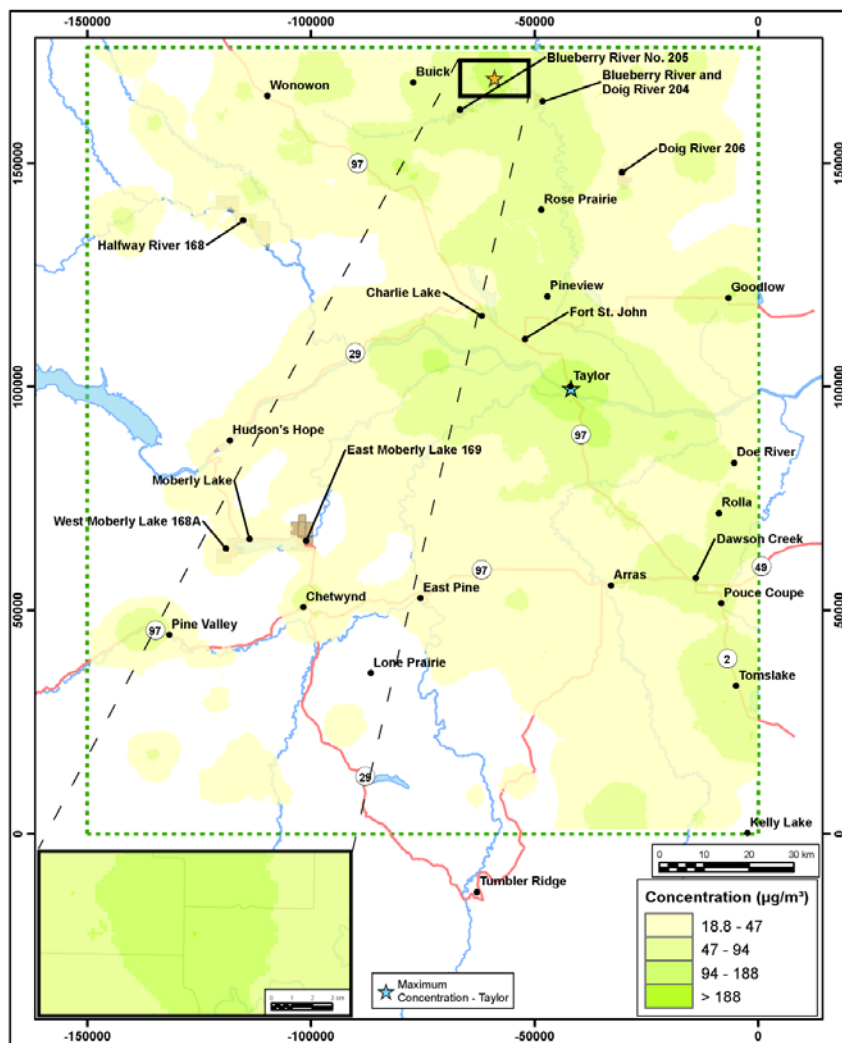


# Inhalation Results

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Findings of interest identified for the following chemicals of potential concern:

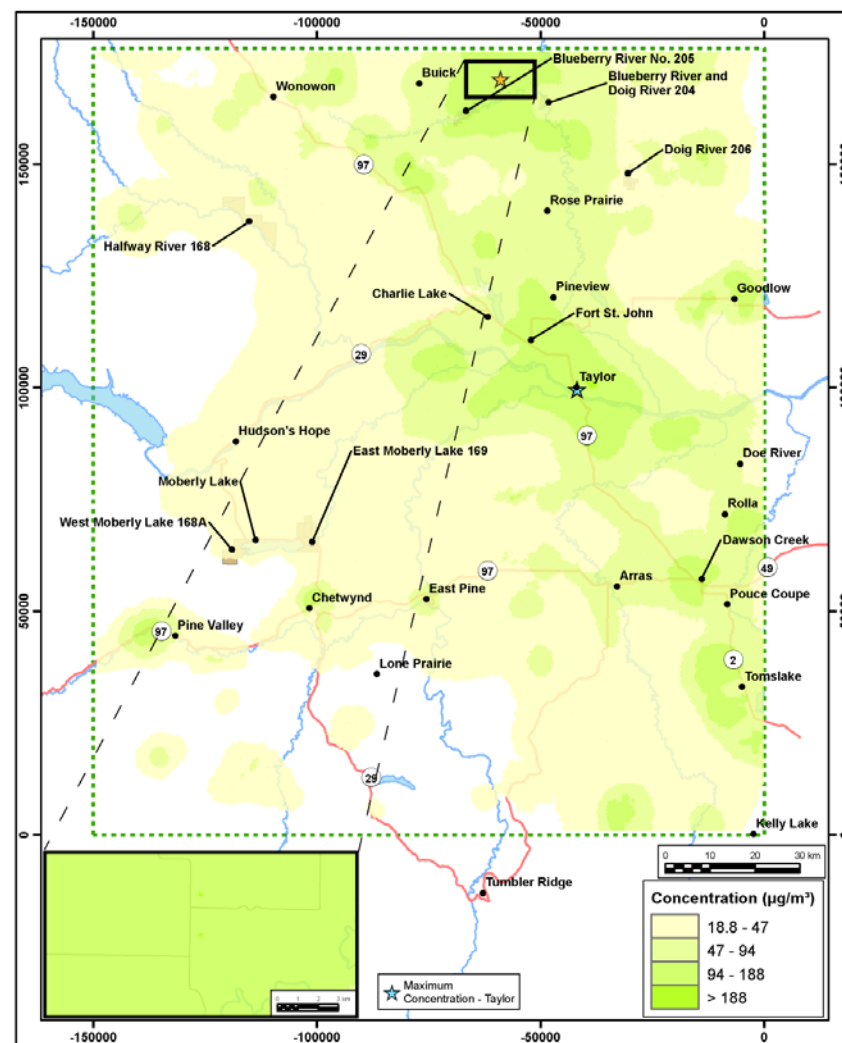
- $\text{NO}_2$
- $\text{PM}_{2.5}$
- $\text{SO}_2$
- Acrolein
- Formaldehyde



