AtlanticPower
Corporation

Technical Assessment

Atlantic Power Preferred Equity Ltd.
Williams Lake, BC Permit Amendment

Application File #341684
Prepared by: Glenda Waddell, President Waddell Environmental Inc
UPDATED: May 31, 2016

Table of Contents

Appendix 1 – Nov 2001 - Request to Amend Permit PA 8088 to Allow RRT

Appendix 2 – Oct. 8, 2015 - Application to amend Permit PA 8808 to allow 50% RRTs

Appendix 3 - Sep 8, 2015 - RWDI - Air Dispersion Modelling Report
Mar 1, 2016 – Meteorologist Assessment and Followup Requirements
Apr 22, 2016 – RWDI – Response to Meteorologist
May 4, 2016 – Meteorologist Followup Requirements
May 6, 2016 – RWDI – Response to Meteorologist

Appendix 4 - Jan 12, 2016 - Intrinsik - Assessment of Human Health Risks
May 26, 2016 – Intrinsik – Commentary on RWDI updates

Appendix 5 – Current Permit PA 8808

Appendix 6 – Source Path Receptor

Appendix 7 – RWDI – Best Achievable Technology Study

Executive Summary

The Williams Lake Power Plant (WLPP), owned and operated by Atlantic Power Corporation has made an application to amend its Air Permit, PA 8808, issued by the BC Ministry of Environment (MoE) under the provisions of the BC Environmental Management Act (EMA).

The WLPP is a 66 Megawatt biomass-fuelled electricity generation station. The plant was commissioned in 1993, in part, to solve the significant air quality issues caused by multiple beehive burners operating within the Williams Lake airshed. The primary fuel source consists of wood residues from local sawmills with up to approximately 600,000 tonnes of biomass converted to renewable energy on an annual basis. The high operating temperature combined with effective pollution control works results in plant emissions that are better than what is considered to be Best Available Technology (BAT).

The WLPP supplies power to BC Hydro under a long-term electricity purchase agreement (EPA). The current EPA expires in 2018. Discussions are under way with BC Hydro to establish an additional ten year EPA but a secure fuel supply is essentiall. The recent reduction in the Allowable Annual Cut (AAC), ongoing impacts of the Mountain Pine Beetle infestation, sawmill closures and increasing competition for biomass fibre have resulted in the need for the WLPP to secure alternate fuel supplies.

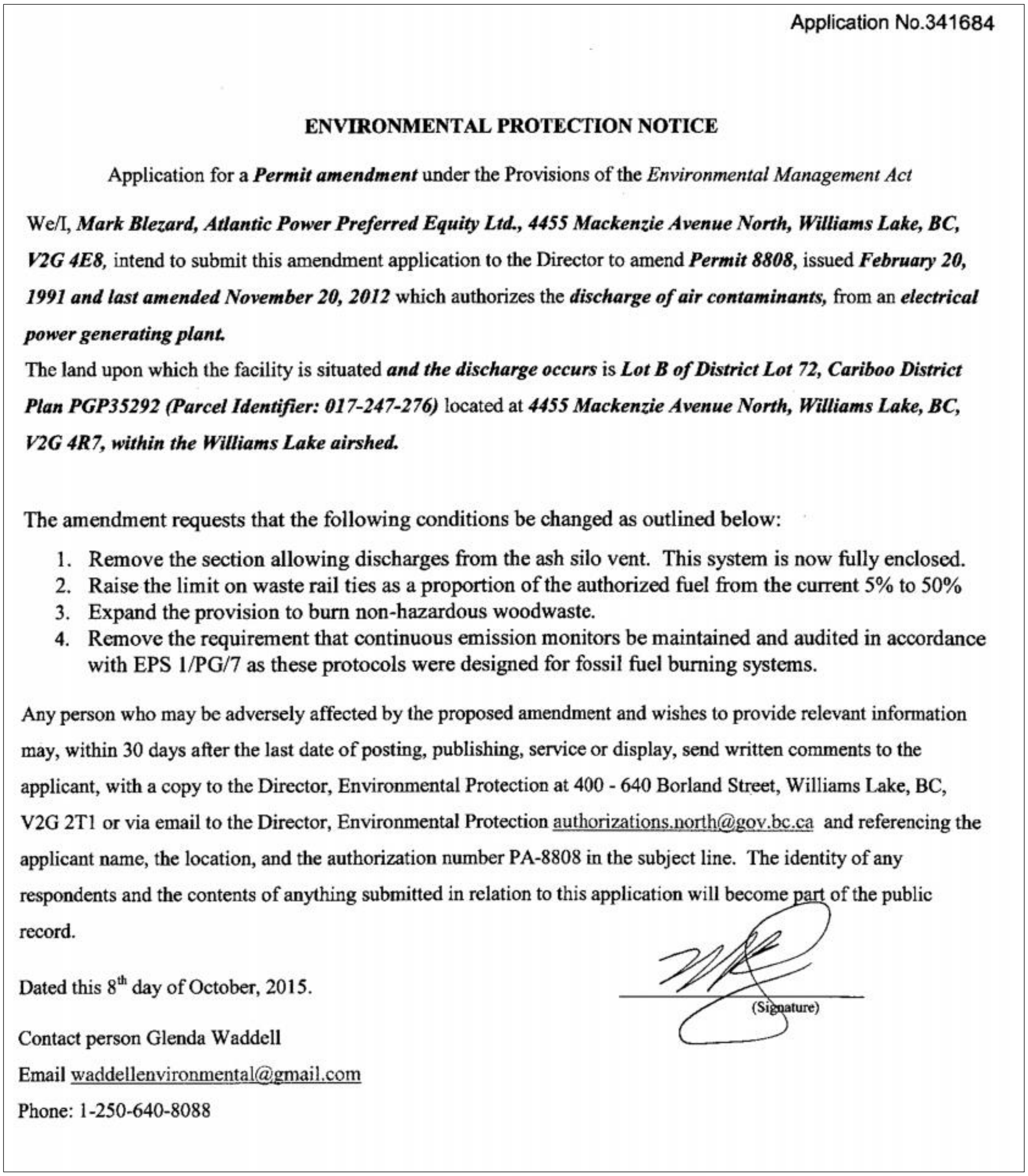
In 2001, the WLPP, as per the requirements of the Ministry of Environment, conducted a trial burn consisting of 100% treated used railway ties (RRT). As a result of the trial, the facility requested, and was allowed, to burn up to 5% RRT. This practice was halted in late 2010 due to concerns related to the RRT shredding operation that was located in a sensitive area of the downtown.

In late 2014 Atlantic Power, in support of extending WLPP operations beyond the expiry of the EPA in 2018, evaluated alternate fuel sources. Given the availability and multiple environmental benefits, converting used RRT to electricity was selected as the best option to supplement the diminishing supply of sawmill residuals. To inform a permit amendment to allow up to 50% RRT in the WLPP fuel feed, a comprehensive program of dispersion modelling, impact assessment and communications was launched in early 2015.

Application to Amend Air Permit

On July 10, 2015 the WLPP made an application to amend Air Permit 8808 to increase the maximum component of RRT in the fuel feed from 5% to 50%. The application also requested an expansion of the allowance to burn other types of biomass to include local "non-hazardous biomass waste" and "clean construction and demolition waste".

The Environmental Protection Notice, as amended for issue as required by the BC Public Notification Regulation, is shown here for reference.



Application No.341684

ENVIRONMENTAL PROTECTION NOTICE

Application for a ***Permit amendment*** under the Provisions of the *Environmental Management Act*

We/I, ***Mark Blezard, Atlantic Power Preferred Equity Ltd., 4455 Mackenzie Avenue North, Williams Lake, BC, V2G 4E8,*** intend to submit this amendment application to the Director to amend ***Permit 8808***, issued ***February 20, 1991 and last amended November 20, 2012*** which authorizes the ***discharge of air contaminants,*** from an ***electrical power generating plant.***

The land upon which the facility is situated ***and the discharge occurs*** is ***Lot B of District Lot 72, Cariboo District Plan PGP35292 (Parcel Identifier: 017-247-276)*** located at ***4455 Mackenzie Avenue North, Williams Lake, BC, V2G 4R7, within the Williams Lake airshed.***

The amendment requests that the following conditions be changed as outlined below:

1. Remove the section allowing discharges from the ash silo vent. This system is now fully enclosed.
2. Raise the limit on waste rail ties as a proportion of the authorized fuel from the current 5% to 50%
3. Expand the provision to burn non-hazardous woodwaste.
4. Remove the requirement that continuous emission monitors be maintained and audited in accordance with EPS 1/PG/7 as these protocols were designed for fossil fuel burning systems.

Any person who may be adversely affected by the proposed amendment and wishes to provide relevant information may, within 30 days after the last date of posting, publishing, service or display, send written comments to the applicant, with a copy to the Director, Environmental Protection at 400 - 640 Borland Street, Williams Lake, BC, V2G 2T1 or via email to the Director, Environmental Protection authorizations.north@gov.bc.ca and referencing the applicant name, the location, and the authorization number PA-8808 in the subject line. The identity of any respondents and the contents of anything submitted in relation to this application will become part of the public record.

Dated this 8th day of October, 2015.

(Signature)

Contact person Glenda Waddell

Email waddellenvironmental@gmail.com

Phone: 1-250-640-8088

Atlantic Power

Atlantic Power Corporation headquartered in Boston, Massachusetts, is a power generation and infrastructure company with assets in the United States and Canada.

The following are the coordinates for Atlantic Power Headquarters:

Dedham, MA (Headquarters):
3 Allied Drive, Suite 220
Dedham, MA 02026
Phone: 617-977-2400
Info@atlanticpower.com

The following are the coordinates and contact information for the WLPP:

Atlantic Power Preferred Equity Ltd.
4455 Mackenzie Avenue North
Williams Lake, BC, V2G 4E8

Mark Blezard, Plant Manager
Phone: 250-392-6395
Fax: 250-392-8412
Email: mblezard@atlanticpower.com

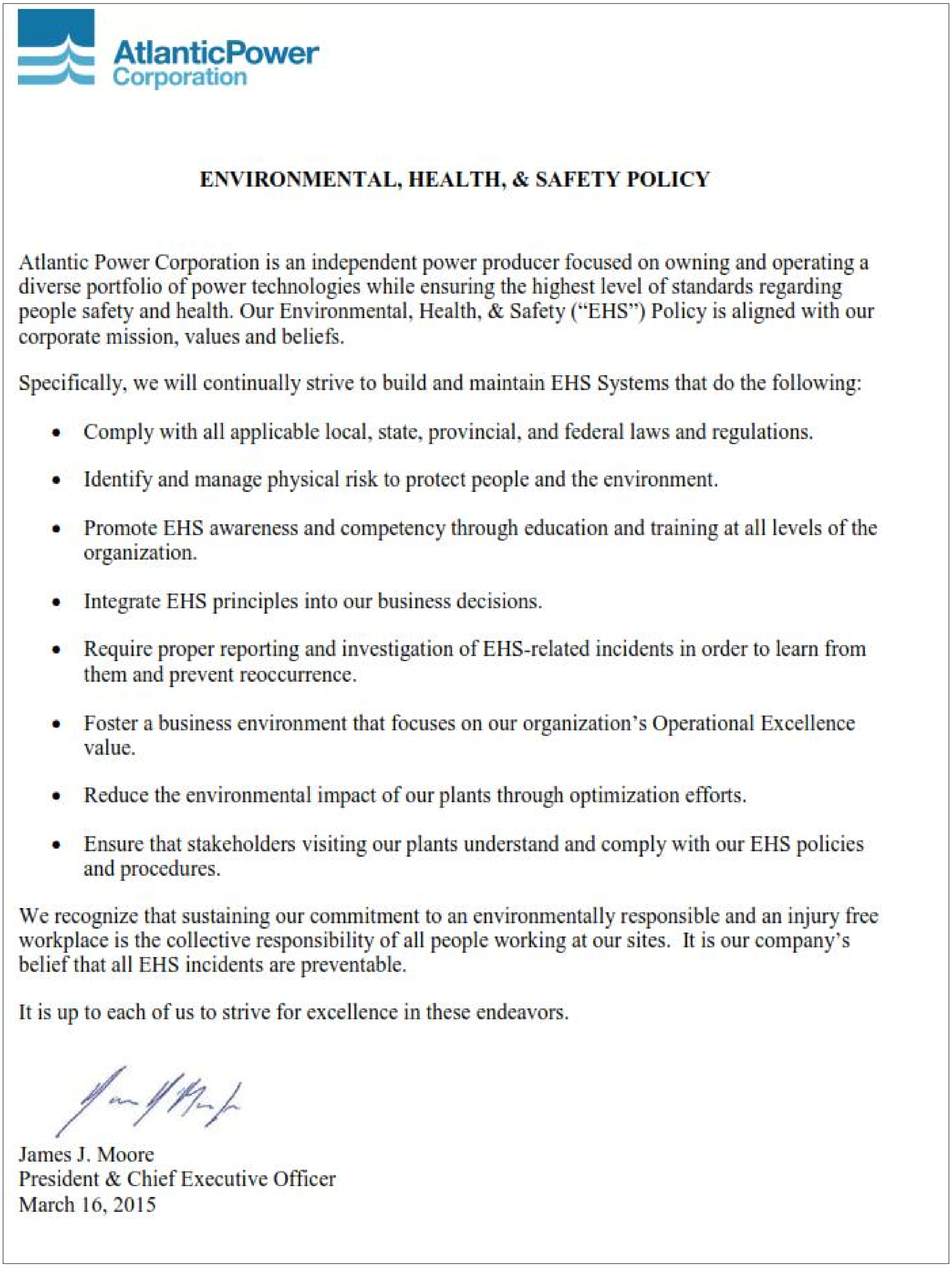
The WLPP is located at Lot B of District Lot 72, Cariboo District Plan PGP35292 (Parcel Identifier: 017-247-276).

Figures 1 and 2 are provided to show the plant layout

Figure 1: WLPP

Figure 2: WLPP – Plant Layout (Google Maps)

The Atlantic Power corporate Environmental Policy is shown on the next page for reference



AtlanticPower Corporation

ENVIRONMENTAL, HEALTH, & SAFETY POLICY

Atlantic Power Corporation is an independent power producer focused on owning and operating a diverse portfolio of power technologies while ensuring the highest level of standards regarding people safety and health. Our Environmental, Health, & Safety ("EHS") Policy is aligned with our corporate mission, values and beliefs.

Specifically, we will continually strive to build and maintain EHS Systems that do the following:

- Comply with all applicable local, state, provincial, and federal laws and regulations.
- Identify and manage physical risk to protect people and the environment.
- Promote EHS awareness and competency through education and training at all levels of the organization.
- Integrate EHS principles into our business decisions.
- Require proper reporting and investigation of EHS-related incidents in order to learn from them and prevent reoccurrence.
- Foster a business environment that focuses on our organization's Operational Excellence value.
- Reduce the environmental impact of our plants through optimization efforts.
- Ensure that stakeholders visiting our plants understand and comply with our EHS policies and procedures.

We recognize that sustaining our commitment to an environmentally responsible and an injury free workplace is the collective responsibility of all people working at our sites. It is our company's belief that all EHS incidents are preventable.

It is up to each of us to strive for excellence in these endeavors.

James J. Moore
President & Chief Executive Officer
March 16, 2015

Project Description

Timeline/Reports

The following timeline is provided to convey the critical history of the WLPP Air Permit and of the current Permit amendment process:

- Feb 20, 1991 – Permit 8808 was issued.
- 1993 - WLPP commenced operations consuming up to 600,000 tonnes of wood waste, primarily from area sawmills.
- Dec 1992 to Dec 1996 - all beehive burners in the Williams Lake airshed phased out.
- April 2001 – Study compares emissions and ash from 100% rail way ties (RRT) versus untreated wood fuel. A copy of this report can be found in Appendix 3 with the RWDI modelling report.
- Nov 22, 2001 – Application to amend the Permit to allow RRT as a fuel source. The Request to Amend Permit PA 8088 to Allow RRTs to be used as Minor Fuel Source – TransCanada Williams Lake Power Plant and the Technical Assessment Report (TAR) that supported the application can be found in Appendix 1.
- Jan 17, 2003 – Air Permit amendment allows for burning of wood residue treated with creosote or pentachlorophenol (PCP) with no restriction on percent of fuel feed.
- 2004 to 2010 – WLPP utilized 3% to 4% RRT in its biomass fuel. The use of RRT was discontinued due to concerns about chipping in the downtown.
- Nov 20, 2012 – Air Permit amendment allows burning of wood residue treated with creosote and/or a creosote-PCP blend up to 5% of the total biomass fuel supply. This is the current Permit and can be found in Appendix 5.
- Jul 8, 2015 - Meeting with MoE in Williams Lake to initiate the current amendment application.
- Jul 10, 2015 - Application submitted to Victoria EPD Permit Administration.
- Sep 8, 2015 – Completion of *RWDI Air Dispersion Modelling Study Final Report*. This study was commissioned to apply emissions data from the 2001 trial burn to the Calpuff model. Staff at the Ministry of Environment had input to the scope and basis of the study. The report and follow-up items below can be found at Appendix 3.
  - Mar 1, 2016 – MoE Meteorologist assessment of the above modeling report and request for follow-up items based on new information concerning a previous modelling study conducted by MoE. Items requested include additional isopleth maps, revisions to isopleth maps showing NO_2 and SO_2, and the NO2, PM2.5 and SO2 statistics predicted by the model at the closest Calpuff grid point to the Columneetza air station.
  - Apr 22, 2016 – RWDI response to above Meteorologist requests and updates to model.
  - May 4, 2016 – MoE Meteorologist acknowledges RWDI Apr 22, 2016 response items and model updates and requests detailed information on ozone data used in the modelling.
  - May 6, 2016 – RWDI supplies detailed information on ozone data as requested by MoE.
- Oct 16, 2015 – Final step in public notification requirements completed and 30 day comment period begins. A copy of the application, as issued in compliance with the BC Public Notification Regulation, can be found in Appendix 2.
- Nov 15, 2015 - Completion of 30 day consultation period.
- Jan 12, 2016 – Completion of *Intrinsik – Assessment of the Human Health Risks Associated with the Proposed Changes in the Emissions from the Williams Lake Power Plant*. Stakeholder questions concerning possible health impacts were referred to Intrinsik Environmental Sciences. Intrinsik is a recognized leader in the field of human health risk assessment. The Intrinsik report and follow-up commentary below can be found in Appendix 4.
  - May 26, 2016 – Intrinsik commentary on RWDI April 22, 2016 modelling updates.

- Feb 21, 2016 – DRAFT Consultation Report submitted to Ministry of Environment at 1011 Fourth Avenue in Prince George to attention Peter Lawrie, Senior Environmental Protection Officer.
- Feb 24, 2016 - Issue and delivery of DRAFT Technical Assessment to Ministry of Environment at 1011 Fourth Avenue in Prince George to attention Peter Lawrie, Senior Environmental Protection Officer.
- May 17, 2016 – Completion of *RWDI BAT Assessment*. The report can be found at Appendix 7.
- May 31, 2016 - Issue and delivery of this UPDATED Technical Assessment to Ministry of Environment at 1011 Fourth Avenue in Prince George to attention Peter Lawrie, Senior Environmental Protection Officer.

WLPP Products

The WLPP utilizes wood residues, formerly disposed of with no energy recovery and with substantial emissions, by burning in beehive burners. From this renewable fuel source, WLPP produces enough energy to power 52,000 homes in British Columbia.

WLPP converts up to 600,000 of wood waste per year, primarily from local sawmills, into electricity displacing the need for fossil fuels. The addition of RRT provides additional benefits in that used RRTs are diverted from landfill where they would generate methane as they decompose over a lengthy period of time.

Project Plan

RRT burning at WLPP was discontinued in late 2010 due to concerns related to the process of shredding the ties. At that time ties were shredded on CN property in close proximity to the downtown. Citizen concerns included noise, odour and fire risk.

WLPP has a comprehensive plan to receive, store, shred and consume RRT at its site on Mackenzie Avenue North. The specifics are outlined in the Fuel Management section of this report.

Assessment

To assist the reader, the following assessment is provided in the order of the stakeholder Q&A which can be found in Appendix C of the Consultation Report.

1. Air

1.1. Air Quality General

1.1.1. Williams Lake Airshed Management Plan Potential Impacts

The pollution controls in place at the Williams Lake Power Plant (WLPP) are such that particulate emissions are extremely low. The trial burn using 100% railway ties (RRT) showed that the plant will continue to operate well below its permitted levels for particulate. Based on the documented improvements in Williams Lake's particulate levels after the plant came on-line, it is concluded that continued operation of the plant going forward is beneficial to maintaining the continuous improvement in the area's air quality.

1.1.2. Medium to Long Term Effect on Air Quality

The RWDI Dispersion Modelling Study Report (see Appendix 3) projects that any increases due to the burning of RRT will not cause exceedances of the BC Ambient Air Quality Objectives (BCAAQO).

1.1.3. Net Impact on Airshed

All predicted results in the community are within the BC Ambient Air Quality Standards or, absent a BC Standard, the Ontario Ambient Air Quality Standard. The testing and dispersion modelling show that some emissions (e.g. hydrogen chloride and sulphur dioxide) may increase and some (e.g. particulate and some trace metals) may decrease but all remain within BC standards. When our plant opened in 1993, there was an immediate improvement in air quality because we consumed the material that used to be burned in beehive burners. If we keep operating, Williams Lake continues to have cleaner air, local sawmills continue to have a wood residue disposal solution, and fossil fuels like coal, oil and natural gas are displaced with renewable fuels. RWDI points out in the report that the process of adding background ambient values to the modeled emissions data has the effect of double counting NO2, leading to the predicted 1 hour NO2 value plus the background to be slightly above the objective. The double counting effect is consistent with the fact that nitrogen dioxide emissions are virtually unchanged whether burning traditional wood fibre or 100% rail way ties. This, and other conservative assumptions in the analysis, indicates that the BC Ambient Air Quality Standards for this compound will not be exceeded during actual operations.

1.1.4. Rail-Tie Trial Burn

The WLPP conducted a multi-day test in 2001, burning 100% RRT, and the air testing results were well below permit standards. Since then, there have been no material changes to the plant process that would alter the results. Within that context, and given that we will be burning at most a 50/50 mixture of RRT and traditional fuel sources, we are assured the process will meet all standards.

1.1.5. Consideration of Health Standards

The design of the Williams Lake Plant was reviewed and approved by the MOE. The subsequent emission limits established for the plant were based on British Columbia's regulatory structure at the time of the plant's start-up, which do consider health impacts. Similarly, any additional emission limits that may result from this permit amendment will be based on British Columbia regulations, as directed by the MOE.

However, in a Human Health Risk Study (See Appendix 4) completed by Intrinsik Environmental Sciences, Inc., (Intrinsik), emissions from the plant were compared to other scientific and regulatory exposure limits, and were determined to pose a negligible risk, as described below:

Potential health risks were determined by comparing the predicted maximum ground-level air concentrations of the COPC at the MPOI for averaging times associated with both short-term and long-term exposures with exposure limits established by regulatory and leading scientific authorities responsible for the protection of public health. These limits incorporate a high degree of protection to accommodate vulnerable members of the population in order to determine the potential health risks to the people living in the area or who might frequent the area for work, recreation or other purposes. In accordance with accepted HHRA protocol, the exposure limits were based on a COPC's most sensitive toxicological endpoint. In all cases, the cancer risk estimates were predicted to be less than one in 100,000 (i.e., one extra cancer case in a population of 100,000 people), indicating that the chemical emissions from the WLPP burning 100% RRT are associated with a negligible level of risk, as defined by BC MOE and Health Canada.

1.1.6. Consideration of Airshed Inversions

Based on the results of the RWDI Air modeling, the potential air quality effects due to inversions were not significant with respect to burning RRT. The dispersion modelling, which is calculated on an hourly basis (i.e. taking into account inversions), is conducted using the CALPUFF modelling system as required by the Guidelines for Dispersion Modelling in British Columbia (Section 2.3.2.4). Accordingly, there is no need to alter and/or reduce the amount of ties during inversion conditions.

1.2. Emissions

1.2.1. Boiler Combustion Management

Excess oxygen in the boiler flue gas is consistently maintained at the required boiler design level which supports complete combustion. In addition, the plant has a continuous emission monitoring system (CEMS) unit which monitors opacity and NOx, Carbon Monoxide (CO) and Oxygen (O2), that alerts operators to conditions where complete combustion may not occur. The results from the CEMS monitoring relative to permit compliance (opacity and NOx) are regularly reported to the MOE. Incomplete combustion occurs in an uncontrolled environment, whereas fuel burnt in a wood-fired boiler is part of a tightly controlled high-temperature combustion environment. In addition, the shredded RRT have a higher heating value and tend to burn more quickly and completely than green / wet wood.

Please see 1.2.2 and 1.2.8 for additional information.

1.2.2. Complete Combustion of RRT

There is only a small amount of RRT burning at any one time (<1 ton/min at the 50% limit). If there is a significant equipment malfunction, the plant would trip and shut down. Upset conditions happen quickly, typically in a second or two. So with the RRT being contained in the large metal furnace, if there is a significant equipment malfunction, the RRT will stay in place and burn out very quickly, in a matter of minutes. Also, shredding the RRT only as they are consumed, with only a small quantity of shredded RRT in an enclosed bin or silo eliminates any issues with handling shredded RRT and any potential for spontaneous combustion.

1.2.3. Process Equipment

The same combustion equipment is in place and operating as it did during the 2001 test burn. We will be adding a shredder to process the ties on site, as well as conveyor equipment and a silo to contain the shredded ties.

Also, please see 2.1.2 and 2.6.2 for additional information.

1.2.4. Emission Standards

The following table is offered for comparison.

Standards for Emissions from New Large Biomass Energy Facilities			
	Particulate milligrams/m^3	Dioxins/Furans nanograms/m^3	Opacity
BCMoE FactSheet on Air Emissions from *(new)* Biomass-Fired Electrical Power Generation – Nov 2011	20	0.1	10
WLPP Average emissions	4.0[1]		1.12[2]
WLPP Burning 100% Rail Ties	2.3	0.0034	<3

Notes:

1. 2008 – 14 average
2. 2015 average

Also please see 1.2.5 and 1.2.8 for further information.

1.2.5. Destruction of Hazardous Compounds

Modeling of the furnace temperature by Jansen Combustion and Boiler Technologies confirmed the operating temperature of the WLPP system is in excess of 2000 degrees F (1400 degrees K,), which is more than adequate to destroy the contaminants of concern in creosote (dioxins, furans, pentachlorophenols), all of which decompose at temperatures significantly below 2000 degrees F. This was verified in our trial burn of 100% railway ties where dioxins and furans were measured at 30 times lower than required by the BCMoE

FactSheet on Air Emissions from (new) Biomass-Fired Electrical Power Generation – Aug

2013. The very low levels of dioxins/furans in the stack emissions during the 2001 test burn was expected given the plant's boiler design with a furnace temperature in excess of 2,000 F and long residence time.

1.2.6. Dioxins and Furans

The proportion of penta treated ties is expected to be relatively low, (less than 10%), and the other factors that lead to formation of dioxins/furans (low furnace temperatures and low residence times in the furnace) do not exist for this boiler.

In addition, the following two documents, published by Environment Canada, confirm that the proportion of penta treated ties is relatively low and will diminish even further over time:

- The Strategic Options for the Management of CEPA-Toxic Substances from the Wood Preservation Sector - Volume I - Final Report from the Issue Table was published by Environment Canada in 1999. The following is taken from page 22 of the report:

  "PCP railway ties in-service were assumed to have been treated with older penta formulations. Quantities of PCP treated ties still in service were obtained from CN Rail (Masterton, R, September 1997) and the number was rounded up slightly to account for smaller rail companies which may use penta treated ties. CN has never used penta ties except for experimental purposes (1000-2000ties) in the early 1970s."

  The report can be found at:

  http://publications.gc.ca/collections/collection_2014/ec/En84-120-1999-eng.pdf.

- From the *Recommendations for the Design and Operation of Wood Preservation Facilities*, 2013 - Environment Canada "the PCP tie market has been converted to creosote/oil treatments, leading to a decline in use since 1981."

  This document can be found at:

  http://ec.gc.ca/Publications/default.asp?lang=En&xml=7272DC78-9A6B-4EFA-B88D-2F553EAF8885.

  Also, please see 1.2.5 for additional information.

1.2.7. WLPP Stack Height and Elevation

The WLPP stack measures 60.7 meters in height. The stack was designed to discharge at this elevation for optimal dispersion while maintaining stability of the structure. In addition, the ground elevation of WLPP is approximately 17 meters above the ground elevation of downtown Williams Lake.

The RWDI air dispersion modeling (Appendix 3) includes the effects of inversions for our project and finds no significant deterioration in Williams Lake air quality due to the inclusion of RRTas a fuel source.

Accordingly, the stack is of sufficient height to avoid air quality impacts during inversions and thus there is no need to increase the stack's height.

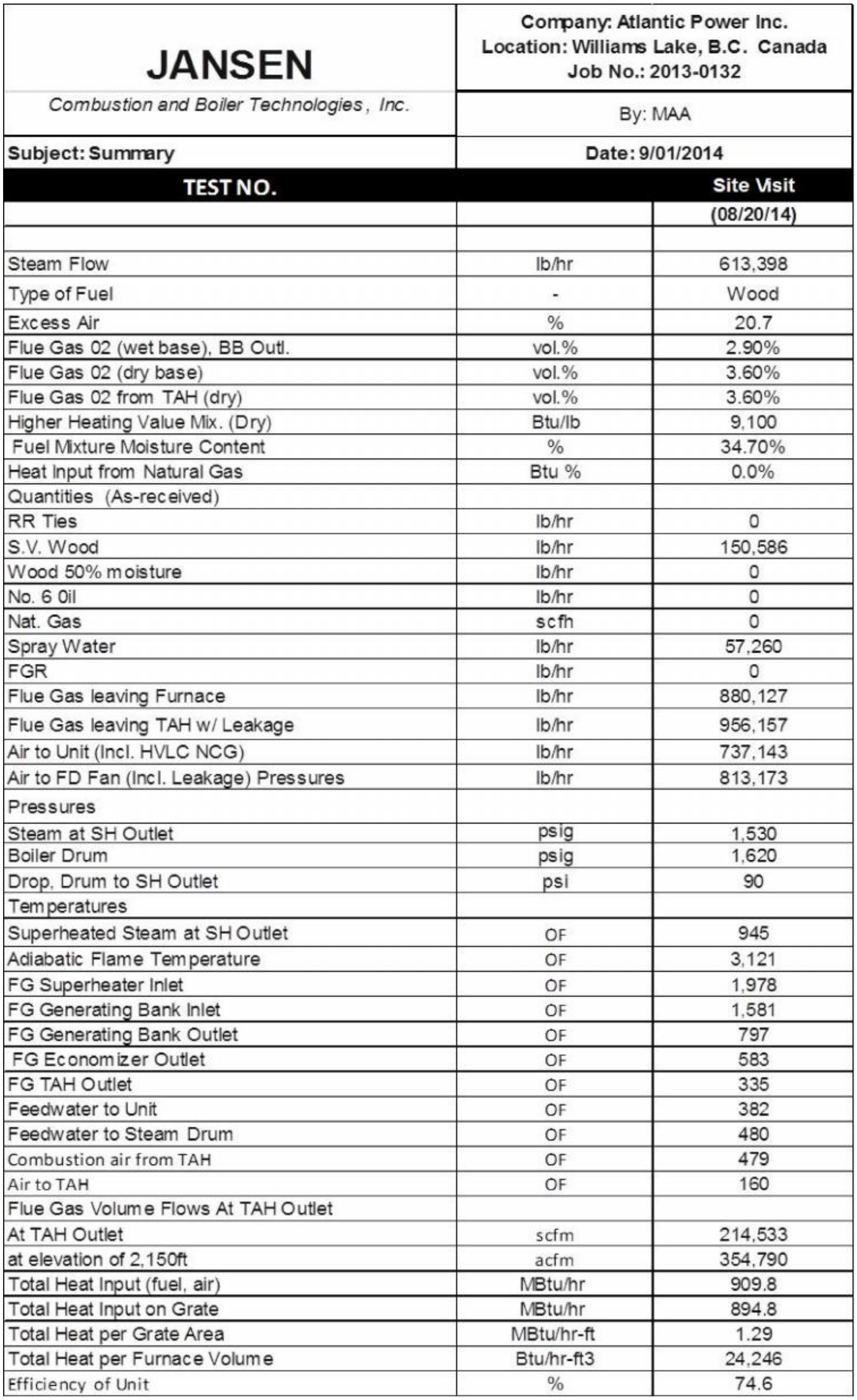
1.2.8. Burner Design

The effectiveness of the plant's combustion system was verified in our trial burn of 100% RRT where dioxins and furans were measured at 30 times lower than required by the BCMoE FactSheet on Air Emissions from (new) Biomass-Fired Electrical Power Generation – Aug 2013.

The boiler is made by Babcock & Wilcox, Canada. It is a Stirling type boiler with a specifically designed furnace for biomass fuel called a CCZ (controlled combustion zone), and the boiler has a Detroit stoker hydro-grate, which holds the combusting wood. Heat input to the boiler typically ranges between 900 - 1,000 million Btu/hr depending on the moisture content of the fuel. Boiler efficiency is approximately 75% to 68% over the same range, and the thermal output of the boiler (which does not vary with fuel moisture content) is approximately 680 million Btu /hr. The boiler can produce about 615,000 lb/hr of steam at 950 degrees F and 1550 psi.

The attached table shows the operating temperatures of the boiler at full load. Most of the values are from field measurements collected on 8/14/14. Our consultant used these field measurements to calculate other parameters which cannot be measured by typical instruments due to accessibility and very high temperatures. For the flue gas temperatures (identified as FG), we have highlighted the calculated values including the flue gas temperature at the inlet to the superheater of 1,978 F. The corresponding lower furnace temperature (above the grate) is about 2,500 F. The Adiabatic Flame Temperature provided in the table is a theoretical value and is not a physical parameter. The retention time is approximately 1 second. Reformation of toxic substances does not occur in this boiler due to insufficient time in the reformation temperature range as well as flue gas characteristics. The lack of reformation is demonstrated by the results of the 2001 stack test which showed very low levels of polychlorinated dibenzo-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF).

Boiler Operating Characteristics **Summary**



JANSEN

Combustion and Boiler Technologies , Inc.

Company: Atlantic Power Inc.
Location: Williams Lake, B.C. Canada
Job No.: 2013-0132

By: MAA

Subject: Summary

Date: 9/01/2014

TEST NO.		**Site Visit** **(08/20/14)**
Steam Flow	lb/hr	613,398
Type of Fuel	-	Wood
Excess Air	%	20.7
Flue Gas 02 (wet base), BB Outl.	vol.%	2.90%
Flue Gas 02 (dry base)	vol.%	3.60%
Flue Gas 02 from TAH (dry)	vol.%	3.60%
Higher Heating Value Mix. (Dry)	Btu/lb	9,100
Fuel Mixture Moisture Content	%	34.70%
Heat Input from Natural Gas	Btu %	0.0%
Quantities (As-received)		
RR Ties	lb/hr	0
S.V. Wood	lb/hr	150,586
Wood 50% moisture	lb/hr	0
No. 6 0il	lb/hr	0
Nat. Gas	scfh	0
Spray Water	lb/hr	57,260
FGR	lb/hr	0
Flue Gas leaving Furnace	lb/hr	880,127
Flue Gas leaving TAH w/ Leakage	lb/hr	956,157
Air to Unit (Incl. HVLC NCG)	lb/hr	737,143
Air to FD Fan (Incl. Leakage) Pressures	lb/hr	813,173
Pressures		
Steam at SH Outlet	psig	1,530
Boiler Drum	psig	1,620
Drop, Drum to SH Outlet	psi	90
Temperatures		
Superheated Steam at SH Outlet	OF	945
Adiabatic Flame Temperature	OF	3,121
FG Superheater Inlet	OF	1,978
FG Generating Bank Inlet	OF	1,581
FG Generating Bank Outlet	OF	797
FG Economizer Outlet	OF	583
FG TAH Outlet	OF	335
Feedwater to Unit	OF	382
Feedwater to Steam Drum	OF	480
Combustion air from TAH	OF	479
Air to TAH	OF	160
Flue Gas Volume Flows At TAH Outlet		
At TAH Outlet	scfm	214,533
at elevation of 2,150ft	acfm	354,790
Total Heat Input (fuel, air)	MBtu/hr	909.8
Total Heat Input on Grate	MBtu/hr	894.8
Total Heat per Grate Area	MBtu/hr-ft	1.29
Total Heat per Furnace Volume	Btu/hr-ft3	24,246
Efficiency of Unit	%	74.6

1.3. Emissions Monitoring

1.3.1. Continuous Emission Monitors

The application seeks to remove the requirement to follow a federal protocol for maintaining and auditing the CEMs that was not designed for biomass facilities. The CEMs at WLPP will continue to operate and will continue to be verified by the MoE auditing program and by third party stack testing (in accordance with BC Manual for Continuous Monitoring and Collection of Air Samples, 2003 Edition).This is consistent with all similar CEMs at pulp mills and power plants throughout the province.

Also please see 1.3.2 for additional information.

1.3.2. Continuous Emission Monitors Verification

The continuous emission monitors (CEMs) at the Williams Lake Power Plant are currently and will continue to be subjected to the same rigorous calibration protocols as other similar systems in the province (BC Manual for Continuous Monitoring and Collection of Air Samples, 2003 Edition). This includes hog and recovery boilers at pulp mills (some of which are permitted to burn waste oil, RRT and other fuel types) and other biomass energy systems. All Permitted CEMs are audited by Ministry of Environment twice yearly and must meet a series of requirements. In addition, the CEM readings are compared with the annual stack testing required by the Permit. The federal EPS Protocols are redundant to the provincial requirements. When compared to the large amount of non-fossil-fuel containing biomass which will still be used in the event the permit amendment is approved, the amount of fossil fuel contained in the waste streams noted above is considered to be a minor percentage. Accordingly, it is concluded that the Provincial rules and protocols are more than sufficient to ensure comprehensive quality control of the CEMs.

The current permit allows the burning of hydrocarbon contaminated materials with the prior written approval of MOE along with recordkeeping provisions. The permit amendment seeks to broaden the type of contaminated materials allowed (i.e. absorbent materials), eliminate the prior written approval administrative burden while maintaining the recordkeeping provisions. The provision to burn “hydrocarbon contaminated absorbent materials originating from accidental spills” up to a maximum of 872 liters/day is intended to allow for spill recovery materials (obtained through cleanup efforts within the local area) to be disposed of in the energy system. These occurrences are rare, the volumes would normally be low and the high temperatures within our furnace ensure complete destruction. The burning of these materials is allowed under our current permit but requires written authorization by the Director.

Eliminating the time consuming step of obtaining prior written approval to burn hydrocarbon contaminated materials will allow us to accept these materials from 3rd parties in an expeditious manner to ensure they are handled properly.

1.3.3. Emissions Testing

Continuous emission monitors measure nitrogen oxides and opacity (particulate). Reports are sent monthly to the MOE and a 3rd party test is done annually. This is in addition to the spot checks that the MOE performs twice a year. The MOE may require additional testing.

1.3.4. Trial Burn 2001

Out of caution, the 2001 trial was conducted using 100% RRT. The stack testing technology and methodology have not changed. Our data, which is representative of a fuel mix consisting of 100 % rail-ties, is considered to be very conservative and indicative of insignificant impacts on human health and the environment.

1.3.5. Variability of Emissions

Electrical power plants across North America have been burning used RRT for many years. For reference, please see an interview conducted by the Williams Lake Tribune, on August 4, 2015, with a plant representative from the French Island plant in Wisconsin, which summarizes their experience with burning rail-ties, wood waste and RDF. In addition, our pollution control equipment delivers emissions that are well within our permit limits. This added to the highly controlled, high temperature furnace results in almost no variability over time.

As stated above, the data from the test in 2001 are considered conservative and representative. If WLPP is approved to use a higher percentage of RRT in its fuel mix, testing of the emissions (continuous emissions monitoring and annual stack tests) will be conducted on a routine basis going forward, so as to confirm the lack of any adverse impact on the Williams Lake air shed.

1.3.6. Independent Stack Testing

As stated above, there is almost no variability in our process and the continuous emissions monitoring system provides a thorough check of combustion effectiveness. All of our stack testing is conducted by a qualified, independent firm and Ministry of Environment conducts verification audits of our continuous emission monitors twice yearly.

1.4. Ambient Monitoring

1.4.1. Williams Lake Ambient Monitoring Program

The Ministry of Environment, with financial support from local industry, is responsible for monitoring air contaminants. It is the Ministry’s role to determine whether the current monitoring system should be expanded to include other contaminants of concern. Note that because the trial burn was run using 100% RRT, and that we are applying to raise the limit to a 50% maximum, it is concluded that emissions of all the compounds of concern noted above will be within the applicable Provincial standards. This conclusion is documented in the RWDI Air Modeling Report (Appendix 3).

1.4.2. Monitoring Toxic Compounds

As noted above, the Ministry of Environment, with financial support from local industry, is responsible for monitoring air contaminants. Monitoring is done on a continuous basis and results are available on the Ministry website. AP will continue to support and participate in the community airshed monitoring system. The decision to add monitors should continue to be based on health and environmental concerns. If that rationale indicates a new monitor and AP is a key source of the contaminant in question we will support the cost of the new monitoring equipment.

1.5. Emissions – Fugitive

1.5.1. Dust Control

A dust suppression program is in place, and additional actions are taken as weather conditions warrant. In addition, WLPP works with the MOE to meet their requirements in addressing any public complaints. The project will not materially change the total truck deliveries to the plant site since the RRT deliveries replace current residual wood waste deliveries. In addition, in the event the permit amendment is approved, it is anticipated that truck deliveries of fiber to the plant, as well as use of the truck dumper, will be reduced, due to the supplemental use of RRT in its place. The RRT will be stored whole on the power plant site until needed. Once the RRT are shredded, the shredded material will be stored in a bunker or silo (not in open piles) which will minimize fugitive dust.

Also, please see 1.8.1.8 for additional information.

1.5.2. Odour

As noted in the following item, it is not expected that there will be sufficient emissions of any potentially odiferous compounds emitted from the RRT while stored in their whole state that could result in offsite odours**.** The RRT being used for fuel will typically have been removed from service after 20-30 years or more. These end-of-service RRT have experienced several decades of chemical loss mechanisms including exposure to the sun’s UVs and radiation, freezing and leaching due to heat and precipitation. The shredded RRT will be stored in a silo or bin to minimize odours.

1.5.3. Off-gassing

Onsite worker exposure is regulated by WorkSafe BC and is not part of the regulatory environmental permitting process. The 2001 study did include a list of speciated PAH substances that were included in the Total PAH emission rate and predicted concentrations in the stack. Within the data, naphthalene is noted as being an “artifact” and therefore there is no data available for a direct evaluation. Therefore, total PAHs were assessed and related to the potential impact to neighbours in the report (see Table 8, for example).

The RRT being used for fuel will be ‘aged’ in the sense that as a result of weathering in place they should be relatively depleted of volatiles and semi- volatility in the outer layers. As such, there will be limited off-gassing associated with the ties when stored whole prior to shredding and consumption.

AP routinely assesses the exposure of our employees to hazards. In addition, Intrinsik is being contracted to conduct a work-place health and safety evaluation of the use of rail-ties as a supplement to our combustion fuel, so as to ensure there are no adverse health impacts posed to our workers. In addition, WorkSafe BC provides routine oversight and reviews of our worker safety program.

1.6. RRT Variability/Sources

1.6.1. Variability of Hazardous Compounds and Metals from RRT Burn

The PAH levels in Table 8 of the 2001 test report show a wide range of PAH levels between regular fuel and RRT fuel, yet the PAH emission levels in the stack did not show a significant difference. Therefore, it is expected that further variations of the PAH levels in the RRT fuel will also not show a significant difference in stack PAH levels.

Table 8 of the RWDI report shows the maximum predicted concentration of metals, chlorophenol, and dioxins/furans, all of which are well below 1% of the AAQOs. Therefore, variations in the feedstock mixture are not expected to significantly change the results of the air dispersion model.

1.6.2. Variability of RRT Preservative Treatments

The combustion of wood residue treated with metal derived preservatives (such as CCA or ACQ) is prohibited in the current permit, and no changes to this provision are being requested. Further, CN (the expected primary RRT supplier) has confirmed that they have not used metal treated ties in their system, and our fuel supply agreement with CN (and others) will prohibit any metal treated RRTs.

CN has indicated that the expected RRT supply will consist of mostly creosote treated ties with some penta treated ties. The ties used in the 2001 test were randomly selected and are expected to be representative of the future supply. The PAH levels of the ties are shown in Table 8 of the 2001 test report (appended to the RWDI report in Appendix 3 (see Appendix D of RWDI report)). The PAH emission levels in the stack during the 2001 test did not show a significant difference between regular wood fuel and RRT fuel, indicating that the PAH emission rate is not directly related to the PAH levels in the fuel.

Also, see 1.2.6, 1.5.2, 1.5.3 and 1.6.1 for additional information.

1.6.3. PLACE HOLDER

1.6.4. RRT Sources and Rate of Usage

Based on our discussions with CN, the RRTs will be coming from the western Canada portion of their system. We anticipate that deliveries of RRTs may diminish at certain times of the year. At no time will our fuel mix show greater than 50% RRT.

We expect that on average the plant would consume between 55,000 - 85,000 tonnes of RRTs per year up to a maximum of 100,000 tonnes per year. The plant consumed about 410,000 tonnes of fuel in 2014, so the expected RRT use would equate to about 25% of the annual fuel mix if the plant continues to operate as it did in 2014. However, in the future the plant may operate less frequently causing the percentage of RRT use to approach as much as one third of the total fuel use on an annual basis. Over shorter durations, RRTs would not exceed 50% of the plant fuel mix.

Also please see 1.6.2 for additional information.

1.6.5. Emissions from RRT treated with PCP

Table 8 of the RWDI report shows the maximum predicted concentration of metals, chlorophenol, and dioxins/furans, all of which are well below 1% of the AAQOs. Therefore, variations in the feedstock mixture are not expected to significantly change the results of the air dispersion model.

1.7. Trial Burn

1.7.1. Trial Design

The decision to use the April 2001 Stack test was based on a determination that the testing methods, fuels, and worst-case scenario (100 % rail-ties) would be a scientifically valid basis for evaluating the permit amendment request to burn a 50 % rail-tie mixture. In addition, prior to conducting the modeling effort by RWDI, the use of the 2001 report was evaluated and approved by the MOE.

AP engaged independent consultants to conduct both air modeling (RWDI) and human health evaluations (Intrinsik), both of which concluded that emissions from burning rail-ties at a 50 % mixture, added to background levels in the airshed, are within the applicable BC or Ontario provincial standards, and do not pose a risk to the environment or human health.

1.7.2. Relevance of 2001 Trial

There have not been any material changes to plant design or configuration since 2001 that would affect the point source stack parameters, beyond an increase in allowable flow rate (100 - 110 m3/sec) made to the Discharge permit in 2010. Given a constant stack concentration, an increase in flow rate would result in a similar increase in emissions. But the increased flow would also result in a greater exit velocity which would enhance dispersion, offsetting the increase in emissions. In addition, the total pollutant emissions are controlled by the amount of fuel burned. If the same amount of fuel was burned using a higher air flow, overall pollutant emissions would remain constant and the higher flow rate would again increase dispersion. For these reasons, the flow rate increase is not expected to have a material impact on the test results.

1.7.3. Future Emissions Testing

If WLPP is approved to use a higher percentage of rail-ties in its fuel mix, testing of the emissions from the stack will be conducted on a routine basis going forward, so as to ensure the lack of impact from the combustion of rail-ties.

Also, please see 1.3.5. 1.7.1 and 1.7.2 for additional information.

1.7.4. Pollution Control Efficiency

The pollution control equipment was oversized for the system meaning that we are able to achieve much lower emissions than industry standard. Our equipment and associated controls are all functioning as they did during the trial. Similarly, stack testing methods and lab technologies have not changed.

Please see 1.7.1, 1.7.2 and 1.7.3 for additional information.

1.7.5. Emission Controls 2001 to Present

There have not been any changes to our emission controls at the plant since the 2001 stack test. Our CEMs and third party stack test results verify that the electrostatic precipitator (ESP) is functioning at high efficiency.

Also please see 1.7.2 for additional information.

1.7.6. Boiler Controls

The design temperature of the furnace, and its effectiveness in ensuring complete combustion with low emissions was confirmed by the 2001 stack test and the recent air modelling. The primary parameters for measuring combustion effectiveness (and therefore reaching the design combustion temperatures) are carbon monoxide (CO) and excess oxygen (O2). If combustion is inefficient CO levels will rise and excess O2 levels will drop, typically. CO levels and excess O2 levels are monitored closely, and fuel and air flow to the boiler are regulated to ensure complete combustion, regardless of fuel composition. Table 6 of the 2001 test report shows CO levels were within their normal range during the test, and dropped slightly from the regular-wood-fuel portions of the test to the rail-tie-fuel portions of the test.

Furnace temperature (fireball temperature) is not measured routinely, and we do not have the requested historical values.

Also, please see 1.2.8 for additional information.

1.7.7. Impact of RRT on Combustion Efficiency

The plant ensures good combustion using regular wood fuel today, and given the higher energy content and lower moisture content of RRTs, continued operation of the plant with good combustion can be assured. Combusting RRTs with regular wood fuel will not result in incomplete combustion. The boiler is monitored closely for combustion efficiency and the fuel and air flow are adjusted to ensure complete combustion. The introduction of some RRT fuel will only enhance the current excellent operating conditions of the boiler.

The WLPP boiler was specifically designed for biomass with the ability to achieve full steam output with fuel moisture contents up to 55%. The plant's wood deliveries range from green wood and bark (~40% moisture content) to mill shavings (~15% moisture content). The plant maintains a large wood inventory in the fuel yard, and the fuel in the yard is well mixed. The moisture level of the fuel fed into the boiler typically stays in the 30-40% range.

Also, please see 1.2.8 for additional information.

1.7.8. Selection of RRT for 2001 Trial

CN has indicated that the expected RRT supply will consist of mostly creosote treated ties with some penta treated ties. The ties used in the 2001 test were randomly selected and are expected to be representative of the future supply. The PAH levels of the ties are shown in Table 8 of the 2001 test report (appended to the RWDI report). The PAH emission levels in the stack during the 2001 test did not show a significant difference between regular wood fuel and RRT fuel, indicating that the PAH emission rate is not directly related to the PAH levels in the fuel.

In addition, Table 8 of the RWDI report shows the maximum predicted concentration of metals, chlorophenol, and dioxins/furans, all of which are well below 1% of the AAQOs. Therefore, variations in the feedstock mixture are not expected to significantly change the results of the air dispersion model.

1.8. Dispersion Model – See Report in Appendix 3 FORMATS ARE DIFFERENT

1.8.1. Model Design

1.8.1.1. Model Oversight

The modelling was conducted in accordance with regulatory guidelines and a detailed model plan was approved by MOE staff prior to commencement of the study.

1.8.1.2. Ambient Standards in Absence of BC Standards

Where applicable, preference is given to Canadian objectives developed in regard to similar industry under similar national guidelines and objectives. This is a standard approach for BC applications.

1.8.1.3. Ambient Air Quality Standards

Where they exist air quality standards for British Columbia are used. In absence of local standards, ambient air standards from Ontario are used for reference.

B.C. Ambient Air Quality Objectives – Updated October 30, 2015 can be found at http://www.bcairquality.ca/reports/pdfs/aqotable.pdf

Ontario Ambient Air Quality Criteria - April 2012 can be found at http://www.airqualityontario.com/downloads/AmbientAirQualityCriteria.pdf

1.8.1.4. Model Period

A one year period is a standard approach for a study of this type and conforms to BC Modelling Guidelines. As noted in the report, BC MOE has provided province-wide WRF data for certain years to assist with standardized dispersion studies in BC. The 2012 was selected by MOE as a representative year for those inputs. The data provided was included in our monitoring plan that was approved by the Ministry (see correspondence in Appendix B of the modelling report in Appendix 3 of this report).

1.8.1.5. Model Year 2012:

With regards to the use of 2012 as a model year, a study of trends in PM up to 2011 has been completed previously by MOE.

http://www.bcairquality.ca/reports/pdfs/aq_williams_lake_Sept2012.pdf

The results of that study show that the PM background values of 20.2 FORMAT µg/m^3 from 2012 used for the study is higher than 2011 and equal or higher than all years since 2006, within the exception of 2010 which was dominated by forest fires. When the effects of forest fires are removed from the historical measurements, then the $PM_{2.5}$ value of 20.2 µg/m used for background is higher than 2010 also. In general $PM_{2.5}$ values, with the exclusion of forest fires, show a slight downward trend since 2006. Similar trend is seen for PM_{10}.

The BC Lung Association also publishes historical summary of air quality in BC. http://www.bc.lung.ca/airquality/stateoftheair-report.html Although William's Lake is not specifically noted, the results show that both PM and NO_x show downward trends across the province. This is due to factors such as vehicle emission standards and restrictions on open burning and reduced use of wood as fuel for home heating.

1.8.1.6. Airshed Inversions

The dispersion modelling, calculated on an hourly basis, was conducted using the CALPUFF modelling system as required by the Guidelines for Dispersion Modelling in British Columbia. The BC guideline states in Section 2.3.2.4 regarding CALPUFF and CALMET:

CALPUFF is a Gaussian puff model that can account for time- and space-varying meteorological conditions, different source configurations and contaminants, and chemical transformations. The specific treatments include curved trajectories, building downwash, plume penetration into a capping inversion, fumigation, coastal interaction effects, terrain impingement, stagnation, and transformation- related effects (contaminant removal due to wet scavenging and dry deposition, chemical reactions) and visibility effects of particulates. It can be applied to model near field effects (in the order of tens of metres) to transport distances of hundreds of kilometers. CALPUFF is a modelling system comprised of three component sub models: CALMET (meteorological model), CALPUFF (calculates output), CALPOST (analysis and display of output). The meteorological fields used by CALPUFF are produced by CALMET — a meteorological model that includes a diagnostic wind field model. This model contains treatments of slope flows, valley flows, terrain blocking effects, kinematic terrain effects (i.e., speed up over hills), lake and sea breeze circulations, and a procedure to insure mass is conserved in the domain. CALMET inputs include surface and upper-air meteorological data as well as the option to use the gridded meteorological fields produced by mesoscale meteorological models.

The excerpted portions above (from RWDI report in Appendix 3) all pertain to the model's ability to include atmospheric processes in complex terrain, including inversions.

1.8.1.7. Other Sources

The model considers point sources from WLPP and adds the predicted impact to the ambient levels experienced in the airshed over the period of 2012. In this way, the combined impact from all sources in the community is considered.

1.8.1.8. Fugitive Dust

Fugitive dust sources are not typically covered in discharge permits and are thus also not included in the modelling. The design of the equipment to be used for the shredding of railroad ties includes measures that will be used to reduce and eliminate fugitive emissions from the shredding activities. In addition, a Fugitive Dust Plan is in-place at the Plant, which specifies steps taken to minimize fugitive dust generated by plant activities. Further, any fugitive dust created by this process would be mechanically generated wood particles (as opposed to being the result of combustion, for example) and would therefore likely occur in large size fractions greater than PM2.5 and PM10 that would be easily captured by mitigation efforts, and that would settle within or close to the plant should they occur. There would be negligible influence on ambient PM2.5 or PM10 on or off site.

Per RWDI's response above, the air dispersion model focuses on point sources (e.g. the stack) and does not include fugitive sources. Nevertheless, management of fugitive emissions is a key element of the design process for the new RRT (RRT) shredding system and the Fugitive Dust Plan will be modified in coordination with the MOE to account for the potential for fugitive dust from the rail-tie handling activities that will occur. The preliminary design of the rail-tie handling system includes these measures:

- Receipt of whole ties and unloading with a grapple arm (i.e. no dumping).
- Covered conveyors will be used.
- The collecting conveyor beneath the shredder will be equipped with an enclosed skirtboard, just below the shredder's discharge chute, and the outlet opening of the skirtboard will be enclosed with dust curtains.

- The stream of shredded RRTs through the disc screen and hog tower (or secondary shredder) will be enclosed with chutes that are fitted with dust curtains at the inlet and outlet chute openings.

- The collecting conveyor below the disc screen and hog (or secondary shredder) will be fitted with an enclosed skirtboard, just below the disc screen's and hog's discharge chute, and the outlet opening of the skirtboard will be enclosed with dust curtains.

- Shredded RRTs will be stored in an enclosed area (e.g. silo or bin).

These design features, while still preliminary, will ensure minimal fugitive dust from the receipt, handling, and storage of the RRTs.

1.8.1.9. Off-gassing

The model does not consider fugitive emissions (particulate or vapor) from RRT or chips. However, these emissions will be minimized by limited onsite storage of shredded rail-tie fuel supply, containing shredded RRTs in a bin or silo and managing the volume of whole RRT.

In addition, please see 1.5.2, 1.5.3, 2.4.3 and 2.5.3 for additional information.

1.8.2. Particulate

1.8.2.1. Particulate Emissions

Particulate emissions from the plant are consistently lower than the permitted limits of 50 mg/m3, averaging 6.3 mg/m3, or 12.5 % of that limit, in the last thirteen years of testing. In addition, as detailed in Table 6 of RWDI's Report, the plant's particulate emissions are less than 2% of the 24 hour ambient air quality standard, while 80% of the 82% of such emissions in the Williams Lake area come from other sources. The addition of RRTs to the fuel mixture does not increase the particulate emissions. Furthermore, the studies by RWDI and Intrinsik conclude there are no significant impacts to either human health or the environment from the proposed amendment.

1.8.3. Sulphur Dioxide (SO2)

1.8.3.1. Background SO_2

To confirm, no background data was available for SO_2.

1.8.3.2. Ambient Data for SO_2

Ideally background concentrations for all contaminants would be assessed with the modelling for comparison to the AAQOs. However, in many cases, not all contaminants have existing background data for comparison. Local background concentrations vary, so we would be concerned about applying a background concentration from another area to this area. We would also note that typically air quality monitors are only deployed when potential concerns with specific facilities are suggested based on permitted emissions or modelling studies. Thus the fact that there are no specific monitors for SO_2, (while PM and NO_X are currently monitored) tends to suggest that there are no existing major facilities or sources in the area for which resulting ambient concentrations of SO_2 are a concern.

In addition, Intrinsik's human health evaluation (see Appendix 4) concludes, based on "the potential change in SO2 emissions associated with the proposed increase in the volume of RRTs in the fuel mix at the WLPP; the conservatism incorporated in the predicted ground-level air concentrations of SO2; the areal extent of the predicted exceedances of the BC MOE AAQO; the likelihood of an exceedance of the BC MOE AAQO occurring; and the levels of exposure that have resulted in observed adverse health effects in humans, as documented in the most recent scientific literature, the predicted short-term SO2 air concentrations are not expected to adversely affect the health of people living in the area or who might frequent the area for work, recreation or other purposes."

1.8.3.3. Sulphur from Diesel Fuel Carrier

The RWDI Modelling study showed Sulphur dioxide levels all below the BC Ambient Air Quality Standard at 50% RRTs.

In addition, please see 1.8.3.2 for additional information.

1.8.4. Nitrogen Oxides (NOx)

1.8.4.1. Double Counting of NO_x

In general, modelling must account for the effect of emissions both from the facility being evaluated (typically a new facility) and existing emissions from other sources. That is why modelling results for a proposed facility alone are added to the background from existing sources as measured by the ambient monitoring. However, because this facility is already in operation, emissions from the plant that do not change (such as NO_X) will also be captured in the background-monitoring data, hence the potential for double counting. It is not possible to completely remove the effect of current facility operations from the monitoring results. As such there is no update that can be done to remove the artefact of double counting. The NO_2 results were presented with and without the background included so as to bound the results. As stated below, the inclusion of RRTs in the fuel mix has no or very little effect on the plant NO_X emissions.

1.8.4.2. NO_x Emissions

The inclusion of RRTs in the fuel mix has no or very little effect on the plant NO_X emissions, and, therefore, there is no impact expected from revising the permit from the current 5% RRT limit to a higher limit. Further mitigation is not warranted given the conservatism of the model study and the limited potentially affected area.

1.8.4.3. NO_x Ambient Standard

RWDI points out in the report that the process of adding background ambient values to the modelled emissions data has the effect of double counting. This is consistent with the fact that nitrogen dioxide emissions are virtually unchanged whether burning traditional wood fibre or 100% rail way ties. This, and other conservative assumptions in the analysis, indicates that the BC Ambient Air Quality Standards for this compound will not be exceeded during actual operations.

In addition, please see 1.8.4.1 for additional information.

1.8.4.4. NO_x Emissions Unchanged

Measured ambient nitrogen dioxide levels are significantly lower than the BCAAQO and the plant's emissions are less than its permit limits. NOx emission remained largely unchanged when burning 100% RRTs versus traditional wood fibre. We expect that Williams Lake will continue to achieve the AAQO for nitrogen dioxide.

In addition, please see 1.8.4.1, 1.8.4.2 and 1.8.4.3 for additional information.

1.8.4.5. WLIB Sensitive Receptors

RWDI will complete the analysis of air quality objective exceedances in cooperation with WLIB. Note: the potential exceedances of the objectives relate to NO_X, and the inclusion of RRTs in the fuel mix has no or very little effect on the plant NO_X emissions.

1.8.5. Miscellaneous

1.8.5.1. Confidence in Calpuff and Validation Monitoring

The Calpuff model is utilized for airshed management and regulatory decision making throughout North America and is routinely compared with local ambient data. There are a number of ambient monitors in Williams Lake and the Ministry of Environment is responsible for ensuring that the monitoring program is protective of residents and the environment.

The Ministry of Environment, with financial support from local industry, is responsible for monitoring air contaminants. Monitoring is done on a continuous basis and results are available on the Ministry website. AP will continue to support and participate in the community airshed monitoring system. The decision to add monitors should continue to be based on health and environmental concerns. If that rationale indicates a new monitor and AP is a key source of the contaminant in question we will support the cost of the new monitoring equipment.

Please see 1.8.1.6 for additional information.

1.8.5.2. Integrity of the Science

The RWDI modelling study was designed with input from the Ministry of Environment. The dispersion model (Calpuff/Calmet) is the model system routinely used for airshed management and regulatory purposes throughout the US and Canada. In addition, the RWDI study used test data from a 100 % rail-tie test burn (performed by a certified, independent third party and laboratory), a conservative approach when compared to the maximum limit of 50 % rail-ties requested in the permit amendment request.

Furthermore, in a health study completed by Intrinsik, an independent third party (see Appendix 4 for their report); they concluded that the proposed increase in the RRTs used to fuel the WLPP would not be expected to result in an increase in health risks to the neighboring area.

Also, please see 1.7.1 for additional information.

1.8.5.3. Consideration of Other Sources

The dispersion model uses emission data from the WLPP, local topography, and one year of weather data to predict the path and concentration of those emissions as they leave the site. These predictions are then added to the currently measured ambient data at monitors in the airshed. All other sources, including industrial, residential, transportation, etc. are accounted for in the ambient measurements. The fact that the full emissions from the WLPP are input to the model, and not just the projected changes, explains how double counting can occur. Further, nitrogen dioxide emissions are not predicted to change materially with an increase in RRT.

Also, please see 1.3.2, 1.7.1, 1.7.2 and 1.7.5 for additional information.

1.8.5.4. Dioxins and Furans

From the RWDI Air Dispersion Modelling Report - Executive Summary and Table 8, (see Appendix 3) the maximum predicted “Dioxin and furan concentrations were less than 0.01% of the regulatory objective (Ontario’s objective in the absence of a British Columbia objective).”

1.8.5.5. Modelling Report Accessible to Residents

We acknowledge that dispersion modelling reports take some time to interpret. However, we opted to provide the full report to the public. The Q&A document contained in Appendix C of the Consultation Report provides specific responses to resident’s questions.