NO<sub>2</sub> - 1hr Averaging Period (98th Perc.)  
Oil and Gas Activities Only

Drawn by: NBN | Isopleth: 5  
Approx. Scale: 1:1,000,000  
Date Revised: Aug. 8, 2014

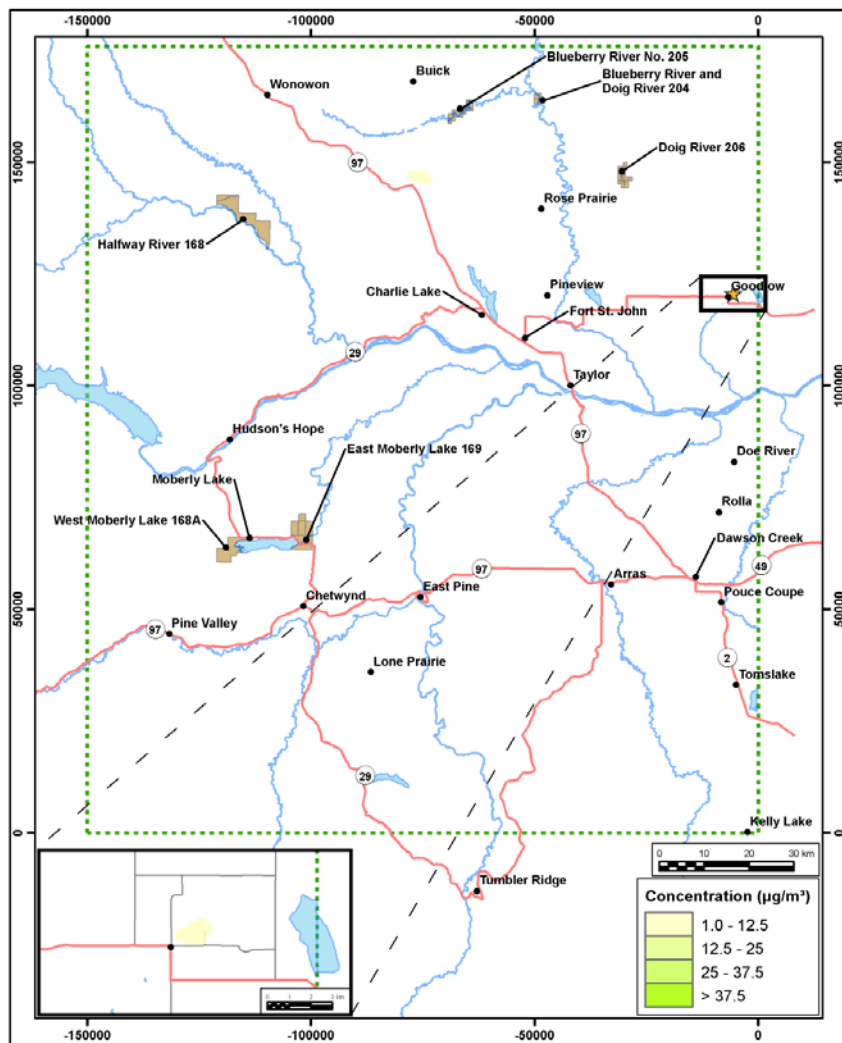
BC Ministry of Health, BC, Canada



NO<sub>2</sub> - 1hr Averaging Period (98th Perc.)  
Oil and Gas Activities and Background Sources

Drawn by: NBN | Isopleth: 6  
Approx. Scale: 1:1,000,000  
Date Revised: Aug. 8, 2014