1.8.5.6. Model Output Scale

The design of the modelling study and the final report were agreed between the qualified professionals at RWDI and at Ministry of Environment. See previous answer.

Dispersion modelling was conducted over a 25 km by 25 km study area surrounding WLPP using CALPUFF 6.42 in full three-dimensional CALMET mode. This is a recommended approach under the *Guidelines for Air Dispersion Modelling in British Columbia* (British Columbia Ministry of Environment [B.C. MOE] 2008) for studies of this type. All aspects of the dispersion model set-up, including meteorological data (CALMET), land use data, terrain data, receptor grid and various other model assumptions were established as per the *Guidelines for Air Dispersion Modelling in British Columbia*. A detailed model plan for the dispersion modelling study area was submitted for review by B.C. MOE. The Ministry approved the plan with additional suggestions that have also been incorporated in the modelling.

From the air dispersion model, contaminants were demonstrated to be below their respective AAQO's or AAQC's for 50% RRTs, except the 1-hour NO2 predicted concentrations were at or slightly above the air quality objective, but the adjustment for background potentially double counts the plant NOx emissions. The effect of double counting and other conservative assumptions leads to the conclusion that actual NO2 levels will be within the air quality objective and an assessment on a neighborhood level is not needed.

1.8.5.7. Monitoring Ambient Contaminants

The Ministry of Environment, with financial support from local industry, is responsible for monitoring air contaminants. Monitoring of the plant's stack is done on a continuous basis and results are available on the Ministry website. Previously completed stack tests by WLPP document that plant emissions have all been within the permit limits established by the MOE.

Please see 1.3.3, 1.3.5 and 1.3.6 for additional information.

1.8.5.8. Accumulated Toxic Compounds

The model includes accumulated pollutants including worst cases where inversion conditions and/or calm winds limit dispersion.

Please see 4.2.1 for additional information.

1.8.5.9. Model Verification

The model, which was run in compliance with the Guidelines for Air Quality Dispersion Modelling in British Columbia, considered worst case scenarios. Existing ambient monitors can be used to verify model predictions.

Please see 4.2.1 for additional information.

1.8.5.10. Impact on Williams Lake Airshed

As discussed in 1.7.1, AP engaged independent consultants to conduct both air modelling (RWDI - Appendix 3) and human health evaluations (Intrinsik – Appendix 4), both of which concluded that emissions from burning rail-ties at a 50 % mixture are within the applicable BC or Ontario provincial standards, and do not pose a risk to the environment or human health.

All impacts in the community, including worst case scenarios, are predicted to be within B.C. Ambient Air Quality Objectives – Updated October 30, 2015

Also, please see 4.1 and 4.2 for additional information.

1.8.5.11. Airshed Inversions

The RWDI modelling considered weather patterns for a full year, in this case 2012. Based on the results of the RWDI Air modelling, the modelling demonstrated that potential air quality effects due to inversions were not significant, and that there was no demonstrated need to alter and/or reduce the amount of ties during inversion conditions.

Also, please see 1.1.6, 1.2.7, 1.8.1.4 and 1.8.1.6 for additional information.

1.8.5.12. Apparent Exceedance of NO_2

From the air dispersion model, contaminants were below their respective AAQO's or AAQC's for 50% RRTs, except the 1-hour NO2 predicted concentrations were at or slightly above the air quality objective, but the adjustment for background potentially double counts the plant NOx emissions. The effect of double counting and other conservative assumptions leads to the conclusion that actual NO2 levels will be within the air quality objective.

The results indicate that emissions associated with all compounds evaluated are adequately mitigated by a combination of the plant's boiler design and its air pollution control system.

Also, and as previously noted, testing of the emissions from the stack will be conducted on a routine basis going forward.

1.8.5.13. Modelling Study Oversight

The RWDI study was designed and completed following Ministry of Environment protocols and with input from the Ministry of Environment. The 2001 trial burning 100% RRT was also designed, with Ministry guidance, to identify all contaminants of concern.

2. Fuel Management

2.1. RRT Quantities

2.1.1. Environmental Protection Notice

The Environmental Protection Notice is a brief outline of key amendments and was drafted following Ministry guidance. Here we refer to the application to “Raise the limit on waste RRTs as a proportion of the authorized fuel from the current 5% to 50%.” Further detailed information has been provided in the form of the Q&A in Appendix C of the Consultation Report, in our Fact Sheet and in this Technical Assessment Report.

2.1.2. RRT Volumes Burned and in Storage

600,000 tonnes of wood waste is the maximum quantity of wood waste that could be burned by WLPP. In recent years the total annual quantity of wood waste consumed has been closer to 400,000 tones. We expect the lower annual consumption to continue or be reduced further. We expect that the plant would consume between 55,000 and 85,000 tonnes of RRTs per year, up to a maximum of approximately 100,000 tonnes per year. 85,000 tonnes of RRTs per year would be equivalent to about 1.2 million RRTs per year (~14 whole ties per tonne).

The size of the whole tie pile would vary seasonally. On average, we expect an inventory of approximately 10,000 tonnes, but, to be conservative, it is estimated that approximately 20,000 tons of whole ties may be stored onsite for a limited period of time, in addition to a small quantity of shredded ties stored onsite in an enclosed bin or silo. The 20,000 tonnes of whole ties constitutes approximately 21 days of fuel supply, if the ties are being burned at a 50:50 mixture with other traditional wood fibre.

We envision RRTs being delivered as we require them. We would develop a RRT storage area at the plant for whole ties. It would be close to the shredder, which is the piece of equipment that would take whole RRTs and ‘shred’ them into smaller pieces that would be mixed with other residual wood fibre before entering the plant on conveyors for combustion. We would maintain a limited supply of shredded RRTs at our site stored only for short periods of time so as not to create a fire hazard and minimize fugitive dust blowing off the plant site and any runoff from the shredded material.

Our project proposes to receive used RRTs at a rail yard location in an industrial area of the City. The ties will be loaded onto trucks and transported to our plant primarily by highway and then a short distance on Mackenzie Avenue North. Our project will not materially change the total truck deliveries to the plant site since the RRT deliveries replace current residual wood waste deliveries. We envision RRTs being delivered as we require them with some storage of whole ties on the power plant site.

2.1.3. RRT Storage Volume Variability

The size of the whole-tie pile would vary seasonally. On average, we expect an inventory of approximately 10,000 tonnes, but this could range as high as 20,000 tonnes during peak periods (approximately 300,000 ties).

2.1.4. RRT Volumes Whole and Shredded

It is conservatively estimated that approximately 20,000 tonnes of whole ties may be stored onsite for a limited period of time, in addition to approximately three days of shredded ties stored onsite in an enclosed bin or silo. The 20,000 tonnes of whole ties constitutes approximately 21 days of fuel supply, if the ties are being burned at a 50:50 mixture with other traditional wood fibre.

2.2. Fire Prevention

2.2.1. Spontaneous Combustion

Spontaneous combustion can occur when piles of shredded wood have been left for long periods of time (typically >3 months), and when certain other ambient conditions are met. The RRTs in this case will only be shredded as needed and will be maintained in a controlled environment in relatively small quantities (up to a 3 day supply).

2.2.2. Fire Response System

The plant has an irrigation sprinkler system surrounding the fuel pile, a fire water loop with deluge stations around the perimeter, and qualified and trained staff to manage any potential fire situations. Although we have not experienced a fire requiring the deluge systems to be used, the deluge system is designed to manage a fire associated with the much larger wood waste pile.

2.2.3. Wildfire

Please see 2.2.

2.2.4. Woodpile Combustion

While small fires do occur in the larger wood stockpile, plant systems, including video camera monitoring and rapid response of plant operators with bulldozers and front end loaders, are effective in minimizing the significance of such fires.

Regarding statements of RRT in the wood stockpile, there are no RRT, chipped or whole at the WLPP currently and RRTs have not been used as fuel at the plant since 2010. The volume of shredded ties will be maintained at or less than a 3 day supply and these will be stored in a controlled environment, not in the fibre pile.

2.3. Transportation, Receiving RRTs

2.3.1. Location of RRT Storage and Shredding

Our project proposes to receive used RRTs at a railyard location in an industrial area of the City. The ties will be loaded onto trucks and transported to our plant primarily by highway and then a short distance on Mackenzie Avenue North. Traffic will not increase as a result of RRT fuel offsetting other fuel deliveries. We will use slow speed shredding equipment to prepare the ties on site to minimize dust in addition to numerous other dust suppression design features previously discussed.

Also, please see 1.5.2, 1.5.3, 2.4.3 and 2.5.3 for additional information.

2.4. Storage

2.4.1. Surface Runoff Mitigation

The shredded ties represent larger concerns than the whole ties due to the increase in the overall surface area of the material. In order to reduce the risk of run-off, ties will only be shredded as needed and stored in small quantities in an enclosed bin or silo and will not be exposed to wind, rain or snow. The whole ties will be stored in a designated area on site, and will be managed in accordance with an updated Storm Water Management and Monitoring Plan (SWMMP). The SWMMP will conform to all provincial requirements and current best practices for storage of end-of-service whole RRTs. The provisions of the SWMMP will be finalized prior to the storage of any shredded and whole rail-ties onsite.

2.4.2. Leaching from RRT

Please see 2.4.1.

2.4.3. Off-gassing from RRT

This was a key concern from past years due to the large volume of chipped ties that was stored at a downtown location. Removal of the RRT processing from the downtown to the plant will allow us to maintain control over the shredding process. The inventory of shredded ties will be minimized with all shredded ties stored in a bin or silo.

Please see 1.8.1.9 for additional information.

2.4.4. Fugitive Dust Management

WLPP has prepared and submitted a Fugitive Dust Management Plan to the MOE. The Plan will be modified in the event the permit application is approved. This Plan specifies the controls and practices used by the plant in managing fugitive dusts that arise from both its operations, as well as adjacent properties. The Plan includes provisions for managing fugitives that can be generated by the various trucking, material transfer, fuel pile, roadway and ash handling activities that occur at the plant. This Plan includes actions to be taken when either plant-related or weather conditions warrant. In addition, we work with the MOE to meet their requirements in addressing any public complaints

Please see 1.5.1 and 1.8.1.8 for additional information.

2.4.5. Soil Contamination

There are a number of former and operating creosote treating plants that are contaminated. There is a significant difference between a creosote treating plant, where the liquid chemicals are applied under pressure and charges of wet rail way ties or utility poles are then taken from the treatment vessel out into the yard for storage, and end-of-service ties. End of service ties have experienced several decades of chemical loss mechanisms including exposure to the sun's UVs and radiation, freezing and leaching due to heat and precipitation. In addition, creosote treating plants of earlier years did not have final vacuum phases to remove excess liquid creosote from ties before removal from the vessel nor contained staging yards.

As noted above, shredded ties will be kept in an enclosed bin or silo, and whole ties will be stored in a designated area on site, and managed in accordance with an updated Storm Water Management and Monitoring Plan (SWMMP The provisions of the SWMMP will be in accordance with MOE requirements, and will be finalized prior to the storage of any shredded and whole rail-ties onsite

2.5. Shredding

2.5.1. Dust Mitigation

The process will involve the use of a low speed shredder, not a high speed hog as had been used in the past during previous grinding activities. This process would emit very little fugitive dust; Management of fugitive emissions is a key element of the design process for the new RRT (RRT) shredding system.

Please see 1.5.1 and 1.8.1.8 for additional information.

2.5.2. Dust Collection and Recovery

Our plan includes an extensive, permanent RRT shredding system (see previous answer) at the power plant site. The system will include numerous measures to control fugitive dust such as covered belts. Similar to current operating practices, the plant staff will periodically clean up any of the limited amounts of dust and chips near the shredding equipment that are not addressed by the fugitive dust mitigation measures noted previously, and this material will be deposited in the shredded RRT silo or bin.

2.5.3. Odour

The RRTs being used for fuel will typically have been removed from service after 20-30 years or more and will be stored whole. Shredded RRTs will be stored in a silo or bin to minimize odours.

Also please see 1.5.2, 1.5.3 and 1.8.1.9 for additional information.

2.6. Fuel Blending

2.6.1. RRT 50% Limit

The amount of RRTs burned will vary on the supply and availability of the ties, as well as supply and availability of traditional biomass supply. We expect to burn an average concentration of RRTs of approximately 15%-25% on an annual basis. However, we are requesting the flexibility to go up to a 50/50 mix. The 50/50 ratio is being used as the basis for all modeling as a proactive measure.

Please see 2.1.2 for additional information.

2.6.2. Projected Volume RRT

As previously discussed, we expect that the plant would consume between 55,000 and 85,000 tonnes of RRTs per year, up to a maximum of 100,000 tonnes per year. 85,000 tonnes of RRTs per year would be equivalent to about 1.2 million RRTs per year (~14 whole ties per tonne). In recent years the total annual quantity of wood waste consumed has been about 400,000 tonnes. If operating 24/7, the plant would burn up to 600,000 tonnes/year. We expect this lower annual consumption to continue or be reduced further.

We envision RRTs being delivered as we require them. We would develop a RRT storage area at the plant for whole ties. It would be close to the shredder, which is the piece of equipment that would take whole RRTs and 'shred' them into smaller pieces that would be mixed with other residual wood fibre before entering the plant on conveyors for combustion. We would maintain a limited supply of shredded RRTs at our site stored only for short periods of time in a bin or silo, so as not to create a fire hazard and minimize fugitive dust blowing off the plant site and any runoff from the shredded material.

Our project proposes to receive used RRTs at a rail yard location in an industrial area of the City. The ties will be loaded onto trucks and transported to our plant primarily by highway and then a short distance on Mackenzie Avenue North. Our project will not materially change the total truck deliveries to the plant site since the RRT deliveries replace current residual wood waste deliveries.

Please see 2.1.2 for additional information.

2.6.3. Primary Fuel Source

Our primary fuel source will always be our traditional fuel supply from the local mills. In the event that additional area mills are closed, no more than 50% of our fuel supply would come from RRTs as permitted. Furthermore, the availability of RRTs is also subject to supply and transportation limitations.

2.6.4. Fuel Mix During Inversions

Please see 1.8.5.11.

2.7. Boiler Operation

2.7.1. Routine and Emergency Shutdown

The facility operates 24/7. During planned maintenance shutdowns, fuel flow to the boiler is gradually reduced to empty the fuel feed bins for maintenance, and combustion parameters and emissions are normal during the shutdown which occurs over about 2 hours. During a recent (11/2) planned shutdown, flue gas temperatures in the economizer reduced by about 125 F over the 2 hour shutdown period, and NOx decreased from about 120 ppm to 40ppm.

An unplanned shutdown can occur, for example if the BC Hydro transmission system goes down or if a major piece of equipment fails. In these cases, the plant would trip (which means the steam turbine generator is electrically disconnected from the grid and the fuel flow to the boiler is stopped). Such an upset condition happens quickly, typically in less than a minute. Even with the fans shut down, air continues to flow to the boiler immediately after a trip and any fuel already in the boiler on the grate continues to combust.

There is only a small amount of RRT burning at any one time (<1 ton/min at the 50% limit). Because the RRT/regular wood fuel mixture on the grate is contained in the large metal furnace, the RRT will stay in place and burn out very quickly in matter of minutes. Plant trips are rare, but during a 2014 plant trip, flue gas temperatures were steady up to the point of the trip and then began a gradual decline. NOx was 110ppm immediately prior to the trip, and then also began a slow decline (5 minutes later it was 76ppm)

2.8. Combustion of Spill Absorbents

2.8.1. Frequency

The provision to burn "hydrocarbon contaminated absorbent materials originating from accidental spills" up to a maximum of 872 liters/day is intended to allow for spill recovery materials to be disposed of in the energy system. These occurrences are rare, the volumes would normally be low and the high temperatures within our furnace ensure complete destruction. The only material change is that formal authorizations will not be required, offloading Ministry staff from this administrative function and allowing for spill clean-up material to be disposed of quickly.

Please see 1.3.2 for additional information.

2.8.2. EPS 1/PG/7 Protocols and Performance Specifications Relative to Combustion of Hydrocarbon Spill Absorbents

Please see 1.3.1 and 1.3.2 for information.

2.9. Other Non-hazardous Biomass

2.9.1. Construction and Demolition Waste

The use of any contaminated (i.e. asbestos-containing drywall) construction and/or demolition wastes as fuel would be prohibited under the terms of the revised Permit Amendment. Furthermore, any construction and/or demolition wastes received for fuel would be subject to specific Contract terms prohibiting the supplier of such materials from including such materials in any shipments sent to the plant. In addition, such materials would be subject to onsite visual and remote video camera monitoring by the plant's operations staff, so as to prevent such materials from being introduced into the plants material handling system.

3. Ash

3.1.1. Hazardous Compounds and Metals

Table 8 of the 2001 test report (Appended to the RWDI report in Appendix 3 (see Appendix D of RWDI Report)) shows the referenced constituents of the ash (dioxins/furans, PAH, chlorophenols, and total metals) which are all within the applicable standards. Section 5.0 of the 2001 test report indicates that "Extractable metals met the leachate quality criteria under the BC Special Waste Regulation and that pH ranged from 5.15 (final) to 9.73 (initial). The BC Special Waste Regulation has been replaced by the BC Hazardous Waste Regulation which can be found at http://www.bclaws.ca/civix/content/complete/statreg/414786120/03053/reg03053/1871199216/?xsl=/templates/browse.xsl

The leachate quality standards did not change between the two regulations.

3.1.2. Ash Handling and Testing

All ash (bottom ash from the bottom of the boiler, ash from the mechanical collectors, and fly ash from the electrostatic precipitator) is consolidated for disposal at the project's ash landfill.

Also see 3.1.1.

3.1.3. PLACE HOLDER

3.1.4. Ash Analysis and Comparison with BC Regulation

See 3.1.1 and 3.1.2.

3.1.5. Ash from Incomplete Combustion

The potential for incomplete combustion would be highlighted by the boilers air monitors and visually detected at the submerged ash bunker. In the unlikely event that wood is not completely burned and is apparent in the ash, this ash would be collected by a loader and re-introduced back to the furnace.

3.1.6. pH of Ash

The uptake of CO_2, mainly from precipitation, serves to neutralize ash in a relatively short period of time. This natural process of carbonation is what allows for the landfilling of ash and the common practice of using ash from traditional wood fibre as an agricultural fertilizer in most Canadian provinces.

The plant's ash landfill is subject to a Management Plan approved by the MOE. An engineering firm (AMEC Foster Wheeler) is contracted by the plant to oversee the activities associated with the ash landfill, and to prepare an Annual Report in accordance with the requirements of both the Discharge Permit for the Landfill (# 8809) as well as the Management Plan. The Discharge Permit and Management Plan contain specific requirements relative to the development and closure of the landfill; fugitive dust management; site preparation and restoration; surface runoff and erosion control; monitoring, sampling and analysis of groundwater, surface water, stability and settlement; quality assurance; and reporting. These mandates have been developed in conjunction with the MOE to ensure the operation of the landfill is protective of human health and the environment. The most recent sampling of the groundwater monitoring system did not indicate any levels of concern relative to groundwater contamination.

3.1.7. Contaminant Levels

The pollutant levels in the ash from RRTs, although higher for some compounds than those from traditional fuel sources, are still extremely low. For example, dioxins and furans in 100% RRT ash were 788 picograms / gram. To put this in context, a picogram is 1/1,000,000,000,000 of one gram so the result was less than one part per billion (ppb), versus the limit of 100 ppb. The BC Hazardous Waste Regulation defines waste containing dioxin as “a waste containing a concentration greater than 100 parts per billion”. PAHs and metals were not significantly higher when burning RRT and many of the metals were lower than the ash from the traditional wood fibre baseline.

3.1.8. Ash Landfilling

As discussed below, the combustion ash is applied to the landfill and covered with a soil layer to prevent exposure to the environment. In addition, when the concentration of dioxins in the

RRT ash is compared to the applicable soil standard for dioxins (0.00035 mg/kg), it is concluded that the potential for significant human health and/or environmental impacts is negligible. It is anticipated that an updated Management Plan will be prepared and submitted to the MOE for review and approval. Any revisions needed to ensure the landfill activities are protective of human health and the environment will be incorporated at that time.

WLPP will be applying to the MOE and the Ministry of Forestry, Lands and Natural Resources Operations (MFLNRO), prior to the landfill reaching full capacity, in accordance with the procedural requirements of both Ministries, to amend its current landfill permit to allow for any expansion of its current Landfill to accommodate future ash deposits.

Also see 3.1.1 and 3.1.6 for additional information.

3.1.9. Dioxins and Furans

Although the levels of the dioxin/furans was higher in the rail-tie ash, when compared to the regular hog fuel ash, these levels are still protective of human health and the environment, and do not exceed the applicable limits for leaching content. A study conducted for the MOE (Organochlorine Contamination in Various Environmental Compartments-Hatfield Consultants Ltd-1991) concluded that the levels off dioxins/furans observed in combustion ash was not indicative of any significant concern for public exposure.

Ash is applied to the landfill and covered with a soil layer to prevent exposure to the environment. In addition, when the concentration of dioxins in the RRT ash is compared to the applicable soil standard for dioxins (0.00035 mg/kg), it is concluded that the potential for significant human health and/or environmental impacts is negligible. An updated Management Plan will be prepared and submitted to the MOE for review and approval. Any revisions needed to ensure the landfill activities are protective of human health and the environment will be incorporated at that time.

Also see 3.1.1 and 3.1.7 for additional information.

3.1.10. Performance Bonding

If the BC Ministry of Environment implements performance bonding for forest and biomass sector power operations then this would apply to the WLPP landfill. Currently no such security has been required for wood residue, pulpmill dregs, pulpmill lime, wood ash, ash from traditional wood fibre /RRT mixed fuels. We are not aware of wood ash landfills that have resulted in contaminated groundwater or surrounding soils.

3.1.11. Landfill Permit

WLPP has applied to amend the Landfill Permit to accommodate future ash deposits. All terms of the Landfill Permit will be adhered to for the protection of soil, groundwater and the aquatic environment.

4. Human Health

4.1. General

4.1.1. Predicted Health Impacts

As discussed above, the air modeling conducted by RWDI includes consideration of the occurrence of inversions in its modeling design, as per the MOE's guidelines. Based on the RWDI modeling outputs, Atlantic Power commissioned Intrinsik to complete a screening-level HHRA based on the results of an air dispersion modelling study of the emissions from the proposed increase in the volume of RRTs to be consumed annually at the WLPP. The primary aim of the screening-level HHRA was to identify and understand the potential health risks posed to the area residents as a result of the proposed changes in the WLPP emissions. In order to do so, consideration was given to the nature of the emissions, the nature of the exposures that might occur (i.e., amount, frequency and duration), and the nature of the potential health effects that may occur following exposure to the chemicals contained in the emissions.

By convention, the screening-level HHRA embraced a high degree of conservatism through the use of assumptions intentionally selected to represent worst-case or near worst-case conditions. Using this approach, any health risks identified in the screening-level HHRA were unlikely to be understated. Intrinsik concluded that the proposed increase in the RRTs used to fuel the WLPP would not be expected to result in an increase in health risks to the neighboring area.

The Intrinsik Assessment of Human Health Risks Associated with the Proposed Changes in the Emissions from the Williams Lake Power Plant can be found in Appendix 4.

4.1.2. Inversion Conditions

See 4.1.1.

4.1.3. Alternatives Should RRT Cause Health Impacts

As discussed in 4.2.4, Intrinsik concluded that "the proposed increase in the RRTs used to fuel the WLPP would not be expected to result in an increase in health risks to the neighbouring areas."

See 4.1.1.

4.1.4. Drinking Water Quality

As previously addressed, both the Williams Lake plant, as well as the landfill site, is subject to MOE Discharge Permit. In addition, the plant's Storm Water Management Plan and the landfill's Management Plan, contain provisions that are also designed to ensure that there are no adverse impacts to receiving waters, both surface water and ground water.

4.2. Long-term and Cumulative Effects

4.2.1. Assessment Method and BC Standards

It is the Province's role to manage the airshed, and in doing so they impose standards which we must assess as part of our dispersion modelling. This modelling considered all meteorological conditions experienced by the airshed, including temperature inversions over the course of 2012 the representative year to be used in modeling, as designated by MOE.

The regulatory limits evaluated in the air modeling by RWDI are designed to be protective of human health and the environment. The RWDI study concluded that the emissions from the plant would be within allowable British Columbia and Ontario limits for the various compounds considered.

In addition, the Intrinsik study evaluated the long-term human health impacts. Apart from the assessment of the potential health risks related to the exposures to the chemical emissions that may occur *via* the primary pathway of inhalation, consideration also was given to the risks that may have occurred as a result of chemical fall-out or deposition from the air onto the ground, resulting in additional pathways of exposure (i.e., secondary pathways). For the purpose of the screening-level HHRA, concentrations of the non-gaseous chemicals (i.e., metals, PAHs and chlorinated compounds) were predicted in soil and compared with BC's Contaminated Sites Regulation (CSR) numerical soil standards and background soil concentrations in the Cariboo Region (Gov. BC 2014). Specifically, the predicted maximum annual average air concentrations of the non-gaseous COPC associated with the WLPP were assumed to deposit onto the ground at the maximum point of impingement over an 80 year period (i.e., the lifespan of a person, as per Health Canada 2012). The study concluded that the proposed increase in the RRTs used to fuel the WLPP would not be expected to result in an increase in either short-term or long-term health risks to the neighboring area.

For further information see the Source Path Receptor at Appendix 6.

4.2.2. Air Quality

Table 6 of the RWDI report shows that the plant's impact, due to particulate on ambient air quality with a 50% RRT mixture, is less than 2% of the air quality objective. Combining the plant's emissions with the existing background emissions, total particulate matter is 26% of the annual average air quality objective while the 24 hour maximums are 82% for PM10 and PM2.5.

As stated above, the studies by RWDI and Intrinsik conclude there are no significant impacts to either human health or the environment from the proposed amendment.

Please see 1.8.2.1 additional information

4.2.3. Persistent Toxic Chemicals

In the trial burn using 100 % RRT, dioxins and furans were measured at 788 picograms /gram. To put this in context, a picogram is 1/1,000,000,000,000 of one gram so the result was less than one ppb, which is less than the BC Hazardous Waste Regulation limit, which defines waste containing dioxin as "a waste containing a concentration greater than 100 parts per billion".

As discussed above, with regards to the combustion ash, it is applied to the landfill and covered with a soil layer to prevent exposure to the environment. In addition, when the concentration of dioxins in the RRT ash is compared to the applicable soil standard for dioxins (0.00035 mg/kg), it is concluded that the potential for significant human health and/or environmental impacts is negligible. In conjunction with the necessary permitting associated with the Landfill, an updated Management Plan for Landfill activities will be prepared and submitted to the MOE for review and approval. Any revisions needed to ensure the landfill activities are protective of human health and the environment will be incorporated at that time.

In addition, please see 4.2.1 and 4.2.2, above, for information regarding human health and bioaccumulation.

4.2.4. Assessment of Long Term Effects

In order to ensure there are no adverse human health impacts associated with the burning of railroad ties, AP engaged a Qualified Professional (Intrinsik), a firm specializing in Health Heath Risk Assessment, out of Calgary, Alberta (AB).

They conducted a screening-level assessment to identify and understand the potential health impacts that could result from exposure to the emissions associated with the William Lake Power Plant change in fuel mix, with consideration given to the nature of the emissions, the nature of the exposures that might occur (i.e., amount, frequency and duration), and the nature of the health effects that are known to occur following “over-exposure” to the chemicals contained in the emissions (see Appendix 4 for their report). In addition, the assessment evaluated the nature of the exposures that residents might experience on a short-term (acute) and/or long-term (chronic) basis as a result of the changes to the fuel at the plant, and to determine the significance of these exposures from a human health perspective. The modeling calculated soil concentrations for various compounds of concern, and compared them to Contaminated Site Soil Standards. Based on their modeling and analyses, Intrinsik concluded that “the proposed increase in the RRTs used to fuel the WLPP would not be expected to result in an increase in health risks to the neighbouring areas.”

4.2.5. Assessment of Cumulative Effects

Please see 4.2.1, 4.2.3 and 4.2.4 for information regarding cumulative effects and bioaccumulation.

5. Miscellaneous

5.1. Alternatives to Railway Ties

5.1.1. Roadside Logging Debris

WLPP is attempting to diversity its fuel supply with economical alternatives to mitigate an expected decline in forestry and wood processing wastes to ensure the long term economic viability of the plant and its associated economic and environmental benefits to the Williams Lake community. RRTs provide that diversification. Greater use of forestry wastes may be part of WLPP's long term plan, but traditionally this source of fuel is relatively expensive. If, in the future, the province provides incentives for the removal of this material the cost of this material could become more competitive.

Shredding and combusting RRTs to generate electricity at our plant helps solve the issue of RRTs accumulating over time at the side of rail lines, and eventually in landfills, which results in GHG emissions in the form of methane during decomposition.

Our proposal would see the RRTs collected and transported to Williams Lake. They would be carefully handled, stored and shredded and combusted at very high temperatures which result in emissions that are well below provincial standards. The fuel-handling system to be installed for railroad ties will also be capable of processing roadside logging debris. We see this as a long-term win for the environment and a way to sustain the jobs and economic activity at our plant.

5.2. Location

5.2.1. Williams Lake Airshed

The modelling study has indicated that Ambient Air Quality Standards will be met throughout the community when WLPP burns up to 50% RRTs. Further the Intrinsik report concludes there will be no adverse health impacts. For a

Please see Section 1 (Air), 1.2, 1.3 and 1.8, as well as Section 4 (Human Health), 4.1 and 4.2, for additional information.

5.3. Community/Region

5.3.1. Impact on Potential New Industry

The estimated impacts (developed with a conservative methodology) are in the vicinity of the plant. The vast majority of future potential industry in the airshed would not be likely to have significant impacts in the same areas. The long term management of airshed emissions and air quality is the responsibility of the BC MOE. This air dispersion modelling report was also provided to the BC Ministry for review and comment.

5.3.2. History of RRT Burning

The use of rail-ties as a combustion fuel for biomass power plants is a well-developed technology and not experimental or prototypical. RRT has successfully served as the feedstock for a number of biomass facilities across North America for many years. . As discussed in 1.3.5, please see an interview conducted by the Williams Lake Tribune, on August 4, 2015, with a plant representative from the French Island plant in Wisconsin, which summarizes their experience with burning rail-ties, wood waste and RDF.

5.3.3. PLACEHOLDER

5.3.4. Residential Attraction and Retention

As discussed in Section 4.2.4, Intrinsik concluded that “the proposed increase in the RRTs used to fuel the WLPP would not be expected to result in an increase in health risks to the neighbouring areas.”

Please see Section 1, Air (1.1 – 1.6) and Section 4, Human Health (4.1- 4.2) for additional information.

5.3.5. Aboriginal Cogeneration Corporation, Kamloops Permit # 103943

We do not have information regarding the reason for the penta-chlorophenol prohibition for the referenced permit, for that proposed Project. With regards to the Williams Lake plant, our test in 2001 ((including penta-chlorophenol rail-ties per Table 8 of the test report), the emissions associated with the test (while burning RRT at twice the maximum expected rate) were within provincial and/or Ontario standards for PAHs, the class of compounds which includes pentachlorophenols.

Please see 1.2.5.

5.3.6. Role for Williams Lake Air Quality Roundtable

WLPP agrees with the importance of science-based airshed management. We cannot make commitments as to the future role of the Roundtable but if that group continues we will actively support it as before.

5.4. Greenhouse Initiative

5.4.1. WLPP Participation

Atlantic Power representatives have been part of this group since the idea was first proposed. It would involve our plant sending excess hot water through a pipe to help warm the greenhouses. We produce a large quantity of excess hot water in generating electricity at the plant and sending some to heat greenhouses would mean a reduction of our cooling requirements, which in turn would result in a reduction of the water we use each year.

5.5. Drinking Water

5.5.1. Usage Levels

Please see 5.5.2.

5.5.2. WLPP Location and Impact on Water Usage

We do not have a comprehensive history of pre-design considerations for the WLPP. It may be that the benefit of replacing multiple beehive burners with one tightly controlled system with extremely low emissions outweighed an earlier plan that did not prove economically viable.

This project will not increase water usage. More than 90% of our water consumption is used in the power plant's cooling system. If the greenhouse project goes ahead, heat from the plant that goes to the greenhouse will decrease the amount of water that evaporates in the cooling tower, resulting in less make-up water needed for the plant's cooling system.

Additionally, under a recent curtailment agreement that is also expected to continue if we execute an Electricity Purchase Agreement (EPA) extension, we would not normally operate the plant during the hot summer months when our water needs would be the highest. This in itself has and will continue to have a significant impact on the water consumption rates at the plant during the times when the local aquifer is most used.

5.6. Alternative Uses for Wood Waste

5.6.1. Ash Neutralization and Benefits of Biomass Energy

The pH of the ash is neutralized by carbonation (CO2 in rainwater and air) in a relatively short time. This natural process of carbonation is what allows for the safe landfilling of ash and the common practice of using ash from traditional wood fibre wood fuel as an agricultural fertilizer (lime substitute) in most Canadian provinces. The neutralization of acidic soils and the natural process of CO2 uptake combine to reverse causticity and avoid negative environmental impacts.

We view the use of wood residue (a renewable fuel) in the production of green energy as a very positive alternative to energy produced from fossil fuels, In particular, end-of-service RRTs tend to accumulate along rail corridors over long periods of time, and converting them to energy is an environmental improvement.

In Closing

The staff at WLPP would like to thank the Ministry of Environment for their guidance through this process and the residents and local authorities of Williams Lake for their thoughtful and informed inputs. We appreciate the time taken to write letters and participate in public meetings and plant tours.

This report was prepared by Glenda Waddell, President of Waddell Environmental Inc. and is submitted to the Ministry of Environment by:

Mark Blezard, P. Eng.
Plant Manager
Williams Lake Power Plant

APPENDIX 1

Request to Amend Permit PA 8088 to Allow RRT

RECEIVED
DEC 05 2001
WATER, LAND & AIR PROTECTION
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November 22, 2001

Mr. Rick Wagner
Pollution Prevention Officer
British Columbia Ministry of Water Land and Air Protection
Suite 400
640 Borland Street
Williams Lake, British Columbia, V2G 4T1

Dear Mr. Wagner

REQUEST TO AMEND PERMIT PA 8088 TO ALLOW RAIL TIE S TO BE USED AS MINOR FUEL SOURCE - TRANSCANADA WILLIAMS LAKE POWER PLANT

REQUEST TO AMEND PERMIT PA8088 TO REFLECT ADDRESS CHANGE

In response to inquiries from the railway industry about using discarded rail ties as a fuel source for the Williams Lake Power Plant, TransCanada has completed an air quality impact assessment of this material. A summary of the results of this assessment and the public notification and information activities are described in this correspondence.

Based on the results of the air quality assessment and the public information session, TransCanada is requesting that Permit PA 8808 be amended to include treated wood (creosote or pentachlorophenol) as an approved fuel source for the facility.

In support of this amendment request are the following:

- Final copy- 2001 Emission Survey Report (includes analysis of regular and treated wood fuel and ash samples)
- Public Notification Advertisements – January and November, 2001
- Dispersion modelling results for HCl and SO_2 using SCREEN3 model
- Synopsis of November 8, 2001 public information session
- Information Sheets available to public at November information session
- Completed Application for Amendment of Permit under Provisions of Waste Management Act

BACKGROUND & PRE TEST ACTIVITIES

Representatives of several railway companies had approached TransCanada about the possibility of burning rail ties as a fuel source at the Williams Lake Power Plant. The ties are treated primarily with creosote with a minor amount being treated with pentachlorophenol. Based on TransCanada's evaluation of the plant's capabilities and a review of the environmental issues associated with burning rail ties it was determined that the plant had the potential to effectively incinerate the rail ties without adverse incremental environmental impact.

TransCanada consulted with the Ministry of Water Land and Air Protection (the 'Ministry') to determine the appropriate test criteria and proposed to conduct a 'test burn' of the rail ties in April 2001. Prior to receiving Ministry authorization and under Ministry direction, a notice was placed in the local newspaper (Williams Lake Tribune) on January 25 and 26, 2001to announce TransCanada's intentions and to invite interested parties to contract the company with questions or concerns regarding the proposed test. The notice included the reasons, details and duration of the test burn, the proposed test program and contact names and numbers for further contact.

A total of three (3) contacts were made with TransCanada prior to conducting the test burn. Of these, only one person expressed doubts about the ability of the power plant to effectively incinerate treated wood waste. Concern was focussed on the boiler capabilities and the potential for wood treated with heavy metal wood preservatives to be used as fuel at the plant. TransCanada did write to this individual on February 23, 2001 (copy to Ministry also provided) to answer his concerns and to offer reassurance that TransCanada has no intention of using wood treated with heavy metal wood preservatives as a fuel source at the plant. The supplier of the rail tie material used for the test burn informed TransCanada that heavy metal wood preservatives were not used in their business. This individual has not had further contact with TransCanada.

TransCanada also discussed the proposed test burn with the Mayor of Williams Lake and the Williams Lake Roundtable on Air Quality. A copy of the pre test burn notification is appended to this correspondence.

TEST BURN ACTIVITIES & SUMMARY OF RESULTS

The treated wood was comprised of waste rail ties supplied by CN Rail. The ties were brought to the plant chipped and ready to use. The ties were stored at the power plant wood yard away in a separate location from the regular wood waste to ensure that only rail tie waste was burned during the specified test days and times.

The test was conducted over a four-day period during day light hours. Regular wood waste was tested on day one and rail tie wood waste was tested in triplicate, one set of tests on each of three days.

Emissions testing was conducted by Al Lanfranco and Associates, Langley British Columbia. Regular wood waste and rail tie wood waste were evaluated for the following parameters using approved sampling and analysis methods:

Particulate
Trace Metals (class I, II and III)
Sulphur Oxides (as SO_2)
Dioxins and Furans (PCDD/PCDF)
Polyaromatic Hydrocarbons (PAH)
Hydrogen Chloride
Chlorophenols

Process and continuous emissions monitoring data were also collected and are presented in the report along with fuel and ash sample analysis. Oxides of nitrogen (NOx) and percent opacity were well within permit requirements throughout the test program. Ministry staff were on-site for the majority of the test program.

A summary of the emission results is presented here:

Emission Summary

Parameter		Baseline @ 11% O_2	Railtie @ 11% O_2	Provincial Requirements
Particulate	(mg/Sm^3)	6.2	2.3	20 @11% O2
	(Kg/hr)	3.4	1.1	n/a
Trace Metals (mg/m3)				
Class I (sum)		0.050	0.040	3.6 mg/m3 each metal
Class II (sum)		0.0028	0.0023	0.7 mg/m3each metal
Class III (sum)		0.0026	0.0011	0.15 mg/m3 each metal
PCDD & PDCF TEQ (ng/Sm^3)		0.0013	0.0034	0.1 to 0.5*
PAH (ug/Sm^3)		0.063	0.058	5 *
Chlorophenols (ug/Sm^3)		0.010	0.091	1 *
Sulphur Oxides as SO_2 (mg/Sm^3)		***1.0***	***172***	***180***
Hydrogen Chloride (mg/Sm^3)		***< 0.1***	***59.8***	***50***
Flow rate (Sm^3/min.)		5870	5710	6000 WLAP Permit
Oxygen (Vol. %)		6.0	8.2	n/a

	Baseline @ 7% O_2	Railtie @ 7% O_2	Permit @7% O_2
Particulate (mg/Sm^3)	8.6	3.2	51

All above results are expressed at standard conditions of 25°C and 101.3 kPa (dry).

Results expressed at 11% O_2 are a requirement of the BC MOE Special Waste Regulations, while power plant's permit is expressed at 7% O_2.

* Emission Criteria for Municipal Solid Waste Incinerators

The attached emissions report contains the details of the testing program. The emissions report attached to this correspondence is the final version of the draft report that was provided to you in June, 2001. The data has not changed from the draft to final report however, rail tie ash analysis data (using SWEP procedure) has been added to the final report. The test data shows that, with the exception of SO_2 and HCl, emission criteria were well within provincial requirements. The test was conducted under the maximum operating scenario to determine maximum air quality impacts. Operating procedures and availability of treated wood material on an ongoing basis would mean, however, that only a small fraction of rail tie material would be utilized as fuel at the power plant at any given time.

Normal or routine operations utilizing a mixture of regular and treated wood waste would therefore have a significantly reduced impact on air quality as compared to using 100% treated wood as fuel.

Fuel and Ash Samples

In accordance with Ministry requirements under the authorization to conduct the test burn, the fuel and ash samples for both regular and treated wood waste were analyzed for metals, dioxins/furans, PAH and chlorophenols.

Chlorophenol could not be analyzed for the ash samples due to quantification problems at the laboratory. Chlorophenol in the fuel samples contained a variety of tri- and tetra chlorophenols for regular and treated wood waste.

PAH concentrations in regular and wood waste ash were similar in concentration and type. PAH was present in regular and treated wood fuel samples but in much larger concentration in the treated wood.

The composite treated wood ash sample was analyzed for extractable metals using the provincial SWEP procedure. The results were within provincial requirements. Initial and final pH was 9.73 and 5.15 respectively.

Dioxins and furans were present in regular and treated wood waste fuel and ash samples but in greater concentration in the treated wood fuel and ash.

The detailed results are presented in the emission monitoring report.

DRE for Treated Wood

Based on an estimated feed rate of 60 tonnes/hour of dry hog fuel and the hog fuel analysis for dioxin of 4040 ng/kg and chlorophenol of 72 mg/kg, the DRE for dioxin is estimated at 99.9994 and 99.9993 for chlorophenols. Note that the degree of confidence in the dioxin DRE is not high because of the very low results determined (0.0034 ng/m3). Environment Canada's reliable limit of quantification of 0.032 ng/m3 thus the amount of dioxin in the flue gas and feed would need to be about a factor of ten higher to allow for confident quantification of the dioxin DRE.

DISPERSION MODELLING

Based on the emission test results and the HCL and SO_2 emission rates established when burning 100% treated wood, dispersion modelling was undertaken to determine ambient air quality impacts for HCL and SO_2 using the SCREEN 3 dispersion model and local terrain data.

The full meteorology set was used in three terrain assessment modes; flat, simple and complex. Maximum concentrations predicted by SCREEN3 were compared to the ambient air quality criteria for HCl and SO_2 as found in the document "Emission Criteria for Municipal Solid Waste Incinerators" June 1991.

For flat and simple terrain (terrain at or below stack height) the ambient air quality criteria are satisfied. In complex terrain (terrain above stack height) the ambient air quality are exceeded at distances of 550 to 1200 m from the stack on the elevated terrain to the northwest of the stack. The SCREEN3 model will however, tend to overestimate predicted concentrations under the screening level parameters utilized by the model. The HCl and SO_2 impacts from this study are therefore a conservative estimate of actual impacts.

These results were determined using emission data collected while burning 100% rail ties at the power plant. Normal volumes or even maximum normal values of waste treated wood burnt at the site would be only a fraction of the 100% treated wood material used during the test burn, significantly reducing HCl and SO_2 emissions from the power plant to levels that would satisfy ambient air quality criteria.

A copy of the SCREEN3 report is included with this correspondence.

OTHER ENVIRONMENTAL CONSIDERATONS

Storage of Treated Wood at the Site

While the treated wood was especially stockpiled to meet test burn requirements, receipt and management of treated wood waste on an ongoing basis would be the same as for regular wood waste. Based on the projected volumes of treated wood available on an ongoing basis at the Williams Lake power plant, it is not expected that significant volumes of treated wood would be on site at any given time.

PUBLIC INFORMATION FROM POST TEST BURN

A notice announcing the open house at the power plant was placed in the Williams Lake Tribune on November 1 and 8, 2001. As well, members of the Williams Lake Roundtable on Air Quality received individual notification about the open house.

A total of 14 people attended the open house held at the power plant on November 8, 2001 from 3 to 7 p.m. Five were employees of the plant, one was from the Ministry and the remaining eight were from the general public. Attendees indicated that they appreciated the opportunity to meet with company representatives and learn about the test burn results. TransCanada company representatives included representatives from the corporate Health, Safety and Environment and Land and Community departments who were directly involved in the test burn at the power plant.

TransCanada representatives also met with the Mayor of Williams Lake and members of council on November 5 to apprise them of the test results and answer questions as required. TransCanada did receive general support for this initiative from the Mayor and Council who appreciated TransCanada's ongoing commitment to the Williams Lake community.

A synopsis of the post test burn public consultation and a copy of the post test burn notification is appended to this correspondence.

REQUEST TO AMEND PERMIT TO USE TREATED WOOD

Based on the results of the test burn and the outcome of the public information process, TransCanada requests that the plant permit be amended to include the use of treated wood as a minor fuel source for the Williams Lake Power Plant.

REQUEST TO AMEND PERMIT-ADDRESS CHANGE

Permit PA 8088 also requires an address change from:

NW Energy (Williams Lake) Corp., General Partner
1710- 1066 West Hastings Street
Vancouver, B.C.
V6E 3X1

To:

NW Energy (Williams Lake) Corp., General Partner
4455 Mackenzie Avenue North
Williams Lake B.C.
V2G 1M3

TransCanada appreciates the Ministry's guidance in this matter. Please direct questions or concerns to the undersigned at the address information located at the head of this letter.

We look forward to hearing from you.

Sincerely

Sandra Barnett

Sandra Barnett
Senior Environmental Advisor
TransCanada

Attachments:

CC: Martin Meyer TransCanada

BRITISH
COLUMBIA

File: PA 8808
PA 8809

NW Energy (Williams Lake) Limited Partnership
NW Energy (Williams Lake) Crop., General Partner
4455 Mackenzie Avenue North
Williams Lake BC V2G 1M3

Dear Brett Rodgers:

**Re: Application Pursuant to the Waste Management Act
on behalf of NW Energy (Williams Lake) Limited Partnership
NW Energy (Williams Lake) Crop., General Partner, received October 30, 2001**

Your application for Permit amendment cannot be processed due to non-payment of the application fee. Please be advised that the full fee payment must be submitted in order to begin processing your application.

The total amendment fee payment required for both applications is **$200.00**.

Cheques or money orders, made payable to the Minister of Finance and Corporate Relations, should be mailed to:

Attention: Kathy Jenkins
Ministry of Water, Land, and Air Protection
400 640 Borland Street
Williams Lake BC V2G 4T1

Yours truly,

Kathy Jenkins
Supervisor, Licensing and Documentation

Enclosure

PAID
RECEIPT # 300 919K
DATE Dec. 7 '01
AMOUNT 200.00

Ministry of Water, Land, and Air Protection
Cariboo Region
Mailing/Location Address:
400 - 640 Borland Street
Williams Lake BC V2G 4T1
Telephone: 250-398-4530
Facsimile: 250-398-4214

~~DKM~~ · DMc

TransCanada

RECEIVED
OCT 30 2001
WATER, LAND & AIR PROTECTION
WILLIAMS LAKE, BRITISH COLUMBIA

Ministry of Environment, Lands and Parks.
400-640 Borland Street
Williams Lake, B.C.
V2G 4T1

To Rick Wagner

Re: Minor administrative amendment

As per our conversation, I would like to ask for a minor change on the Williams Lake Power Plant permit documentation. The documentation on the permits PA 8088 and PA 8809 has the wrong address on them. The address was pertinent and accurate in 1992 when the business office for the project was at that address.

Our regulatory and compliance department in Transcanada pointed out there may be a discrepancy on the name and the address of the permits. It has been confirmed with Frankie Nelson the name of the company is still correct but the address should be changed to.
4455 Mackenzie Ave. North
Williams Lake, B.C.
V2G 1M3

Thank you for your assistance

Sincerely,

Brett A. Rodgers

Brett Rodgers

PAID
RECEIPT # 300919K
DATE Dec 7'01
AMOUNT 200.00

Williams Lake Power Plant
Test Burn for Treated Wood
Supporting Evidence

Background

Since 1993, the Williams Lake power plant has burned waste wood from forestry operations to generate electricity. This facility has eliminated the need for beehive burners in the Williams Lake area, significantly reducing air quality problems in the area.

A very small amount of the waste wood fuel used at the facility is creosote-treated waste rail ties from B.C. Rail. The plant has been able to burn these small quantities of rail ties without an amendment to the current permit because of the combustion and air pollution control technology used at the plant. As well, data gathered from a similar boiler in Prince George B.C. indicated that pentachlorophenol (PCP) treated wood can be destroyed without adverse environmental impact. This information, the combustion technology and air pollution control equipment used at the plant gave the Ministry the confidence to allow rail tie incineration in limited quantities at the Williams Lake power plant.

In 2000, it was brought to the attention of TransCanada's HS&E Department that an opportunity to burn additional quantities of railway ties from other suppliers (CN Rail and perhaps CP Rail) was available. Waste rail ties are a high value fuel source (creosote is a derivative of coal) and would represent an additional fuel source for the plant. Based on information gathered from CN Rail, B.C. Rail and a CCME document on the management of post-use treated wood, TransCanada has elected to go forward with a proposal to conduct a test burn of rail ties at the Williams Lake facility.

The B.C. Ministry of Environment Lands and Parks supports this initiative. However, a 'test' or 'trial' burn must be conducted using 100% rail ties to assess the environmental impact of the air emissions resulting from the burning of these rail ties. In order to receive provincial approval for the test burn, TransCanada must undergo a 30-day public notification period to solicit comments from the general public regarding the proposed burn. The advertisement for the test burn will first appear in the Williams Lake newspaper on January 25, 2001. Should the approval to conduct the test burn be granted, it will likely take place in March 2001. The provincial regulator will review the results of the test burn and next steps will be determined based on test burn results. Likely those next steps would be dispersion modeling using stack sampling data to determine ambient air quality impacts and perhaps analysis of this data from a risk or health impact perspective. It is anticipated, although not certain, that further public consultation will be required after the environmental impact has been determined.

Although the majority of the rail ties are creosote treated, CN will likely be providing some PCP treated ties for the test burn. Literature data suggests that CN uses PCP treated ties for 1% of eastern Canada tie service and 2% for western Canada tie service.

The following information is provided to give the reader increased knowledge and awareness of the issues related to burning treated wood in North America. Information regarding forecast quantities of treated wood available for incineration in North America or the economics associated with the waste-to-energy process either in general or specific to Williams Lake are not part of the scope of this document.

Some of the components of the wood preservatives creosote and pentachlorophenol (PCP) as well as creosote–impregnated materials themselves are identified as CEPA (Canadian Environmental Protection Act) – Toxic substances. These are:

Creosote-impregnated waste materials	(includes rail ties)
Poly aromatic hydrocarbons (PAH's)	(Creosote)
Dioxins, furans and hexachlorobenzene	(PCP) — as opposed to creosote in 70's.

Wood preservatives are pesticides and their registration and use in Canada is regulated under the authority of the Pest Control Products Act (PCPA), administered by Health Canada via the Pest Management Regulatory Agency (PMRA).

Treated wood is not classified as a special (hazardous) waste in British Columbia and its disposal is regulated by the Waste Management Act. Opening burning of treated wood is not permitted. Waste rail material for the Williams Lake project will be comprised primarily of creosote treated hardwood or softwood rail ties. Some ties will be treated with PCP.

now Environment Management Act

Creosote is an oilborne wood preservative. Creosote, a distillate of coal tar, is about 75% PAH which is the active ingredient in the wood preservative. The Canadian government estimates that from 50 to 80% of the original PAH loading remains in the wood when it is taken out of service. PAH's are generally present in coal tar and produced when organic substances are burned. Railway ties constitute the largest volume of creosote waste products generated in Canada and it is estimated that 90% of the ties are reused. The Canadian gov't estimates that about 2.02 X106 kg/year of creosote is left in discarded railway ties that are not reused. Toxicity Characteristic Leaching Procedure (TCLP) has demonstrated that creosote treated wood products are not a hazardous waste. It appears that creosote enters the environment primarily via creosote contaminated sites.

Pentachlorophenol (PCP) is also a primarily oilborne wood preservative that contains trace quantities of dioxins, furans and hexachlorobenzene (HCB). PCP can also be waterborne through the use of polyethylene glycol. Most waterborne PCP's are destined for residential lumber products. Dioxins, furans and HCB are contaminants within the PCP, not the active ingredient of the wood preservative. Total loss due to leaching and volatilization from utility poles was 0.4 to 2.4% for dioxin and furan and 19 to 20% for HCB. Toxicity Characteristic Leaching Procedure (TCLP) has demonstrated that PCP treated wood products are not a hazardous waste.

Utility poles are primarily PCP treated. In the U.S. about 14% of utility poles are disposed of through incineration. In Canada out of service poles are reused with only about 10% requiring disposal due to decay or mechanical damage. The most common disposal method is landfill.

PAH's are emitted into the environment from natural and anthropogenic sources with forest fires as the single most important and natural source of PAH's in Canada. PAH's are generally non-volatile (with the exception of napthalene a major constituent of creosote) and exhibit low solubility in water. In air, soil and water, PAH's are mostly adsorbed to particulate matter, on which they can be transported and degraded slowly. PAH's adsorbed onto soil can be removed by wet or dry deposition onto water or soil. One relevant (to the Williams Lake project) source of PAH's to ambient air includes emissions from the incineration of wood residues by sawmills in teepee burners (249 t/year). Emissions to atmosphere from industrial incineration are estimated at 1.1 t/year for 1990, representing less than 0.1% of total PAH releases over the year. The Canadian govt' estimates that the quantity of PAH discharged to water and soil from creosote treated wood products could be up to 2000 t/year (this would include atmospheric deposition). The atmosphere is the main medium of transport for PAH's. Ozone-induced oxidation and hydroxylation are the two most important mechanisms by which PAH's are transformed in this atmosphere. Note that PAH's do not contribute to global warming due to their weak absorption of light in the wavelengths that are usually absorbed in chemicals involved in global warming.

Note also that minor transformation pathways for PAH's include reactions with NOx and SO2 which occur at the point of emission where temperatures vary from 100 to 200C.

Contamination of groundwater by PAH's can occur as a result of leaching through soils. Napthalene (the largest component of creosote) was the most mobile PAH reported below a creosote contaminated site in the U.S.

High concentrations of PAH's have been measured in urban areas where heating by wood combustion is common. For example, Whitehorse has very high PAH levels due to the terrain surrounding the city and the prevalence of wood-based heating in the city.

Over, the gov't of Canada (Environment Canada and Health Canada) have concluded that PAH's are entering the environment in a quantity or concentration or under conditions that may have harmful effects on the environment. PAH's, with a few exceptions, are not considered to be a danger to the environment on which human life depends (i.e., does not contribute to global warming). However, certain PAH's are considered to be entering the environment in a quantity or concentration or under conditions that may constitute a danger to human life or health.

Dioxins and furans, due to their overall toxicity, tendency to bioaccumulate and persistence in the environment has been the subject of ongoing public health and environmental concern. Dioxins and furans are contaminants in PCP. There are 75 cogeners of dioxins and 135 congeners of furan. PCP is the major source of dioxins. PCB's are the most significant source of furans. Coplanar PCB's also exhibit dioxin-like toxicity due to structural and conformational similarities to dioxin compounds. Dioxins and furans bind strongly to soils and sediments and are lipophilic, hence the tendency for bioaccumulation. Dioxins are also extremely hydrophobic and have a high degree of chemical and biological stability. Dioxin/furan cogeners with chlorine's attached at a minimum in the 2,3,7 and 8 positions exhibit the high toxicity typically associated with dioxin. The only significant loss mechanism for these compounds appears to be through photolysis (degradation when exposed to sunlight). That is why the residency time of these compounds in the atmosphere is estimated in the range of days.

In the U.S., dioxin releases to air are controlled under EPA regulations based on Maximum Achievable Control Technology (MACT) standards. Canada is expected to release Canada Wide Standards (CWS) for dioxins/furans.

Municipal waste combustion and medical waste incineration have historically been the two largest categories of dioxin release to the environment.

Dioxin is released in the combustion process three ways:

- Dioxin is in the fuel to start with
- Dioxin is generated as a result of incomplete combustion
- Dioxin is formed is the post combustion environment via de novo synthesis

Note that if the temperature is above or below certain range (i.e., 200 to 400C), dioxin formation will not occur (US EPA, 1999).

The three requirements for the formation of dioxin during complete combustion are:

- Appropriate temperatures for formation
- Sufficient retention time
- Presence of catalytic surfaces

Facilities with well-controlled combustion and good pollution control have low levels of dioxin formation and release. However circumstances can exist in which change in chlorine content of the feedstock could affect dioxin emissions. Uncontrolled burning of waste (wood and other) in teepee burners is also a source of dioxin emissions.

Note that the combustion of salt (NaCl) laden wood (associated with western Canada) can result in elevated dioxin emissions. This is one reason why so many non-pulp mills on the West Coast are required to stack sample for dioxins/furans on a regular basis.

Chromated copper Arsenate (CCA)

Other types of preservatives in use include chromated copper arsenate (CCA). CCA is waterborne preservative that bonds tightly to wood during the fixing process so leaching is minimal under normal usage conditions. **It is recommended that wood treated with CCA not be burned because the heavy metals are not destroyed; the chromium and copper become concentrated in the ash and the arsenic becomes a vapour (arsine gas).** Additionally, copper can be a catalyst for dioxin formation so a mix of CCA and PCP treated wood would likely yield increased emissions of dioxin/furans.

Who Uses Treated Wood for power generation?

Treated wood is also referred to as an alternative woodfuel. A number of biomass power plant and industrial boilers throughout the U.S. use alternative woodfuels. As well there are IPP's that have permits to use alternative woodfuels. Here are a few examples:

- **Viking Energy, McBain MI.** 18 MW power plant can burn up to 50% (heat input basis) to creosote treated wood, PCP treated wood and other alternative woodfuels.
- **Craven County Wood Energy Plant, New Bern, N.C.** 45 MW biomass-fired power plant can burn up to 20% creosote treated rail ties on a volume basis.
- **Genesee Power Station, Flint MI.** 35 MW wood fired power plant can burn high quality construction/demolition wood waste and various types of clean untreated wood fuels.
- Koppers Industries Susquehanna, Montgomery, PA. **11 MW plant fuelled totally by used creosote treated rail ties and utility poles.**

The Koppers facility consumes about 1 million ties per year and also burns creosoted utility poles. Steam and about 25% of the electricity generated are consumed on site to produce new rail ties.

A Canadian facility, the St. Lawrence Cement (Ciment St. Laurent) Company participated in a 1996 test burn for utility poles and rail ties in their cement kiln. According to Marc Deschesne, the program manager from the University of Montreal, the project was technically successful. This facility burns a mixture of coal, waste oil and used tires as fuel. Materials in the kiln reach a temperature of 1450 to 1500 C. Environment Canada also participated in this test program. It is not know if the company is using treated wood at this facility at this time.

Dioxins and Furans: A Health Risk Assessment in British Columbia

The health risk assessment for the Elk Falls pulpmill (No. 5 power boiler) conducted in 1992-1993 included the investigation of the combined burning of salty hog fuel and primary and secondary effluent treatment sludge. The exposure estimation included atmospheric dispersion modeling of the stack emissions under local meteorological and geographic conditions using the U.S. EPA's ISC2 model to obtain estimates of the annual average ambient dioxin and furan. The levels of dioxins and furans in the air, soil and local produce were estimated from the modeling study. To compare the effects of different structures of dioxins and furans, toxicity was described using the convention TEQ, toxicity equivalency factor.

The significance of the Elk Falls study is the use of salty (chlorine laden) hog fuel as well as sludge as fuel. The combination of these two materials had the potential to produce substantial amounts of dioxins and furans.

Power boiler dioxin emissions based on data from the EPA's national dioxin study are described in this report as:
- 103.6 ng/m3 at the baghouse inlet
- 82.4 ng/m3 at the baghouse exit

While measurements of the power boiler emissions indicated the presence of dioxins and furans at the Elk Falls facility the levels were below the 'Acceptable Daily Intake' guidelines established by Health and Welfare Canada.

Overall the health risk of dioxin and furans was ranked as low by the study participants. Note that this study does not encompass an environmental risk assessment and was limited to the assessment of airborne emissions. The magnitude of this study was driven by the risks associated with burning sludge with salty hog fuel. While the William Lake project might be considered 'lower risk' aspects of the Elk Falls study will be required for Williams Lake, namely the dispersion modeling exercise and perhaps the conversion of modeling results to TEQ factors.

It is understood that this plant is currently burning salty hog fuel and sludge on an ongoing basis.

Combustion Characteristics For, and Air Emissions From, Treated Wood

Air emissions data from creosote-treated wood combustion indicate low levels of dioxins/furans some PAH's and in some cases low levels of metals. The primary emissions are nitrogen oxides, carbon monoxide, particulate matter and some hydrocarbons; similar to what is emitted when burning regular wood waste.

For the test burn conducted at the Northwood Pulp Mill, Prince George, B.C. in 1989, no dioxins or furans were detected in ambient air samples collected during the test runs. Trace quantities of dioxins and furans were detected in the stack gases during test runs using 'high spike' PCP hog fuels. Trace quantities of hog fuels were also detected in ash samples during one test run.

A comparison of the Northwood boiler and the Williams Lake boiler show similar characteristics with respect to boiler design, gas residence time and interior boiler temperatures. Other facilities reviewed in literature for this project also exhibited similar characteristics to the Williams Lake power boiler.

Public Reaction and Opinion

A common theme throughout the information reviewed for this project was the negative public perception that burning creosote or PCP treated wood is an environmental/human health risk. This despite scientific information that would suggest otherwise. The negative public perception issue was also raised by environmental consultants and a health expert who are familiar with air quality and health impact issues. These persons provided this information during casual discussions regarding the proposed test burn.

People in Williams Lake who are already familiar with the project (plant personnel and the Williams Lake Airshed society, possibly others) have not expressed concern over the proposed test burn. Comments and inquiries collected through the public notification period should be a good forecast of future public interest in this project after the stack testing results are applied to the dispersion model to determine overall air quality impacts.

Summary

Much of information reviewed was related to issues and emissions associated with contaminated sites and waste management practices. The air emissions data reviewed for this project indicate low risk or minimal environmental / human health impacts for various facilities located in North America burning creosote or PCP treated wood. Some of these facilities are similar to the power boiler at Williams Lake in terms of equipment design, combustion temperatures and gas residence time.

Negative public perception could ultimately determine if TransCanada proceeds with the test burn even if provincial authorities authorize the test burn. Issues could occur via various non-governmental organizations like the Sierra Club who are currently very active on the West Coast. It is likely that the publics' most serious inquiries or concerns would be based on health impacts or health effects. TransCanada has retained a medical professional (Dr. Don Johnston) to help deal with these issues should they arise.

Considerations for ongoing use of treated wood at the Williams Lake facility would be:

- Ensuring that appropriate employee health and safety procedures are in place to handle treated wood (this is also a priority for the test burn phase)
- Amendments to the current permit that may require additional ongoing monitoring and/or reporting requirements could affect the viability of ongoing treated wood use
- Securing sufficient quantities of treated wood to meet economic requirements

The path forward for use of treated wood in North America appears to remain as reuse and energy recovery. Energy recovery will be largely limited to utility poles and rail ties. CCA treated wood would likely remain relegated to landfills.

TransCanada must ensure that CCA treated wood is NOT used as fuel or any part of a fuel mix at any TransCanada power facility.

TransCanada Energy
Williams Lake Power Plant Test Burn
Public Consultation Program

Rationale for the Public Consultation Program:
To fulfill a commitment that TransCanada made to the community, prior to conducting the test burn. In the public notice TransCanada placed in the local newspaper, it was indicated that TransCanada would further consult with the public once the results of the test burn were known. As well, the Ministry of Environment suggested that TransCanada pursue further public consultation once the results were known.

Background:
As operator of the Williams Lake Power Plant, TransCanada wanted to explore the feasibility of using larger quantities of treated wood as an additional source of fuel for the plant. The plant already burns a small quantity of railway ties throughout the year and will continue to use wood waste from local forestry operations as its primary source of fuel. To determine the feasibility of burning larger quantities of treated wood at the Williams Lake Power Plant, TransCanada conducted a test burn to monitor and sample the air emissions that resulted from burning the wood.

Key Community Issues:
While the Williams Lake Power Plant has been operational since April 1993, TransCanada's decision to amend its permit to accommodate the burning of treated wood as an additional source of fuel is likely to be of interest to the community. To alleviate the potential for misinformation from circulating through the community, TransCanada will need to address the following issues through its public consultation program:

1. Why are you considering this alternate fuel source?
    - An environmentally friendly option
    - Alternate feedstock
    - The project details
    - The purpose and necessity of proposed changes
    - What alternate sources were/are being considered
    - What the Regulatory Requirements are

2. What is a test burn?
    - What did you burn?
    - How much?
    - How long did the test burn last?
    - What was seen, heard, and smelled during the burn?
    - When did you conduct the test?
    - How did you control the test?
    - Who was present?

TransCanada

TransCanada PipeLines Limited
450 - 1st Street S.W.
Calgary, Alberta, Canada T2P 5H1

tel 403.920.7776
fax 403.920.2330
email sandra_barnett@transcanada.com
web www.transcanada.com

September 27, 2001

Dr. Don Johnson
1605- 73 Street S.W.
Calgary, Alberta,
T3H 3X1

Dr. Dr. Johnson

RE: Results of Williams Lake Power Plant Test Burn Using Creosote and PCP treated rail ties

Further to our recent telephone conversation, TransCanada has completed the test burn using rail ties at the Williams Lake Power Plant and are contemplating requesting an amendment to environmental permit to allow the plant to use treated wood (creosote and PCP only) as a component in our regular fuel mix.

The enclosed report describes the results of this test burn. The report is in draft form and will be finalized in the next few days. The data contained in the draft report will be the same in the final report.

TransCanada will be undertaking to conduct a limited or low key public consultation process prior to applying to the provincial Ministry to amend our permit. *To ensure that TransCanada has addressed the potential impacts that these emission results represent, we request that you undertake to review the draft emissions report and provide TransCanada with a written report with respect to any public health impacts this data represents.*

The report contains both summary and speciated data for air emissions as well as for a bulk sample of the regular wood waste (a.k.a. the 'baseline' sample). There is also data for a bulk sample of the railtie material a.k.a. the 'railtie composite'. The composite of fuel and ash was collected by combining samples of these materials collected at specified times throughout the test burn period.

The local B.C. Ministry official, Rick Wagner, has reviewed the draft report and has not, at this time, raised any serious issues with the results as presented. We note that the HCl emissions from the test burn do exceed the provincial requirements. The test burn, however was conducted under conditions that represent maximum environmental impact i.e., burning only rail ties for fuel. Under routine operating procedures the rail tie or treated wood component of the fuel would represent 2% to 10% of the fuel mix at any given time. This would bring the HCl emissions well within provincial requirements.

The rail tie ash sample was also analyzed for extractable metal (meaning leachable) according to the approved B.C. Ministry 'SWEP' procedure. These results are also included for your information.

Please contact me if you have any questions or concerns regarding this report or project. We look forward to hearing from you.

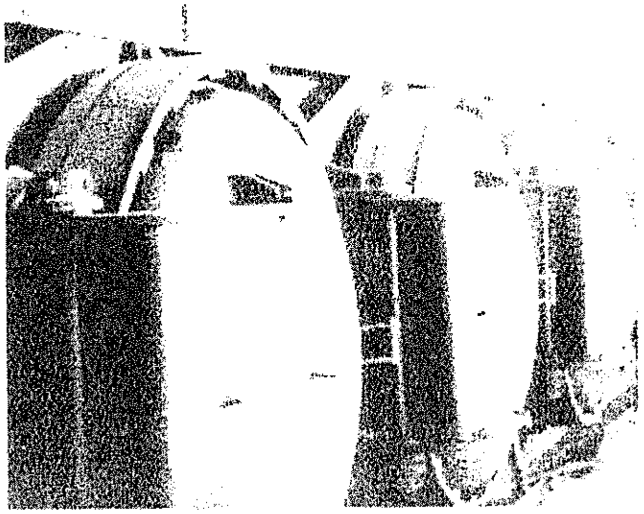
Sincerely

Sandra Barnett

Senior Environmental Advisor
TransCanada

Cc:file

THE TREATMENT OF WOOD CROSSTIES



Wood is a cellulosic material which can be adversely affected by decay fungi, insects, and marine borers. The use of chemical preservatives (organic and/or inorganic) must be used to protect wood from attack from these organisms.

The degree of protection obtained is dependent upon the type of preservative used and achievement of proper penetration and retention of the chemicals. As will be discussed in later chapters, there is a difference in the treatability of wood species. There is also a difference in the treatability of the sapwood and the heartwood portion of the tree.

With respect to wood crossties, the American Wood Preservers' Association (AWPA) Standard, C6 for crossties and switchties, gives the general requirements for preservative treatment by pressure processes. In addition, described within the Standard are the processing, conditioning, treatments, results of treatment (quality control), and storage of treated crosstie materials.

The processing and treatment of wood crossties are somewhat unique. This product, as used by the American railroad industry, has historically been treated with a creosote solution meeting the requirements of AWPA Standard P2. There are also occasions when other timber products such as bridge material will be treated using the AWPA Standard P1/P13 meeting the requirements for coal tar.

A heavy petroleum oil that meets AWPA P4 Standard has also been used for blending with creosote. This creosote/petroleum solution has been used extensively for many years to reduce the cost of the preservation solution. Its use, however, has been in the Western and Rocky Mountain states and Canada which are areas that have climatic conditions which are less conducive to wood deterioration from fungi and insects. Organisms that attack wood - fungi and termites - are not as active at *low* temperature and humidity levels found in many areas of these geographic regions.

-couldn't find the site that says the treatment solution is typically 1:1

APPENDIX 2

Oct. 8, 2015 - Application to amend Permit PA 8808 to allow 50% RRTs

Williams Lake Power Plant

Owned and operated by:
AtlanticPower
Corporation

July 10, 2015

Victoria Permit Administration
Business Services Branch
Environmental Protection Division
Ministry of Environment
PO BOX 9377 Stn Prov Govt
Victoria BC V8W 9M1

PermitAdministration.VictoriaEPD@gov.bc.ca

Re: Application to Amend Atlantic Power Preferred Equity Ltd. Permit 8808

This letter, and the accompanying Environmental Protection Notice, are to request an amendment to the Atlantic Power Preferred Equity Ltd. Permit 8808. This Permit was last amended on November 20, 2012.

This application requests that limitations on alternate biomass fuels are amended. These, and other changes, are outlined in detail in the attached Application.

Thanks to Matthew Lamb-Yorski for your assistance with this amendment.

Sincerely,

for.
Mark Blezard, Plant Manager
Williams Lake Power Plant

Attachment: Application to Amend Air Permit 8808

Cc: Matthew Lamb-Yorski, Environmental Protection Officer

Bag Service 1000
Williams Lake, BC V2G 4R7

T 250 392 6394
F 250 392 6395

www.atlanticpower.com

Application to Amend Atlantic Power Williams Lake Air Permit 8808

Atlantic Power Preferred Equity Ltd.
4455 Mackenzie Avenue North
Williams Lake, BC V2G 4R7

Section	***Before***	***Proposed***
1.3	This section applies to the discharge of air contaminants from an ASH SILO VENT.	**Delete**
2.7	*Authorized Fuel*	
	The Authorized fuel is untreated wood residue unless authorized below or the approval of the Director is obtained and confirmed in writing.	The Authorized fuel is untreated wood residue unless authorized below or the approval of the Director is obtained and confirmed in writing. **All fuels will be stored in on-site collection areas.**
2.7.1	The incineration of wood residue treated with creosote and/or a creosote-pentachlorophenol blended preservative (treated wood) is authorized subject to the following conditions:	**No change**
	The treated wood component shall not exceed **5**% of the total biomass fuel supply calculated on an annual basis;	The treated wood component shall not exceed **50**% of the total biomass fuel supply on an annual basis;
	The treated wood waste shall be well mixed with untreated wood waste prior to incineration;	**No change**
	The incineration of wood residue treated with metal derived preservatives is prohibited;	**No change**
	The Permittee shall measure and record the weight of treated wood residue received. The source of treated wood shall be recorded.	**No change**
	The Permittee may request authorization to increase the proportion of treated wood residue incinerated by submitting a request in writing to the Director.	**Delete**

2.7.2	The incineration of hydrocarbon contaminated wood residues originating from accidental spills is authorized provided that written approval in accordance with section 52 of the Hazardous Waste Regulation has been received by the responsible party for disposal of the waste by incineration. The Permittee shall maintain a record of the quantity, date received, and identity of the responsible party of hydrocarbon contaminated wood residues originating from accidental spills.	The **acceptance and** incineration of hydrocarbon contaminated **absorbent materials** originating from accidental spills is authorized **by the Director** in accordance with section 52 of the Hazardous Waste Regulation **up to a limited quantity of 872 L per day. The free liquid content of the spill material must meet the waste oil provisions of the Hazardous Waste Regulations and material must be handled and stored so as to not cause pollution. For amounts in excess of 872 L per day the Director's authorization is required.** The Permittee shall maintain a record of the quantity, date received, and identity of the responsible party of hydrocarbon contaminated **absorbent materials** originating from accidental spills.
2.7.3	Vegetative residues (i.e. green foliage, invasive weeds, diseased plants, etc.), seedling boxes, and paper records are authorized as fuel **provided such materials constitute less than 1% of the daily feed into the boiler**. Non-biomass contaminants (e.g. plastic, glass metal) shall not exceed 1% of the daily feed into the boiler.	**Non-hazardous biomass wastes originating within the Cariboo Regional District including v**egetative residues (i.e. green foliage, invasive weeds, diseased plants, etc.), **clean construction and demolition waste,** seedling boxes, and paper records are authorized as fuel. Non-biomass contaminants (e.g. plastic, glass metal) shall not exceed 1% of the daily feed into the boiler.
3.2	*Operating Conditions*	
	"The Permittee shall sample the emissions from the boiler in section 1.1 under normal operating conditions. The Permittee shall record the operating conditions of the boiler in terms of steam load (lb/hr) for the sampling period and for the ninety **day period** prior to the sampling event."	"The Permittee shall sample the emissions from the boiler in section 1.1 under normal operating conditions. The Permittee shall record the operating conditions of the boiler in terms of steam load (lb/hr) for the sampling period and for the ninety **operating days** prior to the sampling event."
3.3	*Sampling Procedures*	
	"The continuous emission monitors shall be maintained and audited in accordance with Environment Canada's EPS 1/PG/7 Protocols and Performance Specifications for Continuous Monitoring of Emissions from Thermal Power Generation."	**Delete** These protocols are intended for fossil fuel burning systems. The continuous emission monitors are subject to Ministry of Environment audits and are also verified by regulatory stack testing.

Application No.341684

ENVIRONMENTAL PROTECTION NOTICE

Application for a ***Permit amendment*** under the Provisions of the *Environmental Management Act*

We/I, ***Mark Blezard, Atlantic Power Preferred Equity Ltd., 4455 Mackenzie Avenue North, Williams Lake, BC, V2G 4E8***, intend to submit this amendment application to the Director to amend ***Permit 8808***, issued ***February 20, 1991 and last amended November 20, 2012*** which authorizes the ***discharge of air contaminants***, from an ***electrical power generating plant.***

The land upon which the facility is situated ***and the discharge occurs*** is ***Lot B of District Lot 72, Cariboo District Plan PGP35292 (Parcel Identifier: 017-247-276)*** located at ***4455 Mackenzie Avenue North, Williams Lake, BC, V2G 4R7, within the Williams Lake airshed.***

The amendment requests that the following conditions be changed as outlined below:

1. Remove the section allowing discharges from the ash silo vent. This system is now fully enclosed.
2. Raise the limit on waste rail ties as a proportion of the authorized fuel from the current 5% to 50%
3. Expand the provision to burn non-hazardous woodwaste.
4. Remove the requirement that continuous emission monitors be maintained and audited in accordance with EPS 1/PG/7 as these protocols were designed for fossil fuel burning systems.

Any person who may be adversely affected by the proposed amendment and wishes to provide relevant information may, within 30 days after the last date of posting, publishing, service or display, send written comments to the applicant, with a copy to the Director, Environmental Protection at 400 - 640 Borland Street, Williams Lake, BC, V2G 2T1 or via email to the Director, Environmental Protection authorizations.north@gov.bc.ca and referencing the applicant name, the location, and the authorization number PA-8808 in the subject line. The identity of any respondents and the contents of anything submitted in relation to this application will become part of the public record.

Dated this 8th day of October, 2015.

(Signature)

Contact person Glenda Waddell

Email waddellenvironmental@gmail.com

Phone: 1-250-640-8088

APPENDIX 3

RWDI - Air Dispersion Modelling Report and Follow-up

CONSULTING ENGINEERS
& SCIENTISTS

Tel: 519.823.1311
Fax: 519.823.1316

RWDI AIR Inc.
650 Woodlawn Road West
Guelph, Ontario, Canada
N1K 1B8
Email: solutions@rwdi.com

CANADA'S BEST MANAGED COMPANIES
Platinum member

Atlantic Power Corporation
Williams Lake Power Plant
Williams Lake, British Columbia

Final Report

Air Dispersion Modelling Study
RWDI #1500355
September 8, 2015

SUBMITTED TO:

Terry Shannon
Environmental Manager, West Coast Operations
TShannon@atlanticpower.com

Atlantic Power Corporation
8835 Balboa Ave, Suite D
San Diego, California
92123

P: (250) 392-6394
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SUBMITTED BY:

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EXECUTIVE SUMMARY

Study Objectives

The Williams Lake Power Plant (WLPP) is a biomass-fired generating facility located at Williams Lake, British Columbia. The biomass consumed at WLPP currently consists of wood waste from sawmill operations. WLPP consumed rail ties up to 4% of the total annual fuel supply between 2004-2010, and the current air permit allows up to 5%. WLPP is proposing to supplement the wood waste fuel with shredded rail ties to compensate for reduced wood waste supplies. Atlantic Power Corporation (Atlantic Power) retained RWDI AIR Inc. (RWDI) to complete an air dispersion modelling study of changes in the emissions from the power plant due to the inclusion of rail ties in the fuel mix, to inform an upcoming Ministry of the Environments (MOE) Permit 8808 amendment request to increase the amount of rail ties allowed for use as fuel at WLPP up to 50%.

The air dispersion modelling study was conducted over a 25 km by 25 km study area surrounding the WLPP facility using CALPUFF 6.42 in CALMET three-dimensional which is an approved model under the *Guidelines for Air Dispersion Modelling in British Columbia* (British Columbia Ministry of Environment [B.C. MOE] 2008) for studies of this type.

Emissions for particulate matter (TPM, PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), hydrogen chloride (HCl), dioxins and furans, PAHs, and metals (Pb, Sb, Cu, Mn, V, Zn, As, Cr, Co, Ni, Se, Te, Ti, Cd and Hg) were developed using stack testing results from 2001 with the fuel consisting of 100% rail ties. Oxides of nitrogen (NO_x) values were obtained from the permanently installed Continuous Emissions Monitoring (CEMs) system. The emissions during the 2001 test were below the project's air permit limits, and the particulate and NO_x emissions did not change significantly with the 100% rail tie test. Dioxin and furan concentrations were less than 0.01% of the regulatory objective (Ontario's objective in the absence of a British Columbia objective).

Predicted contaminant concentrations were analyzed at 100% rail ties, as well as the expected maximum operating concentration of 50% rail ties. Only the emissions from the power plant stack were considered for this study.

Predicted contaminant concentrations at and beyond the plant property line were compared to relevant provincial ambient air quality objectives (AAQO). Predicted concentrations of those contaminants without relevant B.C. objectives were compared to Ontario ambient air quality criteria (AAQC). Concentrations of NO_X were converted to concentrations of NO_2 using the OLM method as recommended by the *Guidelines for Air Dispersion Modelling in British Columbia.*

Background concentrations of PM_{10}, $PM_{2.5,}$ and NO_2 were obtained from the Columneetza monitoring station for the year 2012. With the addition of background concentration to the CALPUFF predicted concentrations, contaminants and averaging times assessed were below their respective AAQO's or AAQC's for 100% rail ties, with the exception of 1-hour SO_2 which was below its AAQC for 50% rail ties, the expected operating maximum. 1-hour NO_2 predicted concentrations were at or slightly above the air quality objective, but the conversion to NO_2 is based on the highest one hour ozone value for the year and the background value is derived from a station in town that may overestimate concentrations in the specific area where exceedances are predicted. As noted, the inclusion of rail ties in the fuel mix has no or very little effect on the plant NO_x emissions.

TABLE OF CONTENTS

Figures

Appendices

1. INTRODUCTION

The Williams Lake Power Plant (WLPP) is a 66 MW biomass-fired generating facility located at Williams Lake, in south central British Columbia (B.C.). The biomass consumed at WLPP currently consists of wood waste from sawmill operations. WLPP consumed rail ties up to 4% of the total annual fuel supply between 2004-2010, and the current air permit allows up to 5%. WLPP is proposing to supplement the wood waste fuel with shredded rail ties to compensate for reduced wood waste supplies. Atlantic Power Corporation (Atlantic Power) retained RWDI to complete an air dispersion modelling study of changes in the emissions from the power plant due to the inclusion of rail ties in the fuel mix, to inform an upcoming Ministry of the Environments (MOE) Permit 8808 amendment request to increase the amount of rail ties allowed to be used as fuel at WLPP up to 50%.

The contaminants of interest for the assessment are those identified during a 2001 stack testing program at WLPP, with the power plant combusting 100% rail ties. Emissions for particulate matter (TPM), sulphur dioxide (SO_2), hydrogen chloride (HCl), dioxins and furans, PAHs, and metals (Pb, Sb, Cu, Mn, V, Zn, As, Cr, Co, Ni, Se, Te, Ti, Cd and Hg) were measured during that test. PM_{10} and $PM_{2.5}$ values were derived from the TPM measurements using published emission factors. Oxides of nitrogen (NOx) values were obtained from the permanently installed Continuous Emissions Monitoring (CEMs) system. The emission during the 2001 test were below the project's air permit limits, and the particulate and NOx emissions did not change significantly with the 100% rail tie test.

The impacts of emissions from WLPP were assessed using an air dispersion modelling study conducted over a 25 km by 25 km study area surrounding the facility using CALPUFF 6.42 driven with three-dimensional meteorological files developed using the CALMET pre-processor. This is a recommended approach under the *Guidelines for Air Dispersion Modelling in British Columbia* (British Columbia Ministry of Environment [B.C. MOE] 2008) for studies of this type.

CALPUFF predicted concentrations at and beyond the plant property line were compared to existing B.C. ambient air quality objectives (AAQOs). Predicted concentrations of those contaminants without relevant B.C. objectives were compared to Ontario ambient air quality criteria (AAQC) to provide a context of potential impacts. Concentrations of NO_X were converted to the equivalent NO_2 using the OLM method as recommended by the *Guidelines for Air Dispersion Modelling in British Columbia.*

The B.C. AAQO's and Ontario AAQC's are presented in Tables 1 and 2, respectively, for the various contaminants and averaging periods.

Table 1: B.C. Ambient Air Quality Objectives

Contaminant	Air Quality Objective (µg/m³)	Averaging Period
Total Particulate Matter	120	24 Hours
	60	Annual
PM_{10}	50	24 Hours
$PM_{2.5}$	25	24 Hours
	8	Annual
Sulphur Dioxide	200 [1]	1 Hour
Nitrogen Dioxide	188 [2]	1 Hour
	60	Annual

Notes: [1] Achievement based on annual 99th percentile of daily 1-hour maximum, over one year.
[2] Achievement based on annual 98th percentile of daily 1-hour maximum, over one year.

Table 2: Ontario Ambient Air Quality Criteria for Constituents Not addressed in B.C. Objectives

Contaminant	Air Quality Objective (µg/m³)	Averaging Period
Hydrogen Chloride	20	24 Hours
Dioxins and Furans	0.1 (pg TEQ/m³)	24 Hours
Total PAHs	0.00005	24 Hours
	0.00001	Annual
Lead	0.5	24 Hours
Antimony	25	24 Hours
Copper	50	24 Hours
Manganese	0.4	24 Hours
Vanadium	2	24 Hours
Zinc	120	24 Hours
Arsenic	0.3	24 Hours
Chromium	0.5	24 Hours
Cobalt	0.1	24 Hours
Nickel	0.04	Annual
Selenium	10	24 Hours
Tellurium	10	24 Hours
Titanium	120	24 Hours
Cadmium	0.025	24 Hours
	0.005	Annual
Mercury	2	24 Hours

2. METHODOLOGY

2.1 Emission Estimation

Emissions from the power plant stack for the operation of the generating facility combusting 100% rail ties were based on a 2001 stack testing program and CEMs data for NO_X collected during the stack testing.

The emission rate of each contaminant was calculated from the in-stack concentration and stack flow rate, as reported by the stack testing campaign. The stack testing program reported emissions of Total Particulate Matter (TPM) but did not report emissions of PM_{10} and $PM_{2.5}$ separately. The emissions of these contaminants were based on the emissions of Total Particulate Matter (TPM), which was reported, and applying the ratio of TPM to PM_{10} and $PM_{2.5}$ emission factors as provided in Table 1.6-1 of U.S. EPA's AP-42 Chapter 1.6 for emissions from wood residue combustion with electrostatic precipitator as a control device. The stack testing report is attached as Appendix A.

2.2 Dispersion Modelling

Dispersion modelling was conducted over a 25 km by 25 km study area surrounding WLPP using CALPUFF 6.42 in full three-dimensional CALMET mode. This is a recommended approach under the *Guidelines for Air Dispersion Modelling in British Columbia* (British Columbia Ministry of Environment [B.C. MOE] 2008) for studies of this type. All aspects of the dispersion model set-up, including meteorological data (CALMET), land use data, terrain data, receptor grid and various other model assumptions were established as per the *Guidelines for Air Dispersion Modelling in British Columbia*. The main components of the dispersion modeling are discussed below. A detailed model plan for the dispersion modelling study area was submitted for review by B.C. MOE. The Ministry approved the plan with additional suggestions that have also been incorporated in the modelling. Ministry comments and approval are provided in Appendix B.

2.3 Meteorology

Meteorological information is required by the CALPUFF air dispersion model to provide the transport and dispersion characteristics over the modelling domain. Meteorological characteristics vary with time (e.g., season and time of day) and location (e.g., height, terrain and land use). The CALMET meteorological pre-processing program was used to provide representative time and space varying meteorological parameters for the CALPUFF model. A horizontal grid resolution of 500m was applied in CALMET.

CALMET was applied for a 1-year model period of January 1, 2012 to December 31, 2012. CALMET was initialized using Weather Research and Forecasting (WRF) prognostic model output at a 4 km grid resolution obtained from the B.C. MOE province wide WRF data set.

The WRF outputs were supplemented with hourly observations from the Environment Canada station at the Williams Lake Airport as well as hourly observations from the B.C Ministry of Environment Glendale and the Canadian Tire meteorological stations located in Williams Lake. The locations of these stations are shown in Figure 1.

2.4 Terrain and Land Use Characterization

Terrain elevations for CALMET were extracted from B.C's. Electronic CDED terrain database and land use was obtained from Baseline Thematic Mapping data for B.C., as described in Section 9.4.4 of the B.C. MOE Guidelines. Gridded fields at 500m horizontal resolution were produced for terrain and land use as well as seasonally specific parameters of surface roughness (z_0), leaf area index, albedo, Bowen ratio, soil heat flux, and anthropogenic heat flux for input into CALPUFF.

2.5 Summary of CALMET Model Results

CALMET predicts meteorological conditions based on the combination of the two sources of meteorological observations (WRF model data and surface observation data). Predictions for wind conditions at Williams Lake Airport (Figure 2) showed similar wind patterns to those observed at the same location (Figure 3). Figure 4 shows the wind rose predicted by the model for the WLPP facility

CALMET predictions of atmospheric stability were examined in terms of the predicted frequencies of various Pasquill-Gifford (PG) stability classes by hour of day. The PG stability class scheme represents six levels of turbulence that can occur in the atmosphere. PG classes A, B and C are referred to as "unstable" and represent day-time periods when atmospheric turbulence is enhanced due to solar heating. PG classes E and F are referred to as "stable" and represent night-time periods when turbulence is suppressed due to surface cooling. PG class D (referred to as neutral) represents day- or night-time periods that are either overcast or characterized by high wind speed, mechanically-dominated conditions. Figure 5 shows the PG stability class frequency distribution as predicted by CALMET at the WLPP facility. As expected, stability classes A, B and C are limited to day-time periods, and classes E and F occur mainly during nighttime periods. PG classes D and F are the most frequently occurring classes.

2.6 CALPUFF

The air dispersion modelling study was conducted using CALPUFF 6.42 driven by the CALMET derived meteorology to predict the potential impacts of pollutants resulting from emissions from WLPP.

The CALPUFF model domain within which the potential impacts were predicted is a 25 km by 25 km study area centered on the WLPP facility. Puff transport and dispersion is computed within the CALPUFF model for the entire model domain. Model predictions are reported at discrete receptor locations within the dispersion modelling study area.

A Cartesian nested grid of receptors was defined within the study area, as per the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (B.C. MOE 2008). Receptor spacing for the Cartesian grid is as follows:

- 20-m spacing along the property fenceline;
- 50-m spacing within 500 m of the WLPP sources;
- 250-m spacing within 2 km of the WLPP sources;
- 500-m spacing within 5 km of the WLPP sources; and
- 1,000-m spacing within 10 km of the WLPP sources.

Receptor locations are shown in Figure 1, with receptors within the facility site removed.

All technical options relating to the CALPUFF dispersion model were set according to the *Guidelines for Air Quality Dispersion Modelling in B.C.* (B.C. MOE 2008) or to model defaults. These include parameters and options such as the calculation of plume dispersion coefficients, the plume path coefficients used for terrain adjustments, exponents for the wind speed profile, and wind speed categories.

Emissions from the power plant stack were modelled as a constant point source at unit emission rate. The resulting predicted concentration was scaled by the actual emission rates of the various pollutants to arrive at the pollutant specific predicted concentration. Stack parameters including stack height, stack diameter, exit velocity, and exit temperature are summarized in Table 3. The location of the stack is shown in Figure 1.

The height and diameter of the stack were obtained from plant design drawings provided by WLPP, while the maximum flow rate and exit temperature were obtained from the stack testing report. .

Table 3: Point Source Stack Parameters

Emission Source	Description	Stack Height (m)	Stack Inner Diameter (m)	Exit Temperature (°C)	Exit Velocity (m/s)
S1	Power Plant Stack	60.69	3.5	142.66	19.15

Buildings located close to stacks (i.e., point sources) may influence the dispersion of emissions. Since the buildings at WLPP are relatively tall and close to the power plant stack, building downwash effects were assessed in the dispersion modeling. Building dimensions were based on plant design drawings provided by WLPP.

2.7 Post-Processing of Model Results

Maximum ground-level concentrations were initially predicted for each receptor with the power plant stack emitting a representative contaminant at unit emission rate. Post-processing of 1-hour, 24-hour and annual model results was conducted to determine required results for comparison with ambient air quality objectives or criteria over various averaging periods. The CALPOST post-processor was used to extract required metrics from the resulting binary files.

The resulting concentration at each receptor was then multiplied with the actual emission rates of the various pollutants to arrive at the pollutant specific concentration at each receptor, with the exception of NO_2 concentrations which is discussed below.

The emission rate of each contaminant was calculated from the in-stack concentration and stack flow rate, as reported by the stack testing campaign. The stack testing program did not report emissions of PM_{10} and $PM_{2.5}$; however the emissions of these contaminants were based on the emissions of Total Particulate Matter (TPM), which was reported, by using the ratio of TPM to PM_{10} and $PM_{2.5}$ emission factors as provided in Table 1.6-1 of U.S. EPA's AP-42 Chapter 1.6 for emissions from wood residue combustion with electrostatic precipitator as a control device.

Emissions of NO_X based on CEMs data recorded during the stack testing program also were modeled in CALPUFF. The resulting predicted concentrations of NO_X were converted to concentrations of NO_2 using the OLM method as recommended by the *Guidelines for Air Dispersion Modelling in British Columbia.* The maximum one hour ozone concentration observed by the Columneetza ambient monitoring station for the period of January 1, 2012 to December 31, 2012, 83.8 ppb, was used in the conversion of NO_X to NO_2 using the OLM method. The location of the monitoring station is shown in Figure 1. As noted, NO_x emissions did not change significantly for the 100% rail tie fuel, and therefore, the background NO_x levels already account for the existing plant emissions. By adding the background to the estimated emissions, the NO_x contribution from the plant is likely double counted in some instances.

The estimated emission rates of the pollutants emitted by the power plant stack are provided in Table 4. Sample calculations for NO_x and SO_2 are provided below the table.

Table 4: Contaminant Emission Rates

Contaminant	Emission Rate (g/s)
Total Particulate Matter	2.95E-01
PM_{10} [1]	2.19E-01
$PM_{2.5}$ [1]	1.91E-01
Sulphur Dioxide	2.26E+01
Hydrogen Chloride	7.81E+00
Oxides of Nitrogen [2]	4.76E+01
Dioxins and Furans	4.63E-10
Total PAHs	7.93E-06
Lead	8.49E-04
Antimony	4.92E-05
Copper	4.21E-04
Manganese	9.99E-04
Vanadium	1.29E-05
Zinc	2.74E-03
Arsenic	9.48E-05
Chromium	3.79E-05
Cobalt	6.77E-06
Nickel	1.66E-04
Selenium	4.92E-05
Tellurium	1.23E-04
Titanium	6.34E-05
Cadmium	2.90E-05
Mercury	4.78E-05
Chlorophenol	1.19E-05

Notes: [1] Based on total particulate measurements.
[2] From the plant CEMs.

2.7.1 Sample Calculation for SO_2

The calculation of the SO_2 emission rate is a direct unit conversion from the stack test values. Stack test results for SO_2 are given in Table 1 of Appendix A. There are three tests provided. The emissions for Test 1 are given by:

$$213\frac{mg}{Sm^3}\times 5920\frac{Sm^3}{3}\times\frac{1g}{1000mg}\times\frac{1min}{60s}=21.016\frac{g}{s}$$

The same calculation was done for Test 2 and Test 3 (resulting in 24.125 g/s and 22.680 g/s, respectively). The three values were then averaged to obtain the value of 22.607 g/s given in Table 4.

2.7.2 Sample Calculation for NO_x

Test results for NO_x are given in Table 6 of Appendix A. There are four test results provided; the highest three were averaged to obtain the emission rate. For NO_x the units of measurement are converted from the stack test values of ppm in the flow to a mass emission rate. The STP conversion value in the Alberta Modelling Guidelines (AESRD, 2013) was used to convert values from ppm. For example from Test 2:

$$139ppm\times 40.8862\frac{\mu g/mol}{ppm*m^3}\times 46\frac{g}{mol}\times 11{,}210\frac{Am^3}{min}\times\frac{1g}{1e6\mu g}\times\frac{1min}{60s}=48.84\frac{g}{s}$$

The same calculation was done for Test 3 and Test 4 (resulting in 46.23 g/s and 47.66 g/s, respectively). The three values were then averaged to obtain 47.58 g/s shown in Table 4.

The other emission rates given in Table 4 were calculated similarly.

The *Guidelines for Air Quality Dispersion Modelling in British Columbia* (B.C. MOE 2008) require that representative background concentrations be added to concentrations predicted by dispersion modelling for new sources to account for other emission sources in the study area. Ambient concentrations of NO_2, PM_{10} and $PM_{2.5}$ recorded at the Columneetza monitoring station operated by the B.C. MOE were used in this assessment, however since particulate emissions and NO_x emissions did not change significantly with the 100% rail tie fuel, the inclusion of the background emissions double counts some emissions. Figure 1 shows the location of the ambient monitoring station.

As per the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (B.C. MOE 2008), the 98th to 100th percentile of historical monitoring data is to be added to maximum predicted concentrations. This methodology is conservative as it assumes that the maximum predicted concentration and the background concentration would occur at the same time even though, by definition, concentrations equal to or greater than the 98th percentile occur only 2% of the time and the maximum predicted concentration, by definition, would occur once during the modelled period.

The short-term PM_{10} and $PM_{2.5}$ 24-hour average background concentration was based on the 98th percentile of representative ambient air quality observations from B.C. MOE. The NO_2 1-hour average background concentration was based on the 98th percentile of daily 1-hour maximum concentrations. The annual average background concentration was based on the average of hourly observations. Background concentrations of TPM were not available from the Columneetza monitoring station. However, as TPM includes the smaller size fractions, background TPM would be at least as great as PM_{10}. Therefore the background PM_{10} concentration was used as an estimate of background TPM. Table 5 presents the ambient concentrations monitored by the Columneetza monitoring station.

Table 5: Representative Background Concentrations (in µg/m³)

Contaminant	Averaging Period	Background Concentration
NO_2	1-Hour	63.9
	Annual	16.5
PM_{10}	24-Hour	40.8
$PM_{2.5}$	24-Hour	20.2
	Annual	5

3. DISPERSION MODELLING RESULTS

The maximum predicted concentrations have been compared to B.C. AAQOs in Table 6. Comparisons to the B.C. AAQOs with the addition of monitored ambient data, where available, are shown in Table 7. Contaminants without B.C. AAQOs have been compared to Ontario AAQCs to provide a context to the predicted concentrations, and are presented in Table 8. Predicted contaminant concentrations were analyzed at 100% rail ties, as well as the expected maximum operating concentration of 50% rail ties. It was assumed that the emissions of contaminants of interest would be roughly proportional to the percentage of fuel ties, because the amount of material from the ties themselves will be linear, and the change in emissions from other material should not change the overall volume versus ties by more than a few percent.

Table 6: Modelling Results of Contaminants with B.C. AAQOs without Background Concentrations

Contaminant	Averaging Period	Maximum Predicted Concentration for 100% Rail Ties (µg/m³)	Maximum Predicted Concentration for 50% Rail Ties (µg/m³)	Air Quality Objective (µg/m³)	% of Objective 100% Rail Ties	% of Objective 50% Rail Ties
Total Particulate Matter	24 Hours	0.50	0.50	120	0.41%	0.41%
	Annual	0.08	0.08	60	0.13%	0.13%
PM_{10}	24 Hours	0.37	0.37	50	0.73%	0.73%
$PM_{2.5}$	24 Hours	0.32	0.32	25	1.28%	1.3%
	Annual	0.05	0.05	8	0.63%	0.63%
Sulphur Dioxide	1 Hour	226	113	200	113%	57 %
Nitrogen Dioxide	1 Hour	190	190	188	100%	100%
	Annual	12.0	12.0	60	20%	20%

Table 7: Modelling Results of Contaminants with B.C. AAQOs with Background Concentrations

Contaminant	Averaging Period	Maximum Predicted Concentration (µg/m³)	Background Concentration (µg/m³)	Predicted + Background Concentration (µg/m³)	Air Quality Objective (µg/m³)	% of Objective
Total Particulate Matter	24 Hours	0.50	40.8	41.3	120	34%
	Annual	0.08	15.4	15.5	60	26%
PM_{10} [1]	24 Hours	0.37	40.8	41.3	50	82%
$PM_{2.5}$ [2]	24 Hours	0.32	20.2	20.5	25	82%
	Annual	0.05	5.00	5.05	8	63%
Sulphur Dioxide (50% Rail Ties) [3]	1 Hour	113	--	113	200	57%
Sulphur Dioxide (100% Rail Ties) [3]	1 Hour	226	--	226	200	113%
Nitrogen Dioxide [4]	1 Hour	190	63.9	254	188	135%
	Annual	12.0	16.5	28.5	60	48 %

Notes:

[1] 24 hour background concentration is the 98th percentile 24 hour average concentration.

[2] 24 hour background concentrations is the 98th percentile 24 hour average concentration. Annual background concentration is the average annual concentration.

[3] The maximum predicted concentration for SO_2 is shown for 50% and 100% rail ties. The emissions of the other contaminants do not change between the two combustion scenarios.

[4] 1 hour background concentration is the 98th percentile of daily maximum 1 hour average concentration. The 24 hour background concentration is the 98th percentile 24 hour average concentration. Inclusion of background concentrations double counts NO_2 contribution of the facility

Table 8: Modelling Results of Contaminants without B.C. AAQOs Compared to Ontario AAQCs for 100% Rail Ties

Contaminant	Averaging Period	Maximum Predicted Concentration (µg/m^3)	Background Concentration (µg/m^3)[2]	Predicted + Background Concentration (µg/m^3)	Air Quality Objective (µg/m^3)	% of Criteria
Hydrogen Chloride	24 Hours	13.11	--	13.11	20	66%
Dioxins and Furans (pg TEQ/m^3)	24 Hours	<0.0000001	--	<0.0000001	0.1	<0.01%
Total PAHs	24 Hours	0.00001	--	0.00001	0.00005	27%
	Annual	0.000002	--	0.000002	0.00001	21%
Lead	24 Hours	0.00142	--	0.00142	0.5	0.28%
Antimony	24 Hours	0.00008	--	0.00008	25	<0.01%
Copper	24 Hours	0.00071	--	0.00071	50	<0.01%
Manganese	24 Hours	0.00168	--	0.00168	0.4	0.42%
Vanadium	24 Hours	0.00002	--	0.00002	2	<0.01%
Zinc	24 Hours	0.00460	--	0.00460	120	<0.01%
Arsenic	24 Hours	0.00016	--	0.00016	0.3	0.05%
Chromium	24 Hours	0.00006	--	0.00006	0.5	0.01%
Cobalt	24 Hours	0.00001	--	0.00001	0.1	0.01%
Nickel	Annual	0.00004	--	0.00004	0.04	0.11%
Selenium	24 Hours	0.00008	--	0.00008	10	<0.01%
Tellurium	24 Hours	0.00021	--	0.00021	10	<0.01%
Titanium	24 Hours	0.00011	--	0.00011	120	<0.01%
Cadmium	24 Hours	0.00005	--	0.00005	0.025	0.19%
	Annual	0.00001	--	0.00001	0.005	0.15%
Mercury	24 Hours	0.00008	--	0.00008	2	<0.01%
Chlorophenol [1]	24 Hours	0.00002	--	0.00002	20	<0.01%

Notes: [1] The maximum concentration of Chlorophenol is compared to the 24 hour Ontario AAQC for Pentachlorophenol. It is assumed that Chlorophenol is composed entirely of Pentachlorophenol.
[2] There are no data for background concentrations of these contaminants.

Results in Table 7 with no adjustment for double counting of WLPP emission in background concentrations show that contaminants with B.C. AAQOs are below their respective objectives for all averaging periods, except for NO_2 Spatial plots of dispersion modelling results are also presented (Figures 6 to 9) for SO_2 and NO_2 Model predictions of the maximum TSP, PM_{10} and $PM_{2.5}$ from the plant are all far below (less than 5%) of the applicable objectives and the spatial plots would be dominated by the background values. For brevity they are not shown.

From the SO_2 and NO_2 contour plots in Figures 6-8, it can be seen that the highest concentrations occur to the northwest or to the south east of the WLPP facility. This is in alignment with the general wind patterns of this area. Figure 6 shows SO_2 values with 50% rail ties to be below 57% of the AAQO in all areas.

The predicted annual average NO_2 concentration from 100% rail ties or from base fuel is shown in Figure 7. The maximum predicted annual average NO_2 concentration of 28.5 µg/m^3 is less than half of the corresponding BC AAQO of 60 µg/m^3.

When predicted 1-hour NO_2 from 100% rail ties or from base fuel is plotted without including the background values, as shown in Figure 8, the AAQO is only marginally exceeded, at 190 µg/m³ vs. the objective of 188, and the area of exceedances is limited to a few receptors near the fenceline.

Predicted 1-hour NO_2 from 100% rail ties or from base fuel including background with no adjustment for double counting of WLPP emissions is show in Figure 9. In this case the maximum predicted 98th percentile daily maximum concentration is 253.8 µg/m³, located adjacent to the fenceline to the northwest of the facility. Spatially the occurrence of exceedances of the AAQO is limited to an area within about one to two kilometers to the northwest of the facility and a smaller area within a few hundred meters to the southwest. The 1-hour NO_2 objective including background from 100% rail ties or from base fuel with no adjustment for double counting of WLPP emissions is exceeded up to 33% of days in the model year. The area of maximum frequency corresponds to the area of maximum predictions shown in Figure 10. 1-hour NO_2 predicted concentrations were above the air quality objective, but the adjustment for background includes periods when existing emissions from WLPP may be affecting the monitor. In addition, the NO_x to NO_2 conversion is based on the highest 1-hour ozone value observed for the year, and actual hourly ozone values are much lower for most of the year. As noted, the inclusion of rail ties in the fuel mix has no or very little effect on the plant NOx emissions. As such, 1-hour NO_2 concentrations at the ambient air quality monitoring station will likely remain essentially unchanged at the current background value of 34% of the AAQO.

4. SUMMARY AND CONCLUSIONS

CALPUFF dispersion model was conducted to predict ground level concentration changes that could result from for the WLPP facility combusting 100% or 50% rail ties. Contaminants were below their respective AAQO's or AAQC's for 100% rail ties, with the exception of 1-hour SO_2 which was below its AAQC for 50% rail ties, the expected operating maximum. 1-hour NO_2 predicted concentrations were at or slightly above the air quality objective, but the adjustment for background potentially double counts the plant emissions. As noted, the inclusion of rail ties in the fuel mix has no or very little effect on the plant NOx emissions.

5. REFERENCES

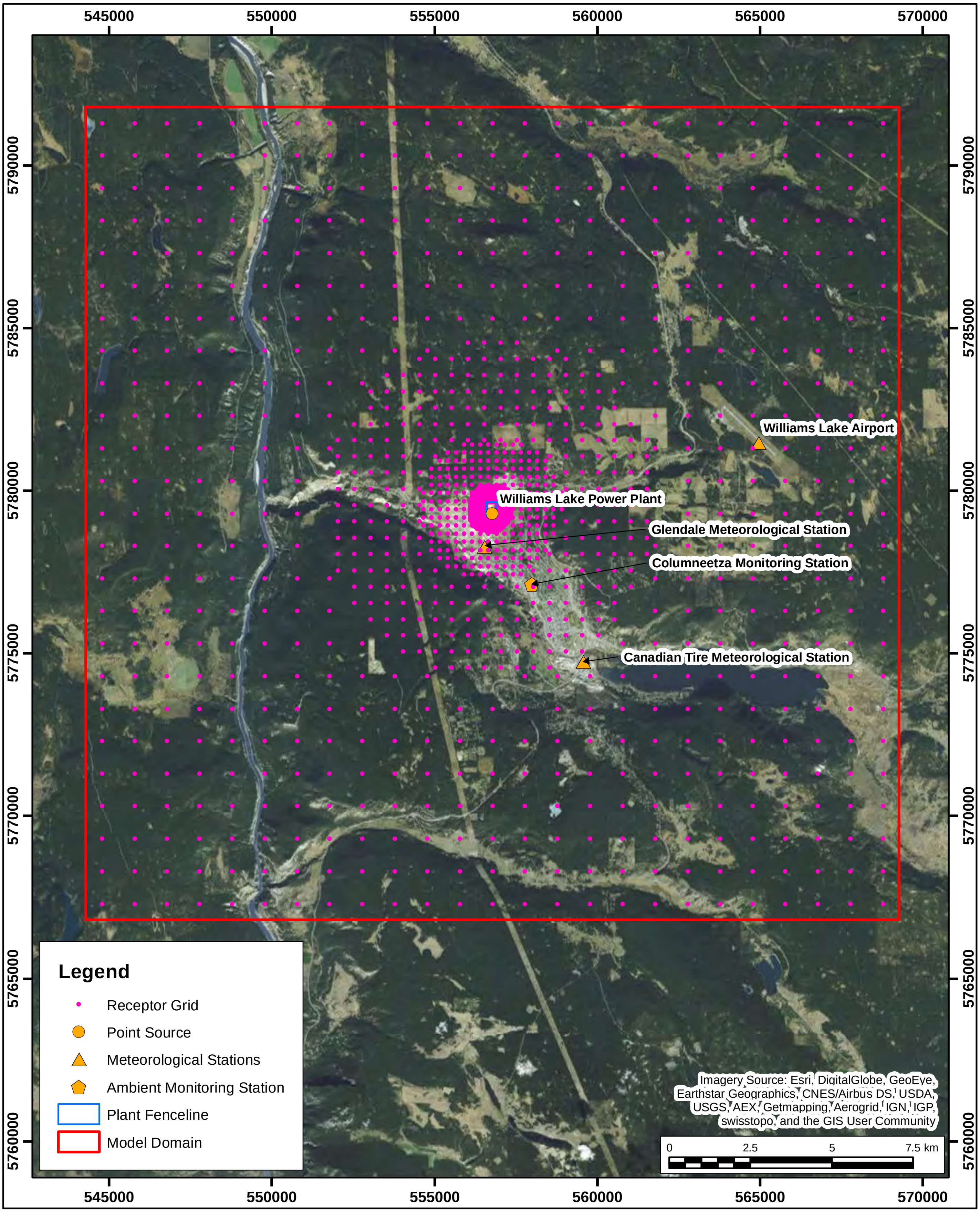
AESRD, 2013: *Air Quality Model Guideline*, Air Policy Section, Alberta Environment and Sustainable Resource Development, Edmonton, Alberta.

B.C. MOE. 2008. *Guidelines for Air Quality Dispersion Modelling in British Columbia*, Environmental Protection Division, Environmental Quality Branch, Air Protection Section. Victoria, British Columbia. March 2008.

B.C. MOE. 2013. British Columbia Ambient Air Quality Objectives.

US EPA. 1998. AP-42, Fifth Edition Compilation of Air Pollutant Emission Factors. Volume 1: Chapter 1.6 Wood Residue Combustion in Boilers.

FIGURES



Model Domain with Receptor Grid

Map Projection: NAD 1983 UTM Zone 10N.

Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by: NBN

Figure: 1

Approx. Scale: 1:160,000

Date Revised: June 29, 2015

RWDI

Figure 2: CALMET Predicted Wind Rose at Williams Lake Airport for 2012 Model Period

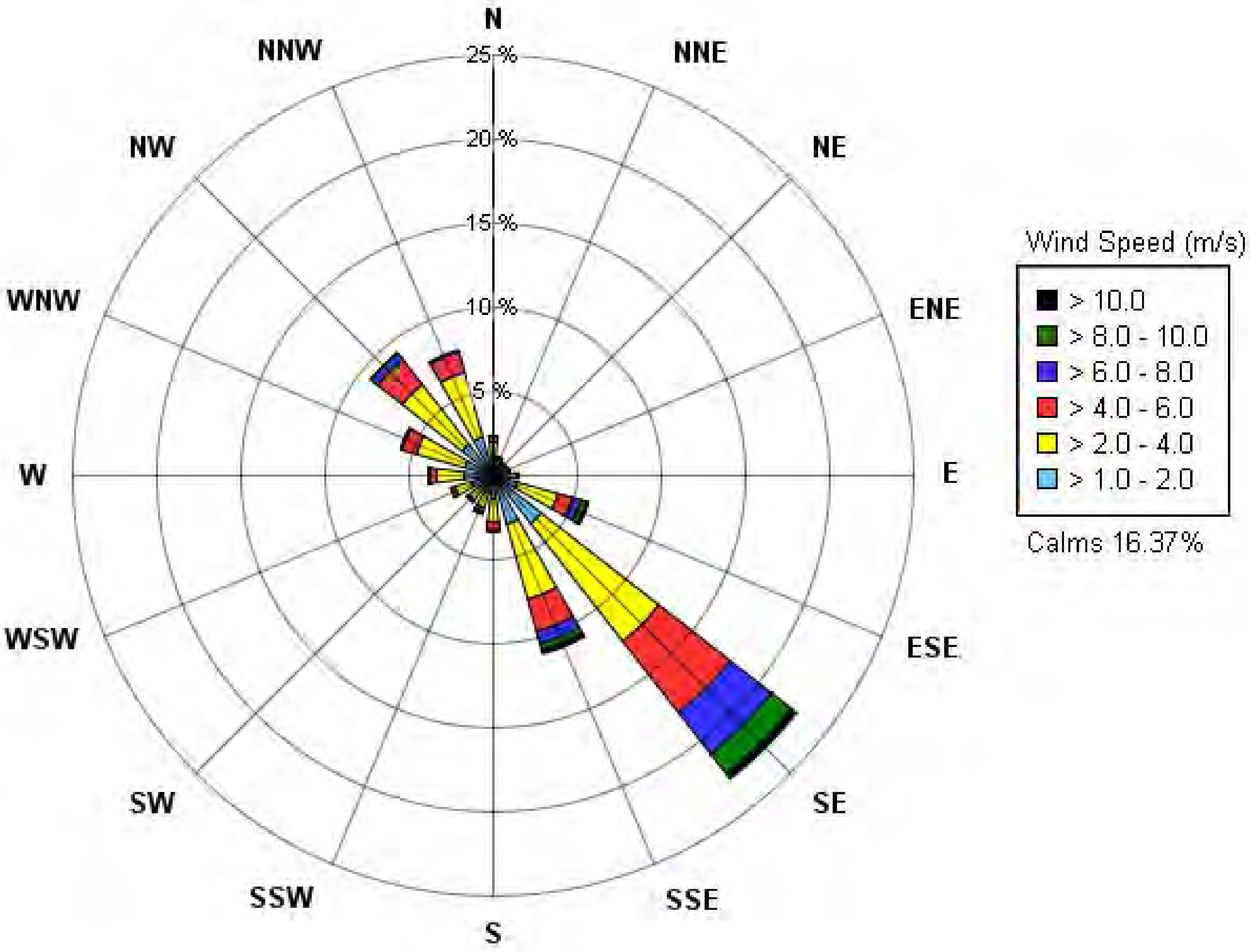


Figure 3: Observed Wind Rose at Williams Lake Airport for 2012 Model Period

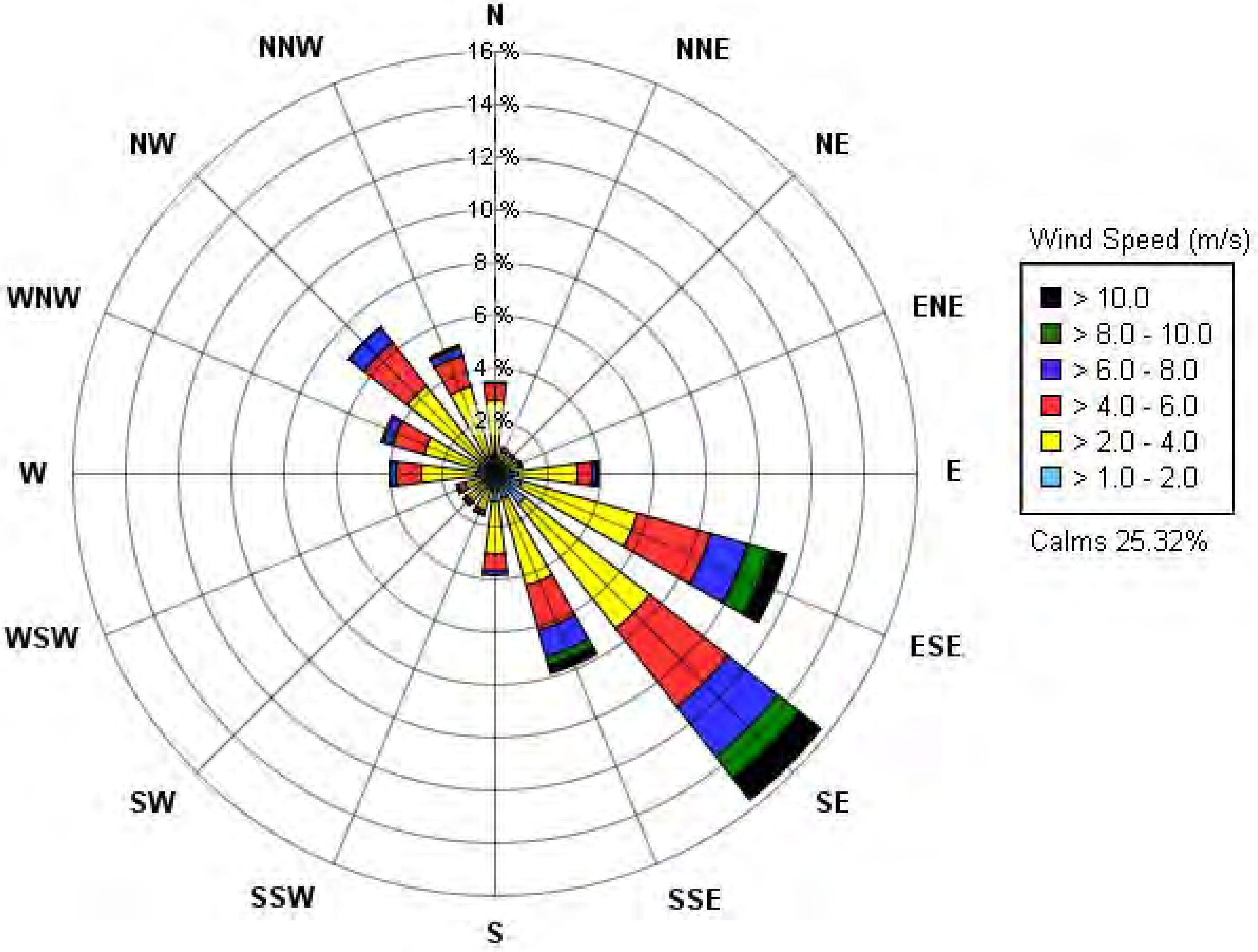


Figure 4: CALMET Predicted Wind Rose at WLPP for 2012 Model Period

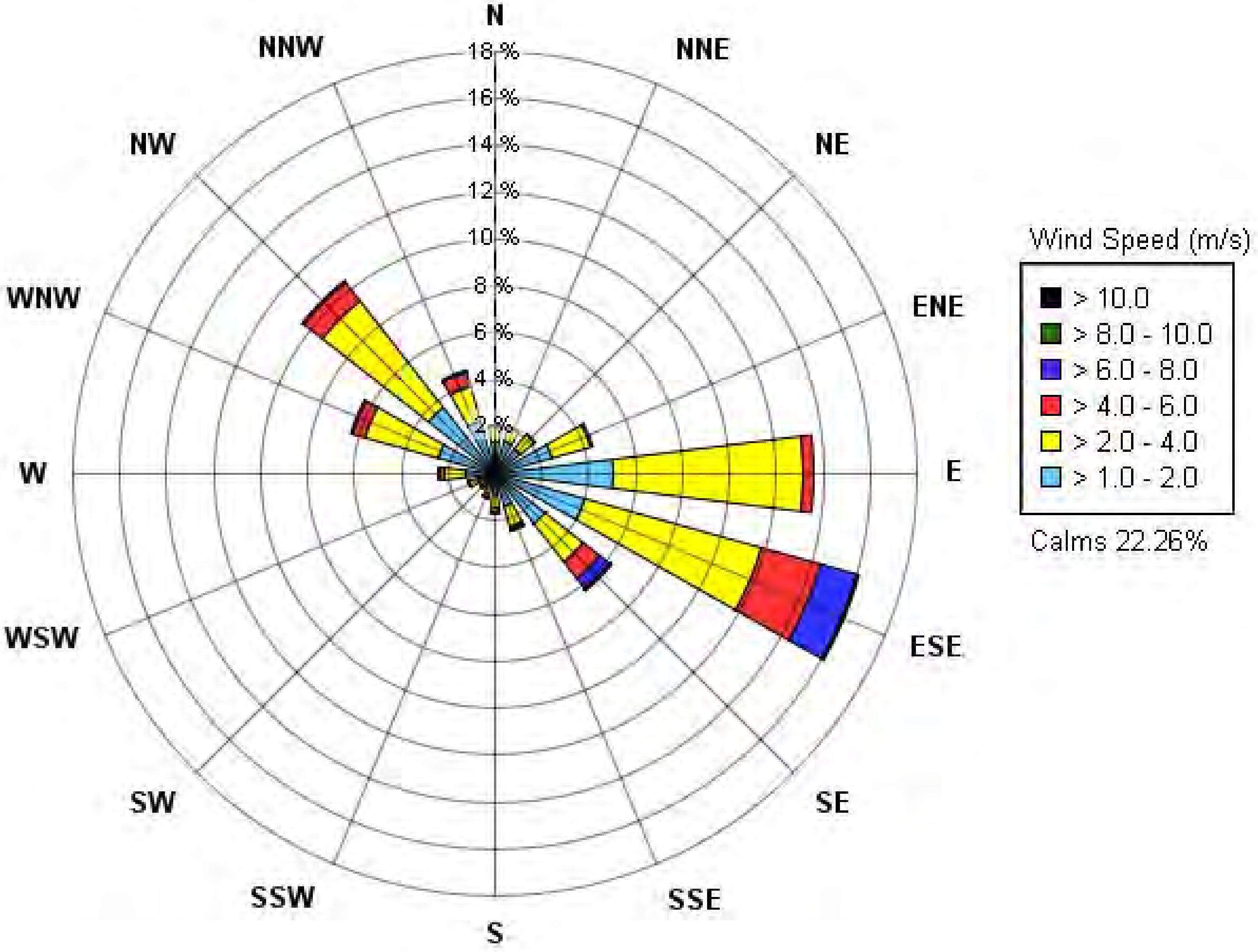
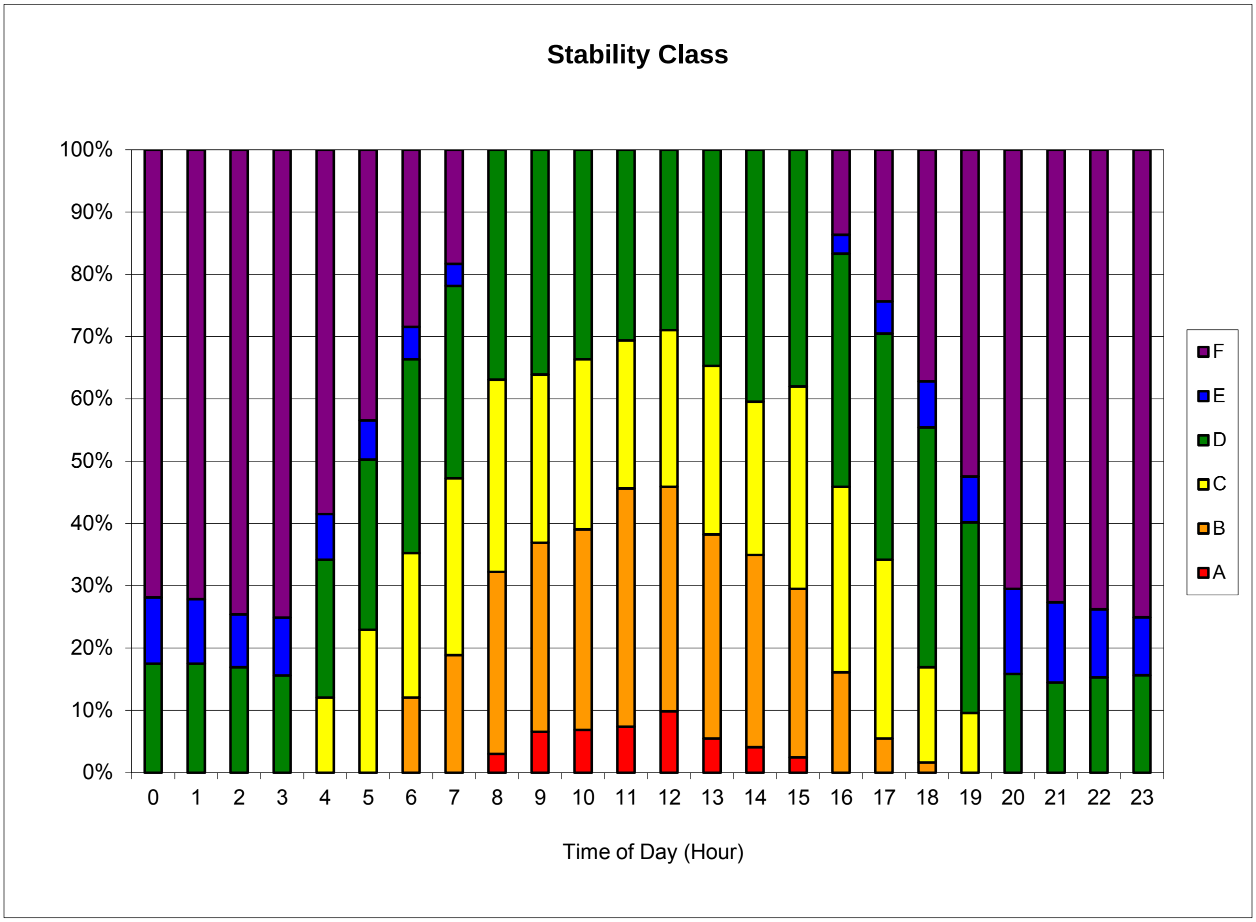
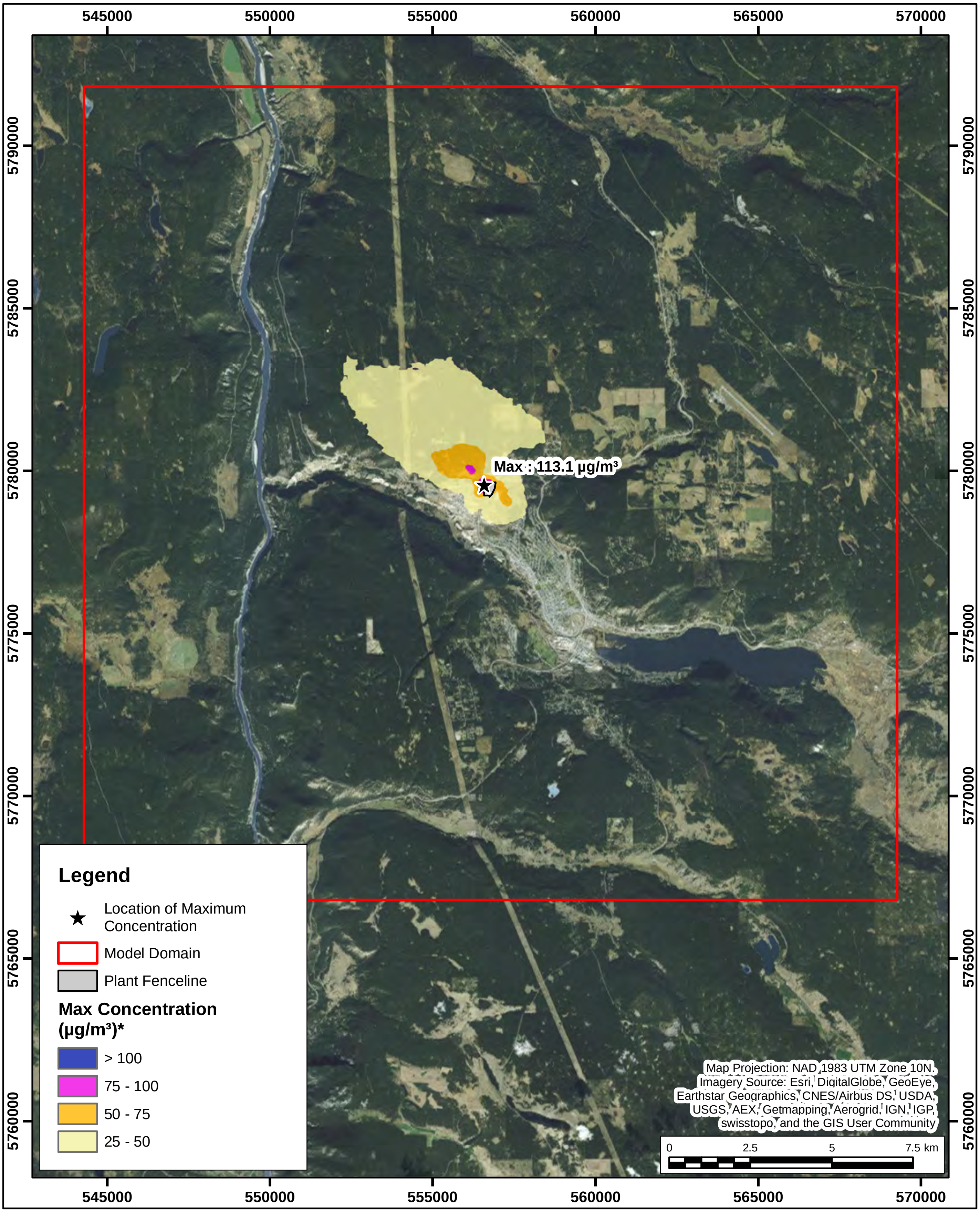


Figure 5:

PG CALMET Predicted Stability Class by Time of Day at WLPP for 2012 Model Year





Predicted Ninety-Ninth Percentile Peak Daily 1-Hour Maximum SO_2 Including Ambient Background Value for 50% Rail Ties

*1-hr SO_2 Interim Provincial Air Quality Objective = 200 µg/m³ (BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

True North

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Figure: 6

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Date Revised: June 30, 2015

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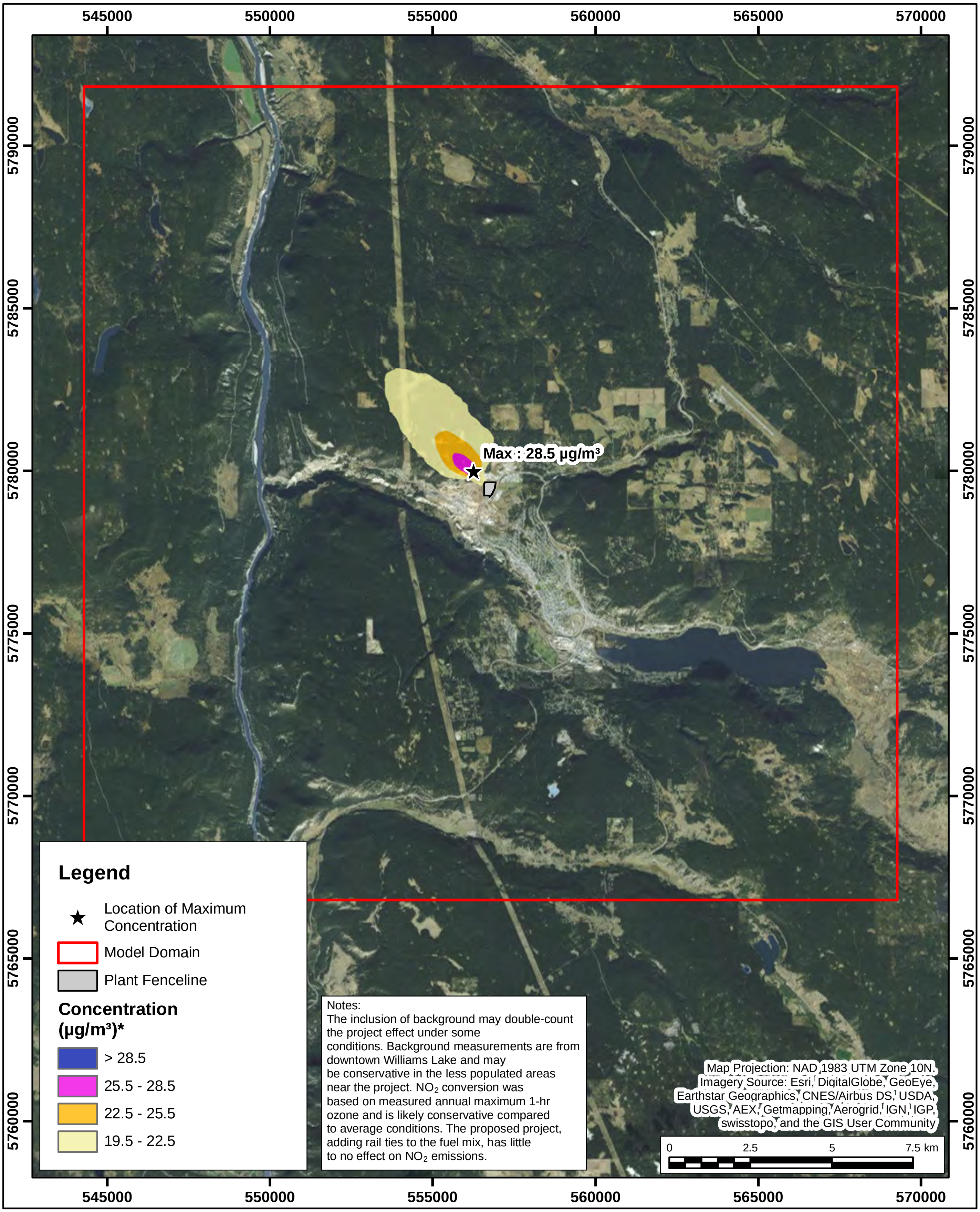


Notes:
The inclusion of background may double-count the project effect under some conditions. Background measurements are from downtown Williams Lake and may be conservative in the less populated areas near the project. NO_2 conversion was based on measured annual maximum 1-hr ozone and is likely conservative compared to average conditions. The proposed project, adding rail ties to the fuel mix, has little to no effect on NO_2 emissions.