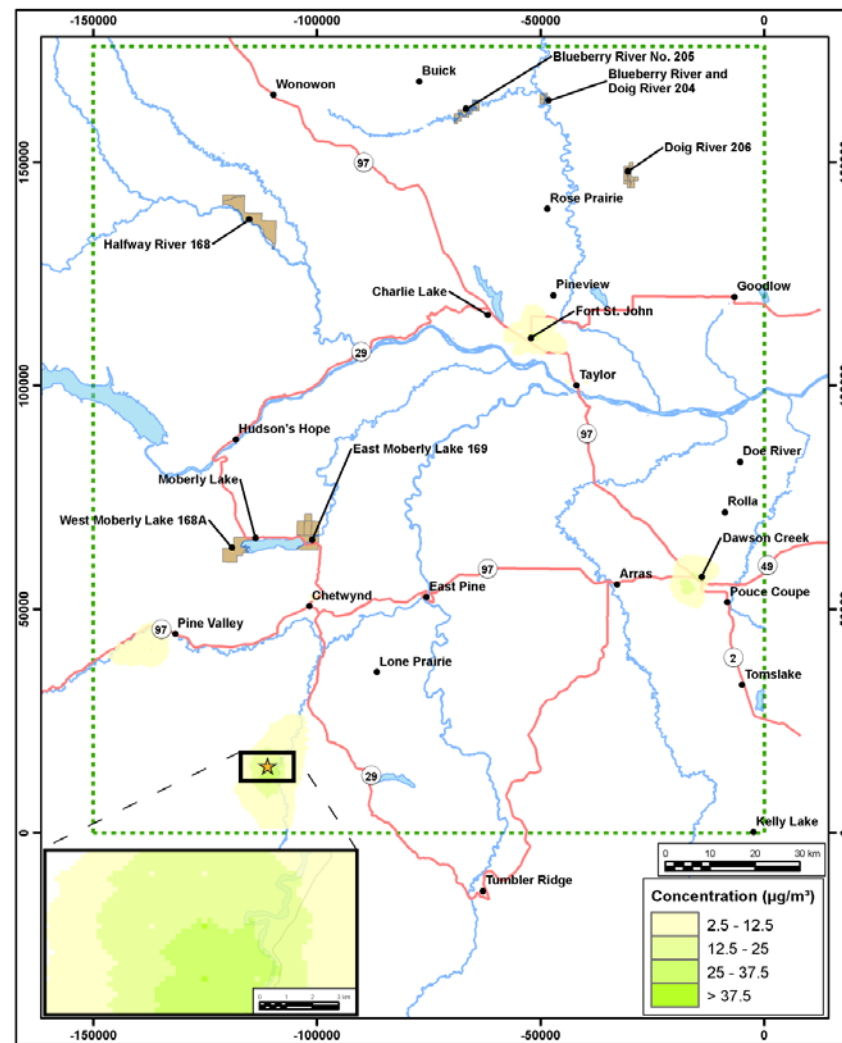
BC Ministry of Health, BC, Canada



PM<sub>2.5</sub> - 24hr Averaging Period (98th Perc.)  
Oil and Gas Activities Only

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Approx. Scale: 1:1,000,000  
Date Revised: Aug. 8, 2014

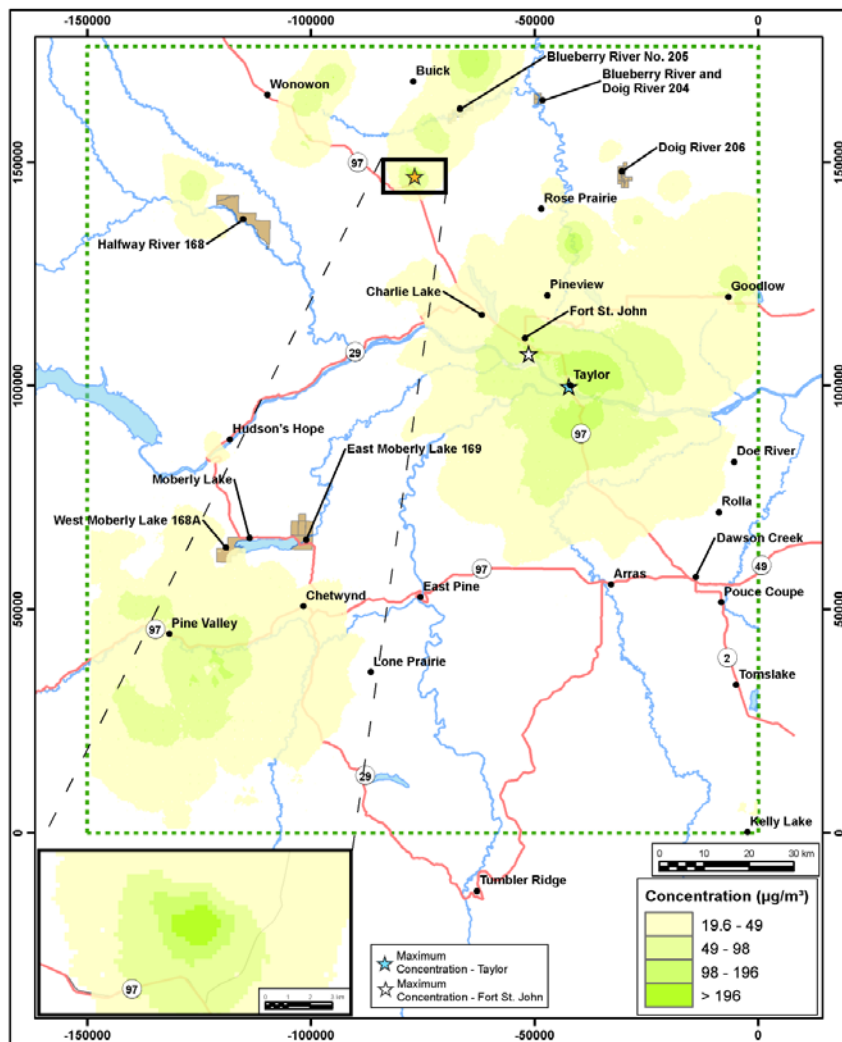
BC Ministry of Health, BC, Canada



PM<sub>2.5</sub> - 24hr Averaging Period (98th Perc.)  
Oil and Gas Activities and Background Sources

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Approx. Scale: 1:1,000,000  
Date Revised: Aug. 8, 2014

BC Ministry of Health, BC, Canada



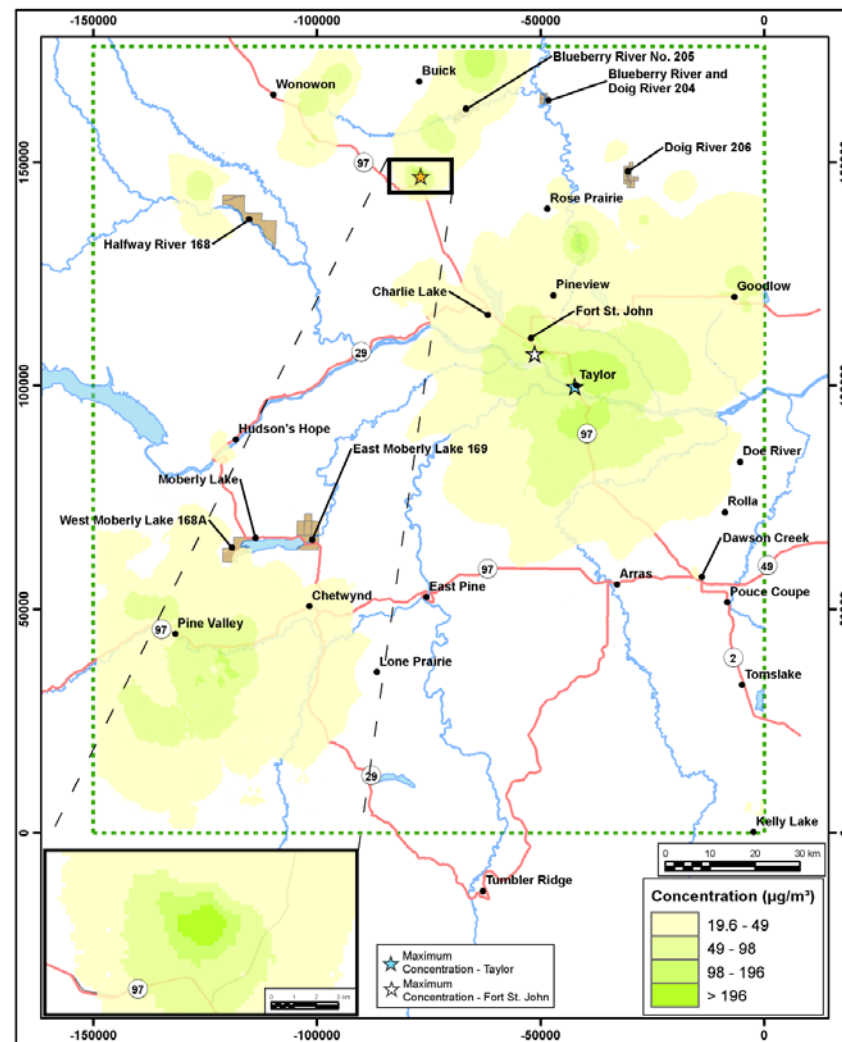
SO<sub>2</sub> - 1hr Averaging Period (99th Perc.)  
Oil and Gas Activities Only

Maximum Concentration - Taylor  
Maximum Concentration - Fort St. John

Streets  
Communities  
First Nations  
Highways  
Waterbody

True North  
Drawn by: NBN  
Isopleth: 9  
Approx. Scale: 1:1,000,000  
Date Revised: Aug. 8, 2014  
Project #1202326  
RWDI

BC Ministry of Health, BC, Canada



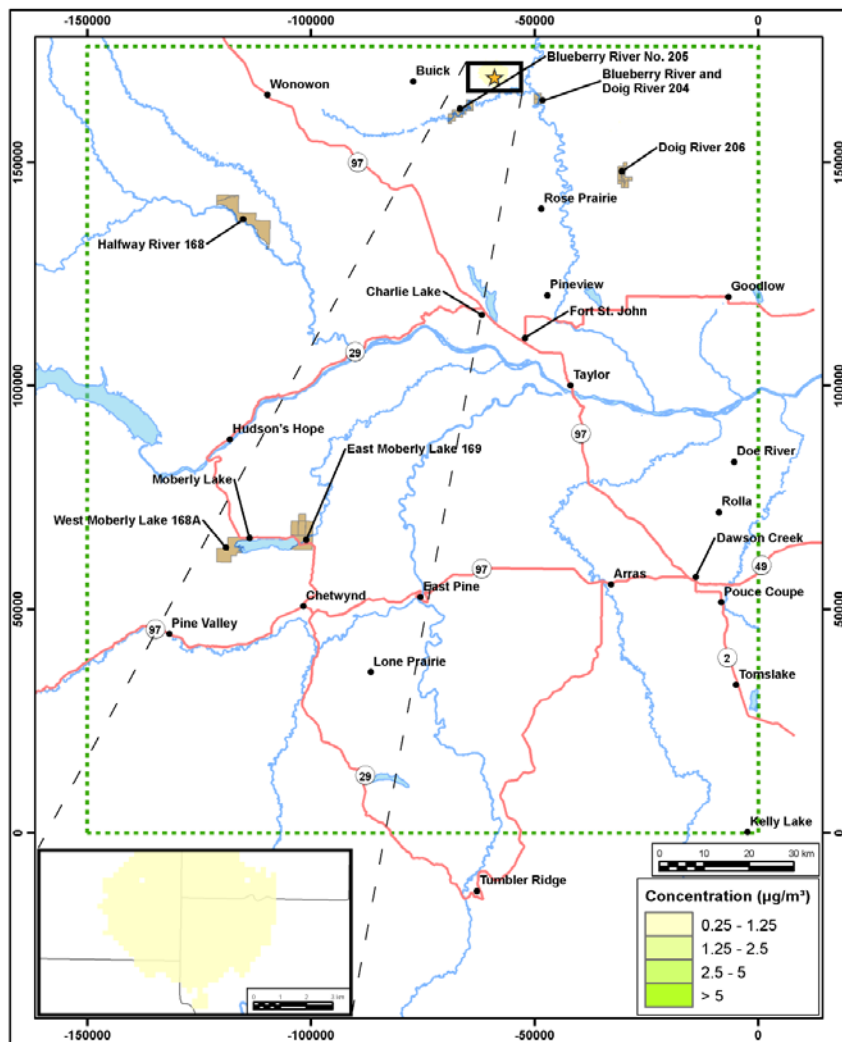
SO<sub>2</sub> - 1hr Averaging Period (99th Perc.)  
Oil and Gas Activities and Background Sources

Maximum Concentration - Taylor  
Maximum Concentration - Fort St. John

Streets  
Communities  
First Nations  
Highways  
Waterbody

True North  
Drawn by: NBN  
Isopleth: 10  
Approx. Scale: 1:1,000,000  
Date Revised: Aug. 8, 2014  
Project #1202326  
RWDI

BC Ministry of Health, BC, Canada



Acrolein - 1hr Averaging Period  
Oil and Gas Activities Only

Background from Geobase Acrolein (2010)  
Isopleths from Geobase Acrolein (2010)  
Projection: Modified Lambert Conformal