Map Projection: NAD 1983 UTM Zone 10N.
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Predicted Annual Average NO_2 Concentrations Including Ambient Background Value for 100% Rail Ties or Base Fuel

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³ (BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

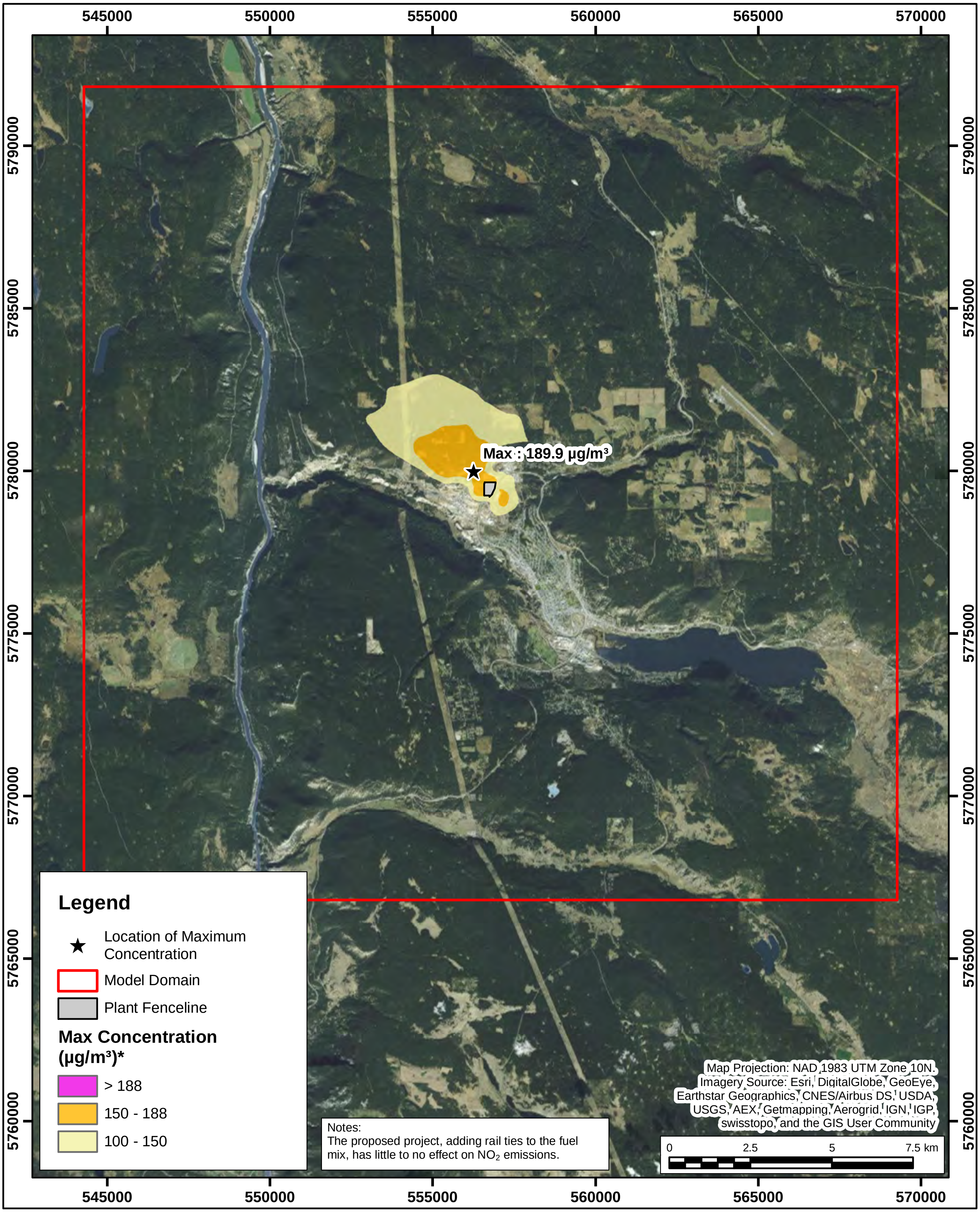
Drawn by: NBN

Figure: 7

Approx. Scale: 1:160,000

Date Revised: Sept. 4, 2015

RWDI



Map Projection: NAD 1983 UTM Zone 10N.
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Notes:
The proposed project, adding rail ties to the fuel mix, has little to no effect on NO_2 emissions.

Predicted Ninety-Eighth Percentile Peak Daily 1-Hour Maximum NO_2
Without Ambient Background Value for 100% Rail Ties or Base Fuel

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³
(BC MOE 2014)

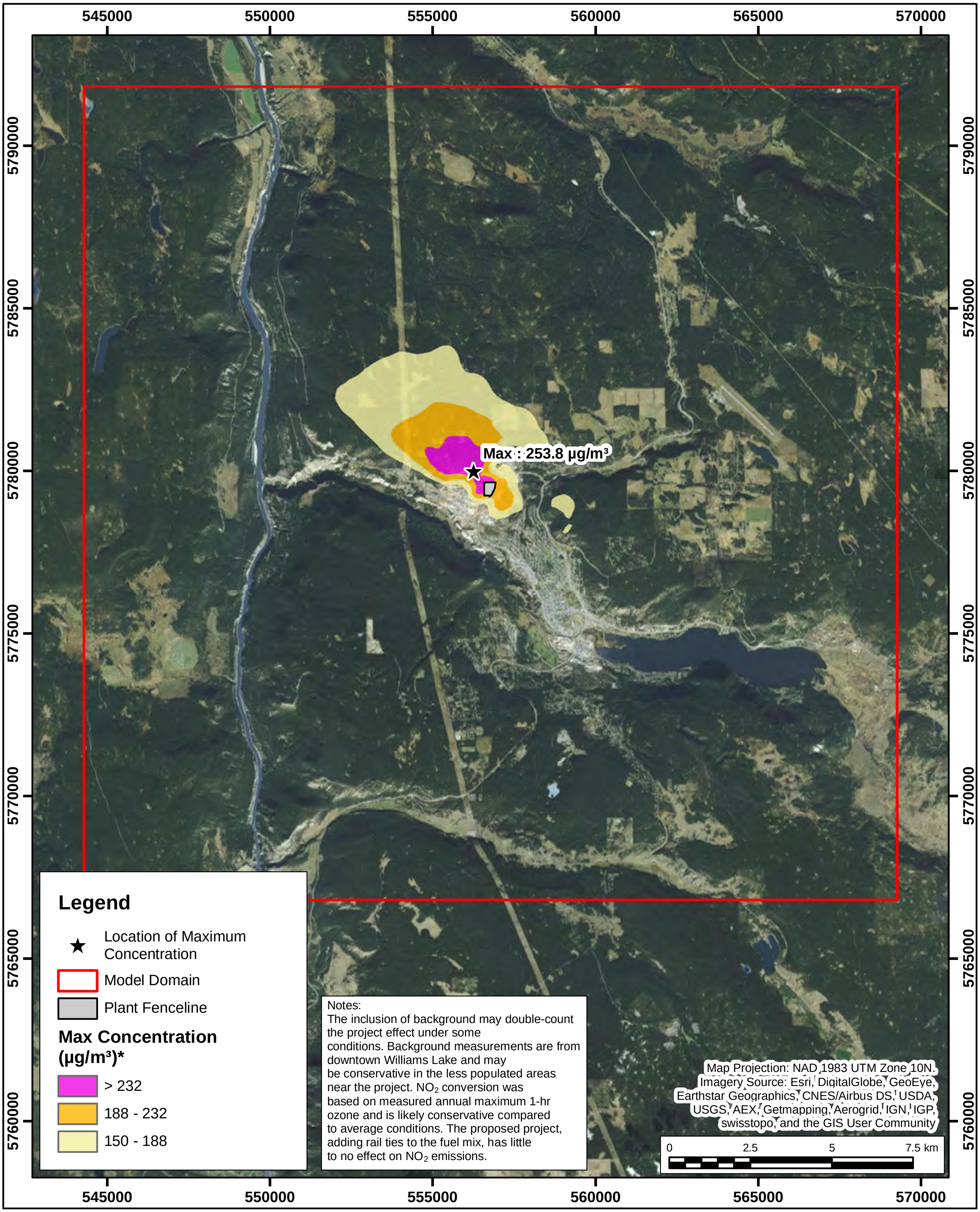
Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by: NBN	Figure: 8
Approx. Scale:	1:160,000
Date Revised:	Sept. 4, 2015

RWDI



Legend

★ Location of Maximum Concentration

🟥 Model Domain

▨ Plant Fenceline

Max Concentration ($\mu g/m^3$)*

🟪 > 232

🟧 188 - 232

🟨 150 - 188

Notes:
The inclusion of background may double-count the project effect under some conditions. Background measurements are from downtown Williams Lake and may be conservative in the less populated areas near the project. NO_2 conversion was based on measured annual maximum 1-hr ozone and is likely conservative compared to average conditions. The proposed project, adding rail ties to the fuel mix, has little to no effect on NO_2 emissions.

Map Projection: NAD 1983 UTM Zone 10N.
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Predicted Ninety-Eighth Percentile Peak Daily 1-Hour Maximum NO_2
Including Ambient Background Value for 100% Rail Ties or Base Fuel

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 $\mu g/m^3$
(BC MOE 2014)

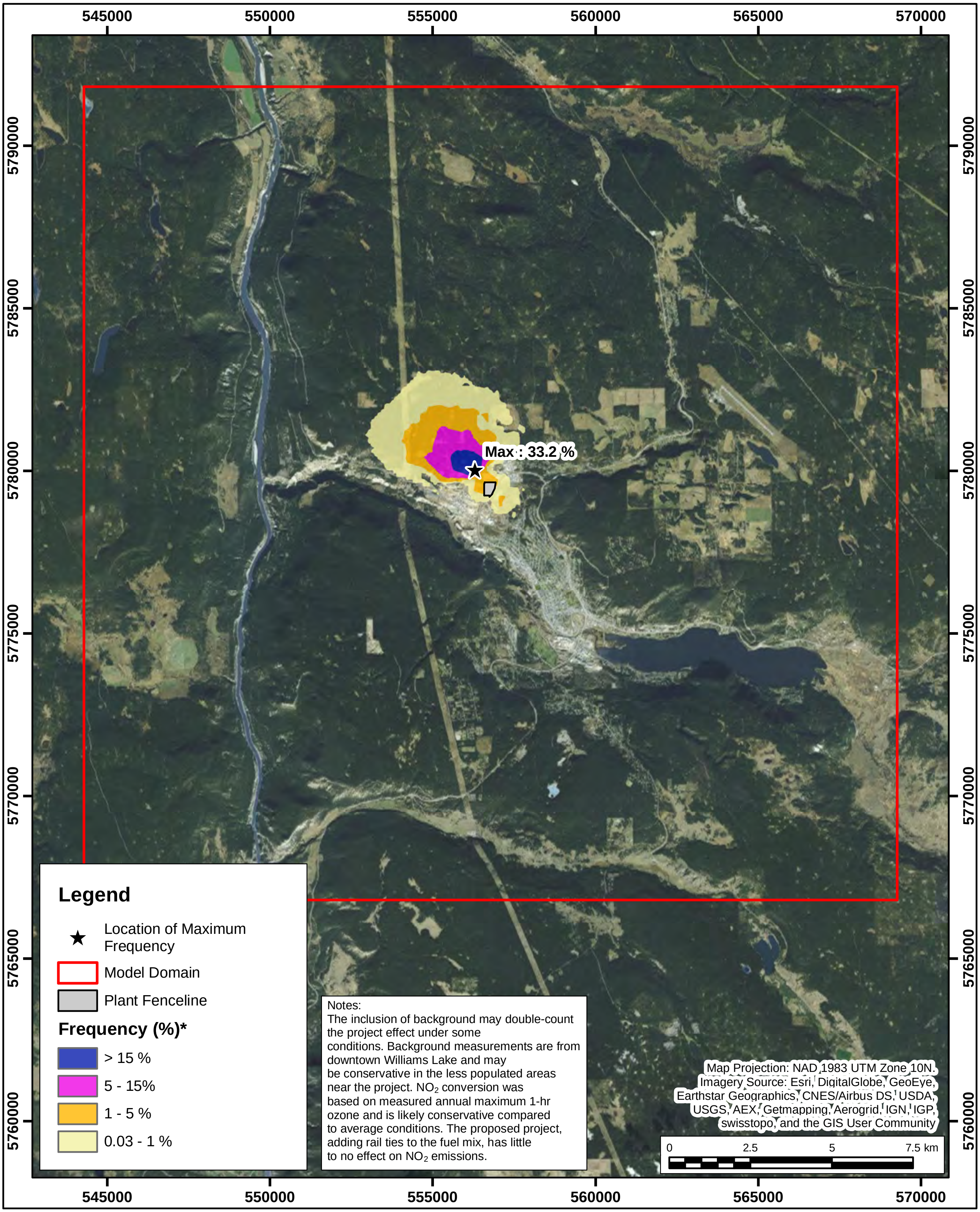
Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by: NBN	Figure: 9
Approx. Scale:	1:160,000
Date Revised:	Sept. 4, 2015

RWDI



Notes:
The inclusion of background may double-count the project effect under some conditions. Background measurements are from downtown Williams Lake and may be conservative in the less populated areas near the project. NO_2 conversion was based on measured annual maximum 1-hr ozone and is likely conservative compared to average conditions. The proposed project, adding rail ties to the fuel mix, has little to no effect on NO_2 emissions.

Map Projection: NAD 1983 UTM Zone 10N.
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Predicted Frequency of Exceedance of 1-Hour NO_2 Objective Including Ambient Background Value

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³ (BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by: NBN	Figure:	10
Approx. Scale:		1:160,000
Date Revised:		Sept. 4, 2015

RWDI

APPENDIX A

TRANSCANADA POWER

EMISSION SURVEY REPORT

Regular Wood Waste and Railtie Wood Waste

(April 2001 Survey)
Final Report

Prepared for

TRANSCANADA POWER

Calgary, Alberta

Prepared by

A. LANFRANCO AND ASSOCIATES INC.

Langley, B. C.

November 2001

CERTIFICATION

The field monitoring conducted for this survey was conducted by certified stack test technicians as required by the B.C. MELP stack testing code. The field crew consisted of:

Mr. M. Holm (certified), Mr. D. Doucette (certified) and Mr. J. Mushtuk (certified).

The report was prepared by Mr. Holm and Mr. Mushtuk using reporting principles and guidelines generally required and accepted by MELP. Mr. A. Lanfranco performed a review of the report for content and format.

The field crew and A. Lanfranco and Associates Inc. certify that the test methods used were EPA or MELP reference methods for the parameters investigated.

Michael Holm Mike Holm

Darren Doucette Darren

Report reviewed by:

A. Lanfranco Lanfranco

A. Lanfranco and Associates Inc.
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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

SUMMARY OF RESULTS

The following table presents the duplicate baseline test and the triplicate railtie test average results for the Williams Lake power plant stack for emission tests conducted on April 3 to 6, 2001.

Parameter		Baseline Results (@ 11% O_2)	Railtie Results (@ 11% O_2)	Provincial Requirements
Particulate	(mg/Sm^3)	6.2	2.3	20 @ 11% O_2
	(Kg/hr)	3.4	1.1	n/a
Trace Metals				
	Class I ug/Sm^3 (sum)	0.050	0.040	3.6 for each metal @ 11% O_2
	Class II ug/Sm^3 (sum)	0.0028	0.0023	0.7 for each metal @ 11% O_2
	Class III ug/Sm^3 (sum)	0.0026	0.0011	0.15 for each metal @ 11% O_2
PCDD & PDCF TEQ (ng/Sm^3)		0.0013	0.0034	0.1 to 0.5*
PAH (ug/Sm^3)		0.063	0.058	5*
Chlorophenols (ug/Sm^3)		0.010	0.091	1*
Sulphur Oxides as SO_2 (mg/Sm^3)		1.0	172	180
Hydrogen Chloride (mg/Sm^3)		< 0.1	59.8	50
Flow rate (Sm^3/min.)		5870	5710	6000 Prov. Permit for power plant
Oxygen (Vol. %)		6.0	8.2	n/a

	Baseline Results (@ 7% O_2)	Railtie Results (@ 7% O_2)	Permit Limit (@7% O_2)
Particulate (mg/Sm^3)	8.6	3.2	51

All above results are expressed at standard conditions of 25°C and 101.3 kPa (dry).

Results expressed at 11% O_2 are a requirement of the BC MOE Special Waste Regulations, while the Williams Lake power plant's air pollution permit is expressed at 7% O_2.

* typical or proposed Emission Criteria for Municipal Solid Waste Incinerators. These limits are not enforceable by the provincial government at present.

1.0 INTRODUCTION

TransCanada Power of Calgary, Alberta has retained A. Lanfranco and Associates Inc. of Langley, B.C. to conduct an emission survey at TransCanada's power plant facility located in Williams Lake, B.C.

The purpose of the emission survey is to document and report the concentrations of specific air pollutants and other operating parameters and emission characteristics from the main stack associated with the combustion of normal woodwaste (baseline tests) and during the combustion of 100% railties.

The pollutants under investigation were: Particulate Matter, Trace Metals, Hydrogen Chloride, Sulphur Oxides, polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDD/PCDF), polyaromatic hydrocarbons, and Chlorophenols.

The monitoring was a requirement of B.C. Ministry of Water, Air and Land Protection. A representative of MWLAP was on-site during most of the test program.

This report documents the methods used and results determined for stack samples from the co-generation stack collected on April 3 to 6, 2001. This sampling program also complies with TransCanada Power's stack monitoring requirement for the first half of 2001 in regards to their air pollution permit No. PA-8808.

2.0 PROCESS DESCRIPTION

The TransCanada Power cogeneration facility operates a Babcock and Wilcox woodwaste fired boiler to produce electricity from steam generation and turbine operation. Some of the energy produced by the system is used to operate the plant while the excess is sold commercially. Maximum gross energy output is about 75 MW.

Fluegases generated by the woodwaste combustion unit are cleaned primarily by multiclones and secondarily by an Environmental Elements Corporation (five field) electrostatic precipitator (ESP) prior to discharge to the atmosphere via a 3.45 meter diameter smokestack.

Baseline tests were conducted with standard woodwaste while the railtie tests were conducted with chipped railties supplied by CN Rail.

3.0 METHODOLOGY

The sampling and analytical methods used throughout this survey conform to the procedures outlined in the B.C. "Source Testing Code for Measurement of Particulates from Stationary Sources", the B.C. Air Analytical Manual, and the US EPA Code of Federal Regulations (CFR) 40, Part 60. Specifically, the methods used were:

Parameter	Reference Method
Sample and velocity traverse points	EPA Method 1
Velocity and flowrate	EPA Method 2
Gas molecular weight (O_2/CO_2)	EPA Method 3
Fluegas Moisture	EPA Method 4
Particulate Matter, Trace Metals	EPA Method 5/EPA Method 29
Dioxin/furan	EPS 1/RM/2
HCl	EPS 1/RM/1
SOx	EPA Method 6

3.1 Preparation Techniques

The preparation, cleaning, and proofing of the sampling equipment and materials is an integral part of the quality assurance/quality control (QA/QC) component of each stack survey. Following are details of the cleaning and proofing of relevant sample train components.

Organic Train Glassware

1. Washed twice with industrial strength cleaner/detergent
2. Rinsed with generous amounts of deionized H_2O
3. Rinsed three times with methylene chloride
4. Rinsed three times with hexane
5. Rinsed three times with acetone
6. Oven baked at 300°C overnight
7. Rinsed three times with hexane (saved for proofing)
8. Rinsed three times with acetone (saved for proofing)

Amberlite XAD-2

1. Rinsed and extracted with deionized H_2O
2. Soxhlet extraction with methanol, methylene chloride and toluene (22 hrs each)

3. Nitrogen purge
4. Oven dried @ 50°C
5. Approx. 40 gram aliquot saved for proofing
6. Individual sample traps packed and spiked with surrogate regime

Organic filters

1. Soxhlet extraction (16 hrs) with toluene
2. Nitrogen drying
3. Save 1 filter for proofing

Metal Train Glassware

1. Hot detergent wash with brushing
2. Rinse with 0.1 N HNO_3
3. Copious rinsing with deionized H_2O
4. Oven drying at 105°C

Metal Train Filters

1. Overnight extraction with 1:1 nitric acid
2. Overnight rinsing with deionized H_2O
3. Drying for 2 hrs @ 105°C, desiccation and weighing
4. Save 1 filter for blank

Other Glassware

1. Hot detergent wash with brushing
2. Copious deionized H_2O rinses

3.2 Sampling Techniques

Following are brief descriptions of the reference method sampling techniques utilized to collect the various samples. The techniques employed for isokinetic sampling of particulate/metals and dioxin/furan from this source were consistent and complied with the previously referenced stack testing methods.

EPA Method 1 - Sampling Site and Traverse Points

The stack sampling location for the co-generation stack was located > 7 diameters downstream and > 2 diameters upstream of the nearest flow disturbances. From this criteria, a measured stack diameter of 138 inches, and Figure 1-1 of EPA Method 1, a 12 point sampling regime, where 3 points along 4 - 90° traverses were sampled for each isokinetic stack test.

EPA Method 2 - Stack Gas Velocity and Volumetric Flowrate

At each traverse point a series of measurements including stack temperature, velocity pressure, static pressure, and sampling rate were recorded. Velocity and static pressures were measured with a calibrated S-type pitot tube mounted alongside the sample probe. Stack temperatures were measured with a calibrated K-type chromel-alumel thermocouple with a control console mounted digital readout. Cyclonic flow angles were measured using the null velocity technique.

EPA Method 3 - Molecular Weight by Gas Analysis

Stack gas molecular weight was determined by use of Fyrite analyzers for corrections of pollutant concentrations to 11% O_2 for special waste and corrected to 7% O_2 for compliance . (see specifications later in this section)

EPA Method 4 - Moisture Content

Stack gas moisture content was determined from the measured condensed water vapour which was collected in the impinger (cold box) section of the sampling trains, and the gas volume sampled corrected to standard conditions of 25°C and 101.3 KPa (dry).

The contaminants investigated during this survey were collected with four independent sampling trains as follows:

EPS Method 1/RM/2 - Dioxin/Furan

This sample train was assembled and leak checked at the laboratory the night prior to testing. Prior to sampling initiation, the stack train was assembled as shown in Figure 1 and leak checked to code specifications. The probe (quartz lined) and filter module were heated to 120 +/- 15°C and crushed ice was placed around the impingers. Iced water was circulated in the condenser and in a cooling jacket around the XAD cartridge. Once the sampling system achieved the appropriate temperatures the probe tip was positioned at point No.1, isokinetic sampling was performed using the Ko orifice constant sampling procedure. A set of recordings was taken every five minutes until 3 or 4 sets of readings for each sample point of traverse one was achieved. The sample pump was shut off and the sample module with attached probe was withdrawn from the stack. The system was repositioned at point No. 1 of the next traverse and an additional 45 to 60 minutes of sampling commenced. This regime was continued until all sample ports had been sampled. The total sample volume for each PCDD/PCDF test was about 3.5 to 4.0 m^3, with the exception of Railtie Test 3 at 2.8 m^3.

At the conclusion of the final traverse sampling the train was final leak checked and the probe was disassembled from the hot box/sample module.

Any open ends of the sampling module and probe assembly were immediately sealed with pre-cleaned aluminium foil or teflon tape, and leak checks were conducted with only teflon tape touching the open ends.

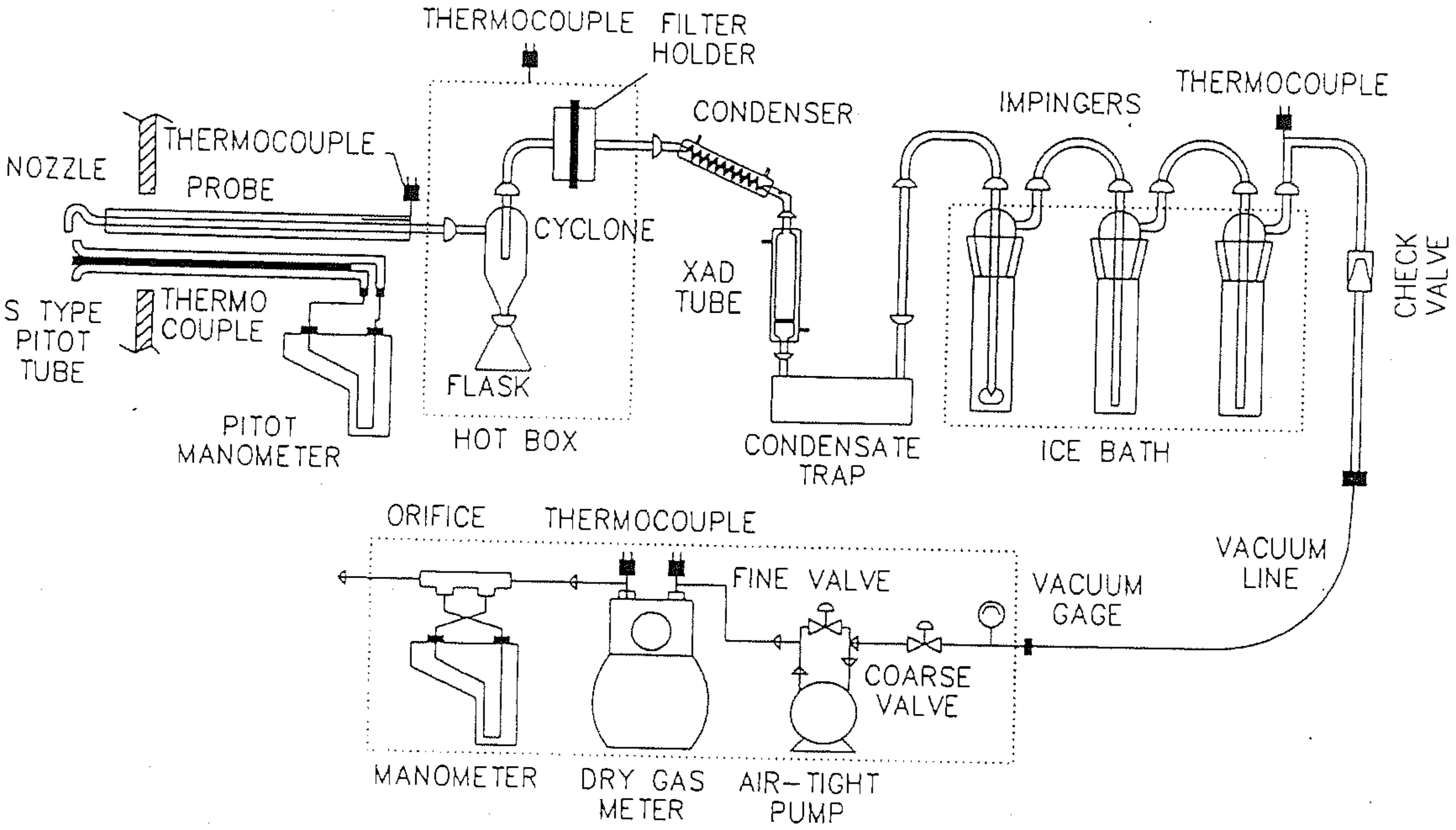


FIGURE I SEMI-VOLATILE ORGANICS SAMPLING TRAIN

At the conclusion of each test the sample module and probe were lowered from the stack location and were in transport to the laboratory without delay. Approximately one hour elapsed from sample conclusion to sample delivery at the sample recovery "laboratory".

EPA Method 5/29 - Particulate, Trace Metals

This train was a normal Method 29 train (Fig. 6) except special (low metal) microquartz glass filters were utilized and the impinger components were:

Incinerator Stack Impingers
100 ml 5% HNO_3 in 10% H_2O_2
100 ml 5% HNO_3 in 10% H_2O_2
100 ml 4% $KMnO_4$ in 10% H_2SO_4
100 ml 4% $KMnO_4$ in 10% H_2SO_4
100 ml distilled H_2O
200 g silica gel

The train was operated isokinetically, sampling a total of 12 points on 4 - 90° traverses for 5 minutes each, resulting in final sample volumes of about 1.3 dscm. Data recordings were conducted at 5 minute intervals. The train utilized a five foot quartz probe and nozzle.

EPS Method 1/RM/1 - HCl

This sample train was equipped with a heated glass probe to prevent condensation and a glass wool particulate removal plug. The impingers in Method 26 were modified to larger volumes for complete gas/liquid contact, and the sample rate was modified to about 10 l/min as allowed by implication in EPS Method 1/RM/1, where non-isokinetic sampling is allowed at rates greater than 10 l/min in large impingers. Each of the first two impingers contained 2 - 100 ml portions of dionized water. An empty impinger and a silica gel impinger completed the collection train.

Samples were collected with dry gas sample volumes measured with a calibrated dry gas litre meter.

EPA Method 6 - SO_x

This train was equipped with a heated glass probe, a glass wool particulate removal plug, and an impinger section with 2 - 100 ml 3% H_2O_2 impingers. Samples were collected for one hour at about 9 l/min. Particulate was removed with glass wool at the probe tip, and gas sample volumes were measured with a calibrated dry gas meter.

3.3 Analytical and Sample Recovery Techniques

Following sampling for PCDD/PCDF, the sample train was sealed and transported to the field laboratory for sample recovery. At the laboratory the sample train was disassembled and six components were identified for each train (Fig. 2). The recovery of each sample is described below:

1. Sample Filter: The exposed sample filter was removed from its holder with clean tweezers, placed on a sheet of aluminium foil, folded inside the foil and sealed in a glass petri dish. This was labelled component 1 of each test.

2. Front/Back Half Washings: This included a thorough acetone/methylene chloride rinsing and brushing of the sample nozzle, probe liner, and connecting glassware prior to the filter. These washings were collected in a pre-cleaned one litre amber sample bottle with a teflon lined lid. This was labelled component 2 of each test. The back half of the filter holder and glassware connecting the filter holder to the condenser were rinsed and soaked with acetone and methylene chloride with the solvents added to the component 2 sample bottle.

3. Amberlite XAD-2 Resin Trap: The resin trap was sealed with teflon tape, covered with aluminium foil and placed kept at about 4 °C prior to shipment to the analytical laboratory. This was labelled component 3 of each test.

4. Impinger Condensate: The condensate contained in the condensate trap, plus water and condensate from the impingers was measured for volume and discarded.

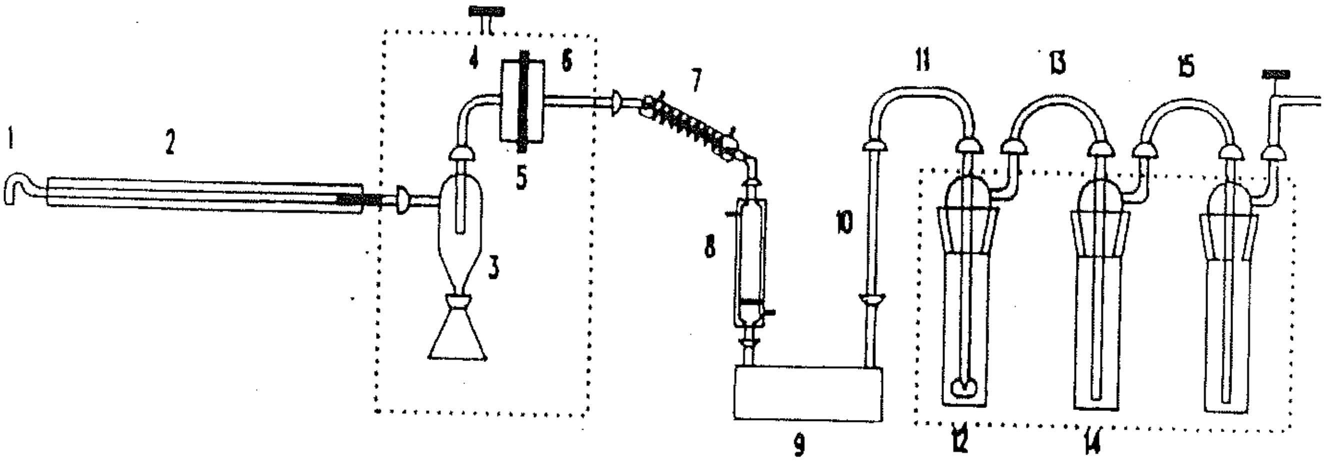
5. Final Rinse: All components of the sample train from the nozzle to the XAD were rinsed and/or soaked three times with toluene into an amber bottle (teflon lid) which was labelled component of each test.

All samples were labelled appropriately and placed in a cold room at 4°C until analysis was initiated. Each bottle containing solvent was marked with the liquid level and the lid was sealed with triplicate wraps of teflon tape.

3.3.1 Organic Sample Analysis

The organic analysis of the sample train components involved an extremely complex series of procedures as detailed in the analytical manuals.

Following is a description, in very simplified terms, of the basic procedures used to process the sample train components (see Fig. 3 and 4).



Container or Sample	Component(s)	Recovery Procedure
1	1, 2, 3, 4	Wash and brush 3 times each with hexane (H) and acetone (A). Rinse 3 times each with H and A.
2	5	Remove carefully from holder. Place on pre-cleaned foil. Fold in half. Place in pre-cleaned glass petri dish.
3	6, 7	Soak 5 minutes each with H and A. Rinse 3 times each with H and A.
4	8	Cap ends and wrap in foil.
5	9, 12	Empty contents into container and rinse each 3 times with HPLC water.
6	6 to 15 except 8	Rinse 3 times each with H and A.

Mark liquid levels on all bottles.
All sample containers are pre-cleaned amber glass bottles with pre-cleaned Teflon lid liners.

FIGURE 2 SEMI-VOLATILE ORGANICS RECOVERY PROCEDURES

FIGURE 3. EXTRACTION SCHEMATIC FOR FRONT HALF TRAIN AND PROCESS SAMPLES.

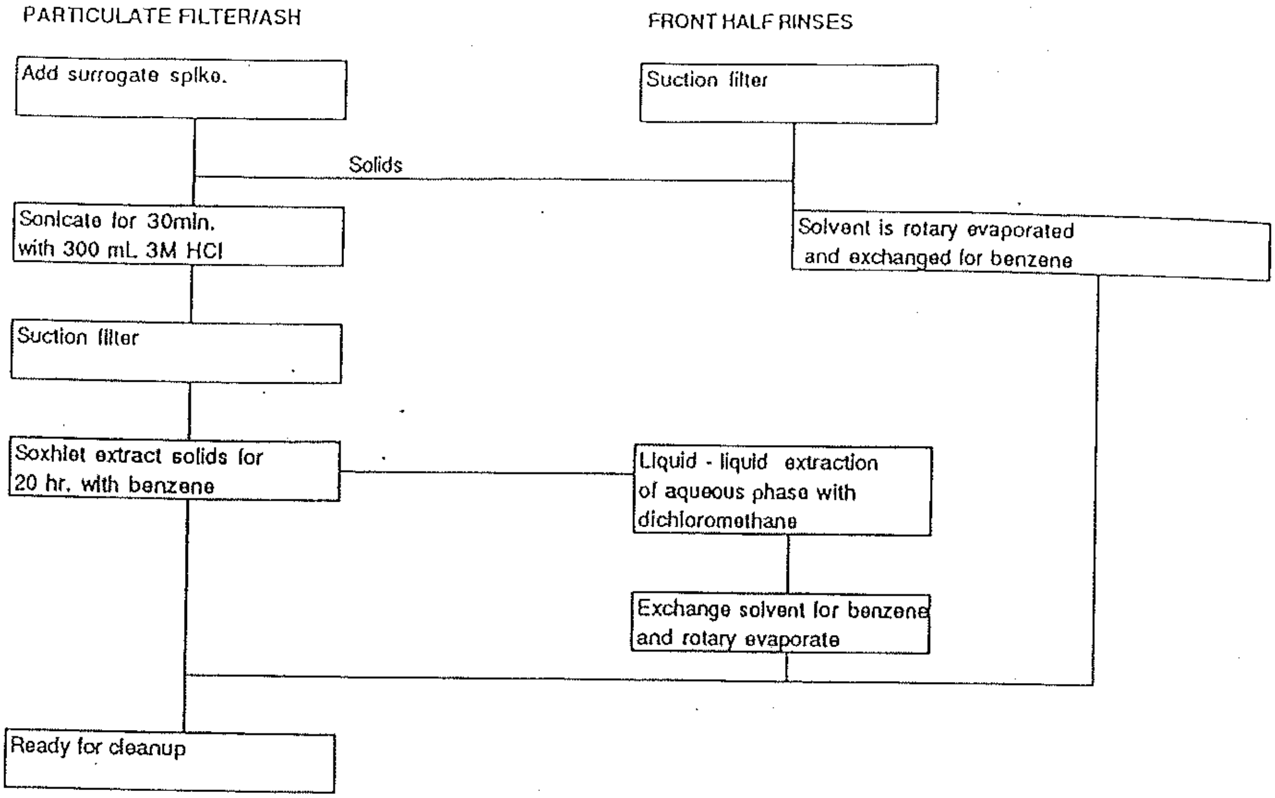
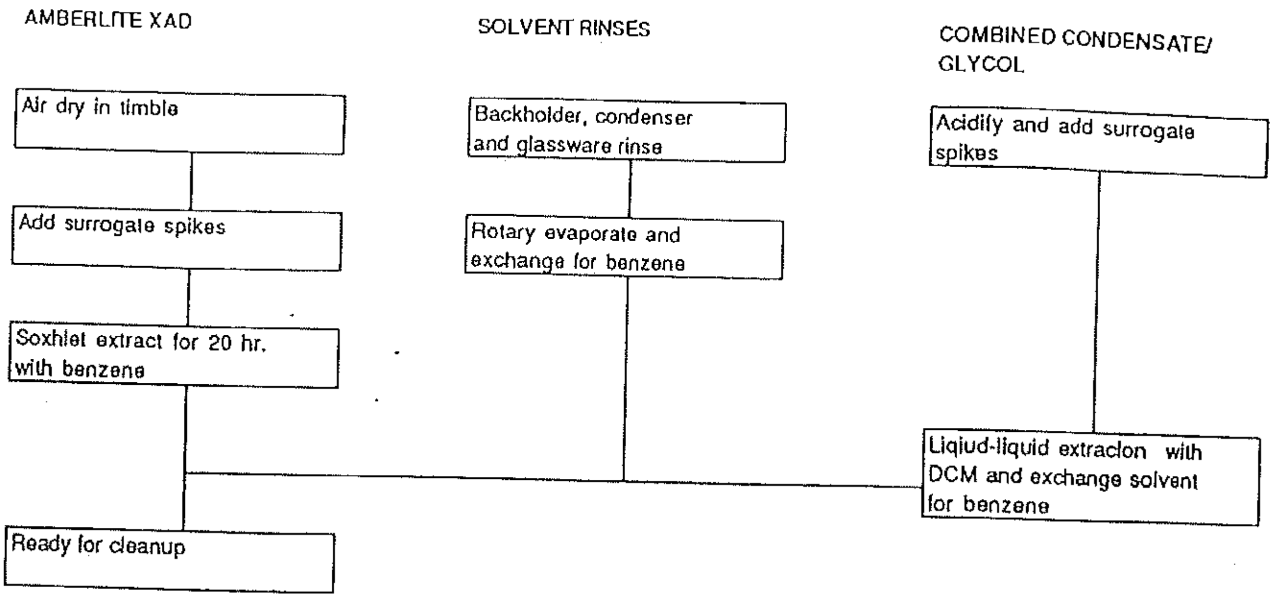


FIGURE 4. EXTRACTION SCHEMATIC FOR BACK HALF TRAIN SAMPLES



Initially the sample components are separated into liquid (containers 2) or solid phases (containers 1 and 3). Solid samples are extracted with various solvents (usually toluene), sometimes under acid conditions. The liquid sample (container 2) is concentrated with a rotary evaporator, with the final concentrate added to the filter and XAD components. At this point, an internal standard solution is added to the sample for QA/QC recovery determinations. This combined sample is Soxhlet extracted with toluene for at least 16 hours, and then concentrated to 5 to 10 ml.

The toluene rinse has internal standards added, with subsequent concentration by rotary evaporation.

The extract volumes are fractionated, cleaned-up analytical
instrumentation (Fig. 5).

3.3.2 Particulate/Trace Metals, Sample Re

The particulate sample filters were removed from th ezers, with
material retained on the gasket recovered with a nylo folded and
placed in an identified plastic petri dish labelled Conta

Sample clean-up of the probe and front half glassw ducted with
sequential rinses and brushings with acetone collecte llowing the
acetone rinse the probe and glassware were rinsed wit

— Where 100ml of
PAR 5 – acetone was used

PAR 6 - The Contents of Impingers
1 and 2 were measured
for volume and transferred
to a Polyethylene sample
Container.

Impingers 1 and 2 were measured for volume and transferred with 100 ml 0.1 N HNO_3 to a polyethylene sample container. Impingers 3, 4, and 5 were transferred to another polyethylene container using 100 ml potassium permanganate and water rinses. HCl rinses of the permanganate impingers were not conducted as visible deposits were effectively removed by the earlier rinsings.

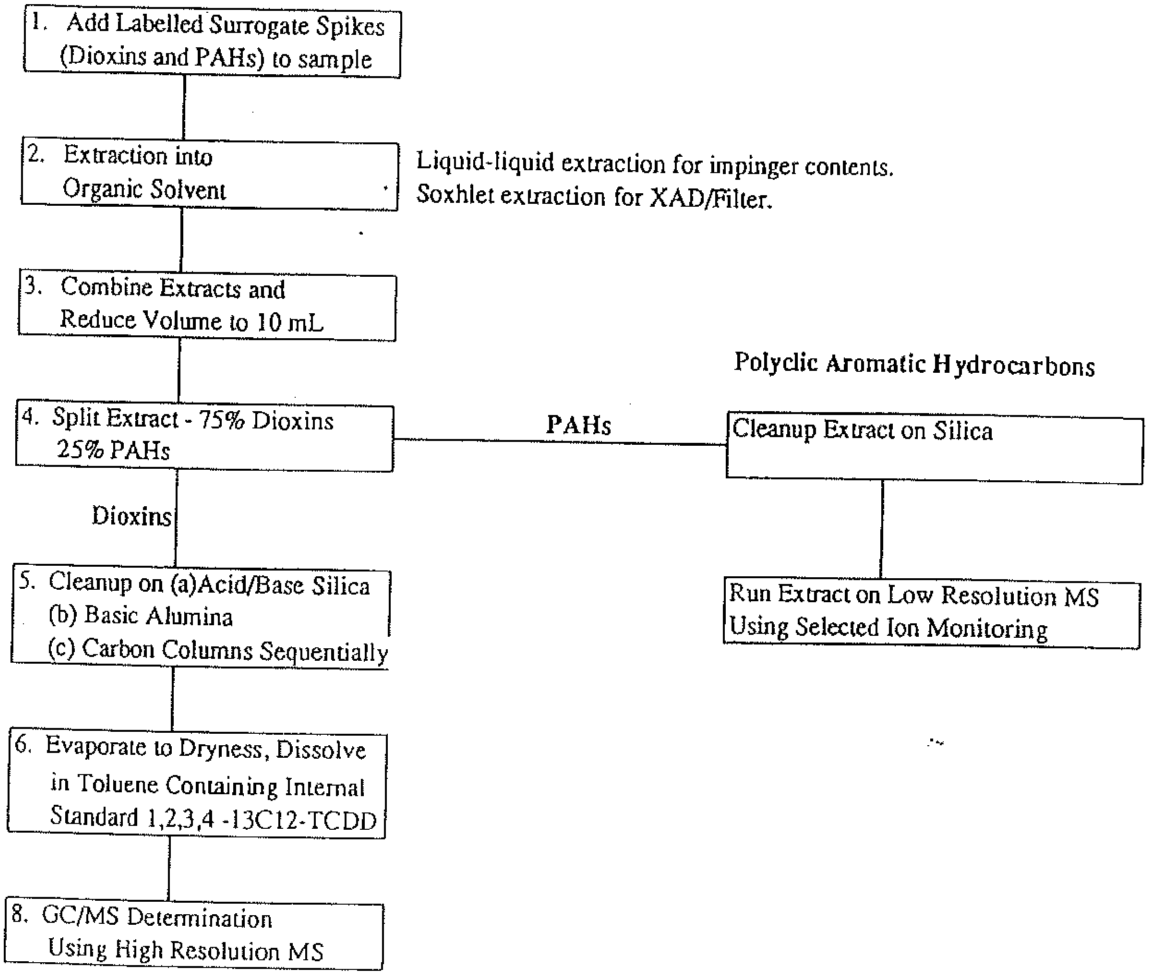
Silica gel from the final impinger was transferred to its original container for final weighing.

Blank filters and solutions for each component of the particulate metals test were collected and labelled appropriately.

Gravimetric Analysis

At A. Lanfranco and Associates Langley, B.C. laboratory, the sample filters were desiccated to constant weight and weighed as per EPA Method 5. Probe and front-half acetone rinsings were evaporated at ambient temperature in tared, precleaned 250 ml glass beakers, with subsequent weighing to constant weight. Blank filters and acetone were carried through the gravimetric process.

Figure 5. Schematic of Analytical Methodology for Chlorinated Dibenzo(p)Dioxins and Dibenzofurans/ Polycylic Aromatic Hydrocarbons in MM5 Trains



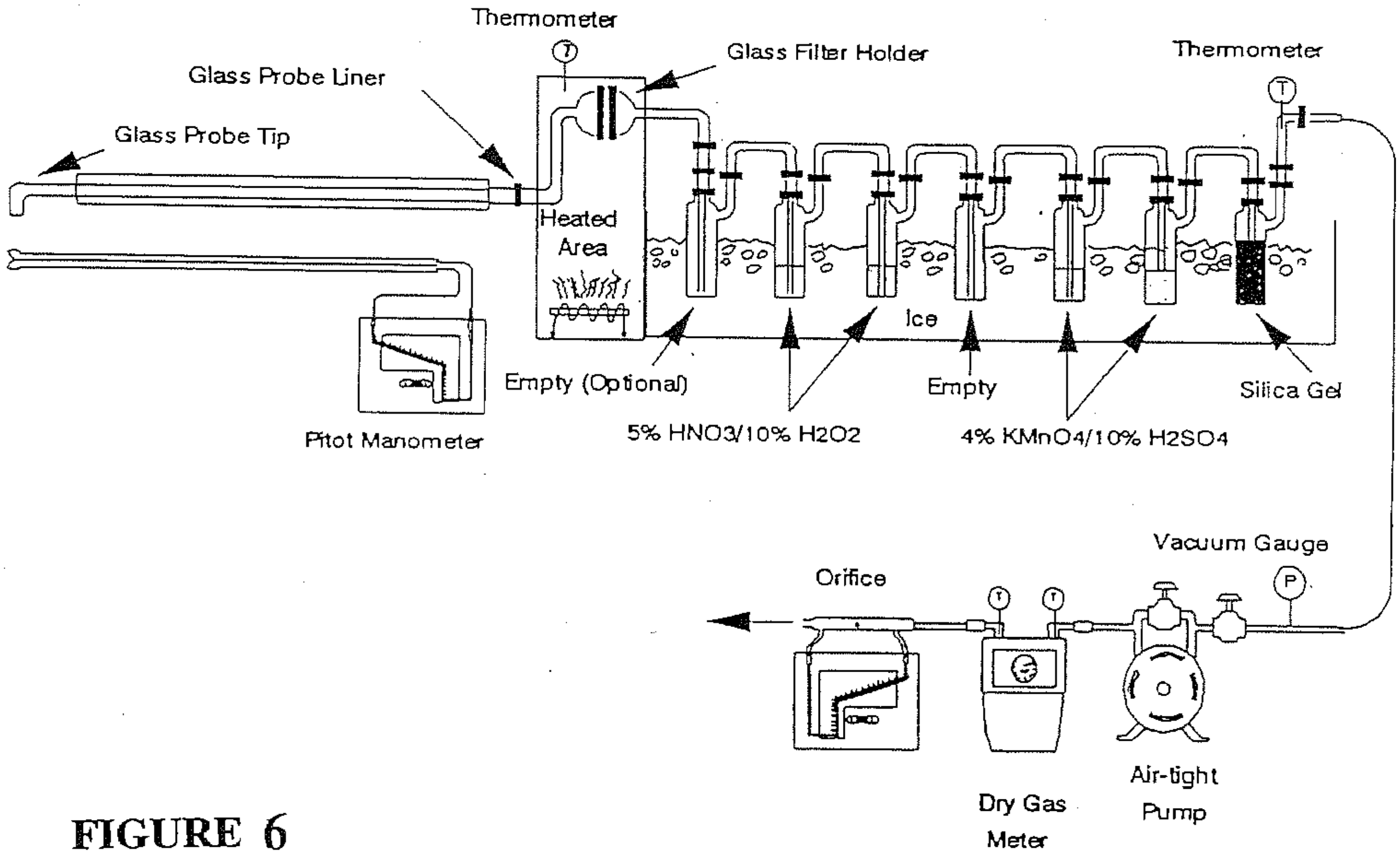


FIGURE 6

Multiple Metals Sampling Train

Trace Metals Analysis

Following the gravimetric analysis, the filters and wash residues, along with the back half liquid samples were forwarded to Norwest Laboratories in Langley, B.C. for analysis of Trace Metals. The samples and appropriate blanks were digested with acids and analyzed for heavy metals by ICAP procedures. Impingers 3, 4 and 5, for Hg, were analyzed at Norwest using flameless atomic absorption.

3.3.3 HCl/SO_x Recovery/Analysis

Sample solutions from the impingers of the HCl and SO_x trains were transferred to polyethylene sample bottles with distilled water rinses. The liquid levels were marked and the lids sealed for transportation.

Chloride analysis of the HCl samples were conducted at Norwest laboratories using ion chromatography techniques as detailed in EPA Method 26. A. Lanfranco and Associates Inc. conducted the SO_x analysis using the barium thorin titration procedure.

Reference materials, blanks and spiked blanks were analyzed to validate all laboratory analyses.

3.4 Quality Assurance / Quality Control (QA/QC) Techniques

The QA/QC component of this survey was designed to exceed the requirements normally instituted by the regulatory agency. Prior to the survey, and in cooperation with US EPA, a series of EPA Audit samples were obtained. The audit samples available (from 1999) were procured for HCl and SO_2. The EPA audit sample designations are:

HCl - ERA CRM 9978
SOx - EPA C8003
Metals - QCP TMS 1

Additionally, QA/QC of this survey was accomplished by the following mechanisms.

1. Pre and Post test leak checks
2. Calibration of volume measuring and monitoring instrumentation
3. Proofing of organic glassware and supplies
4. Analysis of all blank solutions and materials
5. Spiking and recovery analysis of organic trains
6. Use of acid cleaned microquartz filters
7. Duplicate analysis of selected samples
8. Reference material analysis with samples
9. Labelling and record-keeping

4.0 RESULTS

Most of the stack testing results were calculated using a "STACK" computer program developed for EPA and Canadian requirements. Standard conditions used in the program are 77 °F and 29.92" Hg (dry basis)

Corrections to 11% O_2 were calculated by multiplying the determined stack concentrations by;

$$\frac{20.9-11.0}{20.9-\text{ measured } O_2}$$

Corrections to 7% O_2 were calculated by multiplying the determined stack concentrations by;

$$\frac{20.9-7.0}{20.9-\text{ measured } O_2}$$

Hydrogen chloride, Sulphur Oxides and trace metals determinations were conducted by EPA approved calculation techniques, from laboratory analytical data and standardized sample volumes.

Table 1 presents particulate and acid gas data for baseline/railtie tests. Tables 2 and 3 present trace metals data for baseline/railtie tests. Table 4 presents detailed dioxin/furan data, and Tables 5 and 5a independently present PAH and chlorophenol data for baseline and railtie tests. Table 6 presents the plant operated CEM data for some gases and load.

Tables 4 presents PCDD/PCDF data in terms of actual amounts detected and toxic equivalents. In addition, all dioxin/furan results were recovery corrected according to surrogate recovery efficiencies determined for each organic analysis. Surrogates added and the recoveries determined are listed in the analytical data presented in the Appendices.

Table 7 presents the gravimetric data for the particulate/metals tests and Table 8 presents fuel and ash summary analysis.

Table 1 Particulate / Acid Gas Emission Results

Parameter		Baseline		Rail Tie		
		Test 1	Test 2	Test 1	Test 2	Test 3
Test Date		April 3/01	April 4/01	April 4/01	April 5/01	April 6/01
Test Time		13:22-14:30	09:30-10:36	16:00-17:06	15:22-16:28	11:50-12:56
Duration		60	60	60	60	60
Particulate	(mg/Sm^3 @ 11% O_2)	8.5	3.8	6.1	0.5	0.2
	(mg/Sm^3 @ 7% O_2)	11.9	5.3	8.6	0.8	0.3
	(mg/Sm^3)	12.4	5.9	8.1	0.7	0.2
	(Kg/hr)	4.58	2.12	2.88	0.23	0.08
Hydrogen Chloride	(mg/Sm^3 @ 11% O_2)	< 0.1	< 0.1	51.1	75.8	52.4
	(mg/Sm^3)	< 0.1	< 0.1	69.1	93.4	81.5
Sulphur Oxides	(mg/Sm^3 @ 11% O_2)	0.9	1.0	157	203	156
	(mg/Sm^3)	1.4	1.6	213	250	243
Flowrate	(Sm^3/min)	6170	5990	5920	5790	5600
	(Am^3/min)	11660	11750	11210	11090	10860
Oxygen	(Vol. %)	6.5	5.4	7.8	9.0	7.8
Carbon Dioxide	(Vol. %)	14.3	15.3	12.8	12.0	13.0
Moisture	(Vol. %)	20.4	21.9	19.6	20.6	21.0
Temperature	(°C)	142	149	147	140	141
Isokineticity	(Average %)	103.3	105.2	99.8	100.9	104.5

Table 2 Baseline Trace Metals Emission Results

Metal	**Test 1** (mg/dscm) (@ 11% O2)	**Test 2** (mg/dscm) (@ 11% O2)
Class I		
Pb	0.0088	0.0067
Sb	< 0.0007	< 0.0007
Cu	0.0042	0.0028
Mn	0.015	0.0067
V	0.0001	0.000096
Zn	0.041	0.014
Sum of Class I	0.069	0.030
Class II		
As	< 0.0007	< 0.0007
Cr	0.0021	0.00034
Co	0.00010	0.000043
Ni	0.0011	0.00040
Se	0.0010	0.00048
Te	< 0.001	< 0.001
Sum of Class II	0.0043	0.0013
Class III		
Tl	0.0011	0.00039
Cd	0.00040	0.00020
Hg	0.0020	0.0013
Sum of Class III	0.0034	0.0018

Table 3 Railtie Trace Metals Emission Results

Metal	Test 1 Railtie (mg/dscm) (@ 11% O2)	Test 2 Railtie (mg/dscm) (@ 11% O2)	Test 3 Railtie (mg/dscm) (@ 11% O2)
Class I			
Pb	0.0098	0.0080	0.0028
Sb	< 0.0008	< 0.0008	< 0.0008
Cu	0.0036	0.0024	0.0042
Mn	0.019	0.0028	0.0016
V	0.00012	0.00014	0.000055
Zn	0.050	0.0072	0.0072
Sum of Class I	0.082	0.021	0.016
Class II			
As	0.0012	0.00068	< 0.0008
Cr	0.00073	0.00014	< 0.00004
Co	0.000061	0.000061	0.000043
Ni	0.0017	0.00090	0.0014
Se	< 0.0008	< 0.0008	< 0.0008
Te	< 0.002	< 0.002	< 0.002
Sum of Class II	0.0036	0.0018	0.0014
Class III			
Tl	0.0011	0.00030	0.00010
Cd	0.00051	0.000084	0.000088
Hg	0.00069	0.00025	0.00020
Sum of Class III	0.0024	0.00063	0.00039

TABLE 4 **Detailed PCDD/PCDF Emission Results**

		Test 1 (Baseline)		Test 1 (Railtie)		Test 2 (Railtie)		Test 3 (Railtie)	
Component	**TEF**	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)
2378 TCDD	1.0000	0.0042	0.0042	0.0038	0.0038	0.0054	0.0054	0.0000	0.0000
12378 PCDD	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
123478 HxCDD	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0004
123678 HxCDD	0.1000	0.0000	0.0000	0.0077	0.0008	0.0120	0.0012	0.0037	0.0004
123789 HxCDD	0.1000	0.0000	0.0000	0.0110	0.0011	0.0000	0.0000	0.0000	0.0000
1234678 HpCDD	0.0100	0.0000	0.0000	0.0460	0.0005	0.0560	0.0006	0.0270	0.0003
OCDD	0.0010	0.0310	0.0000	0.0710	0.0001	0.1300	0.0001	0.0000	0.0000
2378 TCDF	0.1000	0.0320	0.0032	0.0820	0.0082	0.0820	0.0082	0.0260	0.0026
12378 PCDF	0.0500	0.0000	0.0000	0.0150	0.0008	0.0180	0.0009	0.0067	0.0003
23478 PCDF	0.5000	0.0000	0.0000	0.0000	0.0000	0.0220	0.0110	0.0000	0.0000
123478 HxCDF	0.1000	0.0000	0.0000	0.0000	0.0000	0.0130	0.0013	0.0086	0.0009
123678 HxCDF	0.1000	0.0000	0.0000	0.0110	0.0011	0.0110	0.0011	0.0049	0.0005
234678 HxCDF	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
123789 HxCDF	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1234678 HpCDF	0.0100	0.0000	0.0000	0.0190	0.0002	0.0190	0.0002	0.0000	0.0000
1234789 HpCDF	0.0100	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OCDF	0.0010	0.0000	0.0000	0.0000	0.0000	0.0120	0.0000	0.0083	0.0000
Summed PCDD & PCDF TEQ (ng)			0.0074		0.0164		0.0300		0.0053
Sample Volume (dscm)			3.9966		3.8288		3.8787		2.8474
PCDD & PCDF TEQ	**ng/dscm**		0.0019		0.0043		0.0077		0.0019
PCDD & PCDF TEQ	**ng/dscm (@11% O2)**		**0.0013**		**0.0030**		**0.0061**		**0.0012**
PCDD & PCDF TEQ	**grams/day**		0.00002		0.00004		0.00007		0.00001
Flowrate (dscm/min)			5871		5755		5888		5472
Oxygen (Vol. %)			6.3		6.9		8.3		5.6
Carbon Dioxide (Vol. %)			14.1		13.7		12.1		14.8
Moisture (Vol. %)			19.8		20.5		19.7		22.0
Temperature (oC)			151		148		141		139
Isokinetic Variation (%)			103.3		100.9		99.9		105.2

TABLE 5 PAH/CP EMISSION RESULTS

Client: TransCanada Power
Date: April 3 2001
Jobsite: Williams Lake B.C.
Source: Power Boiler

BASELINE TEST

Component	TEST 1 Analyzed ug
Acenaphthene	0.0160
Acenaphthylene	0.06
Anthracene	ND
Benz(a)anthracene	ND
Benzo(a)pyrene	ND
Benzo(b) fluoranthene	ND
Benzo(e)pyrene	ND
Benzo(g,h,i)perylene	ND
Benzo(k)fluoranthene	ND
Chrysene	ND
Dibenz(a,h)anthracene	ND
Fluoranthene	0.07
Fluorene	ND
Indeno(1,2,3-c,d)pyrene	ND
Naphthalene	artifact
Perylene	ND
Phenanthrene	0.14
Pyrene	0.096
Total PAH (ug)	**0.38**
Total Chlorophenols (ug)	0.061

TABLE 5 PAH/CP EMISSION RESULTS (con't)

Client: TransCanada Power
Date: April 3 2001
Jobsite: Williams Lake B.C.
Source: Power Boiler

	TEST 1
Total CP (ug)	**0.061**
Total PAH (ug)	**0.38**
Sample Volume (dscm)	**3.997**
PAH (ug/dscm @ 11% O2)	**0.063**
PAH (ug/dscm)	0.095
CP (ug/dscm @ 11% O2)	**0.010**
Particulate (mg/m3 @ 12 % CO2) est.*	6
CO (ppm)	10
Flowrate (dscm/min)	6080
Temperature (C)	146
O2 (Vol % dry)	6
CO2 (Vol % dry)	14.8
H20 (Vol %)	21.2
Isokinetic Variation (%)	104

* estimated from filter particulate weight

TABLE 5a PAH/CP EMISSION RESULTS

Client:	Transcanada Power	
Date:	April 4/5/6 2001	RAILTIE TESTS
Jobsite:	Williams Lake B.C.	
Source:	Power Boiler	

Component	TEST 1 Analyzed ug	TEST 2 Analyzed ug	TEST 3 Analyzed ug
Acenaphthene	ND	0.0460	0.0500
Acenaphthylene	ND	0.007	0.015
Anthracene	0.0350	ND	0.0430
Benz(a)anthracene	0.0100	ND	ND
Benzo(a)pyrene	ND	ND	ND
Benzo(b) fluoranthene	ND	ND	0.0230
Benzo(e)pyrene	ND	0.0120	ND
Benzo(g,h,i)perylene	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND
Chrysene	ND	0.0090	0.0210
Dibenz(a,h)anthracene	ND	ND	ND
Fluoranthene	0.07	0.039	0.043
Fluorene	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND
Naphthalene	artifact	artifact	artifact
Perylene	ND	ND	ND
Phenanthrene	0.23	ND	0.096
Pyrene	0.039	0.028	0.041
Total PAH (ug)	**0.38**	**0.14**	**0.33**
Total Chlorophenols (ug)	**0.385**	**0.733**	**0.235**

TABLE 5a PAH/CP EMISSION RESULTS (con't)

Client: Transcanada Power
Date: April 4/5/6 2001
Jobsite: Williams Lake B.C.
Source: Power Boiler

	TEST 1	TEST 2	TEST 3
Total CP (ug)	**0.385**	**0.733**	**0.235**
Total PAH (ug)	**0.38**	**0.14**	**0.33**
Sample Volume (dscm)	**3.829**	**3.879**	**2.847**
PAH (ug/dscm @ 11% O2)	**0.071**	**0.029**	**0.075**
PAH (ug/dscm)	0.100	0.036	0.117
CP (ug/dscm @ 11% O2)	**0.071**	**0.148**	**0.053**
Particulate (mg/m3 @ 12 % CO2) est.*	6	< 1	< 1
CO (ppm)	10	10	10
Flowrate (dscm/min)	5760	5890	5470
Temperature (C)	148	141	139
O2 (Vol % dry)	6.9	8.3	5.6
CO2 (Vol % dry)	13.7	12.1	14.8
H20 (Vol %)	20.5	19.7	22
Isokinetic Variation (%)	101	100	105

* estimated from filter particulate weight

Table 6 PROCESS and CEM DATA

Date/Time	Opacity (%)	NOx (ppm)	CO (ppm)	O2 (%)	Load (MW)
April 3 1448-1938	2.6	126	142	5.3	64
April 4 1115-1549	2.5	139	63	6.1	61
April 5 0912-1428	2.1	133	60	7.2	56
April 6 0822-1135	2.1	140	51	5.1	61

Table 7 Gravimetric Data

Test No.	Filter Particulate (mg)	Washings Particulate (mg)	Total Particulate (mg)
Baseline 1	7.5	9.1	16.6
Baseline 2	3.8	4.0	7.8
Railtie 1	4.6	5.5	10.1
Railtie 2	0.3	0.5	0.8
Railtie 3	0.0	0.3	0.3

Table 8 Fuel and Ash Summary Analytical Data

Sample Type	PCDD/PCDF (pg/g)	PAH (ng/g)	Chlorophenols (ng/g)	Metals (ug/g)
Regular Hog Fuel	1.0 TEQ	12353	30.3	N/A
Railtie Composite (3 days)	4040 TEQ	7361000	72093	N/A
Regular Ash	23.8	899	not quantifiable*	see next
Railtie Ash	788	1267	not quantifiable*	page

* these samples were run twice without recovery of spiked compounds; thus quantification could not confidently be done.