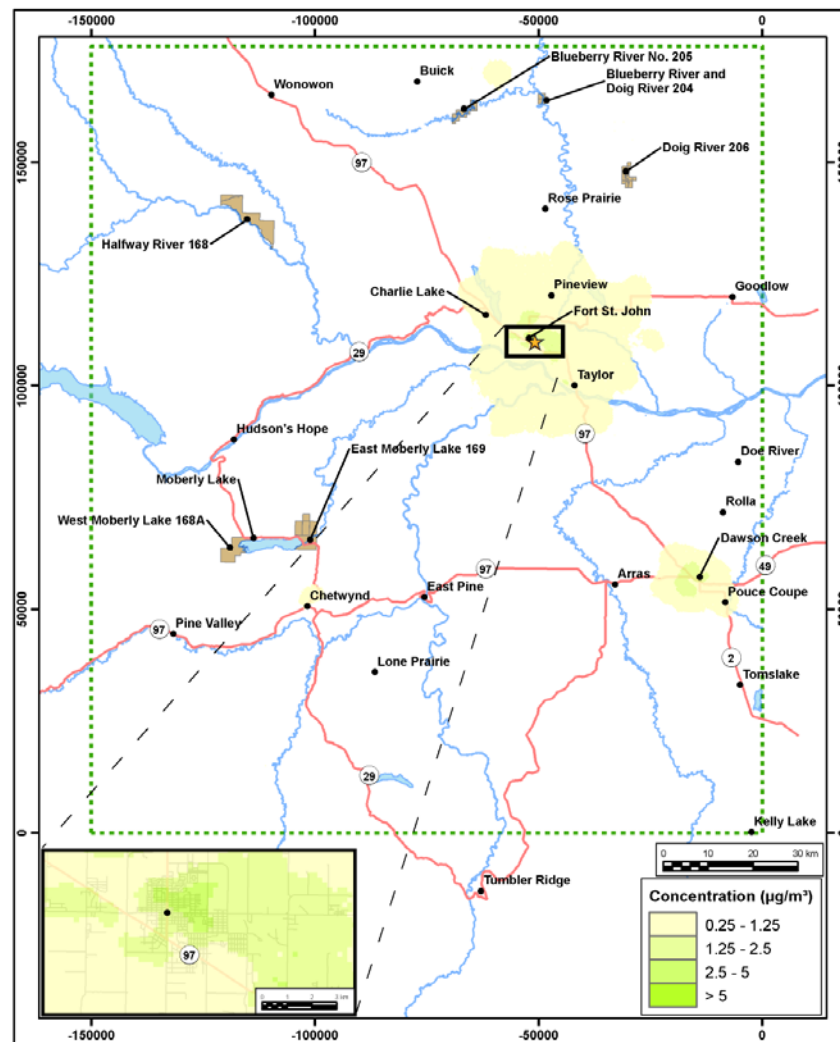
BC Ministry of Health, BC, Canada

★ Maximum Concentration  
● Communities  
— Streets  
— Study Area Extent  
■ First Nations  
■ Waterbody  
— Highways

True North

Drawn by: NBN | Isopleth: 1  
Approx. Scale: 1:1,000,000

Date Revised: Aug. 8, 2014



Acrolein - 1hr Averaging Period  
Oil and Gas Activities and Background Sources

Background from Geobase Acrolein (2010)  
Isopleths from Geobase Acrolein (2010)  
Projection: Modified Lambert Conformal

BC Ministry of Health, BC, Canada

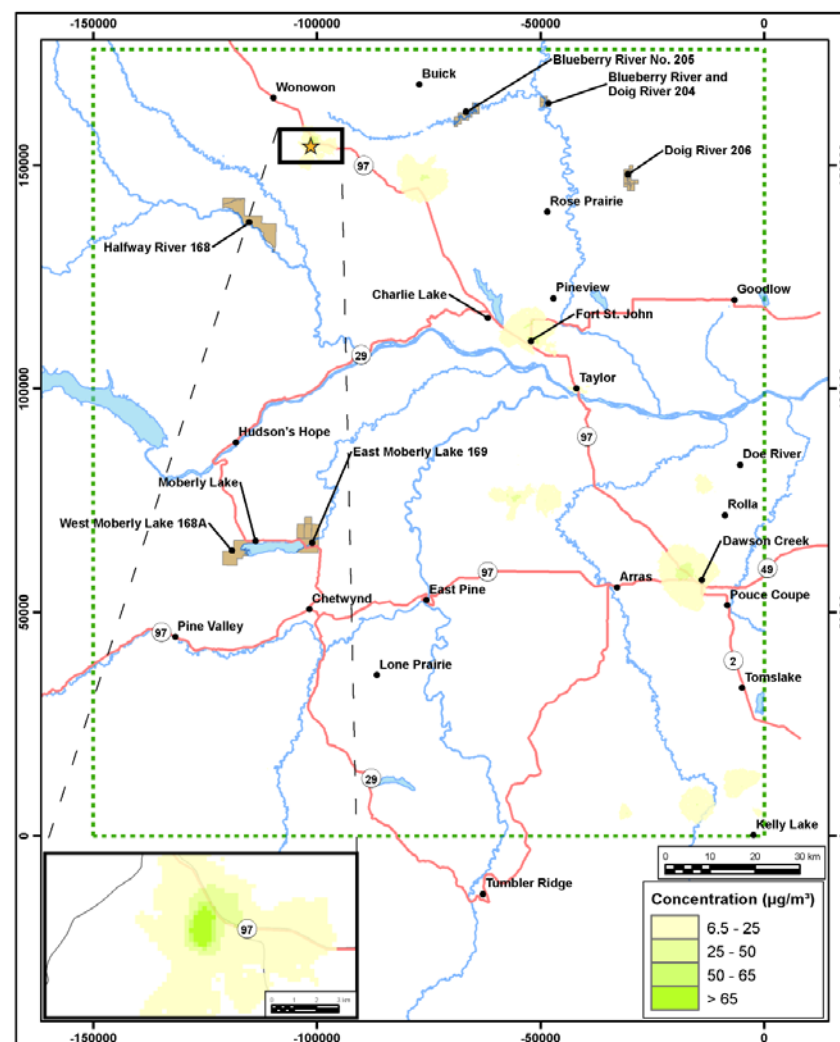
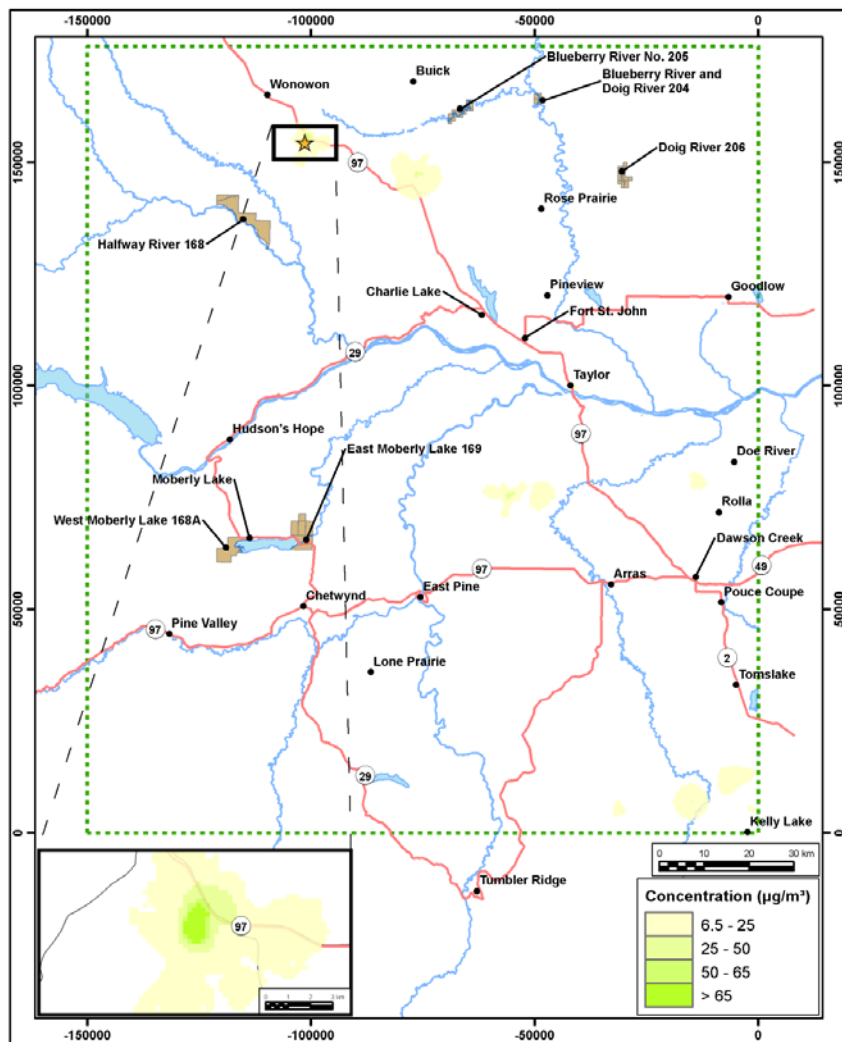
★ Maximum Concentration  
● Communities  
— Streets  
— Study Area Extent  
■ First Nations  
■ Waterbody  
— Highways

True North

Drawn by: NBN | Isopleth: 2  
Approx. Scale: 1:1,000,000

Date Revised: Aug. 8, 2014





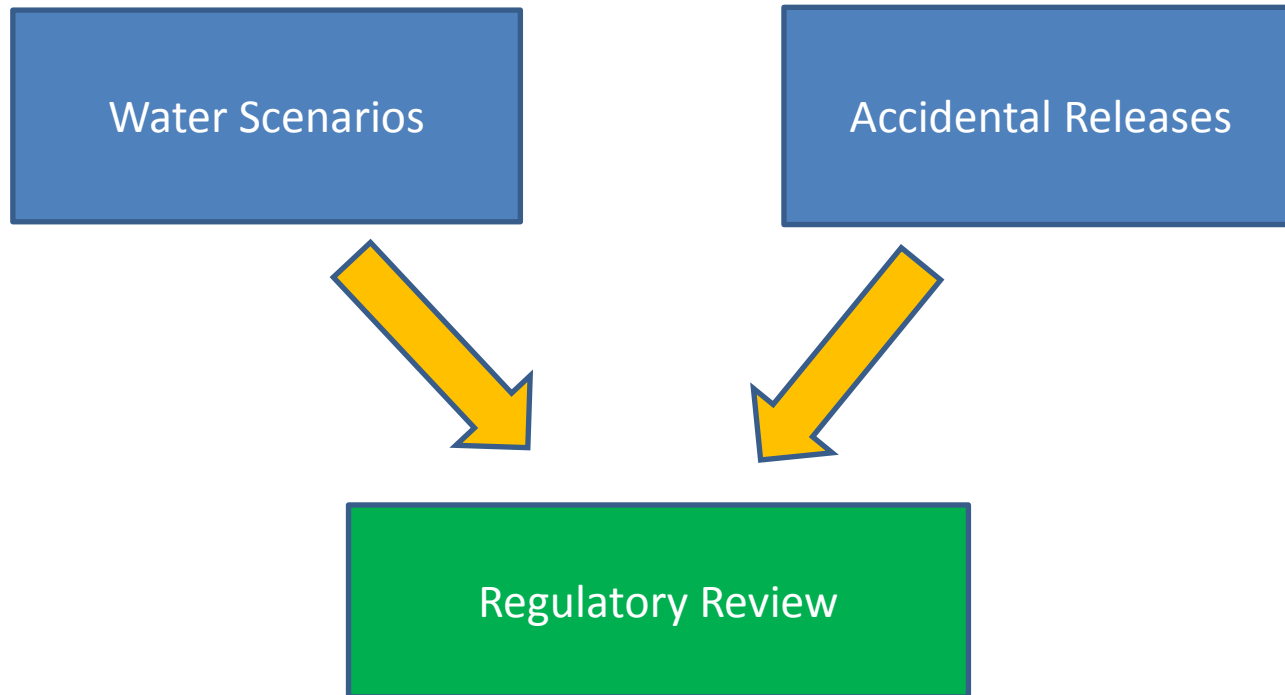
# Conclusion

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***The overall findings of the detailed human health risk assessment suggest that the public health risks associated with oil and gas activity in Northeastern B.C. are low.***

# Omissions from the HHRA

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# Review of Regulatory Framework

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**Objectives:** To identify where current regulations are sufficient or exceed the necessary levels for the protection of public health and identify areas where critical aspects of the framework are lacking.