N/A = not analyzed

File No. M9632r

RESULTS OF ANALYSIS - Solid

Sample ID		L3383-5 Baseline	L3383-10 Fly Ash Comp.
Sample Date			
Sample Time			
ALS ID		*1*	*2*
Physical Tests			
Moisture	%	66.7	42.9
Total Metals			
Aluminum	T-Al	14900	19000
Antimony	T-Sb	<40	<20
Arsenic	T-As	<200	<100
Barium	T-Ba	485	335
Beryllium	T-Be	<1	<0.5
Bismuth	T-Bi	<20	<10
Cadmium	T-Cd	<4	3
Calcium	T-Ca	66200	37200
Chromium	T-Cr	28	67
Cobalt	T-Co	8	10
Copper	T-Cu	35	840
Iron	T-Fe	14100	60000
Lead	T-Pb	<100	316
Lithium	T-Li	6	6
Magnesium	T-Mg	12300	8580
Manganese	T-Mn	2920	1500
Mercury	T-Hg	0.045	0.238
Molybdenum	T-Mo	<8	9
Nickel	T-Ni	28	62
Phosphorus	T-P	2460	1900
Potassium	T-K	13300	7400
Selenium	T-Se	<100	<50
Silver	T-Ag	<4	<2
Strontium	T-Sr	289	198
Thallium	T-Tl	<100	<50
Tin	T-Sn	<20	<10
Titanium	T-Ti	1050	1120
Vanadium	T-V	37	64
Zinc	T-Zn	429	686

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per dry kilogram except where noted.
n/a = no certified values available.
< = Less than the detection limit indicated.

4.1 QA/QC Results

Pre and Post Test Leak Checks

Each test is required to be leak checked prior to, and following the test. The leak checks must show a leak rate of less than 0.02 cfm. All tests passed the code leak check requirements. Evidence of the leak checks is shown on each data sheet of appendix 4.

Equipment Calibrations

The dry gas meters used to measure the stack gas sampled volume were calibrated before and after the field tests. The before/after calibration factors agreed within 1% for both dry gas meters used. See App. 5.

Proofing of Dioxin Glassware and Supplies

Although not required by EPA Method 23, it is our practise to verify that the glassware and sorbent used in dioxin tests is free of contamination. Proofs of the glassware and XAD are included in the analytical data of appendix 3.

Analysis of Blank Materials and Reagents

All blank materials and reagents yielded very low or non-detectable levels of target species.

Spiking and Recovery of Dioxin/Furan Surrogates

The recovery of the nine labelled internal standards ranged from 59 to 110%, thus complying with Method 23 requirements of 40 to 130%. Spiked surrogate recoveries ranged from 98 to 117%, also complying with method performance specifications of 70 to 130%. In addition, all data was recovery corrected for each congener.

Spiking and Recovery Assessments of Inorganic Samples

Blanks of all reagents used for sample collection were spiked to known contaminant concentrations and analyzed with the source samples. Normally a high and low spike was conducted. The various recoveries are reported on the analytical data in appendix 2. In summary the results are:

	High Spike % Recovery	Low Spike % Recovery
HCl	103 %	
Hg	95 %	79%
PCDD/PCDF	59 to 110 % for 9 compounds	

Audit Sample Analysis

EPA or EC audit samples were analyzed for HCl (ERA CRM), and SO_2 (C8003/M6-052). Results are

	Analyzed Value	Audit Value
ERA CRM (Lot 9978)	122 mg/l	122 mg/l
C8003/M6-052	230 (mg/dscm)(1st analysis) 234 (mg/dscm (repeat analysis)	250 mg/dscm

		Analyzed Value	Audit Value
QCP-TMS-1	Lead	833 ug/ml	810 ug/ml
	Cadmium	112	110
	Zinc	459	439

Chain of Custody

All samples were in the possession of the stack test team until relinquishing to a representative of the analytical laboratory. The samples were inspected on arrival from the field, and the shipping containers were observed to be sealed on arrival, with no apparent tampering or sample loss in shipment.

5.0 DISCUSSION OF RESULTS

This survey was a comprehensive investigation into the emission characteristics of the boiler during the firing o. normal hog fuel and chipped railroad ties.

The analytical results of the two fuels as provided in Table 8, shows the significant amount of PAH and Chlorophenols (CP) in the railroad ties, while relatively little (<0.2% of railtie amount) of either compound group was found in the regular hog fuel.

Trace metal emissions were similar for both fuel types, and all trace metal emissions were well below BC Special Waste guidelines.

The emission results showed very little dioxin emissions regardless of fuel, suggesting the boiler and APC system was capable of destroying the PAH and CP associated with the fuel.

A composite Railtie ash sample was also analyzed for total and extractable metal content. Extractable metals met the leachate quality criteria under the B.C. Special Waste Regulations. pH ranged from 5.15 (final) to 9.73 (initial).

SO_x and HCl were almost non-detectable for the regular hog fuel tests, however during the Railtie tests SO_x and HCl were found at levels very close to or above BC Special Waste guidelines.

The QA/QC program was successful in demonstrating good analytical accuracy as shown with sample spikes and reference standards, in proving the avoidance of sample contamination as evidenced by low blank analysis, in showing excellent pollutant capture efficiency, and in proving no precontamination of dioxin trains as shown in the proof analysis of XAD and glassware (appendix 3).

The emission monitoring was conducted by certified emission testing technologists, using calibrated test equipment. No significant problems were encountered in sample collection or analysis (ash CP excepted), and sampling of each sequence only commenced with the approval of TransCanada personnel.

The results, therefore, are reported with confidence and are considered to be an accurate representation of fluegas pollutant and diluent characteristics for the process conditions maintained on the test dates.

APPENDIX 1

COMPUTER OUTPUTS OF MEASURED AND CALCULATEDDATA

STANDARD VOLUME / GAS CONCENTRATION WORKSHEET

Plant:	Trans Canada Power	**Tested for:**	HCl
Location:	Stack	**DGM ID:**	LM - 3
Barometric:	27.7	**DGM Y:**	0.9889
Date:	Apr. 3 - 6, 2001		

		DRY GAS METER				CONSTANTS		RESULTS			Results Corrected to **11.0 % O2**	
RUN	**TIME**	Reading (m3)	Temp In (Avg. oF)	Temp Out (Avg oF)	Avg. Delta H (inches H20)	Y Factor	Pb (In. Hg)	Volume Std. (m3 std.)	Lab Result (mg of HCl)	Concentration (mg HCl/m3)	Oxygen (Vol. %)	HCl (mg/m3) Concentration (@ 11% O2)
1 (baseline)	14:07	41.7403	59.6	58.7	0.0	0.9889	27 70	0 54188	0.040	0.07	6.0	0.05
Apr. 3/01	15:07	42.3125	-	-	-	-	-					
2 (baseline)	16:30	42.8801	63.4	63.7	0.0	0.9889	27.70	0 53009	0.034	0.06	7.4	0.05
Apr. 3/01	18:08	43.4446	-	-	-	-	-					
3 (rail ties)	13:15	44.5682	61 7	63 1	0.0	0.9889	27 68	0.58185	40.21	69.1	7.5	51.1
Apr 4/01	14:33	45.1869	-	-	-	-	-					
4 (rail ties)	12:20	45.8724	50.7	52.7	0.0	0.9889	27.32	0.56354	52 66	93.4	8.7	75.8
Apr. 5/01	13:20	46.4671	-	-	-	-	-					
5 (rail ties)	10:20	47.0635	60.0	61.3	0.0	0 9889	27.21	0.54513	44.43	81.5	5.5	52.4
Apr. 6/01	11:20	47.6512	-	-	-	-	-					

STANDARD VOLUME / GAS CONCENTRATION WORKSHEET

Plant:	Trans Canada Power	**Tested for:**	SOx
Location:	Stack	**DGM ID:**	LM - 3
Barometric:	27.7	**DGM Y:**	0.9889
Date:	Apr. 3 - 6, 2001		

		DRY GAS METER				**CONSTANTS**			**RESULTS**		Results Corrected to **11.0 % O2**	
RUN	**TIME**	Reading (m3)	Temp In (Avg. oF)	Temp Out (Avg. oF)	Avg. Delta H (inches H20)	Y Factor	Pb (in. Hg)	Volume Std. (m3 std.)	Lab Result (mg of SOx)	Concentration (mg SOx/m3)	Oxygen (Vol. %)	SOx (mg/m3) Concentration (@ 11% O2)
1 (baseline)	15:20	42.3179	59.3	60.8	0.0	0.9889	27.70	0.52600	0.72	1.4	5.7	0.89
Apr. 3/01	16:20	42.8743	-	-	-	-	-					
2 (baseline)	18:10	43.4491	71.5	72.5	0.0	0.9889	27.70	0.46678	0.76	1.6	5.3	1.0
Apr. 3/01	19:10	43.9542	-	-	-	-	-					
3 (rail ties)	12:00	43.9745	66.9	66.1	0.0	0.9889	27.68	0.54876	116.7	213	7.5	157
Apr. 4/01	13:00	44.5626	-	-	-	-	-					
4 (rail ties)	11:15	45.2590	58.7	61.9	0.0	0.9889	27.32	0.56364	140.9	250	8.7	203
Apr. 5/01	12:15	45.8638	-	-	-	-	-					
5 (rail ties)	9:15	46.4731	56.1	57.0	0.0	0.9889	27.21	0.54740	132.8	243	5.5	156
Apr. 6/01	10:15	47.0586	-	-	-	-	-					

Client:	TransCanada Power	**Date:**	April 3, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	1 - Baseline
Source:	Power Generation Stack	**Run Time:**	13:22 - 14:30

Particulate Concentration:	12.37 mg/dscm	0.0054 gr/dscf
	6.55 mg/Acm	0.0029 gr/Acf
	8.5 mg/dscm (@ 11% O2)	0.0037 gr/dscf (@ 11% O2)
Particulate Emission Rate:	4.58 Kg/hr	10.096 lb/hr
Sample Gas Volume:	1.3425 dscm	47.410 dscf
Total Sample Time:	60.0 minutes	
Average Isokineticity:	103.3 %	

Flue Gas Characteristics

Moisture:	20.35 %	
Temperature	141.9 oC	287.4 oF
Flow	6172.3 dscm/min	217975 dscf/min
	102.87 dscm/sec	3632.9 dscf/sec
	11660.4 Acm/min	411787 Acf/min
Velocity	20.140 m/sec	66.07 f/sec
Gas Analysis	6.45 % O2	14.25 % CO2
	30.538 Mol. Wt (g/gmole) Dry	27.986 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 3, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	1 - Baseline
Source:	Power Generation Stack	**Run Time:**	13:22 - 14:30

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.70
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	0.0075
Washings (grams)	0.0091
Impinger (grams)	0.0000
Total (grams)	0.0166

Gas Analysis (Vol. %):

	CO2	O2
	13.00	7.00
	14.00	7.00
	15.00	6.00
	15.00	5.80
Average =	14.25	6.45

Condensate Collection:

Impinger 1 (grams)	168.0
Impinger 2 (grams)	66.0
Impinger 3 (grams)	7.0
Impinger 4 (grams)	3.0
Impinger 5 (grams)	0.0
Impinger 6 (grams)	8.4
Total Gain (grams)	252.4

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Temperatures Probe (oF)	Temperatures Impinger (oF)	Temperatures Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	467.344											
1	1	5.0	471.350	0.770	2.06	77	68	2	250	240	41	287	40.9	103.0
	2	10.0	475.750	0.920	2.46	81	69	2	250	240	41	289	20.2	103.2
	3	15.0	479.960	0.840	2.24	83	69	2	250	240	41	289	6.1	103.1
		0.0	479.960											
2	1	5.0	483.720	0.670	1.79	81	69	2	250	240	41	286	40.9	103.0
	2	10.0	487.780	0.780	2.08	84	69	2	250	240	41	290	20.2	103.1
	3	15.0	491.710	0.730	1.95	85	70	2	250	240	41	287	6.1	102.7
		0.0	491.710											
3	1	5.0	496.430	1.050	2.80	83	70	2	250	240	41	287	40.9	103.3
	2	10.0	501.140	1.050	2.80	86	70	2	250	240	41	286	20.2	102.7
	3	15.0	505.630	0.930	2.50	86	70	2	250	240	41	286	6.1	104.0
		0.0	505.630											
4	1	5.0	510.280	1.000	2.69	84	71	2	250	240	41	288	40.9	104.1
	2	10.0	514.830	0.960	2.58	87	72	2	250	240	41	288	20.2	103.6
	3	15.0	519.200	0.880	2.37	87	72	2	250	240	41	286	6.1	103.7
			Average:	0.882	2.360	83.7	69.9	2.0	250.0	240.0	41.0	287.4		103.3

Client:	TransCanada Power	**Date:**	April 4, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	2 - Baseline
Source:	Power Generation Stack	**Run Time:**	09:30 - 10:36

Particulate Concentration:	5.89 mg/dscm	0.0026 gr/dscf
	3.00 mg/Acm	0.0013 gr/Acf
	3.8 mg/dscm (@ 11% O2)	0.0016 gr/dscf (@ 11% O2)
Particulate Emission Rate:	2.12 Kg/hr	4.664 lb/hr
Sample Gas Volume:	1.3252 dscm	46.801 dscf
Total Sample Time:	60.0 minutes	
Average Isokineticity:	105.2 %	

Flue Gas Characteristics

Moisture:	21.87 %	
Temperature	149.2 oC	300.6 oF
Flow	5990.1 dscm/min	211541 dscf/min
	99.84 dscm/sec	3525.7 dscf/sec
	11747.4 Acm/min	414860 Acf/min
Velocity	20.290 m/sec	66.57 f/sec
Gas Analysis	5.38 % O2	15.25 % CO2
	30.655 Mol. Wt (g/gmole) Dry	27.888 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**
Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 4, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	2 - Baseline
Source:	Power Generation Stack	**Run Time:**	09:30 - 10:36

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.68
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	0.0038
Washings (grams)	0.0040
Impinger (grams)	0.0000
Total (grams)	0.0078

Gas Analysis (Vol. %):

	CO2	O2
	16.00	5.00
	16.00	4.50
	14.00	6.50
	15.00	5.50
Average =	15.25	5.38

Condensate Collection:

Impinger 1 (grams)	152.0
Impinger 2 (grams)	84.0
Impinger 3 (grams)	22.0
Impinger 4 (grams)	6.0
Impinger 5 (grams)	1.0
Impinger 6 (grams)	7.9
Total Gain (grams)	272.9

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Temperatures Probe (oF)	Temperatures Impinger (oF)	Temperatures Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	705.210											
1	1	5.0	709.820	1.030	2.70	83	74	2	250	240	41	311	40.9	104.9
	2	10.0	714.490	1.050	2.75	90	78	2	250	240	41	306	20.2	103.8
	3	15.0	719.050	0.960	2.56	91	77	2	250	240	41	302	6.1	105.7
		0.0	719.050											
2	1	5.0	722.850	0.670	1.79	89	77	2	250	240	41	300	40.9	105.3
	2	10.0	726.920	0.730	1.95	93	78	2	250	240	41	301	20.2	107.6
	3	15.0	730.540	0.640	1.71	90	75	2	250	240	41	298	6.1	102.5
		0.0	730.540											
3	1	5.0	734.390	0.730	1.90	71	58	2	250	240	41	298	40.9	105.7
	2	10.0	738.840	0.980	2.55	74	58	2	250	240	41	299	20.2	105.4
	3	15.0	742.910	0.820	2.13	75	58	2	250	240	41	297	6.1	105.0
		0.0	742.910											
4	1	5.0	747.350	0.970	2.52	72	58	2	250	240	41	297	40.9	105.7
	2	10.0	751.890	1.020	2.65	76	59	2	250	240	41	299	20.2	105.1
	3	15.0	756.230	0.930	2.42	76	59	2	250	240	41	299	6.1	105.2
			Average:	0.878	2.303	81.7	67.4	2.0	250.0	240.0	41.0	300.6		105.2

Client:	TransCanada Power	**Date:**	April 4, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	3 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	16:00 - 17:06

Particulate Concentration:	8.12 mg/dscm	0.0035 gr/dscf
	4.29 mg/Acm	0.0019 gr/Acf
	6.1 mg/dscm (@ 11% O2)	0.0027 gr/dscf (@ 11% O2)
Particulate Emission Rate:	2.88 Kg/hr	6.358 lb/hr
Sample Gas Volume:	1.2440 dscm	43.933 dscf
Total Sample Time:	60.0 minutes	
Average Isokineticity:	99.8 %	

Flue Gas Characteristics

Moisture:	19.63 %	
Temperature	146.5 oC	295.7 oF
Flow	5920.1 dscm/min	209070 dscf/min
	98.67 dscm/sec	3484.5 dscf/sec
	11214.4 Acm/min	396036 Acf/min
Velocity	19.369 m/sec	63.55 f/sec
Gas Analysis	7.75 % O2	12.75 % CO2
	30.350 Mol. Wt (g/gmole) Dry	27.925 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**
Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

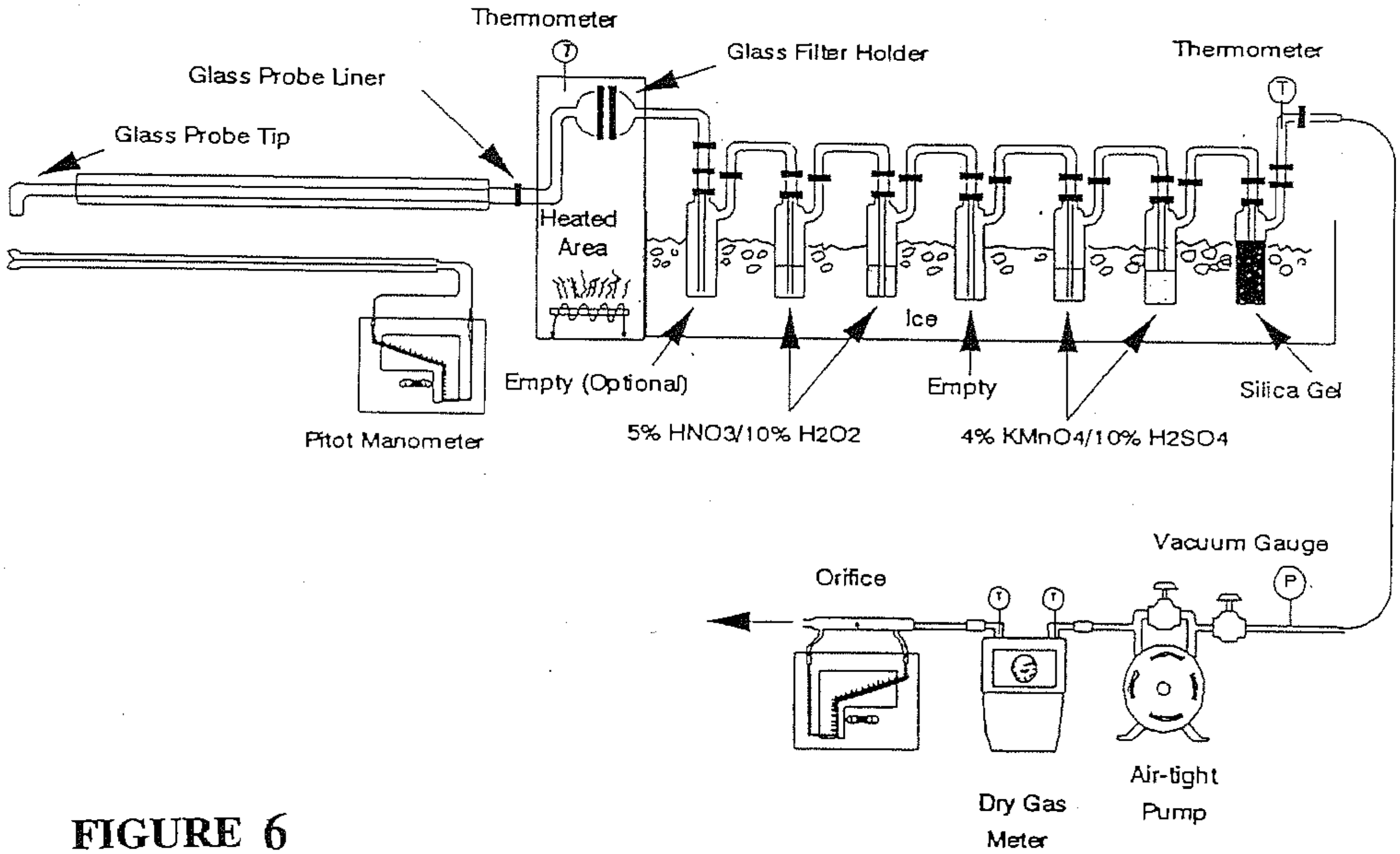


FIGURE 6

Multiple Metals Sampling Train

TABLE 4 Detailed PCDD/PCDF Emission Results

		Test 1 (Baseline)		Test 1 (Railtie)		Test 2 (Railtie)		Test 3 (Railtie)	
Component	**TEF**	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)
2378 TCDD	1.0000	0.0042	0.0042	0.0038	0.0038	0.0054	0.0054	0.0000	0.0000
12378 PCDD	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
123478 HxCDD	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0004
123678 HxCDD	0.1000	0.0000	0.0000	0.0077	0.0008	0.0120	0.0012	0.0037	0.0004
123789 HxCDD	0.1000	0.0000	0.0000	0.0110	0.0011	0.0000	0.0000	0.0000	0.0000
1234678 HpCDD	0.0100	0.0000	0.0000	0.0460	0.0005	0.0560	0.0006	0.0270	0.0003
OCDD	0.0010	0.0310	0.0000	0.0710	0.0001	0.1300	0.0001	0.0000	0.0000
2378 TCDF	0.1000	0.0320	0.0032	0.0820	0.0082	0.0820	0.0082	0.0260	0.0026
12378 PCDF	0.0500	0.0000	0.0000	0.0150	0.0008	0.0180	0.0009	0.0067	0.0003
23478 PCDF	0.5000	0.0000	0.0000	0.0000	0.0000	0.0220	0.0110	0.0000	0.0000
123478 HxCDF	0.1000	0.0000	0.0000	0.0000	0.0000	0.0130	0.0013	0.0086	0.0009
123678 HxCDF	0.1000	0.0000	0.0000	0.0110	0.0011	0.0110	0.0011	0.0049	0.0005
234678 HxCDF	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
123789 HxCDF	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1234678 HpCDF	0.0100	0.0000	0.0000	0.0190	0.0002	0.0190	0.0002	0.0000	0.0000
1234789 HpCDF	0.0100	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OCDF	0.0010	0.0000	0.0000	0.0000	0.0000	0.0120	0.0000	0.0083	0.0000

		Test 1 (Baseline)	Test 1 (Railtie)	Test 2 (Railtie)	Test 3 (Railtie)
Summed PCDD & PCDF TEQ (ng)		0.0074	0.0164	0.0300	0.0053
Sample Volume (dscm)		3.9966	3.8288	3.8787	2.8474
PCDD & PCDF TEQ	**ng/dscm**	0.0019	0.0043	0.0077	0.0019
PCDD & PCDF TEQ	**ng/dscm (@11% O2)**	**0.0013**	**0.0030**	**0.0061**	**0.0012**
PCDD & PCDF TEQ	**grams/day**	0.00002	0.00004	0.00007	0.00001
Flowrate (dscm/min)		5871	5755	5888	5472
Oxygen (Vol. %)		6.3	6.9	8.3	5.6
Carbon Dioxide (Vol. %)		14.1	13.7	12.1	14.8
Moisture (Vol. %)		19.8	20.5	19.7	22.0
Temperature (oC)		151	148	141	139
Isokinetic Variation (%)		103.3	100.9	99.9	105.2

STANDARD VOLUME / GAS CONCENTRATION WORKSHEET

Plant:	Trans Canada Power	**Tested for:**	HCl
Location:	Stack	**DGM ID:**	LM - 3
Barometric:	27.7	**DGM Y:**	0.9889
Date:	Apr. 3 - 6, 2001		

		DRY GAS METER				CONSTANTS			RESULTS		Results Corrected to 11.0 % O2	
RUN	TIME	Reading	Temp In	Temp Out	Avg. Delta H	Y Factor	Pb	Volume Std.	Lab Result	Concentration	Oxygen	HCl (mg/m3) Concentration
		(m3)	(Avg. oF)	(Avg. oF)	(inches H20)		(In. Hg)	(m3 std.)	(mg of HCl)	(mg HCl/m3)	(Vol. %)	(@ 11% O2)
1 (baseline)	14:07	41.7403	59.6	58.7	0.0	0.9889	27.70	0.54186	0.040	0.07	6.0	0.05
Apr. 3/01	15:07	42.3125	-	-	-	-	-					
2 (baseline)	16:30	42.8801	63.4	63.7	0.0	0.9889	27.70	0.53009	0.034	0.06	7.4	0.05
Apr. 3/01	18:08	43.4446	-	-	-	-	-					
3 (rail ties)	13:15	44.5682	61.7	63.1	0.0	0.9889	27.68	0.58185	40.21	69.1	7.5	51.1
Apr. 4/01	14:33	45.1869	-	-	-	-	-					
4 (rail ties)	12:20	45.8724	50.7	52.7	0.0	0.9889	27.32	0.56354	52.66	93.4	8.7	75.8
Apr. 5/01	13:20	46.4671	-	-	-	-	-					
5 (rail ties)	10:20	47.0635	60.0	61.3	0.0	0.9889	27.21	0.54513	44.43	81.5	5.5	52.4
Apr. 6/01	11:20	47.6512	-	-	-	-	-					

STANDARD VOLUME / GAS CONCENTRATION WORKSHEET

Plant: Trans Canada Power
Location: Stack
Barometric: 27.7
Date: Apr. 3 - 6, 2001

Tested for: SOx
DGM ID: LM - 3
DGM Y: 0.9889

		DRY GAS METER				CONSTANTS		RESULTS			Results Corrected to 11.0 % O2	
RUN	TIME	Reading (m3)	Temp In (Avg. oF)	Temp Out (Avg. oF)	Avg. Delta H (inches H20)	Y Factor	Pb (in. Hg)	Volume Std. (m3 std.)	Lab Result (mg of SOx)	Concentration (mg SOx/m3)	Oxygen (Vol. %)	SOx (mg/m3) Concentration (@ 11% O2)
1 (baseline)	15:20	42.3179	59.3	60.8	0.0	0.9889	27.70	0.52600	0.72	1.4	5.7	0.89
Apr. 3/01	16:20	42.8743	-	-	-	-	-					
2 (baseline)	18:10	43.4491	71.5	72.5	0.0	0.9889	27.70	0.46678	0.76	1.6	5.3	1.0
Apr. 3/01	19:10	43.9542	-	-	-	-	-					
3 (rail ties)	12:00	43.9745	66.9	66.1	0.0	0.9889	27.68	0.54876	116.7	213	7.5	157
Apr. 4/01	13:00	44.5626	-	-	-	-	-					
4 (rail ties)	11:15	45.2590	58.7	61.9	0.0	0.9889	27.32	0.56364	140.9	250	8.7	203
Apr. 5/01	12:15	45.8638	-	-	-	-	-					
5 (rail ties)	9:15	46.4731	56.1	57.0	0.0	0.9889	27.21	0.54740	132.8	243	5.5	156
Apr. 6/01	10:15	47.0586	-	-	-	-	-					

Client:	TransCanada Power	**Date:**	April 3, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	1 - Baseline
Source:	Power Generation Stack	**Run Time:**	13:22 - 14:30

Particulate Concentration:		12.37 mg/dscm	0.0054 gr/dscf
		6.55 mg/Acm	0.0029 gr/Acf
		8.5 mg/dscm (@ 11% O2)	0.0037 gr/dscf (@ 11% O2)
Particulate Emission Rate:		4.58 Kg/hr	10.096 lb/hr
Sample Gas Volume:		1.3425 dscm	47.410 dscf
Total Sample Time:		60.0 minutes	
Average Isokineticity:		103.3 %	
Flue Gas Characteristics			
	Moisture:	20.35 %	
	Temperature	141.9 oC	287.4 oF
	Flow	6172.3 dscm/min	217975 dscf/min
		102.87 dscm/sec	3632.9 dscf/sec
		11660.4 Acm/min	411787 Acf/min
	Velocity	20.140 m/sec	66.07 f/sec
	Gas Analysis	6.45 % O2	14.25 % CO2
		30.538 Mol. Wt (g/gmole) Dry	27.986 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**
Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 3, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	1 - Baseline
Source:	Power Generation Stack	**Run Time:**	13:22 - 14:30

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.70
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	0.0075
Washings (grams)	0.0091
Impinger (grams)	0.0000
Total (grams)	**0.0166**

Gas Analysis (Vol. %):

	CO2	O2
	13.00	7.00
	14.00	7.00
	15.00	6.00
	15.00	5.80
Average =	14.25	6.45

Condensate Collection:

Impinger 1 (grams)	168.0
Impinger 2 (grams)	66.0
Impinger 3 (grams)	7.0
Impinger 4 (grams)	3.0
Impinger 5 (grams)	0.0
Impinger 6 (grams)	8.4
Total Gain (grams)	252.4

						Dry Gas Temperature				Temperatures			Wall	
Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Inlet (oF)	Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Probe (oF)	Impinger (oF)	Stack (oF)	Dist. (in.)	Isokin. (%)
		0.0	467.344											
1	1	5.0	471.350	0.770	2.06	77	68	2	250	240	41	287	40.9	103.0
	2	10.0	475.750	0.920	2.46	81	69	2	250	240	41	289	20.2	103.2
	3	15.0	479.960	0.840	2.24	83	69	2	250	240	41	289	6.1	103.1
		0.0	479.960											
2	1	5.0	483.720	0.670	1.79	81	69	2	250	240	41	286	40.9	103.0
	2	10.0	487.780	0.780	2.08	84	69	2	250	240	41	290	20.2	103.1
	3	15.0	491.710	0.730	1.95	85	70	2	250	240	41	287	6.1	102.7
		0.0	491.710											
3	1	5.0	496.430	1.050	2.80	83	70	2	250	240	41	287	40.9	103.3
	2	10.0	501.140	1.050	2.80	86	70	2	250	240	41	286	20.2	102.7
	3	15.0	505.630	0.930	2.50	86	70	2	250	240	41	286	6.1	104.0
		0.0	505.630											
4	1	5.0	510.280	1.000	2.69	84	71	2	250	240	41	288	40.9	104.1
	2	10.0	514.830	0.960	2.58	87	72	2	250	240	41	288	20.2	103.6
	3	15.0	519.200	0.880	2.37	87	72	2	250	240	41	286	6.1	103.7
			Average:	0.882	2.360	83.7	69.9	2.0	250.0	240.0	41.0	287.4		103.3

Client: TransCanada Power
Jobsite: Williams Lake , B.C.
Source: Power Generation Stack

Date: April 4, 2001
Run: 2 - Baseline
Run Time: 09:30 - 10:36

Particulate Concentration:		5.89 mg/dscm	0.0026 gr/dscf
		3.00 mg/Acm	0.0013 gr/Acf
		3.8 mg/dscm (@ 11% O2)	0.0016 gr/dscf (@ 11% O2)
Particulate Emission Rate:		2.12 Kg/hr	4.664 lb/hr
Sample Gas Volume:		1.3252 dscm	46.801 dscf
Total Sample Time:		60.0 minutes	
Average Isokineticity:		105.2 %	
Flue Gas Characteristics			
	Moisture:	21.87 %	
	Temperature	149.2 oC	300.6 oF
	Flow	5990.1 dscm/min	211541 dscf/min
		99.84 dscm/sec	3525.7 dscf/sec
		11747.4 Acm/min	414860 Acf/min
	Velocity	20.290 m/sec	66.57 f/sec
	Gas Analysis	5.38 % O2	15.25 % CO2
		30.655 Mol. Wt (g/gmole) Dry	27.888 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**
Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 4, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	2 - Baseline
Source:	Power Generation Stack	**Run Time:**	09:30 - 10:36

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.68
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	0.0038
Washings (grams)	0.0040
Impinger (grams)	0.0000
Total (grams)	0.0078

Gas Analysis (Vol. %):

	CO2	O2
	16.00	5.00
	16.00	4.50
	14.00	6.50
	15.00	5.50
Average =	15.25	5.38

Condensate Collection:

Impinger 1 (grams)	152.0
Impinger 2 (grams)	84.0
Impinger 3 (grams)	22.0
Impinger 4 (grams)	6.0
Impinger 5 (grams)	1.0
Impinger 6 (grams)	7.9
Total Gain (grams)	272.9

						Dry Gas Temperature				Temperatures			Wall	
Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Inlet (oF)	Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Probe (oF)	Impinger (oF)	Stack (oF)	Dist. (in.)	Isokin. (%)
		0.0	705.210											
1	1	5.0	709.820	1.030	2.70	83	74	2	250	240	41	311	40.9	104.9
	2	10.0	714.490	1.050	2.75	90	78	2	250	240	41	306	20.2	103.8
	3	15.0	719.050	0.960	2.56	91	77	2	250	240	41	302	6.1	105.7
		0.0	719.050											
2	1	5.0	722.850	0.670	1.79	89	77	2	250	240	41	300	40.9	105.3
	2	10.0	726.920	0.730	1.95	93	78	2	250	240	41	301	20.2	107.6
	3	15.0	730.540	0.640	1.71	90	75	2	250	240	41	298	6.1	102.5
		0.0	730.540											
3	1	5.0	734.390	0.730	1.90	71	58	2	250	240	41	298	40.9	105.7
	2	10.0	738.840	0.980	2.55	74	58	2	250	240	41	299	20.2	105.4
	3	15.0	742.910	0.820	2.13	75	58	2	250	240	41	297	6.1	105.0
		0.0	742.910											
4	1	5.0	747.350	0.970	2.52	72	58	2	250	240	41	297	40.9	105.7
	2	10.0	751.890	1.020	2.65	76	59	2	250	240	41	299	20.2	105.1
	3	15.0	756.230	0.930	2.42	76	59	2	250	240	41	299	6.1	105.2
			Average:	0.878	2.303	81.7	67.4	2.0	250.0	240.0	41.0	300.6		105.2

Client:	TransCanada Power	**Date:**	April 4, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	3 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	16:00 - 17:06

Particulate Concentration:	8.12 mg/dscm	0.0035 gr/dscf
	4.29 mg/Acm	0.0019 gr/Acf
	6.1 mg/dscm (@ 11% O2)	0.0027 gr/dscf (@ 11% O2)
Particulate Emission Rate:	2.88 Kg/hr	6.358 lb/hr
Sample Gas Volume:	1.2440 dscm	43.933 dscf
Total Sample Time:	60.0 minutes	
Average Isokineticity:	99.8 %	
Flue Gas Characteristics		
Moisture:	19.63 %	
Temperature	146.5 oC	295.7 oF
Flow	5920.1 dscm/min	209070 dscf/min
	98.67 dscm/sec	3484.5 dscf/sec
	11214.4 Acm/min	396036 Acf/min
Velocity	19.369 m/sec	63.55 f/sec
Gas Analysis	7.75 % O2	12.75 % CO2
	30.350 Mol. Wt (g/gmole) Dry	27.925 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 4, 2001
Jobsite:	Williams Lake ; B.C.	**Run:**	3 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	16:00 - 17:06

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.68
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	**0.0046**
Washings (grams)	**0.0055**
Impinger (grams)	**0.0000**
Total (grams)	**0.0101**

Gas Analysis (Vol. %):

	CO2	O2
	13.00	7.50
	12.00	8.50
	13.00	7.50
	13.00	7.50
Average =	**12.75**	**7.75**

Condensate Collection:

Impinger 1 (grams)	182.0
Impinger 2 (grams)	30.0
Impinger 3 (grams)	2.0
Impinger 4 (grams)	1.0
Impinger 5 (grams)	0.0
Impinger 6 (grams)	8.6
Total Gain (grams)	**223.6**

						Dry Gas Temperature				Temperatures			Wall	
Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Inlet (oF)	Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Probe (oF)	Impinger (oF)	Stack (oF)	Dist. (in.)	Isokin. (%)
		0.0	908.250											
1	1	5.0	912.610	0.920	2.36	86	79	2	250	240	41	295	40.9	100.2
	2	10.0	917.160	1.000	2.57	92	81	2	250	240	41	295	20.2	99.6
	3	15.0	921.430	0.880	2.26	95	82	2	250	240	41	294	6.1	99.1
		0.0	921.430											
2	1	5.0	925.800	0.900	2.33	91	83	2	250	240	41	296	40.9	100.7
	2	10.0	930.300	0.960	2.49	98	83	2	250	240	41	295	20.2	99.8
	3	15.0	934.470	0.820	2.12	99	83	2	250	240	41	293	6.1	99.7
		0.0	934.470											
3	1	5.0	937.820	0.530	1.37	95	83	2	250	240	41	292	40.9	99.8
	2	10.0	941.670	0.700	1.81	98	85	2	250	240	41	296	20.2	99.7
	3	15.0	945.380	0.650	1.68	98	85	2	250	240	41	295	6.1	99.6
		0.0	945.380											
4	1	5.0	949.140	0.670	1.74	93	85	2	250	240	41	297	40.9	100.0
	2	10.0	953.480	0.890	2.31	99	85	2	250	240	41	300	20.2	100.0
	3	15.0	957.490	0.760	1.97	99	85	2	250	240	41	300	6.1	99.9
			Average:	0.807	2.084	95.3	83.3	2.0	250.0	240.0	41.0	295.7		99.8

Client:	TransCanada Power	**Date:**	April 5, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	4 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	15:22 - 16:28

Particulate Concentration:	0.65 mg/dscm	0.0003 gr/dscf
	0.34 mg/Acm	0.0001 gr/Acf
	0.5 mg/dscm (@ 11% O2)	0.0002 gr/dscf (@ 11% O2)
Particulate Emission Rate:	0.23 Kg/hr	0.498 lb/hr
Sample Gas Volume:	1.2316 dscm	43.494 dscf
Total Sample Time:	60.0 minutes	
Average Isokineticity:	100.9 %	

Flue Gas Characteristics

Moisture:	20.60 %	
Temperature	140.2 oC	284.4 oF
Flow	5794.8 dscm/min	204645 dscf/min
	96.58 dscm/sec	3410.8 dscf/sec
	11089.5 Acm/min	391627 Acf/min
Velocity	19.154 m/sec	62.84 f/sec
Gas Analysis	9.00 % O2	12.00 % CO2
	30.280 Mol. Wt (g/gmole) Dry	27.750 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 5, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	4 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	15:22 - 16:28

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.32
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	**0.0003**
Washings (grams)	**0.0005**
Impinger (grams)	**0.0000**
Total (grams)	**0.0008**

Gas Analysis (Vol. %):

	CO2	O2
	12.00	9.00
	12.00	9.00
	12.00	9.00
Average =	**12.00**	**9.00**

Condensate Collection:

Impinger 1 (grams)	194.0
Impinger 2 (grams)	31.0
Impinger 3 (grams)	2.0
Impinger 4 (grams)	0.0
Impinger 5 (grams)	0.0
Impinger 6 (grams)	8.1
Total Gain (grams)	**235.1**

						Dry Gas Temperature				Temperatures			Wall	
Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Inlet (oF)	Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Probe (oF)	Impinger (oF)	Stack (oF)	Dist. (in.)	Isokin. (%)
		0.0	152.400											
1	1	5.0	156.910	0.940	2.52	72	77	2	250	240	41	281	40.9	103.4
	2	10.0	161.210	0.870	2.31	88	78	2	250	240	41	285	20.2	101.1
	3	15.0	165.440	0.850	2.25	88	78	2	250	240	41	285	6.1	100.6
		0.0	165.440											
2	1	5.0	169.210	0.670	1.78	85	78	2	250	240	41	286	40.9	101.2
	2	10.0	173.300	0.790	2.09	88	78	2	250	240	41	284	20.2	100.8
	3	15.0	177.200	0.720	1.91	89	78	2	250	240	41	284	6.1	100.5
		0.0	177.200											
3	1	5.0	180.580	0.540	1.43	86	76	2	250	240	41	285	40.9	101.0
	2	10.0	184.230	0.630	1.67	90	77	2	250	240	41	286	20.2	100.6
	3	15.0	187.760	0.590	1.56	91	78	2	250	240	41	283	6.1	100.1
		0.0	187.760											
4	1	5.0	192.290	0.970	2.57	85	78	2	250	240	41	285	40.9	101.2
	2	10.0	196.940	1.020	2.70	93	78	2	250	240	41	285	20.2	100.6
	3	15.0	201.180	0.850	2.25	93	78	2	250	240	41	284	6.1	100.3
			Average:	0.787	2.087	87.3	77.7	2.0	250.0	240.0	41.0	284.4		100.9

Client:	TransCanada Power	**Date:**	April 6, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	5 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	11:50 - 12:56

Particulate Concentration:	0.24 mg/dscm	0.0001 gr/dscf
	0.13 mg/Acm	0.0001 gr/Acf
	0.2 mg/dscm (@ 11% O2)	0.0001 gr/dscf (@ 11% O2)
Particulate Emission Rate:	0.08 Kg/hr	0.160 lb/hr
Sample Gas Volume:	1.2326 dscm	43.531 dscf
Total Sample Time:	60.0 minutes	
Average Isokineticity:	104.5 %	

Flue Gas Characteristics

Moisture:	21.03 %	
Temperature	141.4 oC	286.6 oF
Flow	5603.1 dscm/min	197875 dscf/min
	93.39 dscm/sec	3297.9 dscf/sec
	10856.1 Acm/min	383381 Acf/min
Velocity	18.751 m/sec	61.52 f/sec
Gas Analysis	7.75 % O2	13.00 % CO2
	30.390 Mol. Wt (g/gmole) Dry	27.784 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

Client:	TransCanada Power	**Date:**	April 6, 2001
Jobsite:	Williams Lake , B.C.	**Run:**	5 - Rail Ties
Source:	Power Generation Stack	**Run Time:**	11:50 - 12:56

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2585
Pitot Factor	0.8402
Baro. Press. (in. Hg)	27.21
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	5.0

Collection:

Filter (grams)	0.0000
Washings (grams)	0.0003
Impinger (grams)	0.0000
Total (grams)	0.0003

Gas Analysis (Vol. %):

	CO2	O2
	13.00	7.50
	13.00	7.50
	13.00	8.00
	13.00	8.00
Average =	13.00	7.75

Condensate Collection:

Impinger 1 (grams)	201.0
Impinger 2 (grams)	30.0
Impinger 3 (grams)	2.0
Impinger 4 (grams)	0.0
Impinger 5 (grams)	0.0
Impinger 6 (grams)	8.5
Total Gain (grams)	241.5

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Temperatures Probe (oF)	Temperatures Impinger (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	328.420											
1	1	5.0	332.640	0.840	2.23	66	56	2	250	240	41	288	40.9	105.8
	2	10.0	337.020	0.910	2.41	73	60	2	250	240	41	286	20.2	104.3
	3	15.0	340.970	0.730	1.93	73	61	2	250	240	41	286	6.1	104.8
		0.0	340.970											
2	1	5.0	345.390	0.920	2.44	68	60	2	250	240	41	287	40.9	105.3
	2	10.0	349.920	0.970	2.57	75	61	2	250	240	41	288	20.2	104.4
	3	15.0	354.080	0.820	2.17	75	61	2	250	240	41	288	6.1	104.2
		0.0	354.080											
3	1	5.0	357.430	0.530	1.40	69	59	2	250	240	41	283	40.9	104.6
	2	10.0	361.110	0.640	1.70	72	61	2	250	240	41	288	20.2	104.5
	3	15.0	364.610	0.580	1.54	73	60	2	250	240	41	287	6.1	104.3
		0.0	364.610											
4	1	5.0	368.060	0.580	1.48	70	60	2	250	240	41	284	40.9	102.8
	2	10.0	372.040	0.750	1.99	73	60	2	250	240	41	287	20.2	104.4
	3	15.0	375.940	0.720	1.91	73	60	2	250	240	41	287	6.1	104.4
			Average:	0.749	1.981	71.7	59.9	2.0	250.0	240.0	41.0	286.6		104.5

Client:	Trans Canada Power	**Date:**	April 3, 2001
Jobsite:	William's Lake, B.C.	**Run:**	1 PCDD/PCDF (Baseline)
Source:	Stack	**Run Time:**	14:48 - 19:38

Concentration:		0.00 mg/dscm	0.0000 gr/dscf
		0.00 mg/Acm	0.0000 gr/Acf
		0.00 mg/dscm (@ 11% O2)	0.0000 gr/dscf (@ 11% O2)
Emission Rate:		0.00 Kg/hr	0.000 lb/hr
Sample Gas Volume:		3.9966 dscm	141.138 dscf
Total Sample Time:		240.0 minutes	
Average Isokineticity:		103.3 %	
Flue Gas Characteristics			
	Moisture:	19.82 %	
	Temperature	150.6 oC	303.1 oF
	Flow	5871.1 dscm/min	207338 dscf/min
		97.85 dscm/sec	3455.6 dscf/sec
		11355.3 Acm/min	401013 Acf/min
	Velocity	19.613 m/sec	64.35 f/sec
	Gas Analysis	6.30 % O2	14.10 % CO2
		30.508 Mol. Wt (g/gmole) Dry	27.943 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

A. Lan. .co and Associates Inc. - Emission Report

Client:	Trans Canada Power	**Date:**	April 3, 2001
Jobsite:	William's Lake, B.C.	**Run:**	1 PCDD/PCDF
Source:	Stack	**Run Time:**	14:48 - 19:38

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2288
Pitot Factor	0.8394
Baro. Press. (in. Hg)	27.70
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	20.0

Collection:

Filter (grams)	0.0000
Washings (grams)	0.0000
Impinger (grams)	0.0000
Total (grams)	0.0000

Gas Analysis (Vol. %):

	CO2	O2
	14.10	6.30
	14.10	6.30
	14.10	6.30
Average =	14.10	6.30

Condensate Collection:

Impinger 1 (grams)	450.0
Impinger 2 (grams)	293.0
Impinger 3 (grams)	14.0
Impinger 4 (grams)	11.8
Total Gain (grams)	768.8

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Temperatures Probe (oF)	Impinger (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	520.031											
1	0	5.0	523.210	0.770	1.27	76	69	2	250	250	50	305	6.1	105.4
		10.0	526 430	0.770	1.27	95	90	2	250	250	50	305	6.1	102.9
		15.0	529.680	0.750	1.28	105	95	2	250	250	50	304	6.1	103.8
		20.0	532.910	0.730	1.26	109	97	2	250	250	50	310	6.1	104.4
	1	25.0	536.440	0.870	1.51	108	97	2	250	250	50	308	20.2	104.5
		30.0	540.100	0.940	1.64	108	96	2	250	250	50	306	20.2	104.3
		35.0	543.770	0.940	1.64	108	96	2	250	250	50	306	20.2	104.6
		40.0	547.350	0.900	1.56	109	96	2	250	250	50	305	20.2	104.1
	2	45.0	550.880	0.870	1.50	109	96	2	250	250	50	307	40.9	104.5
		50.0	554.470	0.910	1.57	108	96	2	250	250	50	306	40.9	103.9
		55.0	558.110	0.920	1.59	108	97	2	250	250	50	308	40.9	104.9
		60.0	561.740	0.920	1.59	109	97	2	250	250	50	310	40.9	104.6
		0.0	561.740											
2	0	5.0	564.810	0.570	0.99	104	95	2	250	250	50	308	6.1	112.8
		10.0	567.770	0.610	1.06	106	96	2	250	250	50	309	6.1	104.9
		15.0	570.770	0.630	1.09	107	95	2	250	250	50	309	6.1	104.6
		20.0	573.720	0.610	1.06	107	95	2	250	250	50	309	6.1	104.6
	1	25.0	576.920	0.720	1.25	107	95	2	250	250	50	308	20.2	104.4
		30.0	580 200	0.750	1.30	107	96	5	250	250	50	307	20.2	104.7
		35.0	583.420	0.730	1.26	107	95	2	250	250	50	307	20.2	104.2
		40.0	586.660	0.730	1.26	107	96	2	250	250	50	307	20.2	104.8
	2	45.0	589.760	0.680	1.18	108	96	2	250	250	50	305	40.9	103.6
		50.0	592.870	0.670	1.16	107	97	2	250	250	50	304	40.9	104.7
		55.0	595.940	0.660	1 14	107	97	2	250	250	50	305	40.9	104.2
		60.0	599.010	0.660	1.14	107	97	2	250	250	50	305	40.9	104.2
		0.0	599.010											
3	0	5.0	602.690	0.950	1.64	103	98	2	250	250	50	305	6.1	104.5
		10.0	606.080	0.800	1.38	107	97	2	250	250	50	304	6.1	104.5
		15.0	609.340	0 750	1.30	107	97	2	250	250	50	302	6.1	103.6
		20.0	612.510	0.700	1.21	92	91	2	250	250	50	284	6.1	105.0
	1	25.0	615.770	0.820	1.37	97	93	2	250	250	50	288	20.2	99.4
		30.0	619.000	0.770	1.29	100	94	2	250	250	50	290	20.2	101.4
		35.0	622.250	0.770	1.31	102	94	2	250	250	50	292	20.2	102.0
		40.0	625.730	0.840	1.45	103	94	2	250	250	50	293	20.2	104.6
	2	45.0	629 120	0.840	1 45	103	94	2	250	250	50	292	40 9	101.8
		50 0	632 470	0 820	1 39	104	93	2	250	250	50	294	40.9	101.9

		55.0	635.820	0.820	1.39	104	93	2	250	250	50	294	40.9	101.9
		60.0	639.180	0.820	1.39	104	93	2	250	250	50	294	40.9	102.3
		0.0	639.180											
4	0	5.0	642.800	0.990	1.68	105	94	2	250	250	50	303	6.1	100.8
		10.0	646.440	0.980	1.67	105	94	2	250	250	50	302	6.1	101.8
		15.0	650.140	1.040	1.77	105	94	2	250	250	50	304	6.1	100.6
		20.0	653.740	0.980	1.67	105	94	2	250	250	50	305	6.1	100.8
	1	25.0	657.360	0.960	1.63	105	94	2	250	250	50	305	20.2	102.4
		30.0	660.880	0.950	1.62	106	94	2	250	250	50	305	20.2	100.0
		35.0	664.510	0.990	1.68	106	94	2	250	250	50	306	20.2	101.1
		40.0	668.120	0.980	1.67	106	94	2	250	250	50	306	20.2	101.1
	2	45.0	671.550	0.860	1.49	106	94	2	250	250	50	305	40.9	101.3
		50.0	674.890	0.840	1.43	106	94	2	250	250	50	305	40.9	100.9
		55.0	678.240	0.840	1.43	106	93	2	250	250	50	305	40.9	101.3
		60.0	681.540	0.830	1.41	105	93	2	250	250	50	305	40.9	100.5
			Average:	0.818	1.402	104.7	94.4	2.1	250.0	250.0	50.0	303.1		103.3

Client:	Trans Canada Power	**Date:**	April 4, 2001
Jobsite:	William's Lake, B.C.	**Run:**	1 PCDD/PCDF (Railtie)
Source:	Stack	**Run Time:**	11:15 - 15:49

Concentration:	0.00 mg/dscm	0.0000 gr/dscf
	0.00 mg/Acm	0.0000 gr/Acf
	0.00 mg/dscm (@ 11% O2)	0.0000 gr/dscf (@ 11% O2)
Emission Rate:	0.00 Kg/hr	0.000 lb/hr
Sample Gas Volume:	3.8288 dscm	135.214 dscf
Total Sample Time:	240.0 minutes	
Average Isokineticity:	100.9 %	

Flue Gas Characteristics

Moisture:	20.51 %	
Temperature	148.1 oC	298.6 oF
Flow	5755.3 dscm/min	203247 dscf/min
	95.92 dscm/sec	3387.5 dscf/sec
	11064.7 Acm/min	390750 Acf/min
Velocity	19.111 m/sec	62.70 f/sec
Gas Analysis	6.90 % O2	13.70 % CO2
	30.468 Mol. Wt (g/gmole) Dry	27.911 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**
Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	RUN: BASELINE TRANS CANADA POWER 03-APR-0	AXYS FILE:	L3385-1 I
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Sample Train	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171189.D

Compound	Lab Flag[1]	Concentration	SDL
Naphthalene		1800	2.6
Acenaphthylene		57	2.6
Acenaphthene		16	2.6
Fluorene	NDR	21	4.9
Phenanthrene		140	1.9
Anthracene	NDR	19	2.2
Fluoranthene		70	1.9
Pyrene		96	1.9
Benz[a]anthracene	NDR	15	3.0
Chrysene	NDR	11	3.4
Benzo[b/j]fluoranthenes	ND		12
Benzo[k]fluoranthene	ND		12
Benzo[e]pyrene	ND		7.9
Benzo[a]pyrene	ND		11
Perylene	ND		11
Dibenz[ah]anthracene	ND		11
Indeno[1,2,3-cd]pyrene	ND		9.2
Benzo[ghi]perylene	NDR	13	11
Dimethyl Naphthalenes		51	2.6
2-Methylfluorene	ND		3.7
Benzo[ghi]fluoranthene	ND		2.4
7,12-Dimethyl Benz[a]Anthracen	NDR	110	76
Benzo[a]Fluorene	ND		3.7
Benzo[b]Fluorene	ND		3.7
Dibenzo[a,h]Acridine	ND		9.9
Dibenzo[a,j]Acridine	ND		9.6
7H Dibenzo[c,g]Carbazole	ND		38
Dibenzo[a,i]Pyrene	ND		15
1-Methylpyrene	ND		3.7
1,6-Dinitropyrene	ND		75
1,8-Dinitropyrene	ND		75

Field Surrogate	Determined	Expected	% Recovery
Anthracene d-10	1951	2024	96

Labeled Compound	% Recovery
Naphthalene d-8	47
Acenaphthylene d-8	53
Phenanthrene d-10	65
Fluoranthene d-10	73
Benz(a)anthracene d-12	73
Chrysene d-12	68
Benzo(b,k)Fluoranthene d-12	64
Benzo(a)pyrene d-12	67
Perylene d-12	76
Dibenzo(ah)anthracene d-14	59
Indeno(123cd)pyrene d-12	59
Benzo(ghi)perylene d-12	60
2,6-Dimethylnaphthalene d-12	66

(1) ND = not detected; NDR = peak detected, but did not meet quantification criteria
(2) SDL = Sample Detection Limit
(3) Concentrations are recovery corrected
(4) Data have not been blank corrected

Approved: ____________
QA Chemist

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 1 TRANS CANADA POWER 04-APR-0	AXYS FILE:	L3385-2 I
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Sample Train	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171190.D

Compound	Lab Flag[1]	Concentration	SDL
Naphthalene		1700	8.5
Acenaphthylene	NDR	14	12
Acenaphthene	NDR	39	10
Fluorene	NDR	57	3.0
Phenanthrene		230	3.0
Anthracene		35	3.6
Fluoranthene		70	3.9
Pyrene		39	4.0
Benz[a]anthracene		9.5	7.3
Chrysene	ND		9.8
Benzo[b/j]fluoranthenes	ND		14
Benzo[k]fluoranthene	ND		14
Benzo[e]pyrene	ND		13
Benzo[a]pyrene	ND		18
Perylene	ND		15
Dibenz[ah]anthracene	ND		6.2
Indeno[1,2,3-cd]pyrene	ND		5.6
Benzo[ghi]perylene	ND		6.6
Dimethyl Naphthalenes		97	3.6
2-Methylfluorene	ND		13
Benzo[ghi]fluoranthene	ND		5.9
7,12-Dimethyl Benz[a]Anthracen	ND		110
Benzo[a]Fluorene	ND		4.2
Benzo[b]Fluorene	ND		4.2
Dibenzo[a,h]Acridine	ND		7.7
Dibenzo[a,j]Acridine	ND		7.5
7H Dibenzo[c,g]Carbazole	ND		49
Dibenzo[a,l]Pyrene	ND		14
1-Methylpyrene	NDR	4.3	4.2
1,6-Dinitropyrene	ND		48
1,8-Dinitropyrene	ND		48

Field Surrogate	Determined	Expected	% Recovery
Anthracene d-10	1205	2024	60

Labeled Compound	% Recovery
Naphthalene d-8	27
Acenaphthylene d-8	26
Phenanthrene d-10	67
Fluoranthene d-10	75
Benz(a)anthracene d-12	71
Chrysene d-12	69
Benzo(b,k)Fluoranthene d-12	68
Benzo(a)pyrene d-12	49
Perylene d-12	69
Dibenzo(ah)anthracene d-14	68
Indeno(123cd)pyrene d-12	71
Benzo(ghi)perylene d-12	72
2,6-Dimethylnaphthalene d-12	57

(1) ND = not detected; NDR = peak detected, but did not meet quantification criteria
(2) SDL = Sample Detection Limit
(3) Concentrations are recovery corrected
(4) Data have not been blank corrected

Approved: QA Chemist

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 1 TRANS CANADA POWER 04-Apr-01	AXYS FILE:	L3385-2
		DATE:	24-May-2001
CLIENT:	A. Lanfranco & Associates Inc.	METHOD NO.:	DX-SG-01/Ver.4
CLIENT NO.:	2585	INSTRUMENT:	GC-HRMS
SAMPLE TYPE:	Train	CONCENTRATION IN:	pg/sample
SAMPLE SIZE:	1 sample		

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	100	2.7	T4CDF - Total	530	1.8
2,3,7,8	3.8	2.7	2,3,7,8	82	1.8
P5CDD - Total	33	1.5	P5CDF - Total	220	2.8
1,2,3,7,8	NDR(7.9)	1.5	1,2,3,7,8	15	2.8
			2,3,4,7,8	NDR(23)	2.8
H6CDD - Total	110	3.0	H6CDF - Total	65	3.0
1,2,3,4,7,8	NDR(5.7)	3.0	1,2,3,4,7,8	NDR(10)	3.0
1,2,3,6,7,8	7.7	3.0	1,2,3,6,7,8	11	3.0
1,2,3,7,8,9	11	3.0	2,3,4,6,7,8	NDR(11)	3.0
			1,2,3,7,8,9	ND	3.0
H7CDD - Total	100	5.0	H7CDF - Total	27	5.0
1,2,3,4,6,7,8	46	5.0	1,2,3,4,6,7,8	19	5.0
			1,2,3,4,7,8,9	ND	5.0
O8CDD	71	8.0	O8CDF	ND	8.0