**Review considered:**

- Relevant regulations, guidelines, directives
- Industry best management practices (e.g., CAPP)

**Focus** of the review was on those aspects of the framework that relate to the protection of water quality, air quality and safety issues associated with normal operation and accidental releases.

# Regulatory Review: Acts Considered

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Provincial	Federal
Drinking Water Protection Act	Canadian Environmental Protection Act
Emergency Program Act	National Energy Board Act
Environmental Assessment Act	Railway Safety Act
Environmental Management Act	Transportation of Dangerous Goods Act
Oil and Gas Activities Act	
Public Health Act	
Transport of Dangerous Goods Act	
Transportation Act	
Water Act	
Water Protection Act	
Workers Compensation Act	

# Comparison to other Jurisdictions and Best Practices

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- All relevant B.C. regulations were compared with equivalent regulations in a number of U.S. states and Alberta, as well as to applicable CAPP and API best practices.
- Where B.C. was observed to differ from other jurisdictions or best practices, this was noted and it was suggested that the Province should review these issues to determine whether the provincial guidelines/regulations should be updated.

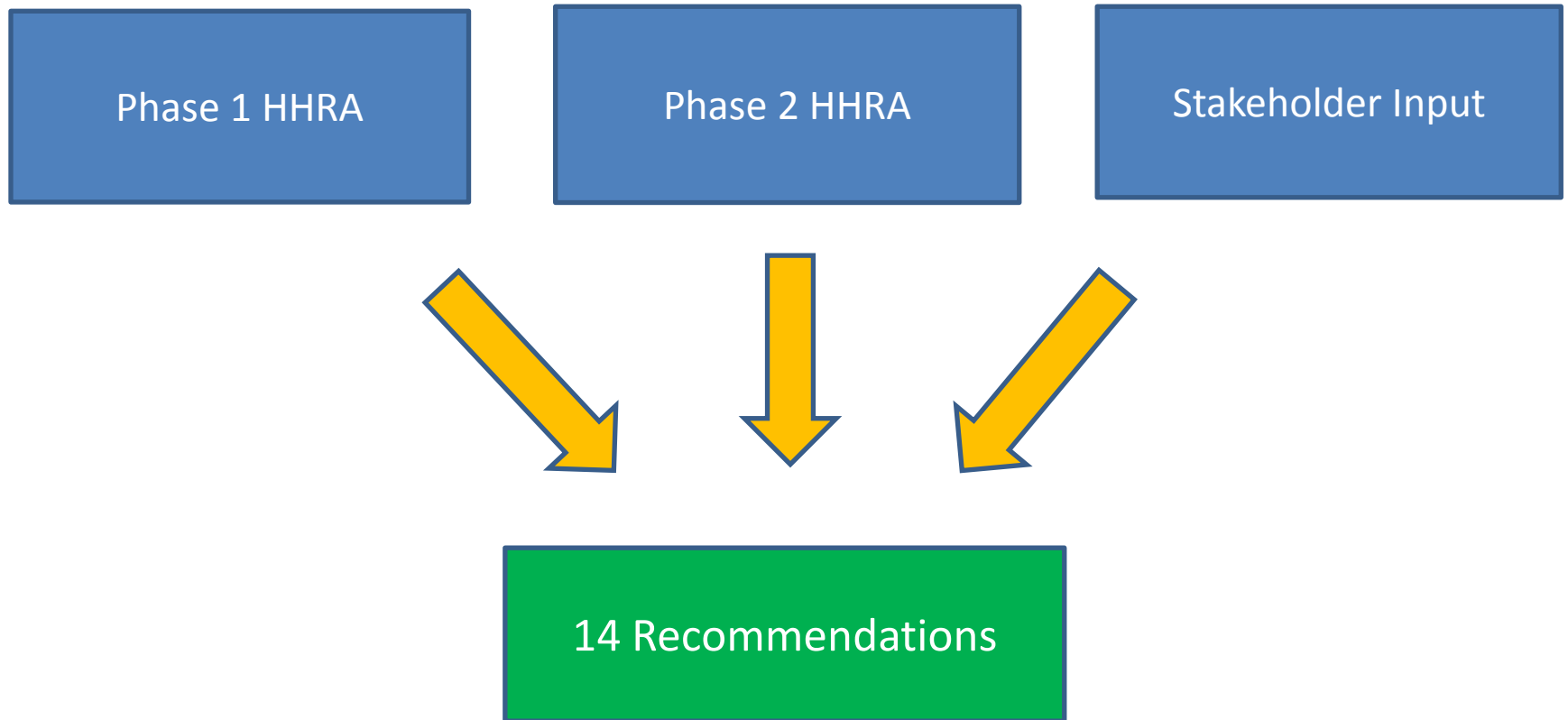
# Key Findings of the Regulatory Review

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- In general, the review demonstrates that existing framework is extensive and broadly protective of health.
- Generally, B.C. regulations were comparable to the measures that have been adopted in other jurisdictions and in line with applicable best management practices.
- Some findings were carried over into the Recommendations Report.

# Recommendations Report

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# Recommendations



Does not consider things like feasibility, enforceability, future (or planned) regulations.