Surrogate Standards	% Recovery	Field Standards	% Recovery
13C-T4CDF	80	13C6-1,2,3,4-TCDD	106
13C-T4CDD	84	13C-1,2,3,4,7,8,9-HpCDF	99.2
13C-P5CDF	79		
13C-P5CDD	110		
13C-H6CDF	88		
13C-H6CDD	100		
13C-H7CDF	88		
13C-H7CDD	82		
13C-O8CDD	81		

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8-TCDD TEQs (NO=1/2 DL)	18.1	pg/sample
2,3,7,8-TCDD TEQs (ND=0) =	16.4	pg/sample

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________
QA Chemist

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	RUN: BASELINE TRANS CANADA POWER 03-Apr-01	AXYS FILE:	L3385-1
		DATE:	24-May-2001
CLIENT:	A. Lanfranco & Associates Inc.	METHOD NO.:	DX-SG-01/Ver.4
CLIENT NO.:	2585	INSTRUMENT:	GC-HRMS
SAMPLE TYPE:	Train	CONCENTRATION IN:	pg/sample
SAMPLE SIZE:	1 sample		

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	29	4.0	T4CDF - Total	240	2.0
2,3,7,8	4.2	4.0	2,3,7,8	32	2.0
P5CDD - Total	13	1.6	P5CDF - Total	15	2.9
1,2,3,7,8	NDR(1.9)	1.6	1,2,3,7,8	NDR(4.2)	2.9
			2,3,4,7,8	NDR(3.6)	2.9
H6CDD - Total	12	3.0	H6CDF - Total	ND	3.0
1,2,3,4,7,8	ND	3.0	1,2,3,4,7,8	ND	3.0
1,2,3,6,7,8	ND	3.0	1,2,3,6,7,8	ND	3.0
1,2,3,7,8,9	ND	3.0	2,3,4,6,7,8	ND	3.0
			1,2,3,7,8,9	ND	3.0
H7CDD - Total	ND	5.0	H7CDF - Total	ND	5.0
1,2,3,4,6,7,8	NDR(7.6)	5.0	1,2,3,4,6,7,8	ND	5.0
			1,2,3,4,7,8,9	ND	5.0
O8CDD	31	8.0	O8CDF	ND	8.0

Surrogate Standards	% Recovery	Field Standards	% Recovery
13C-T4CDF	80	13C6-1,2,3,4-TCDD	111
13C-T4CDD	79	13C-1,2,3,4,7,8,9-HpCDF	103
13C-P5CDF	76		
13C-P5CDD	100		
13C-H6CDF	78		
13C-H6CDD	91		
13C-H7CDF	80		
13C-H7CDD	82		
13C-O8CDD	81		

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8-TCDD TEQs (ND=1/2 DL)	9.75	pg/sample
2,3,7,8-TCDD TEQs (ND=0) =	7.43	pg/sample

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________________
QA Chemist

A. Lanfranco and Associates Inc. - Emission Report

Client:	Trans Canada Power	**Date:**	April 4, 2001
Jobsite:	William's Lake, B.C.	**Run:**	1 PCDD/PCDF
Source:	Stack	**Run Time:**	11:15 - 15:49

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2288
Pitot Factor	0 8394
Baro. Press. (in. Hg)	27.68
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	20.0

Collection:

Filter (grams)	0.0000
Washings (grams)	0.0000
Impinger (grams)	0.0000
Total (grams)	0.0000

Gas Analysis (Vol. %):

	CO2	O2
	13.70	6.90
	13 70	6 90
	13.70	6.90
Average =	13.70	6.90

Condensate Collection:

Impinger 1 (grams)	589.0
Impinger 2 (grams)	125.0
Impinger 3 (grams)	1.0
Impinger 4 (grams)	11.8
Total Gain (grams)	726.8

Traverse	Point	Time	Dry Gas Meter	Pitot ^P	Orifice ^H	Dry Gas Temperature		Vacuum	Box	Temperatures		Stack	Wall	Isokin.
		(min.)	(ft3)	(in. H2O)	(in. H2O)	Inlet (oF)	Outlet (oF)	(in. Hg.)	(oF)	Probe (oF)	Impinger (oF)	(oF)	Dist. (in.)	(%)
		0.0	756.650											
1	0	5.0	760 270	1.060	1.64	72	72	2	250	250	50	297	6.1	102.0
		10.0	763.880	1.050	1.64	82	70	2	250	250	50	299	6.1	101.6
		15.0	767 470	1.030	1.61	85	71	2	250	250	50	300	6.1	101.7
		20.0	771 060	1.040	1 64	87	71	2	250	250	50	301	6.1	101.6
	1	25.0	774.750	1 070	1.69	89	72	2	250	250	50	300	20.2	101.5
		30.0	778.460	1.080	1.71	91	74	2	250	250	50	299	20.2	101.7
		35.0	782.170	1.080	1.71	92	75	2	250	250	50	299	20.2	101.5
		40.0	785.870	1.060	1.69	93	76	2	250	250	50	300	20.2	102.1
	2	45.0	789.170	0 840	1.34	93	76	2	250	250	50	299	40.9	102.1
		50.0	792.440	0.830	1.32	93	76	2	250	250	50	299	40.9	101.8
		55.0	795.720	0 830	1 32	94	77	2	250	250	50	298	40.9	101.8
		60.0	798.990	0.830	1.32	94	78	2	250	250	50	299	40.9	101.5
		0.0	798.990											
2	0	5.0	801.430	0.460	0.73	93	82	2	250	250	50	298	6.1	101.2
		10.0	804.220	0.600	0.97	96	82	2	250	250	50	301	6.1	101.3
		15.0	806.970	0 580	0.93	97	83	2	250	250	50	301	6.1	101.4
		20.0	809.740	0.560	0.93	97	83	2	250	250	50	303	6.1	102.3
	1	25.0	812.750	0.690	1.11	97	83	2	250	250	50	302	20.2	101.9
		30.0	815.750	0.700	1.23	97	84	2	250	250	50	302	20.2	100 7
		35.0	818.770	0 680	1.09	97	83	2	250	250	50	301	20.2	102.9
		40.0	821.680	0 650	1.05	97	83	2	250	250	50	301	20.2	101.4
	2	45.0	824.600	0.650	1.05	96	83	2	250	250	50	298	40.9	101.6
		50.0	827.480	0 630	1.01	96	83	2	250	250	50	297	40.9	101.7
		55.0	830.350	0 630	1 01	96	83	2	250	250	50	297	40.9	101.4
		60 0	833 290	0 660	1.06	96	83	2	250	250	50	296	40.9	101.4
		0.0	833 290											
3	0	5.0	836 050	0 600	0.94	89	83	2	250	250	50	299	6.1	100.7
		10.0	838 850	0.620	0.97	92	83	2	250	250	50	300	6.1	100.3
		15.0	841.640	0.620	0 97	94	83	2	250	250	50	297	6.1	99.5
		20 0	844 420	0 620	0.97	94	83	2	250	250	50	296	6.1	99 1
	1	25 0	847 330	0.650	1.01	93	83	2	250	250	50	296	20.2	101 4
		30 0	850 180	0.650	1.01	93	83	2	250	250	50	296	20.2	99.3
		35 0	853 110	0 680	1.06	94	82	2	250	250	50	295	20.2	99.8
		40 0	856 020	0 670	1 05	94	82	2	250.	250	50	295	20.2	99.6
	2	45 0	859 060	0 730	1 14	83	79	2	250	250	50	291	40 9	101 0
		50 0	862 250	0 800	1 25	88	79	2	250	250	50	294	40 9	101 0

		55.0	865.440	0.800	1.25	90	79	2	250	250	50	296	40.9	100.9
		60.0	868.620	0.810	1.26	91	79	2	250	250	50	296	40.9	99.9
		0.0	868.620											
4	0	5.0	872.080	0 950	1.48	93	81	2	250	250	50	299	6.1	100.2
		10.0	875.470	0.900	1.40	95	81	2	250	250	50	300	6.1	100.8
		15.0	878.830	0.900	1.40	96	83	2	250	250	50	299	6.1	99.5
		20.0	882.200	0.890	1.39	96	83	2	250	250	50	298	6.1	100.3
	1	25.0	885.440	0 850	1.33	97	83	2	250	250	50	300	20.2	98.7
		30.0	888.750	0.880	1.37	96	83	2	250	250	50	300	20.2	99.2
		35.0	892.140	0.880	1.37	96	83	2	250	250	50	301	20.2	101.7
		40.0	895.470	0.880	1.37	96	83	2	250	250	50	300	20.2	99.8
	2	45.0	898.550	0.750	1.17	96	83	2	250	250	50	300	40.9	100.0
		50.0	901.660	0 740	1.15	96	84	2	250	250	50	300	40.9	101.5
		55.0	904.700	0.760	1.18	96	83	2	250	250	50	299	40.9	97.9
		60.0	907.800	0.760	1.19	90	83	2	250	250	50	298	40.9	100.4
			Average:	0.785	1.239	92.9	80.3	2.0	250.0	250.0	50.0	298.6		100.9

Client:	Trans Canada Power	**Date:**	April 5, 2001
Jobsite:	William's Lake, B.C.	**Run:**	2 PCDD/PCDF (Railtie)
Source:	Stack	**Run Time:**	09:12 - 14:28

Concentration:		0.00 mg/dscm	0.0000 gr/dscf
		0.00 mg/Acm	0.0000 gr/Acf
		0.00 mg/dscm (@ 11% O2)	0.0000 gr/dscf (@ 11% O2)
Emission Rate:		0.00 Kg/hr	0.000 lb/hr
Sample Gas Volume:		3.8787 dscm	136.975 dscf
Total Sample Time:		240.0 minutes	
Average Isokineticity:		99.9 %	
Flue Gas Characteristics			
	Moisture:	19.72 %	
	Temperature	140.8 oC	285.5 oF
	Flow	5888.1 dscm/min	207939 dscf/min
		98.14 dscm/sec	3465.6 dscf/sec
		11159.8 Acm/min	394109 Acf/min
	Velocity	19.275 m/sec	63.24 f/sec
	Gas Analysis	8.30 % O2	12.10 % CO2
		30.268 Mol. Wt (g/gmole) Dry	27.849 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

A. Lanfr and Associates Inc. - Emission Report

Client:	Trans Canada Power
Jobsite:	William's Lake, B.C.
Source:	Stack

Date:	April 5, 2001
Run:	2 PCDD/PCDF
Run Time:	09:12 - 14:28

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2288
Pitot Factor	0.8394
Baro. Press. (in. Hg)	27.32
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point.	20.0

Collection:

Filter (grams)	0.0000
Washings (grams)	0.0000
Impinger (grams)	0.0000
Total (grams)	0.0000

Gas Analysis (Vol. %):

	CO2	O2
	12.10	8.30
	12.10	8.30
	12.10	8.30
Average =	12.10	8.30

Condensate Collection:

Impinger 1 (grams)	599.0
Impinger 2 (grams)	88.0
Impinger 3 (grams)	3.0
Impinger 4 (grams)	10.8
Total Gain (grams)	700.8

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Temperatures Probe (oF)	Temperatures Impinger (oF)	Temperatures Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	0.293											
1	0	5.0	3.570	0.880	1.36	70	65	1	250	250	50	289	6.1	99.8
		10.0	6.850	0.880	1.36	73	62	1	250	250	50	290	6.1	100.0
		15.0	10.220	0.930	1.44	74	62	1	250	250	50	290	6.1	99.8
		20.0	13.580	0.930	1.44	74	61	1	250	250	50	288	6.1	99.5
	1	25.0	17.140	1.040	1.61	73	59	1	250	250	50	286	20.2	99.9
		30.0	20.640	1.020	1.58	77	63	1	250	250	50	287	20.2	98.5
		35.0	24.240	1.050	1.63	77	63	1	250	250	50	288	20.2	99.9
		40.0	27.770	1.000	1.56	78	63	1	250	250	50	286	20.2	100.1
	2	45.0	31.120	0.900	1.40	78	64	1	250	250	50	285	40.9	100.0
		50.0	34.380	0.860	1.34	78	64	1	250	250	50	284	40.9	99.4
		55.0	37.780	0.920	1.44	78	64	1	250	250	50	285	40.9	100.4
		60.0	41.130	0.900	1.40	78	64	1	250	250	50	283	40.9	99.8
		0.0	41.130											
2	0	5.0	43.680	0.530	0.83	73	70	1	250	250	50	287	6.1	99.1
		10.0	46.310	0.550	0.86	76	71	1	250	250	50	288	6.1	100.0
		15.0	48.830	0.520	0.81	76	69	1	250	250	50	287	6.1	98.6
		20.0	51.380	0.520	0.81	78	70	1	250	250	50	288	6.1	99.6
	1	25.0	54.220	0.640	1.00	80	70	1	250	250	50	288	20.2	99.9
		30.0	57.050	0.640	1.00	82	70	1	250	250	50	285	20.2	99.1
		35.0	59.780	0.600	0.94	83	71	1	250	250	50	286	20.2	98.6
		40.0	62.530	0.610	0.95	84	71	1	250	250	50	286	20.2	98.4
	2	45.0	65.400	0.660	1.03	84	72	1	250	250	50	286	40.9	98.7
		50.0	68.230	0.630	0.99	84	73	1	250	250	50	286	40.9	99.5
		55.0	71.060	0.630	0.99	84	73	1	250	250	50	287	40.9	99.6
		60.0	73.860	0.620	0.97	83	72	1	250	250	50	286	40.9	99.4
		0.0	73.860											
3	0	5.0	76.670	0.630	0.98	77	69	1	250	250	50	285	6.1	99.7
		10.0	79.460	0.620	0.97	78	68	1	250	250	50	285	6.1	99.8
		15.0	82.350	0.670	1.05	77	64	1	250	250	50	286	6.1	100.0
		20.0	85.190	0.650	1.01	76	64	1	250	250	50	285	6.1	99.8
	1	25.0	88.250	0.750	1.18	75	63	1	250	250	50	284	20.2	100.3
		30.0	91.320	0.750	1.18	76	63	1	250	250	50	283	20.2	100.5
		35.0	94.410	0.770	1.20	77	64	1	250	250	50	283	20.2	99.6
		40.0	97.550	0.770	1.20	78	65	1	250	250	50	284	20.2	101.1
	2	45.0	100.580	0.760	1.19	77	64	1	250	250	50	285	40.9	98.4
		50.0	103.670	0.760	1.19	77	64	1	250	250	50	284	40.9	100.3

		55.0	106.880	0.810	1.26	77	63	1	250	250	50	283	40.9	101.0
		60.0	109.970	0.780	1.22	77	64	1	250	250	50	284	40.9	99.0
		0.0	109.970											
4	0	5.0	113.490	0.990	1.54	69	62	2	250	250	50	283	6.1	101.1
		10.0	116.950	0.960	1.50	74	63	2	250	250	50	285	6.1	100.5
		15.0	120.360	0.940	1.47	77	63	2	250	250	50	284	6.1	99.7
		20.0	123.810	0.950	1.48	77	63	2	250	250	50	283	6.1	100.3
	1	25.0	127.300	0.980	1.53	77	64	2	250	250	50	285	20.2	99.9
		30.0	130.810	0.980	1.53	77	64	2	250	250	50	285	20.2	100.5
		35.0	134.220	0.940	1.47	71	61	2	250	250	50	285	20.2	100.5
		40.0	137.640	0.930	1.45	74	61	2	250	250	50	285	20.2	101.1
	2	45.0	140.990	0.900	1.40	74	61	2	250	250	50	284	40.9	100.6
		50.0	144.300	0.880	1.37	74	61	2	250	250	50	284	40.9	100.5
		55.0	147.630	0.890	1.39	74	61	2	250	250	50	284	40.9	100.5
		60.0	150.990	0.900	1.40	74	61	2	250	250	50	284	40.9	100.9
			Average:	0.800	1.248	76.9	65.1	1.3	250.0	250.0	50.0	285.5		99.9

Client:	Trans Canada Power	**Date:**	April 6, 2001
Jobsite:	William's Lake, B.C.	**Run:**	3 PCDD/PCDF (Railtie)
Source:	Stack	**Run Time:**	08:22 - 11:35

Concentration:	0.00 mg/dscm	0.0000 gr/dscf
	0.00 mg/Acm	0.0000 gr/Acf
	0.00 mg/dscm (@ 11% O2)	0.0000 gr/dscf (@ 11% O2)
Emission Rate:	0.00 Kg/hr	0.000 lb/hr
Sample Gas Volume:	2.8474 dscm	100.555 dscf
Total Sample Time:	180.0 minutes	
Average Isokineticity:	105.2 %	

Flue Gas Characteristics

Moisture:	21.98 %	
Temperature	138.8 oC	281.8 oF
Flow	5472.2 dscm/min	193251 dscf/min
	91.20 dscm/sec	3220.9 dscf/sec
	10662.1 Acm/min	376533 Acf/min
Velocity	18.416 m/sec	60.42 f/sec
Gas Analysis	5.60 % O2	14.80 % CO2
	30.592 Mol. Wt (g/gmole) Dry	27.825 Mol. Wt (g/gmole) Wet

*** Standard Conditions:**

Metric: 25 deg C, 101.325 kPa
Imperial: 77 deg F, 29.92 in.Hg

A. Lanfrai and Associates Inc. - Emission Report

Client:	Trans Canada Power	**Date:**	April 6, 2001
Jobsite:	William's Lake, B.C.	**Run:**	3 PCDD/PCDF
Source:	Stack	**Run Time:**	08:22 - 11:35

Control Unit (Y)	0.9810
Nozzle Diameter (in.)	0.2288
Pitot Factor	0.8394
Baro. Press. (in. Hg)	27.21
Static Press. (in. Hg)	-0.25
Stack Height (ft)	200
Stack Diameter (in.)	138.0
Stack Area (sq.ft.)	103.869
Minutes Per Reading	5.0
Minutes Per Point	15.0

Collection:

Filter (grams)	0.0000
Washings (grams)	0.0000
Impinger (grams)	0.0000
Total (grams)	0.0000

Gas Analysis (Vol. %):

	CO2	O2
	14.80	5.60
	14.80	5.60
	14.80	5.60
Average =	14.80	5.60

Condensate Collection:

Impinger 1 (grams)	505.0
Impinger 2 (grams)	70.0
Impinger 3 (grams)	2.0
Impinger 4 (grams)	13.1
Total Gain (grams)	590.1

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Box (oF)	Temperatures Probe (oF)	Temperatures Impinger (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	218.598											
1	0	5.0	221.810	0.820	1 31	55	52	4	250	250	50	280	6.1	106.2
		10.0	225.100	0.870	1.39	63	54	4	250	250	50	281	6.1	104.7
		15.0	228.350	0.840	1.34	63	53	4	250	250	50	282	6.1	105.4
	1	20.0	231.510	0.800	1.28	63	52	4	250	250	50	281	20.2	105.0
		25.0	234.720	0.830	1.33	63	51	4	250	250	50	279	20.2	104.7
		30.0	237.950	0.830	1.33	64	51	4	250	250	50	279	20.2	105.3
	2	35.0	241.050	0.770	1.23	66	52	4	250	250	50	277	40.9	104.4
		40.0	244 170	0.780	1.25	66	52	4	250	250	50	277	40.9	104.4
		45.0	247.280	0.780	1.25	66	52	4	250	250	50	278	40.9	104.2
		0 0	247.280											
2	0	5.0	250.080	0.620	0 99	60	51	4	250	250	50	276	6.1	105.7
		10.0	252.920	0.650	1.04	66	53	4	250	250	50	279	6.1	104.1
		15.0	255.630	0.590	0.94	69	55	4	250	250	50	281	6.1	103.9
	1	20.0	258.520	0.650	1.04	70	56	3	250	250	50	282	20.2	105.5
		25.0	261.530	0.710	1.15	71	57	3	250	250	50	281	20.2	104.9
		30.0	264 500	0.680	1 10	73	58	3	250	250	50	280	20.2	105.3
	2	35.0	267.390	0 670	1.09	72	59	3	250	250	50	280	40.9	103.2
		40.0	270.420	0.720	1.17	73	59	3	250	250	50	280	40.9	104.3
		45.0	273.410	0.700	1.13	73	59	3	250	250	50	280	40.9	104.4
		0.0	273.410											
2	0	5.0	275.880	0.480	0 78	65	59	2	250	250	50	282	6.1	105.0
		10.0	278.350	0.480	0.78	72	62	3	250	250	50	283	6.1	104.1
		15 0	280.770	0.450	0 74	73	64	3	250	250	50	284	6.1	105.1
	1	20.0	283 540	0.600	0.98	73	63	3	250	250	50	286	20.2	104.5
		25.0	286 300	0.570	0.93	73	63	3	250	250	50	287	20.2	106.9
		30.0	289 100	0.600	0.98	72	62	3	250	250	50	285	20.2	105.7
	2	35.0	291.990	0.650	1.07	72	61	3	250	250	50	284	40.9	104.9
		40.0	294.880	0.650	1.07	71	60	3	250	250	50	284	40.9	105.1
		45.0	297 800	0 650	1.07	71	60	3	250	250	50	284	40.9	106.2
		0.0	297 800											
2	0	5.0	301 120	0.850	1.39	66	57	4	250	250	50	283	6.1	106.4
		10 0	304.440	0.850	1 39	71	58	4	250	250	50	285	6.1	105.9
		15.0	307.850	0.890	1.46	72	59	4	250	250	50	285	6.1	106.2
	1	20 0	311.300	0.920	1.51	72	59	4	250	250	50	284	20 2	105.6
		25 0	314 820	0 950	1 56	73	59	4	250	250	50	284	20 2	105 9

		30.0	318.310	0.940	1.55	73	59	4	250	250	50	284	20.2	105.6
	2	35.0	321.580	0.820	1.34	73	60	4	250	250	50	282	40.9	105.6
		40.0	324.790	0.800	1.31	72	60	4	250	250	50	283	40.9	105.1
		45.0	328.040	0.800	1.31	72	60	4	250	250	50	282	40.9	106.4
			Average:	0.729	1.183	68.9	57.3	3.6	250.0	250.0	50.0	281.8		105.2

APPENDIX 2

ANALYTICAL DATA

FILTER WEIGHTS

Contract:	2585
LIMS:	L3385-1 to -5
Receive Date:	16-Apr-01
Weighing Date:	24-Apr-01
Analyst:	Teresa Rawsthorne
Description:	Weights of the filter disks upon arrival. Disks were weighed 'as is', without drying.

LIMS #	Client ID	Filter weight
L3385-1	Run: Baseline	0.4621 g
L3385-2	Run: Rail Tie 1	0.4584 g
L3385-3	Run: Rail Tie 2	0.4363 g
L3385-4	Run: Rail Tie 3	0.4278 g
L3385-5	Run: Blank	0.4254 g

DX001D-1

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 2 TRANS CANADA POWER 05-Apr-01	AXYS FILE:	L3385-3
		DATE:	24-May-2001
CLIENT:	A. Lanfranco & Associates Inc.	METHOD NO.:	DX-SG-01/Ver.4
CLIENT NO.:	2585	INSTRUMENT:	GC-HRMS
SAMPLE TYPE:	Train	CONCENTRATION IN:	pg/sample
SAMPLE SIZE:	1 sample		

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	120	4.3	T4CDF - Total	550	2.4
2,3,7,8	5.4	4.3	2,3,7,8	82	2.4
P5CDD - Total	72	1.5	P5CDF - Total	250	4.6
1,2,3,7,8	NDR(11)	1.5	1,2,3,7,8	18	4.6
			2,3,4,7,8	22	4.6
H6CDD - Total	100	3.0	H6CDF - Total	85	3.0
1,2,3,4,7,8	NDR(6.6)	3.0	1,2,3,4,7,8	13	3.0
1,2,3,6,7,8	12	3.0	1,2,3,6,7,8	11	3.0
1,2,3,7,8,9	NDR(13)	3.0	2,3,4,6,7,8	NDR(14)	3.0
			1,2,3,7,8,9	ND	3.0
H7CDD - Total	120	5.0	H7CDF - Total	27	5.0
1,2,3,4,6,7,8	56	5.0	1,2,3,4,6,7,8	19	5.0
			1,2,3,4,7,8,9	ND	5.0
O8CDD	130	8.0	O8CDF	12	8.0

Surrogate Standards	% Recovery
13C-T4CDF	62
13C-T4CDD	65
13C-P5CDF	67
13C-P5CDD	110
13C-H6CDF	67
13C-H6CDD	78
13C-H7CDF	75
13C-H7CDD	69
13C-O8CDD	75

Field Standards	% Recovery
13C6-1,2,3,4-TCDD	117
13C-1,2,3,4,7,8,9-HpCDF	98.8

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8-TCDD TEQs (ND=1/2 DL)	31	pg/sample
2,3,7,8-TCDD TEQs (ND=0) =	30	pg/sample

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________
QA Chemist

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 3 TRANS CANADA POWER 06-Apr-01	AXYS FILE:	L3385-4
		DATE:	24-May-2001
CLIENT:	A. Lanfranco & Associates Inc.	METHOD NO.:	DX-SG-01/Ver.4
CLIENT NO.:	2585	INSTRUMENT:	GC-HRMS
SAMPLE TYPE:	Train	CONCENTRATION IN:	pg/sample
SAMPLE SIZE:	1 sample		

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	25	3.9	T4CDF - Total	220	2.7
2,3,7,8	ND	3.9	2,3,7,8	26	2.7
P5CDD - Total	22	2.5	P5CDF - Total	64	2.3
1,2,3,7,8	NDR(4)	2.5	1,2,3,7,8	6.7	2.3
			2,3,4,7,8	NDR(12)	2.3
H6CDD - Total	45	3.0	H6CDF - Total	34	3.0
1,2,3,4,7,8	3.5	3.0	1,2,3,4,7,8	8.6	3.0
1,2,3,6,7,8	3.7	3.0	1,2,3,6,7,8	4.9	3.0
1,2,3,7,8,9	NDR(4.8)	3.0	2,3,4,6,7,8	NDR(6.5)	3.0
			1,2,3,7,8,9	ND	3.0
H7CDD - Total	50	5.0	H7CDF - Total	ND	5.0
1,2,3,4,6,7,8	27	5.0	1,2,3,4,6,7,8	NDR(8.8)	5.0
			1,2,3,4,7,8,9	ND	5.0
O8CDD	NDR(75)	8.0	O8CDF	8.3	8.0

Surrogate Standards	% Recovery
13C-T4CDF	59
13C-T4CDD	62
13C-P5CDF	66
13C-P5CDD	92
13C-H6CDF	61
13C-H6CDD	71
13C-H7CDF	64
13C-H7CDD	66
13C-O8CDD	63

Field Standards	% Recovery
13C6-1,2,3,4-TCDD	103
13C-1,2,3,4,7,8,9-HpCDF	97.7

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8-TCDD TEQs (ND=1/2 DL)	8.98	pg/sample
2,3,7,8-TCDD TEQs (ND=0) =	5.34	pg/sample

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ______________
QA Chemist

PH033A

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 2 TRANS CANADA POWER 05-APR-0	AXYS FILE:	L3385-3 I
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Sample Train	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171191.D

Compound	Lab Flag[1]	Concentration	SDL
Naphthalene		2000	8.9
Acenaphthylene		7.3	2.2
Acenaphthene		46	2.9
Fluorene	NDR	8.5	2.1
Phenanthrene	NDR	140	6.0
Anthracene	NDR	24	7.1
Fluoranthene		39	3.1
Pyrene		28	3.1
Benz[a]anthracene	NDR	9.0	4.2
Chrysene		8.8	5.6
Benzo[b/j]fluoranthenes	NDR	22	9.9
Benzo[k]fluoranthene	ND		9.9
Benzo[e]pyrene		12	6.6
Benzo[a]pyrene	ND		9.0
Perylene	ND		9.1
Dibenz[ah]anthracene	ND		9.3
Indeno[1,2,3-cd]pyrene	NDR	7.5	5.4
Benzo[ghi]perylene	ND		6.3
Dimethyl Naphthalenes		150	2.9
2-Methylfluorene	ND		8.3
Benzo[ghi]fluoranthene	ND		3.6
7,12-Dimethyl Benz[a]Anthracen	ND		92
Benzo[a]Fluorene	ND		4.3
Benzo[b]Fluorene	ND		4.3
Dibenzo[a,h]Acridine	ND		11
Dibenzo[a,j]Acridine	ND		11
7H Dibenzo[c,g]Carbazole	ND		35
Dibenzo[a,i]Pyrene	ND		16
1-Methylpyrene	ND		4.3
1,6-Dinitropyrene	ND		80
1,8-Dinitropyrene	ND		80

Field Surrogate	Determined	Expected	% Recovery
Anthracene d-10	1834	2024	91

Labeled Compound	% Recovery
Naphthalene d-8	32
Acenaphthylene d-8	44
Phenanthrene d-10	62
Fluoranthene d-10	73
Benz(a)anthracene d-12	71
Chrysene d-12	65
Benzo(b,k)Fluoranthene d-12	61
Benzo(a)pyrene d-12	63
Perylene d-12	72
Dibenzo(ah)anthracene d-14	59
Indeno(123cd)pyrene d-12	65
Benzo(ghi)perylene d-12	66
2,6-Dimethylnaphthalene d-12	51

(1) ND = not detected; NDR = peak detected, but did not meet quantification criteria
(2) SDL = Sample Detection Limit
(3) Concentrations are recovery corrected
(4) Data have not been blank corrected

Approved: ______________
QA Chemist

PH033A

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 3 TRANS CANADA POWER 06-APR-0	AXYS FILE:	L3385-4 i
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Sample Train	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171192.D

Compound	Lab Flag[1]	Concentration	SDL
Naphthalene		1800	8.2
Acenaphthylene		15	2.4
Acenaphthene		50	1.9
Fluorene	NDR	30	2.4
Phenanthrene		96	5.5
Anthracene	NDR	11	6.5
Fluoranthene		43	1.5
Pyrene		41	1.5
Benz[a]anthracene	NDR	8.6	3.1
Chrysene		21	4.2
Benzo[b/j]fluoranthenes		23	11
Benzo[k]fluoranthene	ND		11
Benzo[e]pyrene	ND		6.9
Benzo[a]pyrene	ND		9.4
Perylene	ND		9.9
Dibenz[ah]anthracene	ND		11
Indeno[1,2,3-cd]pyrene	ND		7.3
Benzo[ghi]perylene	ND		8.4
Dimethyl Naphthalenes		160	3.3
2-Methylfluorene	ND		4.9
Benzo[ghi]fluoranthene	ND		4.3
7,12-Dimethyl Benz[a]Anthracen	NDR	140	110
Benzo[a]Fluorene	ND		3.3
Benzo[b]Fluorene	ND		3.3
Dibenzo[a,h]Acridine	ND		9.9
Dibenzo[a,j]Acridine	ND		9.6
7H Dibenzo[c,g]Carbazole	ND		45
Dibenzo[a,i]Pyrene	ND		16
1-Methylpyrene		4.5	3.3
1,6-Dinitropyrene	ND		47
1,8-Dinitropyrene	ND		47

Field Surrogate	Determined	Expected	% Recovery
Anthracene d-10	1921	2024	95

Labeled Compound	% Recovery
Naphthalene d-8	36
Acenaphthylene d-8	59
Phenanthrene d-10	68
Fluoranthene d-10	77
Benz(a)anthracene d-12	77
Chrysene d-12	69
Benzo(b,k)Fluoranthene d-12	66
Benzo(a)pyrene d-12	72
Perylene d-12	79
Dibenzo(ah)anthracene d-14	60
Indeno(123cd)pyrene d-12	66
Benzo(ghi)perylene d-12	66
2,6-Dimethylnaphthalene d-12	63

(1) ND = not detected; NDR = peak detected, but did not meet quantification criteria
(2) SDL = Sample Detection Limit
(3) Concentrations are recovery corrected
(4) Data have not been blank corrected

Approved: ____________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RUN: BASELINE TRANS CANADA POWER 03-APR-01	AXYS FILE:	L3385-1
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Train	INSTRUMENT:	GC-MS
		RUN ID:	CP171209.D
SAMPLE SIZE:	1 sample	CONCENTRATION IN:	ng/sample

Compound	Concentration	SDL
2,4,6-Trichlorophenol	42	1.1
2,3,6-Trichlorophenol	ND	0.94
2,3,5-Trichlorophenol	ND	0.99
2,4,5-Trichlorophenol	NDR 2.2	1.1
2,3,4-Trichlorophenol	ND	1
3,4,5-Trichlorophenol	ND	1.1
2,3,5,6-Tetrachlorophenol	ND	1.3
2,3,4,6-Tetrachlorophenol	15	0.98
2,3,4,5-Tetrachlorophenol	ND	1
Pentachlorophenol	3.6	2.2

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	62
2,4,5-Trichlorophenol-13C	63
2,3,4,5-Tetrachlorophenol-13C	100
Pentachlorophenol-13C	87

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.

Approved: ______________________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 1 TRANS CANADA POWER 04-APR-01	AXYS FILE:	L3385-2
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Train	INSTRUMENT: RUN ID:	GC-MS CP171210.D
SAMPLE SIZE:	1 sample	CONCENTRATION IN:	ng/sample

Compound	Concentration	SDL
2,4,6-Trichlorophenol	340	4.3
2,3,6-Trichlorophenol	ND	3.7
2,3,5-Trichlorophenol	ND	3.9
2,4,5-Trichlorophenol	NDR 3.4	1.3
2,3,4-Trichlorophenol	3.4	1.2
3,4,5-Trichlorophenol	ND	1.2
2,3,5,6-Tetrachlorophenol	ND	1.2
2,3,4,6-Tetrachlorophenol	21	0.9
2,3,4,5-Tetrachlorophenol	3.5	0.92
Pentachlorophenol	17	3.9

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	21
2,4,5-Trichlorophenol-13C	47
2,3,4,5-Tetrachlorophenol-13C	97
Pentachlorophenol-13C	67

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.

Approved: ______________________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 2 TRANS CANADA POWER 05-APR-01	AXYS FILE:	L3385-3
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Train	INSTRUMENT:	GC-MS
		RUN ID:	CP171211.D
SAMPLE SIZE:	1 sample	CONCENTRATION IN:	ng/sample

Compound	Concentration	SDL
2,4,6-Trichlorophenol	620	1.9
2,3,6-Trichlorophenol	ND	1.7
2,3,5-Trichlorophenol	3.3	1.7
2,4,5-Trichlorophenol	15	2.1
2,3,4-Trichlorophenol	11	2
3,4,5-Trichlorophenol	ND	2.1
2,3,5,6-Tetrachlorophenol	ND	1.3
2,3,4,6-Tetrachlorophenol	60	1
2,3,4,5-Tetrachlorophenol	3.1	1
Pentachlorophenol	21	1.9

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	62
2,4,5-Trichlorophenol-13C	59
2,3,4,5-Tetrachlorophenol-13C	100
Pentachlorophenol-13C	78

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.

Approved: ______________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RUN: RAIL TIE 3 TRANS CANADA POWER 06-APR-01	AXYS FILE:	L3385-4
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Train	INSTRUMENT:	GC-MS
		RUN ID:	CP171212.D
SAMPLE SIZE:	1 sample	CONCENTRATION IN:	ng/sample

Compound	Concentration	SDL
2,4,6-Trichlorophenol	200	2.5
2,3,6-Trichlorophenol	ND	2.1
2,3,5-Trichlorophenol	ND	2.2
2,4,5-Trichlorophenol	6.5	1.6
2,3,4-Trichlorophenol	NDR 3.3	1.5
3,4,5-Trichlorophenol	ND	1.6
2,3,5,6-Tetrachlorophenol	ND	1.5
2,3,4,6-Tetrachlorophenol	21	1.1
2,3,4,5-Tetrachlorophenol	NDR 1.3	1.1
Pentachlorophenol	6.7	3.5

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	48
2,4,5-Trichlorophenol-13C	53
2,3,4,5-Tetrachlorophenol-13C	100
Pentachlorophenol-13C	80

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.

Approved: ____________________
QA Chemist

C

NORWEST LABS

Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

#104, 19575-55 A Ave.
Surrey, BC. V3S 8P8
Phone: (604) 514-3322
Fax: (604) 514-3323

Analytical Report

Bill to: Al Lanfranco & Associates
Report to: Al Lanfranco & Associates

100A. 20120 - 64 Avenue
Langley. BC. Canada
V2Y 1M8
Attn: Al LanFranco
Sampled By:

Project ID:
Name: Trans Canada Power
Location: Williams Lake
LSD:
P.O.:
Acct. Code: 61338

NWL Lot ID: 113449
Control Number: E 22450
Date Received: Apr 11, 2001
Date Reported: Apr 23, 2001
Report Number: 162110

Aggregate Organic Constituents

NWL Number	Date Sampled	Sample Information	Analyte / Units / Detection Limit Volume Volume mL 1
113449-1		TC Power HG-1 Baseline 3/4/01	430
113449-2		TC Power HG-2 Baseline 4/4/01	430
113449-3		TC Power HG-3 4/4/01	405
113449-4		TC Power HG-4 5/4/01	380
113449-5		TC Power HG-5 6/4/01	370
13449-6		TC Power HCl-1 Baseline 3/4/01	352
113449-7		TC Power HCl-2 Baseline 3/4/01	369
113449-8		TC Power HCl-3 4/4/01	394
113449-9		TC Power HCl-4 5/4/01	331
113449-10		TC Power HCl-5 6/4/01	359
113449-11		Hg Blank	310
113449-12		HCl Blank	435
113449-13		HCl Blank for Spike (10 ppm)	355

Air Quality

NWL Number	Date Sampled	Sample Information	Analyte / Units / Detection Limit Chloride Water Soluble ug 3
113449-6		TC Power HCl-1 Baseline 3/4/01	39
113449-7		TC Power HCl-2 Baseline 3/4/01	33
113449-8		TC Power HCl-3 4/4/01	39100
113449-9		TC Power HCl-4 5/4/01	51200
113449-10		TC Power HCl-5 6/4/01	43200
113449-12		HCl Blank	20
113449-13		HCl Blank for Spike (10 ppm)	<20

NORWEST LABS

Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

#104, 19575-55 A Ave.
Surrey, BC. V3S 8P8
Phone: (604) 514-3322
Fax: (604) 514-3323

Bill to: Al Lanfranco & Associates
Report to: Al Lanfranco & Associates

100A, 20120 - 64 Avenue
Langley, BC, Canada
V2Y 1M8
Attn: Al LanFranco

Sampled By:

Project ID:
Name: Trans Canada Power
Location: Williams Lake
LSD:
P.O.:
Acct. Code: 61338

NWL Lot ID: 113449
Control Number: E 22450
Date Received: Apr 11, 2001
Date Reported: Apr 23, 2001
Report Number: 162110

Air Quality Metals

NWL Number	Date Sampled	Sample Information	Analyte / Units / Detection Limit Mercury Strong Acid Extractable ug 0.005
113449-1		TC Power HG-1 Baseline 3/4/01	3.85
113449-2		TC Power HG-2 Baseline 4/4/01	2.63
113449-3		TC Power HG-3 4/4/01	0.93
113449-4		TC Power HG-4 5/4/01	0.338
13449-5		TC Power HG-5 6/4/01	0.302
113449-11		Hg Blank	0.031

Chloride QC
Sample #13 spiked with 10 ppm Cl.
Reading = 10.3 ppm = 103% Recovery

ERA CRM (Lot 9978) Cl = 122 ppm
Mean value given as 122 ppm
Mercury QC
Sample 11 spiked with 1 ppm Hg. Recovery was 79%.
Sample 2 also spiked. Recovery was 95%.
Report HG as ug/bottle. Measure and report volume +/- 2ml. Report HCl as mg/bottle. Report and measure volume +/- 2ml. TB 12-Apr-01

Approved by:

NORWEST LABS

Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

#104, 19575-55 A Ave.
Surrey, BC. V3S 8P8
Phone: (604) 514-3322
Fax: (604) 514-3323

Bill to: Al Lanfranco & Associates
Report to: Al Lanfranco & Associates

100A, 20120 - 64 Avenue
Langley, BC, Canada
V2Y 1M8
Attn: Al LanFranco

Sampled By:

Project ID:
Name: Trans Canada Power
Location: Williams Lake
LSD:
P.O.:
Acct. Code: 61337

NWL Lot ID: 113460
Control Number: E 22451
Date Received: Apr 11, 2001
Date Reported: Apr 20, 2001
Report Number: 165200

		NWL Number:	113460-1	113460-2	113460-3	
		Sample Date:				
		Sample Description:	TC Power PW-1 Baseline & Metals-1 Baseline (Beaker #M27) 3/4/01	TC Power PW-2 Baseline & Metals-2 Baseline (Beaker #B25) 4/4/01	TC Power PW-3 & Metals-3 (Beaker #M5) 4/4/01	
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Air Quality Metals						
Aluminum	Strong Acid Extractable	ug	87.8	53.1	61.4	0.5
Antimony	Strong Acid Extractable	ug	<1	<1	<1	1
Arsenic	Strong Acid Extractable	ug	<1	<1	2	1
Barium	Strong Acid Extractable	ug	11.4	7.22	9.37	0.03
Beryllium	Strong Acid Extractable	ug	<0.02	<0.02	<0.02	0.03
Bismuth	Strong Acid Extractable	ug	<1	<1	<1	1
Cadmium	Strong Acid Extractable	ug	0.871	0.504	.944	0.03
Calcium	Strong Acid Extractable	ug	826	356	679	0.5
Chromium	Strong Acid Extractable	ug	5.34	2	2.5	0.05
Cobalt	Strong Acid Extractable	ug	0.2	0.09	0.1	0.05
Copper	Strong Acid Extractable	ug	10.1	7.66	7.79	0.05
Iron	Strong Acid Extractable	ug	94.6	50.1	105	0.1
Lead	Strong Acid Extractable	ug	18.5	15.2	17.4	0.3
Lithium	Strong Acid Extractable	ug	<0.3	<0.3	0.3	0.3
Magnesium	Strong Acid Extractable	ug	105	58.1	108	0.5
Manganese	Strong Acid Extractable	ug	31.4	15.3	32.1	0.05
Mercury	Strong Acid Extractable	ug	0.008	<0.005	0.244	0.005
Molybdenum	Strong Acid Extractable	ug	0.6	<0.5	<0.5	0.5
Nickel	Strong Acid Extractable	ug	2.9	1.5	3.4	0.05
Phosphorus	Strong Acid Extractable	ug	85.1	54.9	100	3
Potassium	Strong Acid Extractable	ug	806	380	772	15
Selenium	Strong Acid Extractable	ug	2	1	<1	1
Silicon	Strong Acid Extractable	ug	5.1	4	13	3
Silver	Strong Acid Extractable	ug	0.2	0.1	0.1	0.1
Sodium	Strong Acid Extractable	ug	572	237	411	3
Strontium	Strong Acid Extractable	ug	3.2	2	3.2	0.3
Sulphur	Strong Acid Extractable	ug	360	522	83000	10
Tellurium	Strong Acid Extractable	ug	<2	<2	<2	2
Thallium	Strong Acid Extractable	ug	0.45	0.15	0.35	0.2
Thorium	Strong Acid Extractable	ug	<0.3	<0.3	<0.3	0.3
Tin	Strong Acid Extractable	ug	4.7	4.3	7.8	0.3
Titanium	Strong Acid Extractable	ug	2.5	1.2	2.3	0.05

Analytical Report

Bill to: Al Lanfranco & Associates
Report to: Al Lanfranco & Associates

100A, 20120 - 64 Avenue
Langley, BC, Canada
V2Y 1M8
Attn: Al LanFranco

Sampled By:

Project ID:
Name: Trans Canada Power
Location: Williams Lake
LSD:
P.O.:
Acct. Code: 61337

NWL Lot ID: 113460
Control Number: E 22451
Date Received: Apr 11, 2001
Date Reported: Apr 20, 2001
Report Number: 165200

		NWL Number:	113460-1	113460-2	113460-3	
		Sample Date:				
		Sample Description:	TC Power PW-1 Baseline & Metals-1 Baseline (Beaker #M27) 3/4/01	TC Power PW-2 Baseline & Metals-2 Baseline (Beaker #B25) 4/4/01	TC Power PW-3 & Metals-3 (Beaker #M5) 4/4/01	
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Air Quality Metals - Continued						
Uranium	Strong Acid Extractable	ug	<3	<3	<3	3
Vanadium	Strong Acid Extractable	ug	0.2	0.2	0.2	0.05
Zinc	Strong Acid Extractable	ug	92	40.1	94.6	0.03
Zirconium	Strong Acid Extractable	ug	0.7	0.7	0.69	0.3

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

#104, 19575-55 A Ave.
Surrey, BC. V3S 8P8
Phone: (604) 514-3322
Fax: (604) 514-3323

Bill to: Al Lanfranco & Associates
Report to: Al Lanfranco & Associates

100A. 20120 - 64 Avenue
Langley, BC, Canada
V2Y 1M8
Attn: Al LanFranco

Sampled By:

Project ID:
Name: Trans Canada Power
Location: Williams Lake
LSD:
P.O.:
Acct. Code: 61337

NWL Lot ID: 113460
Control Number: E 22451
Date Received: Apr 11, 2001
Date Reported: Apr 20, 2001
Report Number: 165200

NWL Number: 113460-4 | 113460-5 | 113460-6
Sample Date:
Sample Description: TC Power PW-4 & Metals-4 (Beaker #212) 5/4/01 | TC Power PW-5 & Metals-5 (Beaker #4) 6/4/01 | Blank PW-Probe Wash & Blank Metals (Beaker #B10)

Analyte		Units	Results	Results	Results	Detection Limit
Air Quality Metals						
Aluminum	Strong Acid Extractable	ug	32	26	18	0.5
Antimony	Strong Acid Extractable	ug	<1	<1	<1	1
Arsenic	Strong Acid Extractable	ug	1	<1	<1	1
Barium	Strong Acid Extractable	ug	3.42	3.02	2.51	0.03
Beryllium	Strong Acid Extractable	ug	<0.02	<0.02	<0.02	0.03
Bismuth	Strong Acid Extractable	ug	1	<1	<1	1
Cadmium	Strong Acid Extractable	ug	0.22	0.24	0.096	0.03
Calcium	Strong Acid Extractable	ug	143	128	81.2	0.5
Chromium	Strong Acid Extractable	ug	1.5	1.3	1.3	0.05
Cobalt	Strong Acid Extractable	ug	0.09	0.07	<0.05	0.05
Copper	Strong Acid Extractable	ug	5.44	8.85	1.9	0.05
Iron	Strong Acid Extractable	ug	45.5	39.6	8.1	0.1
Lead	Strong Acid Extractable	ug	13.1	5.77	1.2	0.3
Lithium	Strong Acid Extractable	ug	<0.3	<0.3	<0.3	0.3
Magnesium	Strong Acid Extractable	ug	19	19	11	0.5
Manganese	Strong Acid Extractable	ug	5.64	4.05	1.45	0.05
Mercury	Strong Acid Extractable	ug	0.056	0.056	<0.005	0.005
Molybdenum	Strong Acid Extractable	ug	<0.5	<0.5	<0.5	0.5
Nickel	Strong Acid Extractable	ug	2	2.9	0.67	0.05
Phosphorus	Strong Acid Extractable	ug	43	41	54	3
Potassium	Strong Acid Extractable	ug	110	85	30	15
Selenium	Strong Acid Extractable	ug	<1	<1	<1	1
Silicon	Strong Acid Extractable	ug	5.2	<2	5	3
Silver	Strong Acid Extractable	ug	0.1	0.5	0.1	0.1
Sodium	Strong Acid Extractable	ug	126	152	193	3
Strontium	Strong Acid Extractable	ug	0.78	0.5	<0.3	0.3
Sulphur	Strong Acid Extractable	ug	56900	49600	569	10
Tellurium	Strong Acid Extractable	ug	<2	<2	<2	2
Thallium	Strong Acid Extractable	ug	<0.15	<0.15	<0.5	0.2
Thorium	Strong Acid Extractable	ug	<0.3	<0.3	<0.3	0.3
Tin	Strong Acid Extractable	ug	4.5	4.7	5.47	0.3
Titanium	Strong Acid Extractable	ug	0.84	0.57	0.4	0.05
ranium	Strong Acid Extractable	ug	<3	<3	<3	3

NORWEST LABS

Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

#104, 19575-55 A Ave.
Surrey, BC. V3S 8P8
Phone: (604) 514-3322
Fax: (604) 514-3323

Bill to: Al Lanfranco & Associates
Report to: Al Lanfranco & Associates

100A, 20120 - 64 Avenue
Langley, BC, Canada
V2Y 1M8
Attn: Al LanFranco
Sampled By:

Project ID:
Name: Trans Canada Power
Location: Williams Lake
LSD:
P.O.:
Acct. Code: 61337

NWL Lot ID: 113460
Control Number: E 22451
Date Received: Apr 11, 2001
Date Reported: Apr 20, 2001
Report Number: 165200

	NWL Number:		113460-4	113460-5	113460-6	
	Sample Date:					
	Sample Description:		TC Power PW-4 & Metals-4 (Beaker #212) 5/4/01	TC Power PW-5 & Metals-5 (Beaker #4) 6/4/01	Blank PW-Probe Wash & Blank Metals (Beaker #B10)	
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Air Quality Metals - Continued						
Vanadium	Strong Acid Extractable	ug	0.2	0.09	<0.05	0.05
Zinc	Strong Acid Extractable	ug	22.2	23.4	11.6	0.03
Zirconium	Strong Acid Extractable	ug	0.4	0.59	1.1	0.3

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	BASELINE WILLIAMS LAKE 03-APR-01 REGULAR FUEL	AXYS FILE:	L3383-1
CLIENT:	A. Lanfranco & Associates	DATE:	28/May/2001
CLIENT NO.:	2585		
SAMPLE TYPE:	Pulp	METHOD NO.:	DX-P-01/Ver.4
SAMPLE SIZE:	1.23 g (dry)	INSTRUMENT:	GC-HRMS
		CONCENTRATION IN:	pg/g

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	ND	0.8	T4CDF - Total	ND	0.8
2,3,7,8	ND	0.8	2,3,7,8	ND	0.8
P5CDD - Total	ND	0.8	P5CDF - Total	ND	0.8
1,2,3,7,8	ND	0.8	1,2,3,7,8	ND	0.8
			2,3,4,7,8	ND	0.8
H6CDD - Total	4.4	2.4	H6CDF - Total	9.5	2.4
1,2,3,4,7,8	ND	2.4	1,2,3,4,7,8	ND	2.4
1,2,3,6,7,8	NDR(2.9)	2.4	1,2,3,6,7,8	ND	2.4
1,2,3,7,8,9	ND	2.4	2,3,4,6,7,8	ND	2.4
			1,2,3,7,8,9	ND	2.4
H7CDD - Total	88	4.1	H7CDF - Total	56	4.1
1,2,3,4,6,7,8	49	4.1	1,2,3,4,6,7,8	12	4.1
			1,2,3,4,7,8,9	ND	4.1
O8CDD	310	6.5	O8CDF	64	6.5

Surrogate Standards	% Recovery
13C-T4CDF	56
13C-T4CDD	63
13C-P5CDF	57
13C-P5CDD	68
13C-H6CDF	56
13C-H6CDD	63
13C-H7CDF	66
13C-H7CDD	66
13C-O8CDD	66

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8 - TCDD TEQs (ND=1/2 DL) = 2.73 pg/g

2,3,7,8 - TCDD TEQs (ND=0) = 0.99 pg/g

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________________
QA Chemist

DX001A

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	RAIL TIE COMPOSITE WILLIAMS LAKE COMPOSITE OF RAIL TIE 1,2,3, Treated Wood	AXYS FILE:	L3383-
CLIENT: CLIENT NO.:	A. Lanfranco & Associates 2585	DATE:	28/Ma
SAMPLE TYPE:	Pulp	METHOD NO.:	DX-P-
SAMPLE SIZE:	14.2 g (dry)	INSTRUMENT:	GC-H
		CONCENTRATION IN:	pg/g

Dioxins	Concentration	(SDL)	Furans	Concentration	
T4CDD - Total	35	0.2	T4CDF - Total	97	
2,3,7,8	2.6	0.2	2,3,7,8	11	
P5CDD - Total	350	0.1	P5CDF - Total	2000	
1,2,3,7,8	66	0.1	1,2,3,7,8	57	
			2,3,4,7,8	60	
H6CDD - Total	28000	5.7	H6CDF - Total	45000	
1,2,3,4,7,8	700	5.7	1,2,3,4,7,8	1300	
1,2,3,6,7,8	8300	5.7	1,2,3,6,7,8	390	
1,2,3,7,8,9	880	5.7	2,3,4,6,7,8	610	
			1,2,3,7,8,9	450	
H7CDD - Total	240000 *	530	H7CDF - Total	160000	*
1,2,3,4,6,7,8	130000 *	530	1,2,3,4,6,7,8	32000	*
			1,2,3,4,7,8,9	2200	*
O8CDD	950000 *	44	O8CDF	160000	*

Surrogate Standards	% Recovery
13C-T4CDF	57
13C-T4CDD	52
13C-P5CDF	50
13C-P5CDD	55
13C-H6CDF	42
13C-H6CDD	62
13C-H7CDF	N/A
13C-H7CDD	N/A
13C-O8CDD	N/A

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8 - TCDD TEQs (ND=1/2 DL) = 4040

2,3,7,8 - TCDD TEQs (ND=0) = 4040

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

* = From analysis of 1000-times dilution; not recovery corrected - consider as minimum values.

NA = Additional aliquot of quantification standards added to 1000-times dilution; surrogate %recovery not applicable.

Approved: ____________________
QA Chemist

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	BASELINE WILLIAMS LAKE 03-APR-01 REGULAR FUEL	AXYS FILE:	L3383-1 NK
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	29/May/2001
CLIENT NO.:	2585	METHOD NO.:	PH-A-07/Ver.2
SAMPLE TYPE:	Pulp	INSTRUMENT:	GC-MS
		RUN ID:	PH171222.D
SAMPLE SIZE:	9.45 g (dry)	CONCENTRATION IN:	ng/g

Compounds		Concentration *	SDL
Naphthalene		5700	3.1
Acenaphthylene		58	0.85
Acenaphthene		3200	1.1
Fluorene		1700	0.9
Phenanthrene		1400	2.5
Anthracene		250	3.2
Fluoranthene		45	2.1
Pyrene	NDR	34	1.8
Benz[a]anthracene		ND	2.3
Chrysene		ND	2.6
Benzofluoranthenes	NDR	15.0	3.3
Benzo[e]pyrene		ND	1.8
Benzo[a]pyrene		ND	2.4
Perylene		ND	3.8
Dibenz[ah]anthracene		ND	5
Indeno[1,2,3-cd]pyrene	NDR	4.9	2.2
Benzo[ghi]perylene		ND	2.8

Surrogate Standards	% Recovery
Naphthalene d-8	N/A
Acenaphthylene d-8	N/A
Phenanthrene d-10	N/A
Fluoranthene d-10	N/A
Benz[a]anthracene d-12	N/A
Chrysene d-12	N/A
Benzo[b,k]fluoranthene d-12	N/A
Benzo[a]pyrene d-12	N/A
Perylene d-12	N/A
Dibenz[ah]anthracene d-14	N/A
Indeno[1,2,3-cd]pyrene d-12	N/A
Benzo[ghi]perylene d-12	N/A

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. * Concentrations are not recovery corrected
6. Surrogate recoveries not applicable due to large dilution and a aliquot of surrogate standards.

Approved: ______________________________
QA Chemist

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	RAIL TIE COMPOSITE WILLIAMS LAKE COMPOSITE OF RAILTIE 1,2,3: TREATED WOOD	AXYS FILE:	L3383-9 N2K
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	29/May/2001
CLIENT NO.:	2585	METHOD NO.:	PH-A-07/Ver.2
SAMPLE TYPE:	Pulp	INSTRUMENT:	GC-MS
		RUN ID:	PH171247.D
SAMPLE SIZE:	7.79 g (dry)	CONCENTRATION IN:	ng/g

Compounds	Concentration *	SDL
Naphthalene	190000	690
Acenaphthylene	13000	780
Acenaphthene	730000	680
Fluorene	660000	2100
Phenanthrene	2100000	1600
Anthracene	990000	1800
Fluoranthene	1200000	1600
Pyrene	800000	2100
Benz[a]anthracene	190000	2000
Chrysene	240000	2700
Benzofluoranthenes	89000	7800
Benzo[e]pyrene	55000	9900
Benzo[a]pyrene	72000	9900
Perylene	14000	12000
Dibenz[ah]anthracene	ND	15000
Indeno[1,2,3-cd]pyrene	ND	18000
Benzo[ghi]perylene	18000	17000

Surrogate Standards	% Recovery
Naphthalene d-8	N/A
Acenaphthylene d-8	N/A
Phenanthrene d-10	N/A
Fluoranthene d-10	N/A
Benz[a]anthracene d-12	N/A
Chrysene d-12	N/A
Benzo[b,k]fluoranthene d-12	N/A
Benzo[a]pyrene d-12	N/A
Perylene d-12	N/A
Dibenz[ah]anthracene d-14	N/A
Indeno[1,2,3-cd]pyrene d-12	N/A
Benzo[ghi]perylene d-12	N/A

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. * Concentrations are not recovery corrected
6. Surrogate recoveries not applicable due to large dilution and a aliquot of surrogate standards.

Approved: ______________________

QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	BASELINE WILLIAMS LAKE 03-APR-01 REGULAR FUEL	AXYS FILE:	L3383-1
CLIENT:	A. Lanfranco and Associates	DATE:	30-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-S-01/Ver.3
SAMPLE TYPE:	Pulp	INSTRUMENT:	GC-MS
		RUN ID:	CP160745.D
SAMPLE SIZE:	5.65 g (dry)	CONCENTRATION IN:	ng/g

Compound	Concentration	SDL
2,4,6-Trichlorophenol	ND	1.2
2,3,6-Trichlorophenol	ND	1.0
2,3,5-Trichlorophenol	ND	1.0
2,4,5-Trichlorophenol	ND	0.2
2,3,4-Trichlorophenol	NDR 0.4	0.2
3,4,5-Trichlorophenol	ND	0.2
2,3,5,6-Tetrachlorophenol	1.3	0.4
2,3,4,6-Tetrachlorophenol	6.0	0.3
2,3,4,5-Tetrachlorophenol	ND	0.3
Pentachlorophenol	23	1.6

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	45
2,4,5-Trichlorophenol-13C	37
2,3,4,5-Tetrachlorophenol-13C	39
Pentachlorophenol-13C	28

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.

Approved: ______________________

QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RAIL TIE COMPOSITE WILLIAMS LAKE COMPOSITE OF RAIL TIE 1,2,3: TREATED WOOD	AXYS FILE:	L3383-9 NI
CLIENT:	A. Lanfranco and Associates	DATE:	30-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-S-01/Ver.3
SAMPLE TYPE:	Pulp	INSTRUMENT:	GC-MS
		RUN ID:	CP171249.D
SAMPLE SIZE:	5.48 g (dry)	CONCENTRATION IN:	ng/g

Compound	Concentration	SDL
2,4,6-Trichlorophenol	12	2.0
2,3,6-Trichlorophenol	13	1.7
2,3,5-Trichlorophenol	130	1.8
2,4,5-Trichlorophenol	55	2.9
2,3,4-Trichlorophenol	3.1	2.9
3,4,5-Trichlorophenol	390	3.2
2,3,5,6-Tetrachlorophenol	X	
2,3,4,6-Tetrachlorophenol	X	
2,3,4,5-Tetrachlorophenol	X	
Pentachlorophenol	X	

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	59
2,4,5-Trichlorophenol-13C	44
2,3,4,5-Tetrachlorophenol-13C	X
Pentachlorophenol-13C	X

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.
5. X = Results reported separately

Approved: ______________________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RAIL TIE COMPOSITE WILLIAMS LAKE COMPOSITE OF RAIL TIE 1,2,3: TREATED WOOD	AXYS FILE:	L3383-9 NK
CLIENT:	A. Lanfranco and Associates	DATE:	30-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-S-01/Ver.3
SAMPLE TYPE:	Pulp	INSTRUMENT:	GC-MS
		RUN ID:	CP171248.D
SAMPLE SIZE:	5.48 g (dry)	CONCENTRATION IN:	ng/g

Compound	Concentration *	SDL
2,4,6-Trichlorophenol		
2,3,6-Trichlorophenol		
2,3,5-Trichlorophenol		
2,4,5-Trichlorophenol		
2,3,4-Trichlorophenol		
3,4,5-Trichlorophenol		
2,3,5,6-Tetrachlorophenol	890	120
2,3,4,6-Tetrachlorophenol	3600	76
2,3,4,5-Tetrachlorophenol	ND	83
Pentachlorophenol	67000	310

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	
2,4,5-Trichlorophenol-13C	
2,3,4,5-Tetrachlorophenol-13C	N/A
Pentachlorophenol-13C	N/A

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.
5. * Data are not recovery corrected.
6. N/A: Surrogate recoveries not applicable due to dilution and additional aliquot of surrogate standards.

Approved: ______________________
QA Chemist

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	BASELINE WILLIAMS LAKE 03-APR-01 FLY ASH	**AXYS FILE:**	L3383-5
CLIENT:	A. Lanfranco and Associates	**DATE:**	22-May-2001
CLIENT NO.:	2585	**METHOD NO.:**	DX-A-01/Ver.6
SAMPLE TYPE:	Ash	**INSTRUMENT:**	GC-HRMS
SAMPLE SIZE:	1.72 g (dry)	**CONCENTRATION IN:**	pg/g
% MOISTURE:	66		

Dioxins	Concentration	SDL	Furans	Concentration	SDL
T4CDD - Total	58	0.58	T4CDF - Total	770	1.7
2,3,7,8	6.8	0.58	2,3,7,8	96	1.7
P5CDD - Total	10	0.58	P5CDF - Total	99	0.58
1,2,3,7,8	2.7	0.58	1,2,3,7,8	8.3	0.58
			2,3,4,7,8	8.6	0.58
H6CDD - Total	5.6	1.7	H6CDF - Total	2.7	1.7
1,2,3,4,7,8	ND	1.7	1,2,3,4,7,8	ND	1.7
1,2,3,6,7,8	ND	1.7	1,2,3,6,7,8	ND	1.7
1,2,3,7,8,9	ND	1.7	2,3,4,6,7,8	ND	1.7
			1,2,3,7,8,9	ND	1.7
H7CDD - Total	ND	2.9	H7CDF - Total	ND	2.9
1,2,3,4,6,7,8	ND	2.9	1,2,3,4,6,7,8	ND	2.9
			1,2,3,4,7,8,9	ND	2.9
O8CDD	ND	4.7	O8CDF	ND	4.7

Labeled Compound	% Recovery
13C-T4CDF	65
13C-T4CDD	67
13C-P5CDF	65
13C-P5CDD	81
13C-H6CDF	77
13C-H6CDD	74
13C-H7CDF	84
13C-H7CDD	63
13C-O8CDD	64

2,3,7,8 - TCDD TEQs (Using WHO 1998 TEFs)

2,3,7,8 - TCDD TEQs (ND=1/2 DL) = 24.5 pg/g

2,3,7,8 - TCDD TEQs (ND=0) = 23.8 pg/g

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ______________________
QA Chemist

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	FLY ASH COMPOSITE WILLIAMS LAKE COMPOSITE OF L3383-6 TO -8, Fly Ash	AXYS FILE:	L3383-10
CLIENT:	A. Lanfranco and Associates	DATE:	22/May/2001
CLIENT NO.:	2585	METHOD NO.:	DX-A-01/Ver.6
SAMPLE TYPE:	Ash	INSTRUMENT:	GC-HRMS
SAMPLE SIZE:	3.07 g (dry)	CONCENTRATION IN:	pg/g
% MOISTURE:	40		

Dioxins	Concentration	SDL	Furans	Concentration	SDL
T4CDD - Total	3800	1.5	T4CDF - Total	7800	17
2,3,7,8	82	1.5	2,3,7,8	1200	17
P5CDD - Total	4500	0.79	P5CDF - Total	4700	13
1,2,3,7,8	210	0.79	1,2,3,7,8	230	13
			2,3,4,7,8	430	13
H6CDD - Total	5800	2.5	H6CDF - Total	1800	2.6
1,2,3,4,7,8	200	2.5	1,2,3,4,7,8	170	2.6
1,2,3,6,7,8	260	2.5	1,2,3,6,7,8	200	2.6
1,2,3,7,8,9	350	2.5	2,3,4,6,7,8	160	2.6
			1,2,3,7,8,9	16	2.6
H7CDD - Total	2900	2.2	H7CDF - Total	450	1.6
1,2,3,4,6,7,8	1400	2.2	1,2,3,4,6,7,8	240	1.6
			1,2,3,4,7,8,9	52	1.6
O8CDD	1300	2.6	O8CDF	58	2.6

Labeled Compound	% Recovery
13C-T4CDF	51
13C-T4CDD	48
13C-P5CDF	49
13C-P5CDD	59
13C-H6CDF	58
13C-H6CDD	57
13C-H7CDF	47
13C-H7CDD	49
13C-O8CDD	41

2,3,7,8 - TCDD TEQs (Using WHO 1998 TEFs)

2,3,7,8 - TCDD TEQs (ND=1/2 DL) = 788 pg/g

2,3,7,8 - TCDD TEQs (ND=0) = 788 pg/g

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________________
QA Chemist

ALS Environmental

CHEMICAL ANALYSIS REPORT

Date:	June 4, 2001
ALS File No.	M9632r
Report On:	2585 Solids Analysis
Report To:	**Axys Analytical Services Ltd.** P.O. Box 2219 2045 Mills Road Sidney, BC V8L 3S8
Attention:	**Ms. Diane Luszniak**
Received:	May 15, 2001

ALS ENVIRONMENTAL
per:

Leanne Harris, B.Sc. - Project Chemist
Brent C. Mack, B.Sc. - Project Chemist

File No. M9632r

REMARKS

The detection limits for some total metals were increased for the sample identified as "L3383-5 Baseline" due to high moisture content in this sample.

An extensive quality assurance/quality control program is routinely incorporated with the sample analysis. This program includes the analysis of quality control samples to define precision and accuracy, and to demonstrate contamination control for the type of samples and parameters under investigation. Quality control samples may include method blanks, sample replicates, certified and standard reference materials, and analyte or matrix spikes. For this sample submission, the following quality control analyses were carried out:

- Method Blanks (n=1);
- Laboratory Replicates (n=1);
- Reference Materials (n=1);

The quality control data are reported at the end of this report. This data indicated the following:

> Method Blank, Laboratory Replicate and Reference Material data for all parameters analysed demonstrated that precision, accuracy, and contamination control met acceptance criteria.

MESS-3 is a Marine Sediment Reference Material Certified for Trace Metals in Sediment by the National Research Council of Canada.

The MESS-3 Found Values along with the MESS-3 Lab and Certified Values are included in the following data tables. The MESS-3 Lab values are corrected for Laboratory Bias based on the method of digestion. The MESS-3 Certified Values are based on a rigorous Four Acid Digestion involving Hydrochloric, Nitric, Hydrofluoric, and Perchloric Acid, rather than on the 1:1 Nitric and Hydrochloric Acid Digestion used for these samples.

RESULTS OF ANALYSIS - Quality Control

Sample ID		Method Blank	MESS-3 Found Value	Mess-3 Lab	Mess-3 Cert
Sample Date					
Sample Time					
ALS ID		*MBlk*	*MESS-3*	*MESS-3 LAB*	*MESS-3 CERT*
Total Metals					
Aluminum	T-Al	<50	50900	n/a	n/a
Antimony	T-Sb	<20	<20	<20	1.02
Arsenic	T-As	<100	<100	<50	21.2
Barium	T-Ba	<1	573	n/a	n/a
Beryllium	T-Be	<0.5	1.7	1.74	2.30
Bismuth	T-Bi	<10	<10	n/a	n/a
Cadmium	T-Cd	<2	<2	<2	0.24
Calcium	T-Ca	<50	14600	n/a	n/a
Chromium	T-Cr	<2	69	68.9	105
Cobalt	T-Co	<2	13	12.0	14.4
Copper	T-Cu	<1	34	33.5	33.9
Iron	T-Fe	<50	48600	n/a	n/a
Lead	T-Pb	<50	<50	<50	21.1
Lithium	T-Li	<2	65	59.2	73.6
Magnesium	T-Mg	<50	16800	n/a	n/a
Manganese	T-Mn	<1	308	303	324
Mercury	T-Hg	<0.005	0.088	0.093	0.091
Molybdenum	T-Mo	<4	<4	<4	2.78
Nickel	T-Ni	<5	42	41.7	46.9
Phosphorus	T-P	<50	1160	n/a	n/a
Potassium	T-K	<200	14400	n/a	n/a
Selenium	T-Se	<50	<50	<50	0.72
Silver	T-Ag	<2	<2	<2	0.18
Strontium	T-Sr	<0.5	91.4	90.7	129
Thallium	T-Tl	<50	<50	<50	0.90
Tin	T-Sn	<10	<10	<10	2.50
Titanium	T-Ti	<1	89	n/a	n/a
Vanadium	T-V	<2	174	175	243
Zinc	T-Zn	<1	140	144	159

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per dry kilogram except where noted.
n/a = no certified values available.
< = Less than the detection limit indicated.

File No. M9632r

Appendix 1 - QUALITY CONTROL - Replicates

Solid		L3383-10 Fly Ash Comp.	L3383-10 Fly Ash Comp. QC # 240208
Physical Tests			
Moisture	%	42.9	43.6
Total Metals			
Aluminum	T-Al	19000	20900
Antimony	T-Sb	<20	<20
Arsenic	T-As	<100	<100
Barium	T-Ba	335	374
Beryllium	T-Be	<0.5	<0.5
Bismuth	T-Bi	<10	<10
Cadmium	T-Cd	3	4
Calcium	T-Ca	37200	40100
Chromium	T-Cr	67	74
Cobalt	T-Co	10	11
Copper	T-Cu	840	918
Iron	T-Fe	60000	68800
Lead	T-Pb	316	339
Lithium	T-Li	6	7
Magnesium	T-Mg	8580	9300
Manganese	T-Mn	1500	1600
Mercury	T-Hg	0.238	0.261
Molybdenum	T-Mo	9	10
Nickel	T-Ni	62	68
Phosphorus	T-P	1900	2040
Potassium	T-K	7400	7940
Selenium	T-Se	<50	<50
Silver	T-Ag	<2	<2
Strontium	T-Sr	198	208
Thallium	T-Tl	<50	<50
Tin	T-Sn	<10	<10
Titanium	T-Ti	1120	1260
Vanadium	T-V	64	71
Zinc	T-Zn	686	719

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per dry kilogram except where noted.
n/a = no certified values available.
< = Less than the detection limit indicated.

Appendix 2 - METHODOLOGY

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

Moisture in Sediment/Soil

This analysis is carried out gravimetrically by drying the sample at 103 C for a minimum of six hours.

Recommended Holding Time:

Sample:	14 days
Reference:	Puget

For more detail see ALS Environmental "Collection & Sampling Guide"

Metals in Sediment/Soil

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 Method 3050B or Method 3051, published by the United States Environmental Protection Agency (EPA). The sample is manually homogenized and a representative subsample of the wet material is weighed. The sample is then digested by either hotplate or microwave oven using a 1:1 ratio of nitric acid and hydrochloric acid. Instrumental analysis is by atomic absorption spectrophotometry (EPA Method 7000 series) and/or inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method is not a total digestion technique for most samples. It is a very strong acid digestion that will dissolve almost all elements that could become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

Recommended Holding Time:

Sample/Extract:	6 months (Mercury = 28 days)
Reference:	EPA

For more detail see ALS Environmental "Collection & Sampling Guide"

End Of Report

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	BASELINE WILLIAMS LAKE 03-APR-01 FLY ASH	AXYS FILE:	L3383-5
CLIENT:	A. Lanfranco & Associates	DATE:	05-Jun-2001
CLIENT NO.:	2585	METHOD NO.:	PH-A-07/Ver.2
SAMPLE TYPE:	Ash	INSTRUMENT: RUN ID:	GC-MS PH171349.D
SAMPLE SIZE:	1.93 g (dry)	CONCENTRATION IN:	ng/g

Compounds		Concentration	SDL
Naphthalene		600	3.6
Acenaphthylene		51	1.5
Acenaphthene		ND	2.0
Fluorene	NDR	7.6	2.0
Phenanthrene		140	1.4
Anthracene		14	1.4
Fluoranthene		32	1.0
Pyrene		47	1.0
Benz[a]anthracene		3.0	1.8
Chrysene		12	1.4
Benzofluoranthenes		ND	6.6
Benzo[e]pyrene		ND	24
Benzo[a]pyrene		ND	31
Perylene		ND	32
Dibenz[ah]anthracene		ND	95
Indeno[1,2,3-cd]pyrene		ND	110
Benzo[ghi]perylene		ND	70

Surrogate Standards	% Recovery
Naphthalene d-8	30
Acenaphthylene d-8	57
Phenanthrene d-10	71
Fluoranthene d-10	66
Benz[a]anthracene d-12	31
Chrysene d-12	50
Benzo[b,k]fluoranthene d-12	16
Benzo[a]pyrene d-12	10
Perylene d-12	10
Dibenz[ah]anthracene d-14	4
Indeno[1,2,3-cd]pyrene d-12	2
Benzo[ghi]perylene d-12	3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected

Approved: ______________________
QA Chemist

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	FLY ASH COMPOSITE WILLIAMS LAKE COMPOSITE RAIL TIE 1,2,3 FLY ASH	AXYS FILE:	L3383-10
CLIENT:	A. Lanfranco & Associates	DATE:	05-Jun-2001
CLIENT NO.:	2585	METHOD NO.:	PH-A-07/Ver.2
SAMPLE TYPE:	Ash	INSTRUMENT:	GC-MS
		RUN ID:	PH171350.D
SAMPLE SIZE:	3.13 g (dry)	CONCENTRATION IN:	ng/g

Compounds		Concentration	SDL
Naphthalene		740	0.98
Acenaphthylene		80	1.1
Acenaphthene		2.7	0.89
Fluorene		ND	0.71
Phenanthrene		170	0.75
Anthracene		29	0.79
Fluoranthene		87	0.59
Pyrene		150	0.58
Benz[a]anthracene	NDR	6.1	0.48
Chrysene		9.2	0.5
Benzofluoranthenes	NDR	7.9	1.4
Benzo[e]pyrene		ND	7.0
Benzo[a]pyrene		ND	8.8
Perylene		ND	10
Dibenz[ah]anthracene		ND	11
Indeno[1,2,3-cd]pyrene		ND	25
Benzo[ghi]perylene		ND	18

Surrogate Standards	% Recovery
Naphthalene d-8	24
Acenaphthylene d-8	40
Phenanthrene d-10	68
Fluoranthene d-10	82
Benz[a]anthracene d-12	63
Chrysene d-12	73
Benzo[b,k]fluoranthene d-12	45
Benzo[a]pyrene d-12	32
Perylene d-12	32
Dibenz[ah]anthracene d-14	14
Indeno[1,2,3-cd]pyrene d-12	10
Benzo[ghi]perylene d-12	9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected

Approved: ______________________

QA Chemist

File No. M9632

RESULTS OF ANALYSIS - Solid

Sample ID		L3383-5 Baseline	L3383-10 Fly Ash Comp.
Sample Date			
Sample Time			
ALS ID		*1*	*2*
Physical Tests			
Moisture	%	66.7	42.9
Total Metals			
Aluminum	T-Al	14900	19000
Antimony	T-Sb	<40	<20
Arsenic	T-As	<200	<100
Barium	T-Ba	485	335
Beryllium	T-Be	<1	<0.5
Bismuth	T-Bi	<20	<10
Cadmium	T-Cd	<4	3
Calcium	T-Ca	66200	37200
Chromium	T-Cr	28	67
Cobalt	T-Co	8	10
Copper	T-Cu	35	840
Iron	T-Fe	14100	60000
Lead	T-Pb	<100	316
Lithium	T-Li	6	6
Magnesium	T-Mg	12300	8580
Manganese	T-Mn	2920	1500
Mercury	T-Hg	0.045	0.238
Molybdenum	T-Mo	<8	9
Nickel	T-Ni	28	62
Phosphorus	T-P	2460	1900
Potassium	T-K	13300	7400
Selenium	T-Se	<100	<50
Silver	T-Ag	<4	<2
Strontium	T-Sr	289	198
Thallium	T-Tl	<100	<50
Tin	T-Sn	<20	<10
Titanium	T-Ti	1050	1120
Vanadium	T-V	37	64
Zinc	T-Zn	429	686

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.

File No. M9632

Appendix 1 - QUALITY CONTROL - Replicates

Solid		L3383-10 Fly Ash Comp.	L3383-10 Fly Ash Comp. QC # 240208
Physical Tests			
Moisture	%	42.9	43.6
Total Metals			
Aluminum	T-Al	19000	20900
Antimony	T-Sb	<20	<20
Arsenic	T-As	<100	<100
Barium	T-Ba	336	374
Beryllium	T-Be	<0.5	<0.5
Bismuth	T-Bi	<10	<10
Cadmium	T-Cd	3	4
Calcium	T-Ca	37200	40100
Chromium	T-Cr	67	74
Cobalt	T-Co	10	11
Copper	T-Cu	840	918
Iron	T-Fe	60000	68800
Lead	T-Pb	316	339
Lithium	T-Li	6	7
Magnesium	T-Mg	8580	9300
Manganese	T-Mn	1500	1600
Mercury	T-Hg	0.238	0.261
Molybdenum	T-Mo	9	10
Nickel	T-Ni	62	68
Phosphorus	T-P	1900	2040
Potassium	T-K	7400	7940
Selenium	T-Se	<50	<50
Silver	T-Ag	<2	<2
Strontium	T-Sr	198	208
Thallium	T-Tl	<50	<50
Tin	T-Sn	<10	<10
Titanium	T-Ti	1120	1260
Vanadium	T-V	64	71
Zinc	T-Zn	686	719

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.

File No. M9632

RESULTS OF ANALYSIS - Quality Control

Sample ID Sample Date Sample Time *ALS ID*		Method Blank *MBlk*	MESS-3 Found Value *MESS-3*
Total Metals			
Aluminum	T-Al	<50	50900
Antimony	T-Sb	<20	<20
Arsenic	T-As	<100	<100
Barium	T-Ba	<1	573
Beryllium	T-Be	<0.5	1.7
Bismuth	T-Bi	<10	<10
Cadmium	T-Cd	<2	<2
Calcium	T-Ca	<50	14600
Chromium	T-Cr	<2	69
Cobalt	T-Co	<2	13
Copper	T-Cu	<1	34
Iron	T-Fe	<50	48600
Lead	T-Pb	<50	<50
Lithium	T-Li	<2	65
Magnesium	T-Mg	<50	16800
Manganese	T-Mn	<1	308
Mercury	T-Hg	<0.005	0.088
Molybdenum	T-Mo	<4	<4
Nickel	T-Ni	<5	42
Phosphorus	T-P	<50	1160
Potassium	T-K	<200	14400
Selenium	T-Se	<50	<50
Silver	T-Ag	<2	<2
Strontium	T-Sr	<0.5	91.4
Thallium	T-Tl	<50	<50
Tin	T-Sn	<10	<10
Titanium	T-Ti	<1	89
Vanadium	T-V	<2	174
Zinc	T-Zn	<1	140

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.

File No. M9632

Appendix 2 - METHODOLOGY

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

Moisture in Sediment/Soil

This analysis is carried out gravimetrically by drying the sample at 103 C for a minimum of six hours.

Recommended Holding Time:

Sample:	14 days
Reference:	Puget

For more detail see ALS Environmental "Collection & Sampling Guide"

Metals in Sediment/Soil

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 Method 3050B or Method 3051, published by the United States Environmental Protection Agency (EPA). The sample is manually homogenized and a representative subsample of the wet material is weighed. The sample is then digested by either hotplate or microwave oven using a 1:1 ratio of nitric acid and hydrochloric acid. Instrumental analysis is by atomic absorption spectrophotometry (EPA Method 7000 series) and/or inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method is not a total digestion technique for most samples. It is a very strong acid digestion that will dissolve almost all elements that could become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

Recommended Holding Time:

Sample/Extract:	6 months (Mercury = 28 days)
Reference:	EPA

For more detail see ALS Environmental "Collection & Sampling Guide"

End Of Report

Project	2585 Solid Analysis
Report to	Axys Analytical Services Ltd.
ALS File No.	N4146
Date Received	8/8/01
Date:	8/17/01

RAILTIE ASH
BC SWEP PROCEDURE

RESULTS OF ANALYSIS

Sample ID	L3383-10	Method Blank
Date Sampled		
Time Sampled		
ALS Sample ID	1	MBlk
Nature	Solid	Quality Control
Physical Tests		
Moisture %	43.1	-
Initial SWEP pH	9.73	-
Final SWEP pH	5.15	-
Extractable Metals		
Arsenic As	<0.2	<0.2
Barium Ba	0.2	<0.05
Boron B	1.1	<0.1
Cadmium Cd	0.09	<0.01
Chromium Cr	<0.01	<0.01
Copper Cu	1.01	<0.01
Lead Pb	0.29	<0.05
Mercury Hg	<0.00005	<0.00005
Selenium Se	<0.2	<0.2
Silver Ag	<0.01	<0.01
Zinc Zn	10.2	<0.05

Footnotes:

< = Less than the detection limit indicated.

Results are expressed as milligrams per litre, as per the requirements of the Special Waste Regulations, B.C. Reg.63/88.

APPENDIX 3

QA/QC RESULTS

DX001D-1

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.:	LAB BLANK	AXYS FILE:	WG4351-101
		DATE:	24-May-2001
CLIENT:	A. Lanfranco & Associates Inc.	METHOD NO.:	DX-SG-01/Ver.4
CLIENT NO.:	2585	INSTRUMENT:	GC-HRMS
SAMPLE TYPE:	Blank	CONCENTRATION IN:	pg/sample
SAMPLE SIZE:	1 sample		

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	ND	4.9	T4CDF - Total	ND	1.6
2,3,7,8	ND	4.9	2,3,7,8	ND	1.6
P5CDD - Total	3.3	1.6	P5CDF - Total	2.4	1.5
1,2,3,7,8	3.3	1.6	1,2,3,7,8	2.4	1.5
			2,3,4,7,8	ND	1.5
H6CDD - Total	3.6	3.0	H6CDF - Total	8.1	3.0
1,2,3,4,7,8	ND	3.0	1,2,3,4,7,8	4.2	3.0
1,2,3,6,7,8	NDR(3.8)	3.0	1,2,3,6,7,8	ND	3.0
1,2,3,7,8,9	NDR(5.8)	3.0	2,3,4,6,7,8	ND	3.0
			1,2,3,7,8,9	3.9	3.0
H7CDD - Total	ND	5.0	H7CDF - Total	ND	5.0
1,2,3,4,6,7,8	NDR(6)	5.0	1,2,3,4,6,7,8	ND	5.0
			1,2,3,4,7,8,9	ND	5.0
O8CDD	NDR(22)	8.0	O8CDF	NDR(11)	8.0

Surrogate Standards	% Recovery
13C-T4CDF	64
13C-T4CDD	64
13C-P5CDF	72
13C-P5CDD	110
13C-H6CDF	75
13C-H6CDD	84
13C-H7CDF	73
13C-H7CDD	70
13C-O8CDD	56

Field Standards	% Recovery
13C6-1,2,3,4-TCDD	N/A
13C-1,2,3,4,7,8,9-HpCDF	N/A

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8-TCDD TEQs (ND=1/2 DL)	6.33	pg/sample
2,3,7,8-TCDD TEQs (ND=0) =	2.59	pg/sample

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________________
QA Chemist

ANALYSIS REPORT
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

CLIENT SAMPLE I.D.: RUN: BLANK TRANS CANADA POWER 05-Apr-01

CLIENT: A. Lanfranco & Associates Inc.

CLIENT NO.: 2585

SAMPLE TYPE: Train

SAMPLE SIZE: 1 sample

AXYS FILE: L3385-5

DATE: 24-May-2001

METHOD NO.: DX-SG-01/Ver.4

INSTRUMENT: GC-HRMS

CONCENTRATION IN: pg/sample

Dioxins	Concentration	(SDL)	Furans	Concentration	(SDL)
T4CDD - Total	ND	5.7	T4CDF - Total	ND	2.7
2,3,7,8	ND	5.7	2,3,7,8	ND	2.7
P5CDD - Total	ND	2.8	P5CDF - Total	1.8	1.5
1,2,3,7,8	ND	2.8	1,2,3,7,8	1.8	1.5
			2,3,4,7,8	ND	1.5
H6CDD - Total	7.6	3.0	H6CDF - Total	ND	3.0
1,2,3,4,7,8	ND	3.0	1,2,3,4,7,8	ND	3.0
1,2,3,6,7,8	NDR(3.5)	3.0	1,2,3,6,7,8	ND	3.0
1,2,3,7,8,9	ND	3.0	2,3,4,6,7,8	ND	3.0
			1,2,3,7,8,9	ND	3.0
H7CDD - Total	20	5.0	H7CDF - Total	ND	5.0
1,2,3,4,6,7,8	9.4	5.0	1,2,3,4,6,7,8	ND	5.0
			1,2,3,4,7,8,9	ND	5.0
O8CDD	23	8.0	O8CDF	ND	8.0

Surrogate Standards	% Recovery
13C-T4CDF	65
13C-T4CDD	72
13C-P5CDF	71
13C-P5CDD	93
13C-H6CDF	74
13C-H6CDD	84
13C-H7CDF	67
13C-H7CDD	62
13C-O8CDD	65

Field Standards	% Recovery
13C6-1,2,3,4-TCDD	112
13C-1,2,3,4,7,8,9-HpCDF	107

2,3,7,8 - TCDD TEQs (Using NATO I-TEFs)

2,3,7,8-TCDD TEQs (ND=1/2 DL)	5.35	pg/sample
2,3,7,8-TCDD TEQs (ND=0) =	0.208	pg/sample

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected.

Approved: ____________________
QA Chemist

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG4381-102
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Filter	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171184.D

Compound	Determined	Expected	% Recovery
Naphthalene	5300	4000	132
Acenaphthylene	4400	3900	112
Acenaphthene	4300	3900	109
Fluorene	4900	3900	124
Phenanthrene	5100	3900	131
Anthracene	3300	4000	84
Fluoranthene	5100	4100	125
Pyrene	5100	4000	127
Benz[a]anthracene	4500	3900	115
Chrysene	5200	4000	131
Benzo[b/j/k]fluoranthenes	10000	8000	128
Benzo[e]pyrene	4700	3900	122
Benzo[a]pyrene	4100	3900	106
Perylene	4300	4000	108
Dibenz[ah]anthracene	4800	3900	122
Indeno[1,2,3-cd]pyrene	4600	3800	119
Benzo[ghi]perylene	4800	3800	125
Dimethyl Naphthalenes	5000	4000	127
Field Surrogate			
d10-Anthracene	2000	2000	100

Labeled Compound	% Recovery
Naphthalene d-8	57
Acenaphthylene d-8	68
Phenanthrene d-10	76
Fluoranthene d-10	79
Benz(a)anthracene d-12	78
Chrysene d-12	74
Benzo(b,k)Fluoranthene d-12	69
Benzo(a)pyrene d-12	74
Perylene d-12	80
Dibenzo(ah)anthracene d-14	58
Indeno(123cd)pyrene d-12	64
Benzo(ghi)perylene d-12	67
2,6-Dimethylnaphthalene d-12	79

Approved: ______________________
QA Chemist

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	LAB BLANK	AXYS FILE:	WG4381-101 i
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Filter	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171187.D

Compound	Lab Flag[1]	Concentration	SDL
Naphthalene	NDR	21	6.7
Acenaphthylene	NDR	4.1	1.9
Acenaphthene	ND		6.1
Fluorene	NDR	69	1.7
Phenanthrene	NDR	17	5.0
Anthracene	ND		6.0
Fluoranthene	NDR	18	2.0
Pyrene	NDR	8.9	2.0
Benz[a]anthracene		6.1	5.2
Chrysene	NDR	28	7.8
Benzo[b/j]fluoranthenes	ND		9.4
Benzo[k]fluoranthene	ND		9.4
Benzo[e]pyrene	ND		5.7
Benzo[a]pyrene	ND		7.8
Perylene	ND		8.2
Dibenz[ah]anthracene	ND		8.1
Indeno[1,2,3-cd]pyrene	ND		7.9
Benzo[ghi]perylene	ND		8.8
Dimethyl Naphthalenes		87	3.0
2-Methylfluorene	ND		4.9
Benzo[ghi]fluoranthene	ND		4.5
7,12-Dimethyl Benz[a]Anthracen	ND		120
Benzo[a]Fluorene	ND		5.2
Benzo[b]Fluorene	NDR	16	5.2
Dibenzo[a,h]Acridine	ND		7.6
Dibenzo[a,j]Acridine	ND		7.4
7H Dibenzo[c,g]Carbazole	ND		23
Dibenzo[a,i]Pyrene	ND		8.2
1-Methylpyrene	NDR	11	5.2
1,6-Dinitropyrene	ND		45
1,8-Dinitropyrene	ND		45

Labeled Compound	% Recovery
Naphthalene d-8	47
Acenaphthylene d-8	64
Phenanthrene d-10	69
Fluoranthene d-10	72
Benz(a)anthracene d-12	80
Chrysene d-12	73
Benzo(b,k)Fluoranthene d-12	66
Benzo(a)pyrene d-12	76
Perylene d-12	79
Dibenzo(ah)anthracene d-14	61
Indeno(123cd)pyrene d-12	67
Benzo(ghi)perylene d-12	67
2,6-Dimethylnaphthalene d-12	64

(1) ND = not detected; NDR = peak detected, but did not meet quantification criteria
(2) SDL = Sample Detection Limit
(3) Concentrations are recovery corrected

Approved: ______________________
QA Chemist

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PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.:	RUN: BLANK TRANS CANADA POWER 05-APR-01	AXYS FILE:	L3385-5 I
CLIENT:	A. LanFranco and Associates	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	PH-SG-07/Ver.2
SAMPLE TYPE:	Sample Train	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	CONCENTRATION IN	ng/sample
		PAH RUN ID:	PH171188.D

Compound	Lab Flag[1]	Concentration	SDL
Naphthalene		460	4.2
Acenaphthylene	NDR	4.7	3.0
Acenaphthene		20	2.8
Fluorene	ND		1.3
Phenanthrene		43	2.7
Anthracene		12	3.2
Fluoranthene		19	1.8
Pyrene		16	1.8
Benz[a]anthracene	NDR	7.7	3.2
Chrysene	ND		4.8
Benzo[b/j]fluoranthenes	ND		8.4
Benzo[k]fluoranthene	ND		8.4
Benzo[e]pyrene	ND		5.1
Benzo[a]pyrene	ND		7.0
Perylene	ND		7.6
Dibenz[ah]anthracene	ND		7.2
Indeno[1,2,3-cd]pyrene	ND		5.8
Benzo[ghi]perylene	ND		6.8
Dimethyl Naphthalenes		120	1.9
2-Methylfluorene	ND		3.6
Benzo[ghi]fluoranthene	ND		3.8
7,12-Dimethyl Benz[a]Anthracen	NDR	140	130
Benzo[a]Fluorene	ND		3.1
Benzo[b]Fluorene	ND		3.1
Dibenzo[a,h]Acridine	ND		5.9
Dibenzo[a,j]Acridine	ND		5.7
7H Dibenzo[c,g]Carbazole	ND		41
Dibenzo[a,i]Pyrene	ND		13
1-Methylpyrene	ND		3.1
1,6-Dinitropyrene	ND		52
1,8-Dinitropyrene	ND		52

Field Surrogate	Determined	Expected	% Recovery
Anthracene d-10	2160	2024	107

Labeled Compound	% Recovery
Naphthalene d-8	27
Acenaphthylene d-8	39
Phenanthrene d-10	62
Fluoranthene d-10	72
Benz(a)anthracene d-12	80
Chrysene d-12	72
Benzo(b,k)Fluoranthene d-12	67
Benzo(a)pyrene d-12	75
Perylene d-12	80
Dibenzo(ah)anthracene d-14	61
Indeno(123cd)pyrene d-12	67
Benzo(ghi)perylene d-12	65
2,6-Dimethylnaphthalene d-12	45

(1) ND = not detected; NDR = peak detected, but did not meet quantification criteria
(2) SDL = Sample Detection Limit
(3) Concentrations are recovery corrected
(4) Data have not been blank corrected

Approved:
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG4376-102
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Filter	INSTRUMENT:	GC-MS
		RUN ID:	CP171207.D
SAMPLE SIZE:	1 sample	CONCENTRATION IN:	ng/sample

Compound	Determined	Expected	% Recovery
2,4,6-Trichlorophenol	260	210	124
2,3,6-Trichlorophenol	270	200	135
2,3,5-Trichlorophenol	360	210	171
2,4,5-Trichlorophenol	190	200	95
2,3,4-Trichlorophenol	270	220	123
3,4,5-Trichlorophenol	300	210	143
2,3,5,6-Tetrachlorophenol	150	200	75
2,3,4,6-Tetrachlorophenol	120	220	55
2,3,4,5-Tetrachlorophenol	220	210	105
Pentachlorophenol	240	200	120

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	9
2,4,5-Trichlorophenol-13C	9
2,3,4,5-Tetrachlorophenol-13C	8
Pentachlorophenol-13C	3

Approved: ____________________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	LAB BLANK	AXYS FILE:	WG4376-101
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Filter	INSTRUMENT:	GC-MS
SAMPLE SIZE:	1 sample	RUN ID:	CP171208.D
		CONCENTRATION IN:	ng/sample

Compound	Concentration	SDL
2,4,6-Trichlorophenol	ND	5.7
2,3,6-Trichlorophenol	ND	4.9
2,3,5-Trichlorophenol	NDR 13	5.2
2,4,5-Trichlorophenol	ND	3.9
2,3,4-Trichlorophenol	NDR 31	3.7
3,4,5-Trichlorophenol	ND	3.9
2,3,5,6-Tetrachlorophenol	ND	8.9
2,3,4,6-Tetrachlorophenol	ND	6.7
2,3,4,5-Tetrachlorophenol	ND	6.8
Pentachlorophenol	ND	11

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	14
2,4,5-Trichlorophenol-13C	11
2,3,4,5-Tetrachlorophenol-13C	11
Pentachlorophenol-13C	6

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit

Approved: ____________________
QA Chemist

CHLOROPHENOLIC ANALYSIS REPORT

CP005

CLIENT SAMPLE I.D.:	RUN: BLANK TRANS CANADA POWER 05-APR-01	AXYS FILE:	L3385-5
CLIENT:	A. Lanfranco & Associates Inc.	DATE:	28-May-2001
CLIENT NO.:	2585	METHOD NO.:	CP-E-06/Ver.2
SAMPLE TYPE:	Train	INSTRUMENT:	GC-MS
		RUN ID:	CP171213.D
SAMPLE SIZE:	1 sample	CONCENTRATION IN:	ng/sample

Compound	Concentration	SDL
2,4,6-Trichlorophenol	20	0.84
2,3,6-Trichlorophenol	ND	0.73
2,3,5-Trichlorophenol	ND	0.77
2,4,5-Trichlorophenol	ND	1.8
2,3,4-Trichlorophenol	ND	1.7
3,4,5-Trichlorophenol	ND	1.7
2,3,5,6-Tetrachlorophenol	ND	1.5
2,3,4,6-Tetrachlorophenol	12	1.1
2,3,4,5-Tetrachlorophenol	ND	1.2
Pentachlorophenol	3.8	2.9

Surrogate Standard	% Recovery
2,4,6-Trichlorophenol-13C	88
2,4,5-Trichlorophenol-13C	64
2,3,4,5-Tetrachlorophenol-13C	86
Pentachlorophenol-13C	69

1. ND = Not detected
2. NDR = Peak detected but did not meet quantification criteria
3. SDL = Sample detection limit
4. Data have not been blank corrected.

Approved: ______________________
QA Chemist

APPENDIX 4

FIELD DATA SHEETS and PROCESS DATA

PLANT TransCanada Power - Williams Lk
RUN No. 1-2 HCl [illegible]
LOCATION Stack
DATE 04/03/01
OPERATOR
SAMPLE UNIT
CONTROL UNIT / Y LM-3
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.70
ASSUMED MOISTURE, Bw

PROBE TIP DIAMETER, IN.
PROBE LENGTH, FT / Cp
PROBE HEATER SETTING
INITIAL LEAK TEST 0.003 0.003
FINAL LEAK TEST 0.003 0.003
METER TEMP. COMP. NO

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H_2O
FILTER NUMBER
STACK DIAMETER
STACK HEIGHT
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol. %	Fyrites O_2 Vol. %
0	1407	41.7403				58	57						14	6
10						58	57							
20						59	58						4	6
30						60	59							
40						60	59							
50						61	60							
60	1507	42.3125				61	61						14.5	6.0
0	16:30	42.8801				58	60					308	14	4
10						59	60					309		
20						60	61					307	14	4
30						61	63					305		
40						63	63					285	10.5	10.5
7:10 50						71	69					292	13	7
60	18:08	43.4446				72	70					293		

stop off fuel wood
start @ 7:48

PLANT Trununnda Power- Williams Lk.
RUN No. 1-2 SOx Baseline
LOCATION Stack
DATE 04/03/07
OPERATOR
SAMPLE UNIT
CONTROL UNIT / Y LM-3
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.70
ASSUMED MOISTURE, Bw

PROBE TIP DIAMETER, IN.
PROBE LENGTH, FT / Cp
PROBE HEATER SETTING

	1	2
INITIAL LEAK TEST	0.005	0.003
FINAL LEAK TEST	0.003	0.003

METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H_2O
FILTER NUMBER
STACK DIAMETER
STACK HEIGHT
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol %	Fyrites O_2 Vol %
	15:20	42.3179												
1						53	57					306	15	5.5
2						60	60					306		
3						62	62					310		
4						61	62					310	15	5.5
5						60	62					308		
6	16:20	42.8743				60	62					307	14.5	6.0
0	18:10	43.4491				71	73					293		
1						70	72					294	14	6
2						71	72					296		
3						70	72					300	16	5.0
4						71	73					305	16	50
5						71	73					306		
6	19:10	43.9542				71	73					307		

PLANT Th ~Canada Power - Williams Lake
RUN No 3,5 HCl Rail Ties
LOCATION Stack
DATE 04/04/01 - 04/05/01
OPERATOR
SAMPLE UNIT
CONTROL UNIT / Y LM-3
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.68
ASSUMED MOISTURE, Bw

PROBE TIP DIAMETER, IN.
PROBE LENGTH, FT / Cp
PROBE HEATER SETTING

	3	4	5
INITIAL LEAK TEST	0.002	0.003	0.002
FINAL LEAK TEST	0.002	0.003	0.002

METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT (Dry)
ASSUMED MOL. WT (Wet)
STATIC PRESSURE, IN. H₂O
FILTER NUMBER
STACK DIAMETER
STACK HEIGHT
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol %	Fyrites O_2 Vol. %
0	13:15	44.5682												
1					Atmos	62	63			250		296		
2						62	63					299	12	9
3						62	63					297		
4						62	64					296	12	8.5
5						62	64					295		
6	14:33	45.1869				60	62					291	15	5
						62	63					296		
	April 5/01 Run 4													
	BP: 27.32													
0	12:20	45.8724												
1					Atmos	50	54			250		291		
2						49	50					286	11	9
3						50	53					286		
4						52	54					284	12	8.5
5						49	52					285		
6	13:20	46.4671				53	53					283	12	8.5
						52	53					284		
	April 6/01 Run 5													
	BP 27.21													
0	10:20	47.0635												
1					Atmos	55	56			250		287		
2						55	57					286	15	5.5
3						55	58					284		
4						60	61					284	15	5.5
5						63	64					285		
6	11:20	47.6512				64	67					285	15	5.5
						66	67					284		

stop 4:05
start 4:25

307 190 106 4.9665

21.3793 ~~[illegible]~~ 1.095 - _0154 . .9889 = ~~23.507~~

PLANT TransCanada Power-Williams Lk
RUN No. 3 SOx - Rail Ties
LOCATION Stack
DATE 04/04/01 - 04/05/01 - 04/06/01
OPERATOR
SAMPLE UNIT
CONTROL UNIT / Y Lm-3
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.68
ASSUMED MOISTURE, Bw

PROBE TIP DIAMETER, IN.
PROBE LENGTH, FT / Cp
PROBE HEATER SETTING

	3	4	5
INITIAL LEAK TEST	0.003	0.003	0.002
FINAL LEAK TEST	0.003	0.003	0.002

METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H_2O
FILTER NUMBER
STACK DIAMETER
STACK HEIGHT
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp.		Pump Vac. IN. Hg Gauge	Temperature °F		Temperature °F		Fyrites	
						Inlet °F	Outlet °F		Box	Probe	Impinger Exit	Stack	CO_2 Vol %	O_2 Vol %
0	12:00	43.9745												
1					Atmos	64	63			250		298	12.5	7.0
2						65	66					291		
3						66	66					298		
4						67	66					302	15	5.5
5						68	67					296		
6	13:00	44.5626				69	67					298		
						69	68					298	15	5.5
	April 5/01 Run-4													
	BP-27.32													
0	11:15	452590												
1					Atmos	57	57			250		287	12	8.5
2						59	60					288		
3						63	64					288	12	8.5
4						60	63					288		
5						58	63					287		
6	12:15	45.8638				57	63					287	12	8.5
						57	63					287		
	April 6/01 Run5													
	BP 27.81													
0	09:15	46.4731												
1					Atmos	52	50			250		277		
2						55	53					282	14.5	6.0
3						57	55					280		
4						58	58					280	15.0	5.5
5						57	61					285		
6	10:15	47.0586				57	61					285	15.0	5.5
						57	61					286		

5.205 202 20.6764 1.0996 × 1.0154 1889 = 22.8302

1.65 = 1.71 1.13

PLANT	Trans Canada Co-gen	PROBE TIP DIAMETER, IN.	.224
RUN No.	1 Piorn baseline	PROBE LENGTH, FT / Cp	5E .8394
LOCATION	Stack	PROBE HEATER SETTING	
DATE	April 3/01		
OPERATOR	MTH	INITIAL LEAK TEST	.019 @ 15"
SAMPLE UNIT			
CONTROL UNIT / Y	0990C .981	FINAL LEAK TEST	008 @ 15"
AMBIENT TEMP., °F			
BAROMETRIC PRESSURE, IN. Hg	27.70	METER TEMP. COMP.	
ASSUMED MOISTURE, Bw	18		

HEATER BOX SETTING	
ASSUMED MOL. WT. (Dry)	
ASSUMED MOL. WT. (Wet)	
STATIC PRESSURE, IN. H₂O	-.25
FILTER NUMBER	
STACK DIAMETER	13'
STACK HEIGHT	150'
UPSTREAM DIAMETERS	
DOWNSTREAM DIAMETERS	

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H₂O ΔP	Orifice ΔH IN. H₂O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO₂ Vol. %	Fyrites O₂ Vol. %	
	1444	520.031	Co												
1a		523.21		.77	1.27	76	69	2	225	260	46	305	14.5	6.0	(5.2
b		526.43		.77	1.27	95	90	2	265	268	47	305			
c		529.68	201	.75	1.28	105	95	2	261	265	47	307			
d		532.91		.73	1.26	109	97	2	275	230	49	310			
2a		536.44	126	.87	1.51	108	97	2	278	230	46	308			(5.3)
b		540.10		.94	1.64	108	96	2	271	238	45	306			
c		543.77	172	.94	1.64	108	96	2	238	240	46	308			5.2
d		547.35	175	.90	1.56	109	96	2	274	235	49	305	14.0	6.0	(4.1)
3a		550.88		.87	1.50	109	96	2	230	254	51	307			
b		554.47		.91	1.57	108	96	2	251	233	50	306			
c		558.11		.92	1.59	108	97	2	271	262	50	308			
d	1548	561.74		.92	1.59	109	97	2	242	261	50	310			
4a	1556	564.81		.57	.699	104	95	2	236	241	48	308			
b		567.77	167	.61	1.06	106	96	2	243	238	50	305	14.5	5.5	(5.)
c		570.77		.63	1.09	107	95	2	243	254	53	309			
d		573.72		.61	1.06	107	95	2	240	251	52	309			
5a		576.92	175	.72	1.25	107	95	2	238	245	41	308			
b		580.20		.75	1.30	107	96	2	251	242	41	307			
c		583.42	164	.73	1.26	107	95	2	246	255	40	307			(5.2
d		586.66		.73	1.26	107	96	2	249	240	40	307	14.0	6.0	
6a		589.76	166	.68	1.18	108	96	2	232	225	43	305			(4.9)
b		592.87		.67	1.16	107	97	2	236	252	43	304			
c		595.94		.66	1.14	107	97	2	242	252	42	305			
d	1654	599.01		.66	1.14	107	97	2	231	255	42	305			

w/b

471

21.19

608

36.173

1.73 1.8 .724
1.7 1.61

PLANT	Towers Canal	HEATER BOX SETTING	
RUN No.	1 Moon cont	ASSUMED MOL. WT. (Dry)	
LOCATION		ASSUMED MOL. WT. (Wet)	
DATE	April 3/03	STATIC PRESSURE, IN. H_2O	
OPERATOR		FILTER NUMBER	
SAMPLE UNIT		STACK DIAMETER	
CONTROL UNIT / Y		STACK HEIGHT	
AMBIENT TEMP., °F		UPSTREAM DIAMETERS	
BAROMETRIC PRESSURE, IN. Hg		DOWNSTREAM DIAMETERS	
ASSUMED MOISTURE, Bw			
PROBE TIP DIAMETER, IN.			
PROBE LENGTH, FT / Cp			
PROBE HEATER SETTING			
INITIAL LEAK TEST			
FINAL LEAK TEST			
METER TEMP. COMP.			

Point	Clock Time	Dry Gas Meter Ft³	Co	Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol. %	Fyrites O_2 Vol. %
	1658	599.01												
7a		602.69		.95	1.64	103	95	2	249	275	40	305		
b		606.08		.80	1.34	107	97	2	245	275	37	304	10.5	10.5
c	1713 stop *	609.34		.75	1.30	107	97	2	250	270	35	302		
d	start 1749	612.51	157	.70	1.21	92	91	2	234	228	50	294	13.0	7.0
8a		615.77		.82	1.37	97	93	2	244	265	44	288		
b		619.00	152	.77	1.29	100	94	2	240	237	46	290		
c		622.25		.77	1.31	102	94	2	247	246	47	292		
d		625.73	245	.84	1.45	103	94	2	250	250	46	293		
9a		629.12		.84	1.45	103	93	2	251	200	47	292		
b		632.47		.82	1.39	104	93	2	233	242	47	294	14.0	6.0
c		635.92		.82	1.39	104	93	2	240	239	47	294		
d	1834	639.18		.82	1.39	104	93	2	244	238	41	294		
										~~4~~		~~305~~		
10a	1838	642.80		.99	1.68	105	94	2	229	236	49	303		
b		646.44	894	.98	1.67	105	94	2	236	237	48	302	16	5.0
c		650.14		1.04	1.72	105	94	2	238	238	47	304		
d		653.74		.98	1.67	105	94	2	242	237	48	305		
11a		657.36	285	.96	1.63	105	94	2	241	235	50	305		
b		660.88		.95	1.62	106	94	2	251	240	47	305		
c		664.51		.99	1.68	106	94	2	255	242	47	306		
d		668.12		.98	1.67	106	94	2	256	241	48	306	16	5.0
12a		671.55		.88	1.49	[illegible]	94	2	257	243	48	305		
b		674.89		.84	1.43	106	94	2	258	242	49	305		
c		678.24		.84	1.43	106	93	2	248	241	45	305		
d	1934	681.54		.83	1.41	105	93	2	247	240	50	305		

* lost mod for 10 min

9
8
14
10
9
14

3

5— 156 158 159 72,180 :61

PLANT ... Canada Cogen
RUN NO. Indian [illegible] Rail tie
LOCATION stack
DATE Apr.1 4/01
OPERATOR MJL
SAMPLE UNIT
CONTROL UNIT / Y 0899C
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.64
ASSUMED MOISTURE, Bw

PROBE TIP DIAMETER, IN. .2288
PROBE LENGTH, FT / Cp 8' .8357
PROBE HEATER SETTING
INITIAL LEAK TEST .015 @ 15"
FINAL LEAK TEST .010 @ 15"
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT (Dry)
ASSUMED MOL. WT (Wet)
STATIC PRESSURE, IN. H_2O -.25
FILTER NUMBER
STACK DIAMETER 138"
STACK HEIGHT 180'
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

756.40

Point	Clock Time	Dry Gas Meter Ft³	Cω	Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol %	Fyrites O_2 Vol %
	11:15	756.650												
4		760.27	100	1.06	1.64	75	72	2	225	225	37	297	16.0	5.0
3		763.83		1.05	1.64	82	70	2	260	243	41	299		
2		767.47		1.03	1.61	85	71	2	275	262	41	300		
1		771.08	94	1.04	1.64	87	71	2	271	272	40	301		
4		774.75		1.07	1.69	89	72	2	225	252	40	300		
3		778.46		1.08	1.71	91	74	2	271	277	40	299		
2		782.17	80	1.09	1.71	92	75	2	264	231	41	299		
1		785.87		1.06	1.69	93	76	2	269	233	41	300		
4		789.17		0.84	1.34	93	76	2	270	235	41	299		
3		792.44	65	0.83	1.32	93	76	2	271	254	40	299		
2		795.72		0.83	1.32	94	77	2	262	259	40	298	12.5	7.0
1	12:15	798.99	75	0.83	1.32	94	78	2	260	242	40	299		
4	12:18	801.43		0.46	0.73	93	82		255	251	36	298		
3		804.22	83	0.60	0.97	96	82	2	248	283	35	301		
2		806.97		0.58	0.93	97	83	2	250	271	36	301	15.0	5.5
1		809.74		0.58	0.93	97	83	2	242	270	37	303		
4		812.75	89	0.69	1.11	97	83	2	255	254	37	302		
3		815.75		0.70	1.23	97	81	2	250	271	38	302		
2		818.77		0.68	1.09	97	83	2	254	234	39	301		
1		821.68		0.65	1.05	97	83	2	254	241	39	301	15	5.5
4		824.60	102	0.65	1.05	96	83	2	256	230	37	298		
3		827.48		0.63	1.01	96	83	2	257	225	38	297		
2		830.35	112	0.63	1.21	96	83	2	252	239	38	297		
1	13:18	833.29		0.66	1.06	96	83	2	251	246	38	296		

(4.1)
(5.0)
(6.3)
(5.4)
(5.7)
(5.0)
(6.1)
(7.2)
(7.1)

1 @
156 /30

PLANT	[illegible] Canada
RUN No.	2 dioxin [illegible]
LOCATION	stack
DATE	
OPERATOR	
SAMPLE UNIT	
CONTROL UNIT / Y	
AMBIENT TEMP., °F	
BAROMETRIC PRESSURE, IN. Hg	
ASSUMED MOISTURE, Bw	21 %

PROBE TIP DIAMETER, IN.	
PROBE LENGTH, FT / Cp	
PROBE HEATER SETTING	
INITIAL LEAK TEST	
FINAL LEAK TEST	
METER TEMP. COMP.	

HEATER BOX SETTING	
ASSUMED MOL. WT (Dry)	
ASSUMED MOL. WT. (Wet)	
STATIC PRESSURE, IN. H_2O	
FILTER NUMBER	
STACK DIAMETER	
STACK HEIGHT	
UPSTREAM DIAMETERS	
DOWNSTREAM DIAMETERS	

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol. %	Fyrites O_2 Vol. %	
	1326	~~830~~ 833.29	Cv												
7a		836.05		0.60	0.94	89	83	2	237	228	38	299			
b		838.85	106	0.62	0.97	92	83	2	247	230	37	300	12	9.	(83,
c		841.64		0.67	0.97	94	83	2	245	240	37	297			
d		844.42		0.62	0.97	94	83	2	153	242	40	296			
8a		847.33		0.65	1.01	93	83	2	257	237	41	296			
b		850.18		0.65	1.01	93	83	2	242	238	41	296	12	8.5	
c		853.11		0.68	1.06	94	82	2	240	241	40	295			
d	Stop 1406	856.02	75	0.67	1.05	94	82	2	243	242	42	295			
9a	Start 1426	859.06		0.73	1.14	83	79	2	244	225	38	291			(5.2
b		862.25	90	0.80	1.25	88	79	2	242	238	39	294	15.0	6.0	
c		865.44		0.80	1.25	90	79	2	237	236	38	296			(4.
d	1446	868.62		0.81	1.26	91	79	2	238	240	39	298			
10a	1449	872.08		0.95	1.48	93	81	2	240	252	40	299			
b		875.47		0.90	1.40	95	81	2	238	251	41	300			
c		878.83	160	0.90	1.40	96	83	2	248	245	39	299	14.0	6.5	4.9
d		882.20		0.89	1.39	96	83	2	252	248	39	298			
11a		885.44		0.85	1.33	97	83	2	251	242	39	300			
b		888.75		0.88	1.37	96	83	2	260	242	38	300			
c		892.14		0.88	1.37	96	83	2	262	257	38	301			
d		895.42		0.88	1.37	96	83	2	258	252	37	300			
12a		898.55	107	0.78	1.17	96	83	2	257	245	38	300	12	9	(12
b		901.66		0.74	1.15	96	84	2	258	247	38	300			
c		904.70		0.76	1.18	96	83	2	247	258	38	299			
d	1549	907.80		0.76	1.19	90	83	2	248	252	38	298			
	Final	93													

1.5 1.10 1.57

PLANT	Tran Canada Cogen	PROBE TIP DIAMETER, IN.	.2288
RUN No.	3 Dioxin (2 rel fie)	PROBE LENGTH, FT / Cp	5E .8394
LOCATION	Stack	PROBE HEATER SETTING	
DATE	April 5/01		
OPERATOR	MJK	INITIAL LEAK TEST	.013 @ 15"
SAMPLE UNIT			
CONTROL UNIT / Y	0895C .981	FINAL LEAK TEST	.018 @ 15"
AMBIENT TEMP., °F			
BAROMETRIC PRESSURE, IN. Hg	27.32	METER TEMP. COMP.	
ASSUMED MOISTURE, Bw	19		

HEATER BOX SETTING	
ASSUMED MOL. WT. (Dry)	
ASSUMED MOL. WT. (Wet)	
STATIC PRESSURE, IN. H₂O	-.25
FILTER NUMBER	
STACK DIAMETER	138"
STACK HEIGHT	150'
UPSTREAM DIAMETERS	
DOWNSTREAM DIAMETERS	

ini. 000.013

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H₂O ΔP	Orifice ΔH IN. H₂O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO₂ Vol. %	Fyrites O₂ Vol. %	
	0912	000.293	Cc												
1a		3.57		.88	1.36	70	65	1	200	275	33	289			
b		6.85	79	.88	1.36	73	62	1	211	275	33	290			(5-6
c		10.22		.93	1.44	74	62	1	235	275	34	290	13.0	8.0	
d		13.58		.93	1.44	74	61	1	226	270	33	288			
2a		17.14		1.04	1.61	73	59	1	235	230	33	286			
b		20.64	76	1.02	1.58	77	63	1	236	237	33	287			(5-4
c		24.24		1.05	1.63	77	63	1	234	237	33	288			
d		27.77		1.00	1.56	78	63	1	238	234	33	286			
3a		31.12	65	0.90	1.40	78	64	1	240	234	32	285	14.0	6.5	
b		34.38		0.86	1.37	78	64	1	246	[illegible]	33	284			
c		37.78		0.92	1.44	78	64	1	246	238	34	285			
d	1012	41.13		0.90	1.40	78	64	1	238	231	35	283			
4a	1118	43.68	99	0.53	0.83	73	70	1	225	226	36	287	12.0	8.5	(8-2
b		46.31		0.55	0.86	76	71	1	237	225	36	288			
c		48.83		0.52	0.81	76	69	1	235	[illegible]	36	287			
d		51.38		0.52	0.81	78	70	1	245	232	36	288			
5a		54.22	91	0.64	1.00	80	70	1	226	242	35	288	12.0	8.5	(7-2
b		57.05		0.64	1.00	82	70	1	227	239	34	285			
c		59.78		0.60	0.94	83	71	1	240	211	35	286			
d		62.53		0.61	0.95	84	71	1	241	232	35	286			
6a		65.40		0.66	1.03	84	72	1	237	231	35	286			
b		68.23	97	0.63	0.99	84	73	1	238	242	35	286	12.0	8.5	(7.4/
c		71.06		0.63	0.99	84	73	1	240	238	36	287			
d		73.86		0.62	0.97	83	72		240	240	35	286			

1.6 75 1.17

PLANT	Trans Canada	PROBE TIP DIAMETER, IN.	HEATER BOX SETTING
RUN No.	3 Dioxin cart (2 rail line)	PROBE LENGTH, FT / Cp	ASSUMED MOL. WT. (Dry)
LOCATION	stack	PROBE HEATER SETTING	ASSUMED MOL. WT. (Wet)
DATE			STATIC PRESSURE, IN. H_2O
OPERATOR		INITIAL LEAK TEST	FILTER NUMBER
SAMPLE UNIT			STACK DIAMETER
CONTROL UNIT / Y		FINAL LEAK TEST	STACK HEIGHT
AMBIENT TEMP., °F			UPSTREAM DIAMETERS
BAROMETRIC PRESSURE, IN Hg		METER TEMP. COMP.	DOWNSTREAM DIAMETERS
ASSUMED MOISTURE, Bw			

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp.		Pump Vac. IN. Hg Gauge	Temperature °F		Temperature °F		Fyrites		
	1223	73.86	Co			Inlet °F	Outlet °F		Box	Probe	Impinger Exit	Stack	CO_2 Vol. %	O_2 Vol. %	
7,		76.67		0.63	0.98	77	69	1	227	235	40	285			
3		79.46	91	0.62	0.97	78	68	1	233	225	35	285	-		(7.8)
2		82.35		0.67	1.05	77	64	1	228	240	36	286			
1		85.19		0.65	1.01	76	64	1	225	238	36	285			
8,		88.25	103	0.75	1.18	75	63	1	238	239	36	284	11	9.0	(8.0)
3		91.32		0.75	1.18	76	63	1	240	238	35	283			
2		94.41		0.77	1.20	77	64	1	227	230	34	283			
1		97.55		0.77	1.20	78	65	1	228	233	35	284	12.0	8.5	
9,		100.58		0.76	1.19	77	64	1	225	225	35	285			
3		103.67	108	0.76	1.19	77	64	1	238	225	35	284			
2		106.38		0.81	1.26	77	63	1	243	236	35	283			
1		109.97		0.78	1.22	77	64	1	225	225	34	284			
10,	1328	113.49	113	0.99	1.54	69	62	2	273	215	35	283			(8.8)
3		116.95		0.96	1.50	74	63	2	259	264	35	285	12.0	8.5	
2		120.36		0.94	1.47	77	63	2	241	234	34	284			
1		123.81		0.95	1.48	77	63	2	240	238	35	283			
11,	stop 1351	127.30		0.98	1.53	77	64	2	238	228	35	285			
3	start 1357	130.81		0.98	1.53	77	64	2	272	229	35	285			
2		134.22		0.94	1.47	71	61	2	263	233	34	285			
1		137.64	95	0.93	1.45	74	61	2	264	235	34	285			(7.9)
12,		140.99		0.90	1.40	74	61	2	250	266	34	284			
3		144.30		0.88	1.37	74	61	2	269	265	34	284			
2		147.63	89	0.89	1.39	74	61	2	247	271	35	284	11	9.0	
1	1428	150.99		0.90	1.40	74	61	2	250	270	31	284			

final volume = 151.172

Blank Volume = 0.83 cf

15

[illegible] .1 @ .60 1.60 .14 1.2

PLANT [illegible] Canada
RUN No. 4 [illegible] (3 [illegible])
LOCATION Stack
DATE April 6/01
OPERATOR
SAMPLE UNIT
CONTROL UNIT / Y D8 [illegible]
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN Hg 27.21
ASSUMED MOISTURE, Bw

PROBE TIP DIAMETER, IN. .2288
PROBE LENGTH, FT / Cp 5E .8394
PROBE HEATER SETTING
INITIAL LEAK TEST .015 @ 15"
FINAL LEAK TEST .012 @ 15"
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H_2O -.25
FILTER NUMBER
STACK DIAMETER 138
STACK HEIGHT
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³	CO	Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp.		Pump Vac. IN. Hg Gauge	Temperature °F		Temperature °F		Fyrites		
	8:22	218.598				Inlet °F	Outlet °F		Box	Probe	Impinger Exit	Stack	CO_2 Vol. %	O_2 Vol. %	
1a		221.81	69	0.82	1.31	55	52	4	237	249	33	282	15.0	5.5	5.
b		225.10		0.87	1.39	63	54	4	240	252	36	281			
c		228.35	83	0.74	1.34	63	53	4	263	262	34	282			
2a		231.51		0.80	1.28	63	52	4	264	266	33	281			(6.8)
b		234.72		0.83	1.33	63	51	4	251	278	33	279			
c		237.95		0.83	1.33	64	51	4	255	228	34	278			
3a		241.05	85	0.77	1.23	66	52	4	243	[illegible]	37	277	15.0	5.0	(6.8)
b		244.17		0.78	1.25	66	52	4	245	243	37	277			
c		247.28		0.78	1.25	66	52	4	244	238	33	278			
4a	912	250.08	75	0.62	0.99	60	51	4	231	225	35	276			(5.6
b		252.92		0.65	1.04	66	53	4	224	225	35	279			
c		255.63		0.59	0.94	69	55	4	259	234	35	281			
5a		258.52	65	0.65	1.04	70	56	3	229	245	35	282	14.5	6.0	(5.4
b		261.53		0.71	1.15	71	57	3	232	273	36	281			
c		264.50		0.68	1.10	73	58	3	235	228	37	280			
6a		267.39		0.67	1.09	72	59	3	225	252	36	280			
b		270.42	73	0.72	1.17	73	59	3	238	248	36	280	15.0	5.5	(4.1)
c	957	273.41		0.70	1.13	73	59	3	236	249	36	280			

15 min/pt
5 min/point

..7e65 .7.1
16L 1.64

PLANT	Ayw Canada
RUN No.	o/cont. -
LOCATION	
DATE	
OPERATOR	
SAMPLE UNIT	
CONTROL UNIT / Y	
AMBIENT TEMP., °F	
BAROMETRIC PRESSURE, IN. Hg	
ASSUMED MOISTURE, Bw	

PROBE TIP DIAMETER, IN.	
PROBE LENGTH, FT / Cp	
PROBE HEATER SETTING	
INITIAL LEAK TEST	
FINAL LEAK TEST	
METER TEMP. COMP.	