# Themes

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1. Public safety (2)
2. Flaring, venting and fugitive emissions (1)
3. Hydraulic fracturing (2)
4. Legacy sites (1)
5. Information management (1)
6. Environmental monitoring (5)
7. Health surveillance (1)
8. Standards development (1)

= 14 Recommendations

# Public Safety

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## Recommendation 1:

The current tools applied to the calculation of emergency planning zones may need to be updated.

## Recommendation 2:

Should consider the implementation of a *reciprocal agreement framework for setbacks* between the oil and gas industry and B.C.'s communities.





# Flaring, venting and fugitive emissions

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## Recommendation 3:

The B.C. Ambient Air Quality Objectives should guide the development of regulations; directives and policies pertaining to venting, fugitive emissions; flaring limits; flaring notification and reporting; and flaring performance requirements. This should be done in a transparent manner that demonstrates how the objectives are considered.

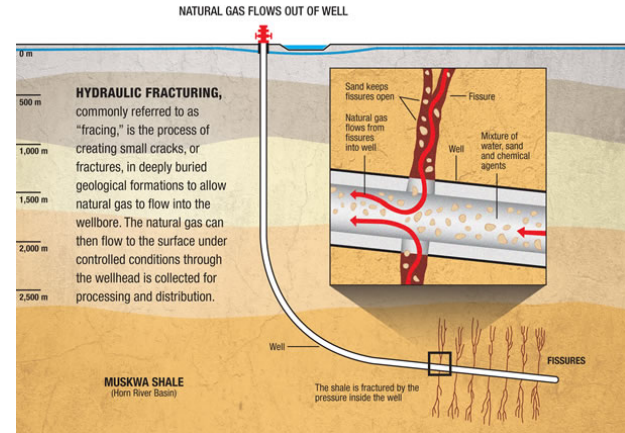
# Hydraulic Fracturing

## Recommendation 4:

Consider the implementation of *baseline, pre-drilling* groundwater testing requirements.

## Recommendation 5:

Consider refining the fracture fluid disclosure process to aid authorities and health professionals in accessing information about fluid ingredients, without compromising confidential business information.



Source: BC Oil and Gas Commission

# Legacy Sites

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## Recommendation 6:

When possible, the Oil & Gas Commission's Site Classification Tool and Ministry of Environment's Contaminated Sites Regulation framework should be used together in the assessment and management of legacy sites

# Information management

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## Recommendation 7:

Evaluate the overall objectives and efficient use of the various databases that manage permits, facility information, wells and flare data, with the aim of identifying means to make the systems more accessible and user-friendly.



# Environmental monitoring

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## Recommendation 8:

Consider using the information from the air quality study and HHRA to help:

- Identify the location of future monitors
- Select the types of pollutants to be monitored.



## Recommendation 9:

Once additional data for NE B.C. is available, the air quality predictions and health risk estimates should be revisited.

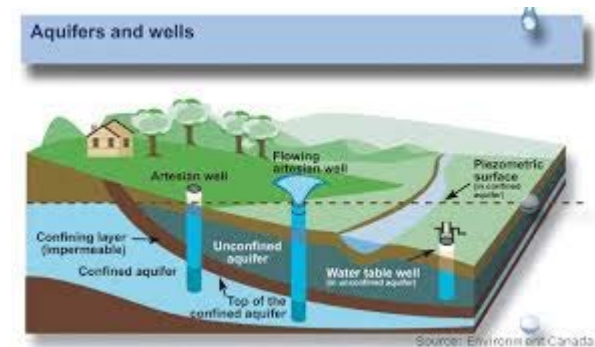
# Environmental monitoring

## Recommendation 10:

Existing aquifer mapping should be expanded for NE B.C. to help enhance the protection of groundwater resources in relation to oil and gas development.

## Recommendation 11:

Additional study of groundwater and surface water interactions with shallow aquifers and local groundwater flow conditions should be completed in NE B.C.



# Environmental monitoring

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## Recommendation 12:

Consider the overall goals of the existing environmental monitoring programs for soil, water and biota, along with the presentation and quality of these data within the existing databases, specifically as these relate to the value that these data could provide with respect to human health and environmental impact.

# Health surveillance

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## Recommendation 13:

The Province should explore tailoring their health surveillance to determine whether or not there are differences in disease rates in those areas identified in the HHRA with the highest predicted air concentrations. If possible, such future health surveillance would help verify the conclusions of the HHRA.



# Standards Development

## BC's Air Quality Objectives



Contaminant	Avg. Period	Level	Air Quality Objective		Date Adopted	Date Last Reviewed	Source
Carbon Monoxide (CO)	1 hour	A	14,300	13,000	1975	-	PCOs for Food-processing, Agriculturally Orientated, and Other Misc. Industries
		B	28,000	25,000			
		C	35,000	30,000			
	8 hour	A	5,500	5,000	1975	-	PCOs for Food-processing, Agriculturally Orientated, and Other Misc. Industries
		B	11,000	10,000			
		C	14,300	13,000			
Formaldehyde <sup>b</sup>	1 hour	Action Episode	60	50	2005	-	Provincial AQO
Nitrogen Dioxide (NO <sub>2</sub> )	1 hour	MAL	400	213	1975	1989	NAAQO
		MTL	1000	532	1978		
		MAL	200	106	1975		
	24 hour	MTL	300	160	1978		
		MDL	60	32	1975		
		MAL	100	53	1975		
Ozone (O <sub>3</sub> )	1 hour	MDL	100	51	1974	1989	NAAQO
		MAL	160	82	1974		
		MTL	300	153	1978		
	8 hour	CAAQS	123	63 <sup>c</sup>	2013	-	CAAQS
	24 hour	MDL	30	15	1974	1989	NAAQO
		MAL	50	26	1974		
		Annual	MAL	30	15		

## Recommendation 14:

The B.C. Ambient Air Quality Objectives should be reviewed and updated based on the existing provincial framework for developing air quality objectives.