HEATER BOX SETTING	
ASSUMED MOL. WT. (Dry)	
ASSUMED MOL. WT. (Wet)	
STATIC PRESSURE, IN. H_2O	
FILTER NUMBER	
STACK DIAMETER	
STACK HEIGHT	
UPSTREAM DIAMETERS	
DOWNSTREAM DIAMETERS	

Point	Clock Time	Dry Gas Meter Ft³	ω	Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp.		Pump Vac. IN. Hg Gauge	Temperature °F		Temperature °F		Fyrites		
						Inlet °F	Outlet °F		Box	Probe	Impinger Exit	Stack	CO_2 Vol. %	O_2 Vol. %	
	1002	273.41													
½		275.88		0.48	0.78	65	59	2	234	257	36	282			
1		278.35	79	0.48	0.78	72	62	3	232	272	32	283			(5.1
2		280.77		0.45	0.74	73	64	3	241	289	33	284	15.0	5.5	
½		283.54	64 ✓	0.60	0.98	73	63	3	247	282	35	285			
1		286.30		0.57	0.93	73	63	3	242	280	36	287			
2		289.10		0.60	0.98	72	62	3	240	238	35	285			
½		291.99		0.65	1.07	72	61	3	234	239	35	284			
1		294.88		0.65	1.07	71	60	3	255	226	35	284	14.0	6.5	
2	1047	297.80		0.65	1.07	70	60	3	256	224	35	284			
10½	1050	301.12		0.85	1.39	66	57	4	232	228	35	283			
1		304.44	86	0.85	1.39	71	58	3	235	229	35	285			(6.5
2		307.85		0.89	1.46	72	59	4	238	262	36	285	15	5.5	
½		311.30		0.92	1.51	72	59	4	238	248	35	284			
1		317.82		0.95	1.56	73	59	4	239	257	35	284			
2		318.31	69	0.94	1.55	73	59	4	240	251	35	284			
½		321.58		0.82	1.34	73	60	4	248	238	35	282	15	5.5	(5.7
1		324.79	69	0.80	1.31	72	60	4	244	239	35	283			
2	1135	328.04		0.80	1.31	72	60	4	246	244	35	282			(5.5

2.65 300 2.67 240 / 2.69 290 /

PLANT Tah 2 Canady Power - Will. LL.
RUN No. 1 Metals / Partic
LOCATION Stack (baseline)
DATE Apr 3/01
OPERATOR DJD
SAMPLE UNIT
CONTROL UNIT / Y D895C .9810
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.70
ASSUMED MOISTURE, Bw 18

PROBE TIP DIAMETER, IN. #269 .2585
PROBE LENGTH, FT / Cp 6A .8402
PROBE HEATER SETTING
INITIAL LEAK TEST .016 @ 15
FINAL LEAK TEST .012 @ 15
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H_2O -0.25
FILTER NUMBER 7A
STACK DIAMETER 138"
STACK HEIGHT 165'
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol. %	Fyrites O_2 Vol. %
	13:22	467.344												
1		471.35	33	.77	2.06	77	68	2	239	241	37	287		
2		475.75	[illegible]	.92	2.46	81	69	2	242	248	36	289	13.0	7.0
3	13:37	479.96	96	.84	2.24	83	69	2	245	249	35	289		
4	13:39	483.72	73	.67	1.79	81	69	2	258	248	35	286		
5		487.78	78	.78	2.08	84	69	2	261	242	34	290		
6	13:54	491.71	71	.73	1.95	85	70	2	260	247	36	287	14.0	7.0
7	13:58	496.43	43	1.05	2.80	83	70	2	279	250	36	287		
8		501.14	14	1.05	2.80	86	70	2	274	259	35	286	15.0	6.0
9	14:13	505.63	63	.93	2.50	86	70	2	274	260	36	286		
10	14:15	510.28	28	1.00	69 2.69	84	71	2	283	250	36	288	15.0	5.8
11		514.83	83	.96	2.58	87	72	2	274	256	36	288		
12	14:30	519.20	20	.88	2.37	87	72	2	280	252	36	286		
		51.85												

2.62 310 2.60 = 300 2.64 310 / 2.67 300 / 2.69 300

PLANT Trans Canada Power
RUN No. 2 Metals / Partic
LOCATION Stack (baseline)
DATE Apr. 4/01
OPERATOR DJO
SAMPLE UNIT
CONTROL UNIT / Y D 895C .9810
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.68
ASSUMED MOISTURE, Bw 18

PROBE TIP DIAMETER, IN. #.269 .2585
PROBE LENGTH, FT / Cp 6A .8402
PROBE HEATER SETTING
INITIAL LEAK TEST .016 @ 15"
FINAL LEAK TEST .014 @ 15"
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H$_2$O -0.25
FILTER NUMBER # 17
STACK DIAMETER 138"
STACK HEIGHT 165'
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H$_2$O ΔP	Orifice ΔH IN. H$_2$O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO$_2$ Vol. %	Fyrites O$_2$ Vol. %
	09:30	705.21												
1		709.82	83	1.03	2.70	83	74	2	278	242	44	311	16.0	5.0
2		714.49	49	1.08	2.75	90	78	2	274	276	53	306		
3	09:45	719.05	05	.96	2.56	91	77	2	280	277	53	302		
4	09:47	722.85	85	.67	1.79	89	77	2	281	247	54	300	16.0	4.5
5		726.42	42	.73	1.95	93	78	2	279	248	55	301		
6	10:02	730.54	54	.64	1.71	90	75	2	270	245	53	298		
7	10:04	734.39	39	.73	1.90	71	58	2	261	247	55	298	14.0	6.5
8		738.84	84	.98	2.55	74	58	2	264	267	53	299		
9	10:19	742.91	91	.82	2.13	75	58	2	263	280	53	297		
10	10:21	747.36	35	.97	2.52	72	58	2	263	279	52	297		
11		751.89	89	1.02	2.65	76	59	2	258	276	50	299	15.0	5.5
12	10:36	756.23	23	.93	2.42	76	59	2	257	273	50	299		
		51.02												

/ 2.57 300/ 2.59 = 300

PLANT TRANS Canada Power
RUN No. 3 Metals /Partic
LOCATION Stack (Rail ties)
DATE Apr 4 /01
OPERATOR DJO
SAMPLE UNIT
CONTROL UNIT / Y D895C .9810
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.68
ASSUMED MOISTURE, Bw 18

PROBE TIP DIAMETER, IN. #269 .2585
PROBE LENGTH, FT / Cp 6A .8402
PROBE HEATER SETTING
INITIAL LEAK TEST .018 @15"
FINAL LEAK TEST .018 @15"
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H₂O -0.25
FILTER NUMBER 74
STACK DIAMETER 138"
STACK HEIGHT 165'
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H₂O ΔP	Orifice ΔH IN. H₂O	Dry Gas Temp.		Pump Vac. IN. Hg Gauge	Temperature °F		Temperature °F		Fyrites	
						Inlet °F	Outlet °F		Box	Probe	Impinger Exit	Stack	CO₂ Vol. %	O₂ Vol. %
	16:00	908.25												
1		912.61	61	.92	2.36	86	79	2	265	266	46	295	13.0	7.5
2		917.16	16	1.00	2.57	92	81	2	278	274	44	295		
3	16:15	921.43	43	.88	2.26	95	82	2	277	283	46	294		
4	16:17	925.80	80	.90	2.33	91	83	2	265	259	44	296		
5		930.30	30	.96	2.49	98	83	2	264	261	43	295	12.0	8.5
6	16:32	934.47	47	.82	2.12	99	83	2	260	261	43	293		
7	16:34	937.82	82	.53	1.37	95	83	2	262	249	44	292	13.0	7.5
8		941.67	67	.70	1.81	98	85	2	268	248	44	296		
9	16:49	945.38	38	.65	1.68	98	85	2	270	248	45	295		
10	16:51	949.14	14	.67	1.74	93	85	2	258	249	40	297		
11		953.48	47	.89	2.31	99	85	2	243	246	41	300	13.0	7.5
12	17:06	957.49		.76	1.97	99	85	2	248	247	41	300		
		49.24												

.60 1.08 @ 290 2.75 300 / 2.51 – 300 / 2.59 @ 300 / 2.65 @ 285 / 269 @ 275 /

PLANT Trans Canada Power
RUN No. 4 Metals / Partic.
LOCATION Stack (Rail ties)
DATE Apr 5/01
OPERATOR DJD
SAMPLE UNIT
CONTROL UNIT / Y D895C .9810
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.32
ASSUMED MOISTURE, Bw 20

PROBE TIP DIAMETER, IN. #269 .2585
PROBE LENGTH, FT / Cp 6A .8402
PROBE HEATER SETTING
INITIAL LEAK TEST .006 @ 15"
FINAL LEAK TEST .006 @ 15"
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H_2O -0.25
FILTER NUMBER #12
STACK DIAMETER 138"
STACK HEIGHT 165'
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

25 min del. starting then

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H_2O ΔP	Orifice ΔH IN. H_2O	Dry Gas Temp. Inlet 82°F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO_2 Vol. %	Fyrites O_2 Vol. %
	15:22	152.40												
1		156.91	51	.94	2.52	[illegible]	77	2	252	274	40	281	12.0	9.0
2		161.21	28	.87	2.3[illegible]	88	78	2	269	251	41	285		
3	15:37	165.44	44	.85	2.25	88.	78	2	275	247	42	285		
4	15:39	169.21	21	.67	1.78	85	78	2	272	258	41	286	12.0	9.0
5		173.30	30	.79	2.09	88	78	2	270	275	42	284		
6	15:54	177.20	20	.72	1.91	89	78	2	267	273	42	284		
7	15:56	180.58	55	.54	1.43	86	76	2	273	241	42	285		
8		184.23	23	.63	1.67	90	77	2	275	247	40	286		
9	16:11	187.76	76	.59	1.56	91	78	2	283	253	40	283	12.0	9.0
10	16:13	192.29		.97	2.57	85	78	2	276	244	40	285		
11		196.94		1.02	2.70	93	78	2	278	249	40	295		
12	16:28	201.18		.85	2.25	93	78	2	274	252	40	284		

/ [illegible] / 2.69 : 275

PLANT Tr. s Canada Power
RUN No. 5 Metals / Partic.
LOCATION Stack (Rail Ties)
DATE Apr. 6/01
OPERATOR DJP
SAMPLE UNIT
CONTROL UNIT / Y D895C .9810
AMBIENT TEMP., °F
BAROMETRIC PRESSURE, IN. Hg 27.21
ASSUMED MOISTURE, Bw .18

PROBE TIP DIAMETER, IN. # 269 .2582
PROBE LENGTH, FT / Cp 6A .8402
PROBE HEATER SETTING
INITIAL LEAK TEST .012 @ 15"
FINAL LEAK TEST .012 @ 15"
METER TEMP. COMP.

HEATER BOX SETTING
ASSUMED MOL. WT. (Dry)
ASSUMED MOL. WT. (Wet)
STATIC PRESSURE, IN. H₂O -0.25
FILTER NUMBER 7A
STACK DIAMETER 138"
STACK HEIGHT 165'
UPSTREAM DIAMETERS
DOWNSTREAM DIAMETERS

Point	Clock Time	Dry Gas Meter Ft³		Pitot IN. H₂O ΔP	Orifice ΔH IN. H₂O	Dry Gas Temp. Inlet °F	Dry Gas Temp. Outlet °F	Pump Vac. IN. Hg Gauge	Temperature °F Box	Temperature °F Probe	Temperature °F Impinger Exit	Temperature °F Stack	Fyrites CO₂ Vol. %	Fyrites O₂ Vol. %
	11:50	328.42												
1		332.64	64	.84	2.23	66	56	2	225	245	42	288	13.0	7.5
2		337.02	02	.91	2.41	73	60	2	255	242	38	286		
3	12:05	340.97	95	.73	1.93	73	61	2	250	240	40	286		
4	12:07	345.39	39	.92	2.44	68	60	2	276	244	39	287		
5		349.92	92	.97	2.57	75	61	2	281	246	39	288	13.0	7.5
6	12:22	354.08	08	.82	2.17	75	61	2	274	249	39	288		
7	12:24	357.43	43	.53	1.40	69	59	2	275	247	40	283		
8		361.11		.64	1.70	72	61	2	282	271	41	288	13.0	8.0
9	12:39	364.61		.58	1.54	73	60	2	282	274	42	287		
10	12:41	368.06	06	.56	1.48	70	60	2	279	272	41	284		
11		372.04		.75	1.99	73	60	2	274	268	41	287	13.0	8.0
12	12:56	375.94		.72	1.91	73	60	2	271	274	41	287		

Date / Time	Opacity (%)	Nox (ppm)	O2 (%)	CO (ppm)	CO2 (%)
April 3 - 14:48 - 19:38	2.6	126	5.3	142	15.2
April 4 - 11:15 - 15:49	2.5	139	6.1	63	14.0
April 5 - 9:12 - 14:28	2.1	133	7.2	60	12.5
April 6 - 8:22 - 11:35	2.1	140	5.1	51	14.6

Power (MW)
64
61
56
61

APPENDIX 5

CALIBRATIONDATA

A. LANFRANCO and ASSOCIATES INC.

DRY GAS METER CALIBRATION FORM

Date: Nov.29,2000
Tech. I.D.: Mark L
Console I.D.: d895C

Parameter Summary	Run No. 1	Run No. 2	Run No. 3
Ta = Ambient (Wet Test Meter) temp.	59.0	60.0	59.0
ΔP = Press. diff. @ Wet Test Meter	-0.90	-1.20	-1.70
Pb = Atmospheric Pressure	29.45	29.45	29.45
Pv = Vapour Pressure at Temp. Ta	0.5035	0.5218	0.5035
ΔH = Press. diff. @ Orifice	1.0	2.0	3.0
Ti = Dry Test inlet Temp.	80.8	89.3	92.5
To = Dry Test outlet Temp.	67.5	75.8	77.8
Ri = Initial Dry Test vol.	963.168	988.796	0.551
Rf = Final Dry Test vol.	971.577	1000.551	14.943
Vi = Initial Wet Test vol.	5518.781	5543.790	5555.152
Vf = Final Wet Test vol.	5527.058	5555.152	5569.030
Pw = Pb + (ΔP / 13.6)	29.3838	29.3618	29.3250
Pd = Pb + (ΔH / 13.6)	29.5235	29.5971	29.6706
Tw = Ta + 460	519.0	520.0	519.0
Td = [(Ti + To) / 2] + 460	534.2	542.6	545.2
Bw = Pv / Pb	0.01710	0.01772	0.01710
Wet Test Meter Factor (WTF)	0.9950		
CALCULATED VALUE (Y)	0.9860	0.9778	0.9790

AVERAGE (Y) = **0.9810**

Calibration Equation: Y = [((Vf-Vi)*WTF) / (Rf-Ri)] * [(Pw/Pd)*(Td/Tw)] * (1-Bw)

AUTHORIZATION

Calibration Section

A. LANFRANCO and ASSOCIATES INC.

ORIFICE METER CALIBRATION FORM

Date: Nov.29,2000
Tech. I.D.: Mark L
Console I.D.: d895C

Parameter Summary	Run No. 1	Run No. 2	Run No. 3
Md = Mol. Wet Dry Air	28.96	28.96	28.96
Pb = Atmospheric Press.	29.45	29.45	29.45
Y = Dry Gas Meter Calibration	0.9810	0.9810	0.9810
ΔH = Press. Diff. @ Orifice	1.0	2.0	3.0
Ri = Initial Dry Test Vol.	963.168	988.796	0.551
Rf = Final Dry Test Vol.	971.577	1000.551	14.943
ΔT = Measured Interval (minutes)	15.0	15.0	15.0
$Qm = Y * (Rf - Ri) / \Delta T$	0.54993	0.76875	0.94121
$Tm = To + 460$	527.5	535.8	537.8
$Pm = Pb + (\Delta H/13.6)$	29.524	29.597	29.671
CALCULATED VALUE (Ko)	0.7001	0.6875	0.6869

AVERAGE (Ko) = 0.6915

Calibration Equation: $Ko = Qm / (Tm/Pm * \Delta H/Md)^{0.5}$

AUTHORIZATION

M Lanfranco
Calibration Section

A. LANFRANCO and ASSOCIATES INC.

DRY GAS METER CALIBRATION FORM

Date: Dec.1,2000
Tech. I.D.: Mark L
Console I.D.: LM-3

Parameter Summary	Run No. 1	Run No. 2	Run No. 3
Ta = Ambient (Wet Test Meter) temp.	60.0	60.0	60.0
ΔP = Press. diff. @ Wet Test Meter	-0.30	-0.20	-0.20
Pb = Atmospheric Pressure	29.50	29.50	29.50
Pv = Vapour Pressure at Temp. Ta	0.5218	0.5218	0.5802
ΔH = Press. diff. @ Orifice	0.0	0.0	0.0
Ti = Dry Test inlet Temp.	68.0	72.5	74.3
To = Dry Test outlet Temp.	66.0	70.5	72.3
Ri = Initial Dry Test vol.	1345.127	1350.261	1353.605
Rf = Final Dry Test vol.	1349.831	1353.605	1355.512
Vi = Initial Wet Test vol.	5728.273	5733.428	5736.747
Vf = Final Wet Test vol.	5733.000	5736.747	5738.618
Pw = Pb + (ΔP / 13.6)	29.4779	29.4853	29.4853
Pd = Pb + (ΔH / 13.6)	29.5000	29.5000	29.5000
Tw = Ta + 460	520.0	520.0	520.0
Td = [(Ti + To) / 2] + 460	527.0	531.5	533.3
Bw = Pv / Pb	0.01769	0.01769	0.01967
Wet Test Meter Factor (WTF)	0.9950		
<u>CALCULATED VALUE (Y)</u>	0.9947	0.9911	0.9810

AVERAGE (Y) = **0.9889**

Calibration Equation: Y = [((Vf-Vi)*WTF) / (Rf-Ri)] * [(Pw/Pd)*(Td/Tw)] * (1-Bw)

AUTHORIZATION

Calibration Section

A. LANFRANCO and ASSOCIATES INC.

S - TYPE PITOT CALIBRATION FORM

Date:	Nov. 24/00
Technician:	M. Aiken
Pitot I.D.:	A.L. 6A
Nozzle I.D.:	0.250

Approx. Wind Vel.	Ref. Pitot Vel. Pressure		S-Type Pitot Vel. Press.		Pitot Coefficient
Ft/sec.	ΔPref.	Cref. SQRT(ΔPref.)	ΔPs	SQRT(ΔPs)	Cp
25.49	0.150	0.38343	0.210	0.45826	0.83670
39.49	0.360	0.59400	0.500	0.70711	0.84004
52.24	0.630	0.78579	0.880	0.93808	0.83765
64.15	0.950	0.96493	1.300	1.14018	0.84630

AVERAGE Cp = 0.8402

Calibration Equation: $Cp = C_{ref.} * SQRT (\Delta P_{ref.}/\Delta Ps)$

$C_{ref.}$ = 0.99

Where:

$\Delta P_{ref.}$ = velocity pressure measured by reference pitot

$C_{ref.}$ = coefficient of reference pitot

ΔPs = velocity pressure measured by S - type pitot

Cp = coefficient of S - type pitot

AUTHORIZATION

Merv Aiken

CALIBRATION SECTION

A. LANFRANCO and ASSOCIATES INC.

S - TYPE PITOT CALIBRATION FORM

Date:	Nov. 28/00
Technician:	M. Aiken
Pitot I.D.:	A.L. 5E
Nozzle I.D.:	0.250

Approx. Wind Vel.	Ref. Pitot Vel. Pressure		S-Type Pitot Vel. Press.		Pitot Coefficient
Ft/sec.	Δ Pref.	Cref. SQRT(Δ Pref.)	Δ Ps	SQRT(Δ Ps)	Cp
25.49	0.150	0.38343	0.210	0.45826	0.83670
40.57	0.380	0.61028	0.530	0.72801	0.83828
53.07	0.650	0.79816	0.890	0.94340	0.84605
65.82	1.000	0.99000	1.400	1.18322	0.83670

AVERAGE Cp = 0.8394

Calibration Equation: $C_p = C_{ref.} * \mathrm{SQRT}(\Delta P_{ref.}/\Delta P_s)$

$C_{ref.} = 0.99$

Where:

$\Delta P_{ref.}$ = velocity pressure measured by reference pitot

$C_{ref.}$ = coefficient of reference pitot

ΔP_s = velocity pressure measured by S - type pitot

Cp = coefficient of S - type pitot

AUTHORIZATION

Merv Aiken

CALIBRATION SECTION

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

TEMPERATURE CALIBRATION FORM

Technician: M. Holm

Date: Jan. 2, 2001

Barometric Pressure: 29.89

Land Elevation: 30 feet

Signature:

TEMPERATURE DEVICE CALIBRATIONS

Device	Mercury In Glass Thermometer Temp.			Temperature Device Reading		
I.D.	Ice Bath (°C)	Boiling Water(°C)	Hot Oil (°F)	Ice Bath (°F)	Boiling Water (°F)	Hot Oil (°F)
N31 D895C	0.0	100.1				
N31 D836C	0.0	100.1	398	35	213	399
N31 D621C	0.1	100.2	395	27	207	395
N31-200TC	0.1	100.1	398	33	212	403
NAPP31 D979C	0.1	100.0	396	31	211	399
NAPP40	0.0	100.2	399	32	213	405
PM-100	0.1	100.0	395	28	210	399
BEI	-0.1	100.0	396	32	211	398
FORDING C241	0.0	100.1	400	34	212	403
Harmac D423	-0.1	100.0	400	33	213	402
UEI-1 DT150	0.2	100.3	400	32	212	407
UEI-2 DT150	0.1	100.2	401	32	212	404
KM-1 KM330	0.0	100.0	400	30	211	403
Fyrite Pro-1	0.1	100.1	400	29	211	403
Fyrite Pro-2	0.1	100.1	401	30	212	403
PCA	0.1	100.1	399	27	206	390
Jenco-1	0.0	100.1	398	32	213	404
Jenco-2	-0.1	100.0	398	32	216	408
Jenco-3	0.1	100.2	399	32	212	403
Jenco-4	0.0	100.0	399	33	214	407
KM450-1	0.1	100.1	398	32	212	406

K-TYPE THERMOCOUPLE CALIBRATIONS

Probe/TC ID	Hg Thermometer Temp (°C)	UEI-1 Readout Temp (°F)	Probe/TC ID	Hg Thermometer Temp (°C)	UEI-1 Readout Temp (°F)
3B	100.5	212.7	12B	100.2	210.9
3C	101.0	213.0	TC 3-3	100.6	212.0
4A	100.5	212.3	TC 4-3	100.8	212.8
4B	101.2	213.9	TC 4-4	100.7	214.0
5A	100.4	211.7	TC 5-4	100.0	211.7
5B	100.6	212.6	TC 5-5	100.1	212.5
5C	100.9	211.6	TC 5-6	101.6	213.9
5E	101.0	212.8	TC 6-4	100.7	212.5
6A	100.5	211.6	TC 10-3	101.1	211.0
6B	100.2	211.7	TC 10-4	101.0	213.3
6C	100.6	212.8	TC Marshall	100.5	212.6
7C	101.1	211.4	5' Fording	100.6	212.5
8A	100.4	212.1			
8B	101.2	213.2			
10A	100.0	212.5			
10B	100.8	213.0			
11A	99.9	212.6			
12A	101.1	213.0			

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

NOZZLE DIAMETER CALIBRATION FORM

Technician: Michael Holm
Date: 2-Jan-01
Signature: Michael Holm

Nozzle ID	Dia. #1 (inches)	Dia. #2 (inches)	Dia. #3 (inches)	Difference (inches)	Average Diameter (inches)	Average Area (ft^2)
I	0.1665	0.1630	0.1650	0.0035	0.1648	0.0001482
II	0.1740	0.1735	0.1745	0.0010	0.1740	0.0001651
III	0.1800	0.1775	0.1780	0.0025	0.1785	0.0001738
XXIX	0.1875	0.1845	0.1855	0.0030	0.1858	0.0001884
XXXI	0.1860	0.1890	0.1850	0.0040	0.1867	0.0001900
XXX	0.1855	0.1890	0.1860	0.0035	0.1868	0.0001904
XVIII	0.2015	0.2040	0.2020	0.0025	0.2025	0.0002237
IV	0.2190	0.2165	0.2190	0.0025	0.2182	0.0002596
0.233	0.2310	0.2275	0.2280	0.0035	0.2288	0.0002856
V	0.2445	0.2440	0.2465	0.0025	0.2450	0.0003274
XX	0.2510	0.2505	0.2510	0.0005	0.2508	0.0003432
XXI	0.2525	0.2525	0.2540	0.0015	0.2530	0.0003491
XXVIII	0.2540	0.2545	0.2520	0.0025	0.2535	0.0003505
#269	0.2590	0.2585	0.2580	0.0010	0.2585	0.0003645
0.265	0.2605	0.2595	0.2590	0.0015	0.2597	0.0003678
0.275	0.2625	0.2600	0.2610	0.0025	0.2612	0.0003720
VI	0.2640	0.2650	0.2620	0.0030	0.2637	0.0003792
VII	0.2750	0.2755	0.2735	0.0020	0.2747	0.0004115
0.284	0.2830	0.2865	0.2870	0.0040	0.2855	0.0004446
XXVII	0.2900	0.2930	0.2895	0.0035	0.2908	0.0004613
XXII	0.2920	0.2940	0.2900	0.0040	0.2920	0.0004650
XIV	0.2950	0.2970	0.2990	0.0040	0.2970	0.0004811
XXXVII	0.3230	0.3250	0.3245	0.0020	0.3242	0.0005731
XXXVIII	0.3245	0.3260	0.3275	0.0030	0.3260	0.0005796
XXXVI	0.3275	0.3280	0.3290	0.0015	0.3282	0.0005874
XXVI	0.3305	0.3300	0.3310	0.0010	0.3305	0.0005958
IX	0.3620	0.3625	0.3630	0.0010	0.3625	0.0007167
0.362	0.3620	0.3660	0.3620	0.0040	0.3633	0.0007200
X	0.3670	0.3680	0.3710	0.0040	0.3687	0.0007413
#278	0.3855	0.3880	0.3895	0.0040	0.3877	0.0008197
XI	0.4040	0.4045	0.4075	0.0035	0.4053	0.0008961
XII	0.4160	0.4120	0.4150	0.0040	0.4143	0.0009363
XV	0.4315	0.4320	0.4315	0.0005	0.4317	0.0010163
XXIV	0.4325	0.4315	0.4320	0.0010	0.4320	0.0010179
XXV	0.4380	0.4400	0.4380	0.0020	0.4387	0.0010495
XVI	0.4435	0.4470	0.4470	0.0035	0.4458	0.0010841
XXXIX	0.4940	0.4970	0.4945	0.0030	0.4952	0.0013373
XXIII	0.5020	0.4980	0.5015	0.0040	0.5005	0.0013661
XVII	0.5690	0.5695	0.5685	0.0010	0.5690	0.0017659
XIII	0.6455	0.6420	0.6460	0.0040	0.6445	0.0022655

Where:

(a) Dia. #1, Dia. #2, Dia. #3 = three different nozzle diameters, each diameter must be measured to within (0.25mm) 0.001 inches

(b) Difference = maximum difference between any two diameters, must be less than or equal to (1.0 mm) 0.004 inches

(c) Average = average of Dia. #1, Dia. #2, and Dia. #3

APPENDIX B

Katie Allen

From: Adams, Ralph ENV:EX <Ralph.Adams@gov.bc.ca>
Sent: Wednesday, May 20, 2015 5:27 PM
To: Jeff Lundgren
Cc: 'Terry Shannon'; Lamb-Yorski, Matthew J ENV:EX
Subject: RE: Detailed Model Plan for Atlantic Power Williams Lake
Attachments: glendale_met_station_location.jpg; Glendale_met_2012.csv

Jeff:

I have reviewed the modelling plan that you sent. The plan I reviewed was dated May 6th, 2015 and is watermarked "draft".

In my opinion the planned modelling will be suitable for assessment of the upcoming permit amendment. In particular I note that: the latest version of the CALMET/CALPUFF suite is to be used, the domain is 25km square centered on the plant, the CALMET resolution is 500m, both WRF mesoscale model and local meteorological stations are to be used as inputs for the model year 2012, and that stack test results for the existing plant will be used as the basis for emission factors.

I have some comments and suggestions concerning both the modelling plan, and the subsequent technical report that will be based in part on the modelling results.

- In table B.2 for emission sources it is stated that Particulate matter will be modelled. I assume this is TPM, as specified in the permit. While I understand that the modelling does not need to consider the size fractions of TPM, I suggest that you also prepare isopleth maps and tables for PM10 and PM2.5 concentrations. PM10 and PM2.5 are of considerable concern at the moment in the airshed.
- NO2 is not listed. While there is not a significant NO2 issue in the airshed, I recommend that NO2 be added to the list of emissions modelled. BC is in the process of bringing in new NO2 objectives based on 1 hour values, and there is more concern about this pollutant due to its inclusion in the AQHI formula.
- In table B.2 for Planned Meteorological Input, it is stated that in addition to WRF model data, the Canadian Tire and WL airport stations will be used. There is an additional station which may be useful, the MoE Glendale met site which is much closer that the other surface stations. I have appended a Google earth Image and a file of the 2012 output form the archive. I note that there is a gap in data in July which may have influenced your decision.
- I realise that this is not part of the modelling plan, but in the technical report which will eventually be produced, the background concentrations for PM and PM2.5 should be based on both the current Columneetza station measurements, and the Partisol measurements which are currently being conducted in the airshed. I can supply the data and more information on the appropriate backgrounds when they are needed.

Regards.

Ralph Adams.

Ralph Adams - Air Quality Meteorologist
Air Quality Section
Monitoring, Assessment, and Stewardship
Environmental Protection

1259 Dalhousie Drive
Kamloops, BC
V2C-5Z5
Ph. (250) 371-6279 Fax. (250) 828-4000
ralph.adams@gov.bc.ca

BC Air Quality: http://www.bcairquality.ca/

From: Jeff Lundgren [mailto:Jeff.Lundgren@RWDI.com]
Sent: Friday, May 8, 2015 9:50 PM
To: Adams, Ralph ENV:EX
Cc: Brad Bergeron; Joe Cleary (joe.cleary@comcast.net); 'Terry Shannon'
Subject: Detailed Model Plan for Atlantic Power Williams Lake

Ralph,

Attached please find a detailed model plan for Atlantic Power in Williams Lake. Please let me know if you have any concerns or would like to discuss.

Thank you.

Jeff

Jeff Lundgren, M.Sc.
Technical Director/Principal

RWDI AIR Inc.
830 - 999 West Broadway, Vancouver, B.C., Canada V5Z 1K5
T: (604) 730-5688 ext3224 **M:** (604) 603-4984 **F:** (604) 730-2915 **W:** www.rwdi.com

Peter Lawrie
Senior Environmental Protection Officer
Northern Region
Prince George
Via email

File:Atlantic Power Corporation

Date: 1st March, 2016

Peter:

I have completed my initial review of the technical assessment prepared by RWDI Air Inc. in support of Atlantic Power Corporation's application for a major permit amendment to fire up to 50% rail-ties in the boiler of the Williams Lake Power Plant, *Air Dispersion Modelling Study, RWDI #1500355*, dated September 8th 2015 (the report).

I am requesting some additional information related to the RWDI report. If you agree with my request, please forward this document to Atlantic Power and their consultants[1].

The reason for this request is not that I found significant errors or omissions in the report, but that additional information has come to light in the last months. In particular I have become aware that in 2004 the ministry contracted Levelton Engineering to model air quality for the entire Williams lake Airshed using the Calmet/Calpuff model suite. Emission factors for all permitted point sources were prepared and supplied to Levelton by the ministry, non-point source emissions were developed by Levelton. The model produced estimates of PM_{10}, $PM_{2.5}$, secondary PM, VOC, NO_2, SO_2 and CO for the entire airshed. These documents have now been loaded on the ministry air quality website at:

http://www.bcairquality.ca/reports/region_Cariboo.html

The project resulted in three reports: one on Calmet modelling for Williams lake Airshed (2004). Calpuff modelling of the Williams Lake Airshed (2005) and a report on fine particulate apportionment based on the modelling (2005). It is my opinion that these reports need to be carefully reviewed and considered during the review of the Atlantic Power amendment application. There is considerable work involved, for instance I note that in the Calpuff report the stack height and flow rates used for the Atlantic Power site (then NW Energy) appear to be in

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[1] Given the correspondence we have been receiving form the public and stakeholders regarding this application, I am of the opinion that there is a strong possibility that any decision may be appealed. During the Pinnacle Pellet Lavington application, Matt Lamb-Yorski and I used this method of relaying all information through the lead EPO, this made later FOI request and disclosures during the appeal far easier a there was a single point of contact. Therefore, I have sent this note to you, but assumed it will be forwarded to the proponent.

Ministry of Environment
Southern Interior Region
Environmental Protection Division
Mailing Address:
1259 Dalhousie Drive
Kamloops BC V2C 5Z5
Telephone: 250 371-6200
Facsimile: 250 828-4000
Website: www.gov.bc.ca/env

error (I have already requested and received clarification of the stack height). The reports also predicted significant levels of SO_2 in the airshed due to various sources, but in particular an asphalt batch-plant (I am also informed that there is a second batch plant now operating).

In order to include a review of these documents in the referral I am preparing for you, I would like to request some additional information from Atlantic Power and RWDI relating to the September TAR. This request is based on the assumption that the unity-emission-factor approach[2] was used in the RWDI modelling, if this is not the case I do not recommend any further modelling without additional consultation between the proponent and the ministry.

I am requesting the following:

- Additional isopleth maps showing the distribution of maximum annual $PM_{2.5}$ and maximum 24 hour average (98th percentile) $PM_{2.5}$ using the permitted maximum TPM discharge rate rather than the stack based TPM emission rate.

- A revision of the isopleth map in Figure 8 showing maximum 1 hour NO2 concentrations without background. This version should show the distribution of lower values rather than concentrations on the highest values and exceedances. The objective of this request is to show what the predicted NO2 concentrations due to the operation of Atlantic Power facility are near the Columneetza Air station.

- As above, but a revision of the SO_2 isopleth map in Figure 6.

- The NO2, PM2.5 and SO2 statistics predicted by the model at the closes Calpuff grid point to the Columneetza air station. Note that I am not requesting the model be rerun with Columneetza as a special receptor, just the predictions for the closed grid point.

If there are any questions or concerns with this request please contact me directly.

Sincerely,

Ralph Adams

Ralph Adams.
Monitoring, Assessment, and Stewardship
Environmental Protection

---

[2] This means that the model does not have to be rerun to produce the information I am requesting. The post-processing software CALPOST can be used to extract the information from existing model output files.

RWDI
CONSULTING ENGINEERS
& SCIENTISTS

CANADA'S BEST MANAGED COMPANIES
Platinum member

Memorandum

Tel: 604.730.5688

RWDI AIR Inc.
Suite 280 – 1385 West 8th Avenue
Vancouver, British Columbia, Canada V6H 3V9
Email: solutions@rwdi.com

Date: **April 22, 2016** **RWDI Reference #:** 1500355

To: Ralph Adams
British Columbia Ministry of the Environment
E-Mail: Ralph.Adams@gov.bc.ca

cc: Terry Shannon
Atlantic Power, Williams Lake Power Plant
E-Mail: tshannon@atlanticpower.com

From: Jeff Lundgren
RWDIAIR Inc.
E-Mail: Jeff.Lundgren@rwdi.com

Re: **Supplementary Modelling Results and MOE Information Request**
Atlantic Power, Williams Lake Power Plant
Williams Lake, British Columbia

Dear Ralph,

This memorandum contains supplemental information in regards to Air Dispersion Model Study for Atlantic Power Williams Lake Power Plant dated September 8, 2015, RWDI reference No. 1500355. The modelling results were updated to reflect the following changes from the report:

- The NO_x emission rate derived from the 2001 stack test was corrected to use the standard flow rate, rather than the actual flow rate used previously.
- The stack base elevation used in the modelling was corrected from 646 meters to 657 meters ASL.
- NO_x to NO_2 conversion was refined to use hourly ozone rather than the annual 1-hour maximum in the ozone limiting calculation.

In addition the following additional information requested by MOE is provided:

- Additional isopleth maps showing the distribution of maximum annual $PM_{2.5}$ and maximum 24-hour average (98th percentile) $PM_{2.5}$ using the permitted maximum Total Particulate Matter (TPM) discharge rate rather than the TPM emission rate based on the 2001 stack testing report.
- A revision of the isopleth map in Figure 8 showing maximum 1-hour NO_2 concentrations without background.
- As above, but a revision of the SO_2 isopleth map in Figure 6.
- The NO_2, $PM_{2.5}$ and SO_2 statistics predicted by the model at the closest CALPUFF grid point to the Columneetza air station.

REVISIONS TO ORIGINAL ASSESSMENT

The updated model results and explanation of the specific changes made are provided with these sections. All other methodology is the same as was provided in the September 8, 2015 RWDI report. To facilitate comparison, where applicable, tables and plots are provide using the same Figure and Table references as in the original RWDI report (September 8, 2015).

Revised NO_x Emissions

In the September 2015 RWDI report, NO_x emissions were incorrectly calculated using the actual flow rate provided in the 2001 stack testing report. The 2001 Stack Testing Report provides NO_x emissions as ppm. At standard conditions, the equation to convert to ppm to g/m^3 is estimated by:

$$\text{g/m}^3 = \text{NO ppm} * \text{molecular weight} * 40.8862 / 10^6$$

http://www.assembly.ab.ca/lao/library/egovdocs/2009/alen/173465.pdf

The emission rate in grams per second is found by multiplying the in-stack concentration (g/m^3) by the flow rate.

$$\text{g/s} = NO_x \text{ ppm} * \text{molecular weight} * 40.8862 * 10^6 * \text{standard flow rate}$$

In the September 2015 RWDI report, the above equation using the average of the three (3) NO_x test values and the *actual flow rates* (bolded) given in Tables 6 and Table 1 of the 2001 Stack Testing Report, respectively, and converting for units gave:

NO_x emission rate based on actual flow (Am^3/min) =

Average of (**139** ppm * 40.8862 * 46 * **11210** m^3/min / (10^6 µg/g * 60 s/min),
133 ppm * 40.8862 * 46 * **11090** m^3/min / (10^6 µg/g * 60 s/min),
140 ppm * 40.8862 * 46 * **10860** m^3/min / (10^6 µg/g * 60 s/min))
= 47.6 g/s

However, the calculation should have used the *standard flow rates* given in Table1 of 2001 Stack Testing Report. Using the correct standard flow that calculation is:

NO_x emission rate based on standard flow (Sm^3 /min) =

Average of: (**139** ppm * 40.8862 * 46 * **5920** m^3/min / (10^6 µg/g * 60 s/min),
133 ppm * 40.8862 * 46 * **5790** m^3/min / (10^6 µg/g * 60 s/min),
140 ppm * 40.8862 * 46 * **5600** m^3/min / (10^6 µg/g * 60 s/min))
= 24.8 g/s

Stack Base Height

In the process of revisiting the modelling results, it was discovered that an incorrect stack base elevation of 646 meters above sea level was used in the original 2015 assessment. This was corrected to 657 meters elevation and the air dispersion modelling was updated accordingly. As a result, the previous stack release height was 11 meters too low relative to the surrounding terrain. The effect of this correction resulted in a reduction of the model predictions across pollutants and averaging time by approximately 10-20%. Of particular note the 99th percentile daily max SO_2 prediction for 100% rail ties is reduced from 223µg/m^3 to 187µg/m^3, eliminating the predicted exceedance of the BC AAQO for SO_2 for that scenario.

NO_x to NO_2 Conversion using Hourly Ozone Columneetza

In the September 2015 model study, the maximum 1-hour ozone value measured at the Columneetza air quality station was used to convert NO_x predictions to NO_2 using the Ozone Limiting Method (OLM). The maximum value used was 83 pbb. Using this value means for most of the year was effectively resulting in 100% conversion of NO_x to NO_2, particularly during winter months when ambient ozone would tend be far less that the 1-hour maximum for the year. This led to a likely over-prediction of NO_2 resulting in exceedances of the BC AAQO for NO_2.

To provide a more refined prediction, the OLM NO_x to NO_2 conversion was recalculated using the hour by hour ozone concentration from the Columneetza station, which is a more refined and more rigorous method of estimating the resulting NO_2 concentrations. When combined with the reduced emission rate noted above, the effect of this change is to reduce the 98th percentile daily maximum NO , including background, from 254 µg/m^3 to 149 µg/m^3, which eliminates the predicted exceedance of the BC AAQO for NO_2.

Overall Summary of Updates

Attachment 1 contains the updated Table 6, Table 7, and Table 8. These updated results should directly replace the previous provide Tables from the September 8, 2015 modelling report.

ADDITIONAL INFORMATION REQUEST

The following section summarizes the additional information requested by the MOE.

Permitted Rates for Particulate Matter

The MOE has requested that additional isopleth maps showing the distribution of maximum annual $PM_{2.5}$ and maximum 24-hour average (98th percentile) $PM_{2.5}$ using the permitted maximum total particulate matter (TPM) discharge rate be evaluated rather than the stack based TPM emission rate.

As requested, the $PM_{2.5}$ and PM_{10} are now presented using the permitted total PM emission rate. The updates tables and plots in this memorandum show all PM fractions calculated from the permitted rate. **Attachment 1** contains the updated Tables 6 and 7 with the updated TPM, PM_{10} and $PM_{2.5}$ results using the permitted TPM emission rate.

Attachment 2 contains the new Figures A and B outlining the revised isopleths.

Revisions NO_2 and SO_2 Isopleths

The MOE has requested that the isopleth map in Figure 8 showing maximum 1-hour NO_2 concentrations without background be revised. The revised version should show the distribution of lower values rather than concentrations on the highest values and exceedances. The objective of this request is to show what the predicted NO_2 concentrations due to the operation of Atlantic Power facility are near the Columneetza Air station. The same revision of the SO_2 isopleth map in Figure 6 was also requested.

Attachment 3 contains the updated Figure 6 and 8 with the above noted revisions. It should be noted that Figure 8 was split into Figure 8 and Figure C containing the 1-hour (98th percentile) NO_x with background (Figure 8) and without background (Figure C) using the OLM NO_x to NO_2 conversion of hour by hour ozone concentration from the Columneetza station.

Predicted Results at Columneetza Air Station

The MOE requested that the NO_2, $PM_{2.5}$ and SO_2 statistics predicted by the model at the closes Calpuff grid point to the Columneetza air station be provided.

Attachment 4 contains a summary table of the predicted results at the Columneetza Air Station.

Best Available Technology Analysis

The MOE had requested that a Best Available Technology Analysis specifically for NO_x, SO_x and HCl be completed. RWDI completed this evaluation and the report is provided under separate cover.

Secondary Formation

The MOE has requested clarification regarding the potential for secondary particulate formation. As such, RWDI reviewed the potential for this occurrence and provided a discussion document in **Attachment 5**.

CLOSING

We trust the information provided addresses the comments received by the MOE regarding the Williams Lake Power Plant permit amendment. Should you have any questions, please feel free to contact us directly.

Kind regards,

Jeff Lundgren, M.Sc.
Technical Director/Principal

JRL/BCB/jo

ATTACHMENT 1

Table 6: Modelling Results of Contaminants with B.C. AAQOs without Background Concentrations

Contaminant	Averaging Period	Maximum Predicted Concentration for 100% Rail Ties (µg/m³)	Maximum Predicted Concentration for 50% Rail Ties (µg/m³)	Air Quality Objective (µg/m³)	% of Objective 100% Rail Ties	% of Objective 50% Rail Ties
Total Particulate Matter	24 Hours	7.70	7.70	120	6.41%	6.41%
	Annual	1.28	1.28	60	2.14%	2.14%
PM_{10}	24 Hours	5.70	5.70	50	11.4%	11.4%
$PM_{2.5}$	24 Hours	3.35	3.35	25	13.4%	13.4%
	Annual	0.83	0.83	8	10.4%	10.4%
Sulphur Dioxide	1 Hour	187	93.7	200	93.7%	46.8%
Nitrogen Dioxide [1]	1 Hour	85.2	85.2	188	45.2%	45.2%
	Annual	4.53	4.53	60	2.07%	2.07%
Nitrogen Dioxide [2]	1 Hour	161	161	188	86%	86%
	Annual	6.24	6.24	60	10.4%	10.4%

Notes: [1] Ozone limiting method applied using hourly ozone data
[2] Ozone limiting method applied using constant ozone concentration of 83.8 ppb

Table 7: Modelling Results of Contaminants with B.C. AAQOs with Background Concentrations

Contaminant	Averaging Period	Maximum Predicted Concentration (µg/m^3)	Background Concentration (µg/m^3)	Predicted + Background Concentration (µg/m^3)	Air Quality Objective (µg/m^3)	% of Objective
Total Particulate Matter	24 Hours	7.70	40.8	48.5	120	40.4%
	Annual	1.28	15.4	16.7	60	27.8%
PM$_{10}$ [1]	24 Hours	5.70	40.8	46.5	50	93.0%
PM$_{2.5}$ [2]	24 Hours	3.35	20.2	23.6	25	94.2%
	Annual	0.83	5.00	5.83	8	72.9%
Sulphur Dioxide (50% Rail Ties) [3]	1 Hour	93.7	--	93.7	200	46.8%
Sulphur Dioxide (100% Rail Ties) [3]	1 Hour	187	--	187	200	93.7%
Nitrogen Dioxide [4] [5]	1 Hour	85.2	63.9	149	188	79.2%
	Annual	4.53	16.5	21.0	60	35.0%
Nitrogen Dioxide [4] [6]	1 Hour	161	63.9	225	188	120%
	Annual	6.24	16.5	22.7	60	37.9%

Notes:

[1] 24 hour background concentration is the 98th percentile 24 hour average concentration.

[2] 24 hour background concentrations is the 98th percentile 24 hour average concentration. Annual background concentration is the average annual concentration.

[3] The maximum predicted concentration for SO$_2$ is shown for 50% and 100% rail ties. The emissions of the other contaminants do not change between the two combustion scenarios.

[4] 1 hour background concentration is the 98th percentile of daily maximum 1 hour average concentration. The 24 hour background concentration is the 98th percentile 24 hour average concentration. Inclusion of background concentrations double counts NO$_2$ contribution of the facility

[5] Ozone limiting method applied using hourly ozone data

[6] Ozone limiting method applied using constant ozone concentration of 83.8 ppb

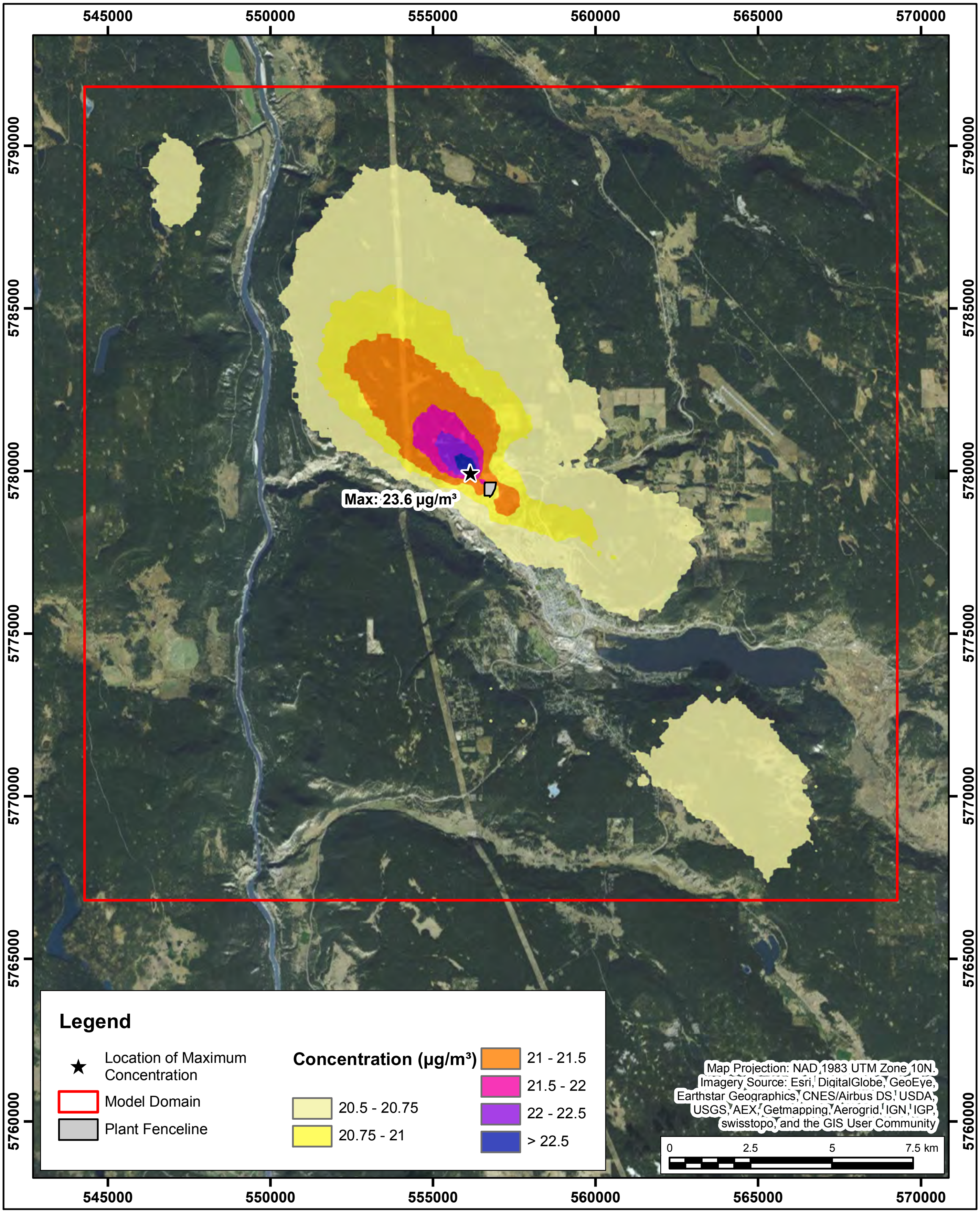
Table 8: Modelling Results of Contaminants without B.C. AAQOs Compared to Ontario AAQCs for 100% Rail Ties

Contaminant	Averaging Period	Maximum Predicted Concentration (µg/m^3)	Background Concentration (µg/m^3)[2]	Predicted + Background Concentration (µg/m^3)	Air Quality Objective (µg/m^3)	% of Criteria
Hydrogen Chloride	24 Hours	11.8	--	11.8	20	59%
Dioxins and Furans (pg TEQ/m^3)	24 Hours	<0.0000001	--	<0.0000001	0.1	<0.01%
Total PAHs	24 Hours	0.00001	--	0.00001	0.00005	24%
	Annual	0.000002	--	0.000002	0.00001	20%
Lead	24 Hours	0.0013	--	0.0013	0.5	0.26%
Antimony	24 Hours	0.00007	--	0.00007	25	<0.01%
Copper	24 Hours	0.00064	--	0.00064	50	<0.01%
Manganese	24 Hours	0.00151	--	0.00151	0.4	0.38%
Vanadium	24 Hours	0.00002	--	0.00002	2	<0.01%
Zinc	24 Hours	0.0041	--	0.0041	120	<0.01%
Arsenic	24 Hours	0.00014	--	0.00014	0.3	0.05%
Chromium	24 Hours	0.00006	--	0.00006	0.5	0.01%
Cobalt	24 Hours	0.00001	--	0.00001	0.1	0.01%
Nickel	Annual	0.00004	--	0.00004	0.04	0.10%
Selenium	24 Hours	0.00007	--	0.00007	10	<0.01%
Tellurium	24 Hours	0.00019	--	0.00019	10	<0.01%
Titanium	24 Hours	0.00010	--	0.00010	120	<0.01%
Cadmium	24 Hours	0.00004	--	0.00004	0.025	0.18%
	Annual	0.000007	--	0.000007	0.005	0.15%
Mercury	24 Hours	0.00007	--	0.00007	2	<0.01%
Chlorophenol [1]	24 Hours	0.00002	--	0.00002	20	<0.01%

Notes: [1] The maximum concentration of Chlorophenol is compared to the 24 hour Ontario AAQC for Pentachlorophenol. It is assumed that Chlorophenol is composed entirely of Pentachlorophenol.

[2] There are no data for background concentrations of these contaminants.

ATTACHMENT 2



Predicted 98th Percentile 24-Hour $PM_{2.5}$, Including Ambient Background, for Permitted PM Emission Rate

*24-hr $PM_{2.5}$ Interim Provincial Air Quality Objective = 25 µg/m³ (BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

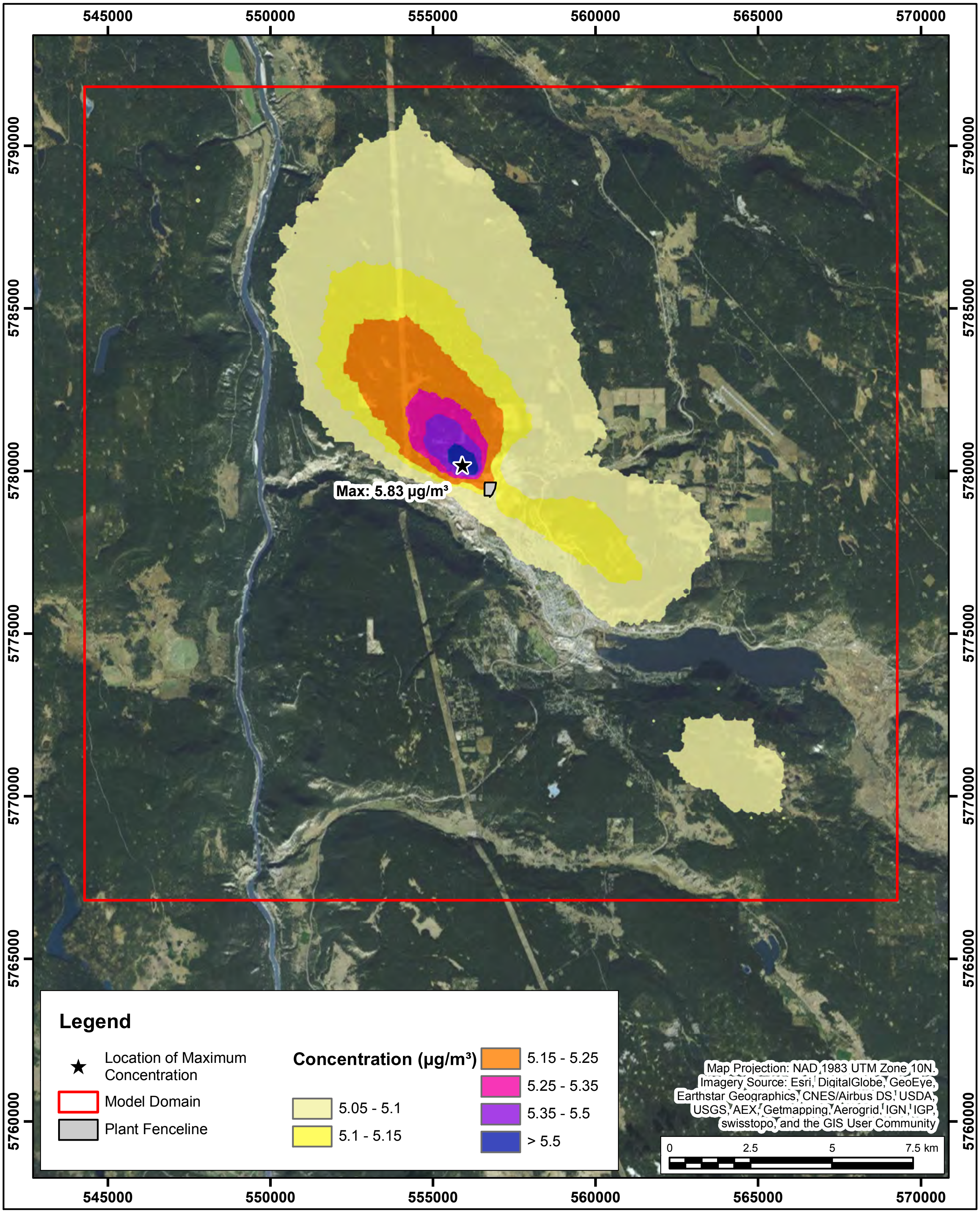
True North

Background Value = 20.2 µg/m³

Project #1500355

Drawn by:	DJH	Figure:	A
Approx. Scale:		1:160,000	
Date Revised:		Apr. 12, 2016	

RWDI



Predicted Annual Average PM$_{2.5}$, Including Ambient Background, for Permitted PM Emission Rate

*Annual PM$_{2.5}$ Interim Provincial Air Quality Objective = 8 µg/m³
(BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

True North

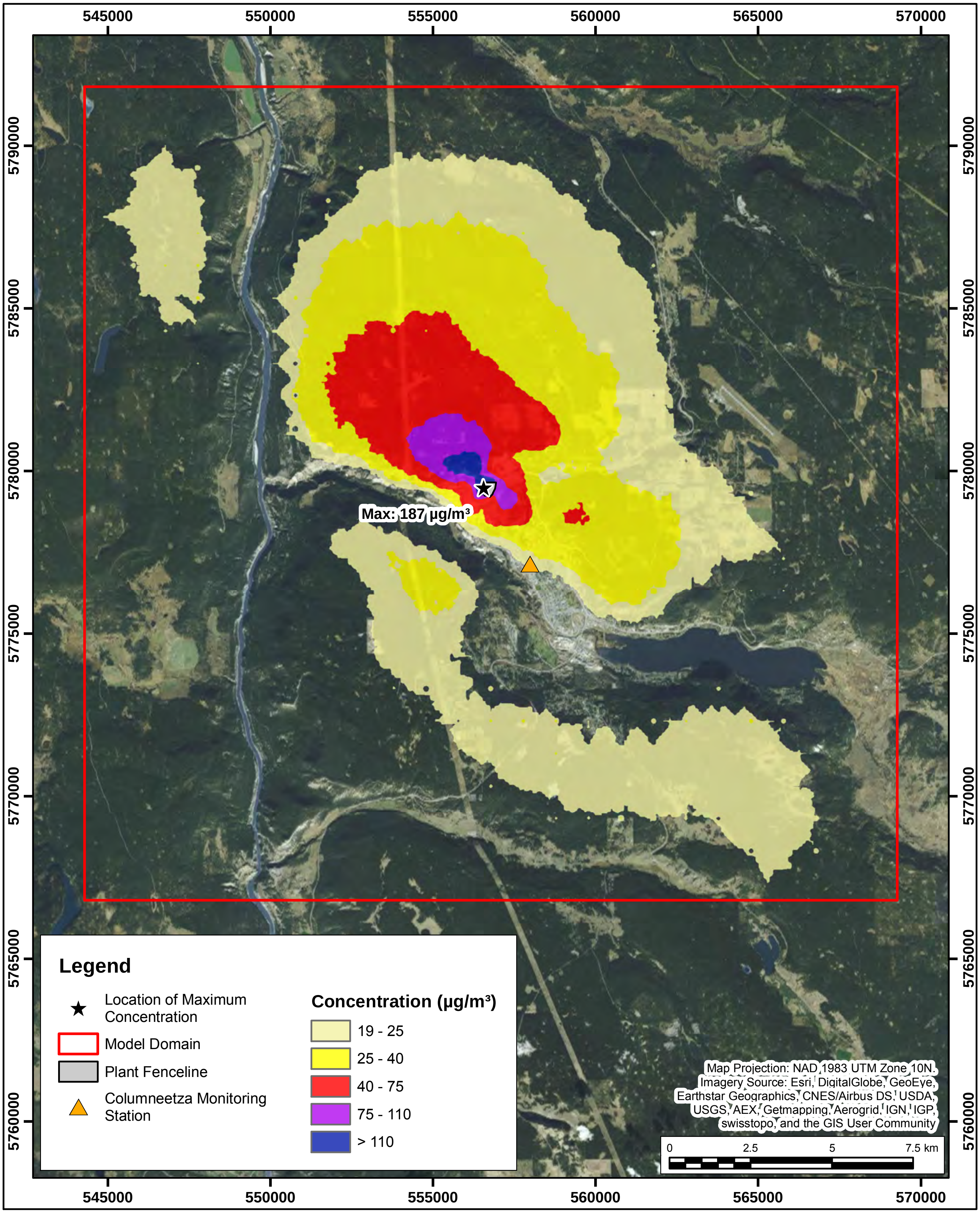
Background Value = 5.0 µg/m³

Project #1500355

Drawn by:	DJH	Figure:	B
Approx. Scale:			1:160,000
Date Revised:			Apr. 12, 2016

RWDI

ATTACHMENT 3



Predicted Ninety-Ninth Percentile Peak Daily 1-Hour Maximum SO_2 for 100% Rail Ties

*1-hr SO_2 Interim Provincial Air Quality Objective = 200 µg/m³ (BC MOE 2014)

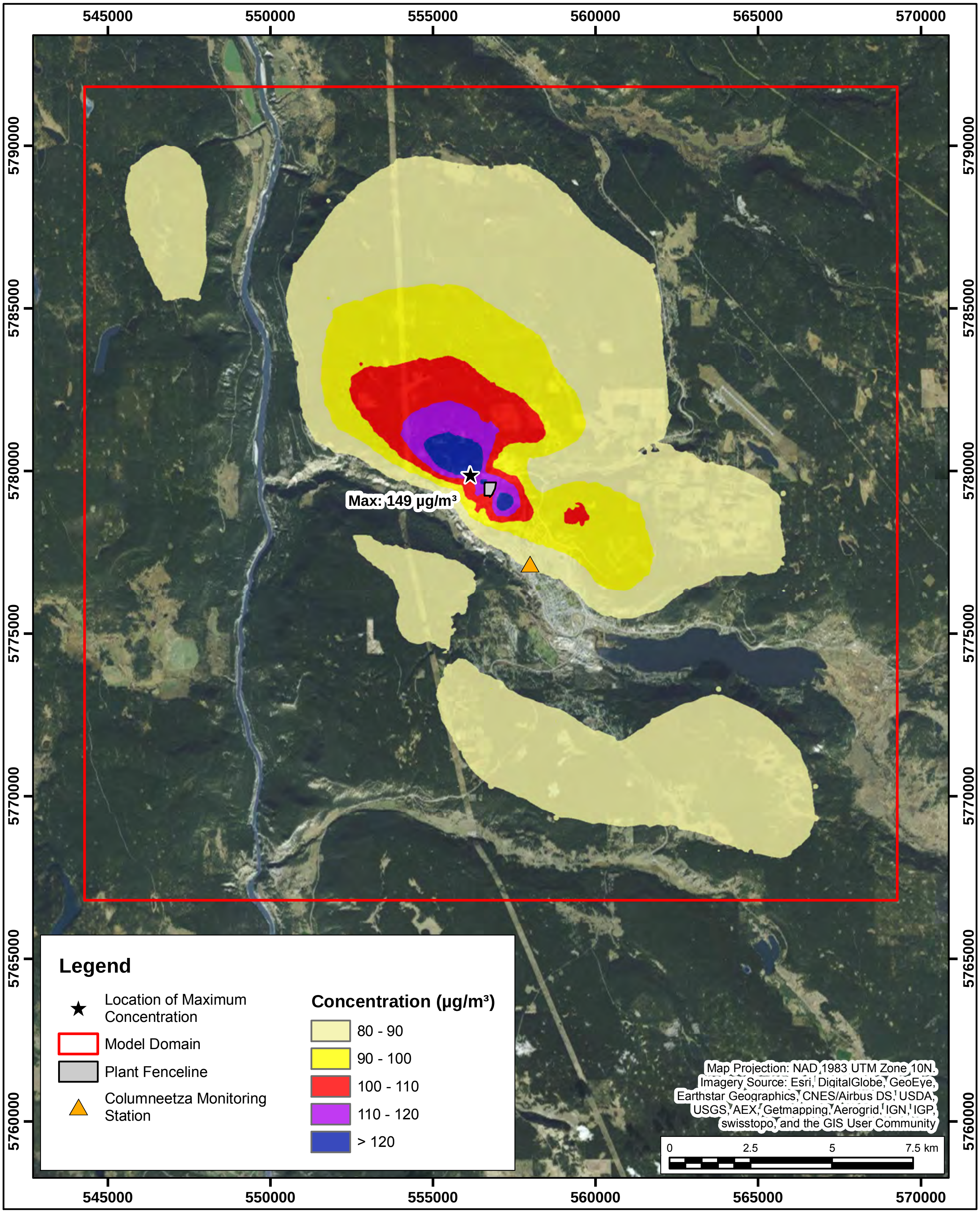
Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by:	DJH	Figure:	6
Approx. Scale:			1:160,000
Date Revised:			Apr. 12, 2016

RWDI



Predicted Ninety-Eighth Percentile Peak Daily 1-Hour Maximum NO_2
With Ambient Background Value for 100% Rail Ties or Base Fuel

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³
(BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

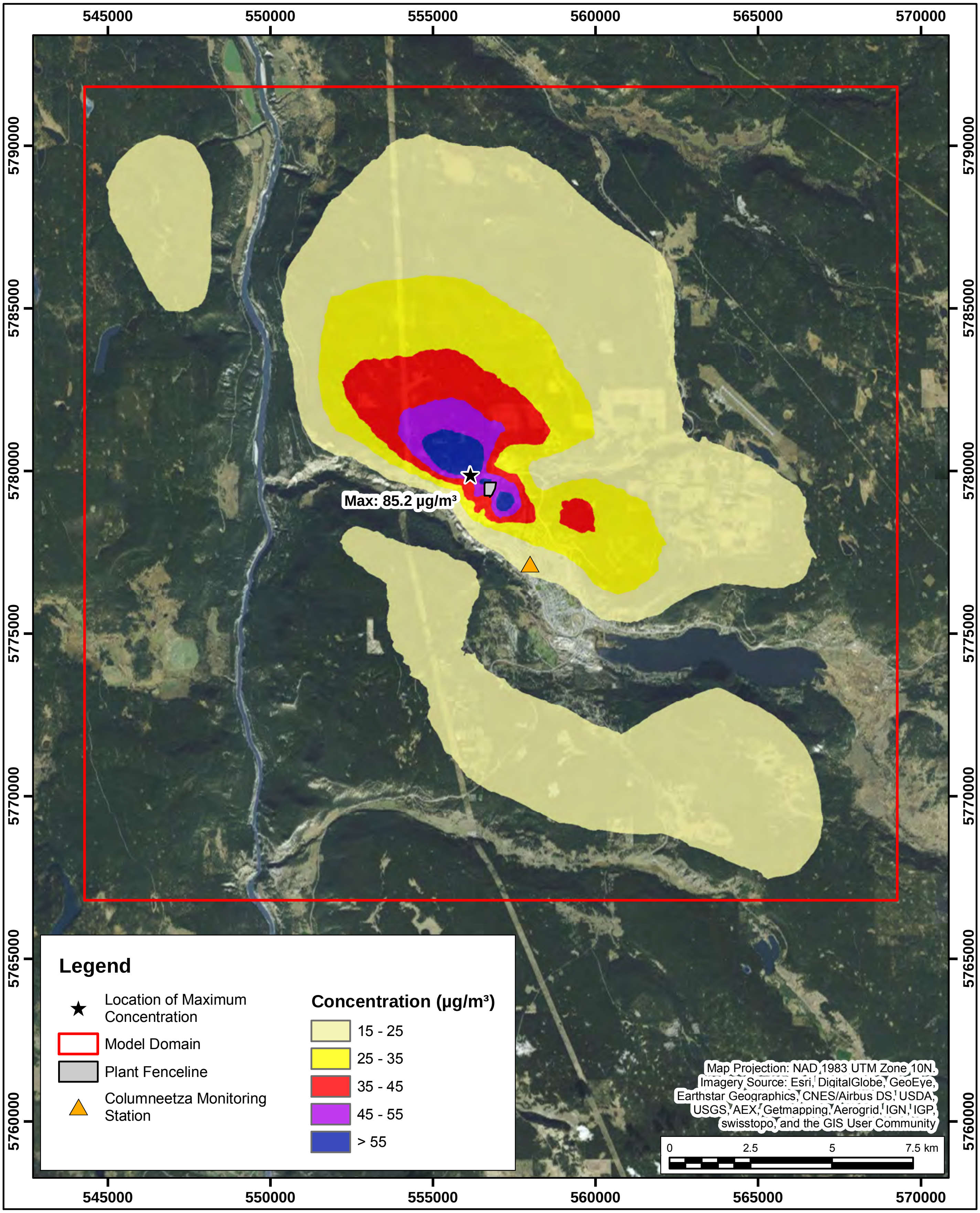
True North

Using hourly ozone from Columneetza for OLM

Project #1500355

Drawn by:	DJH	Figure:	8
Approx. Scale:			1:160,000
Date Revised:			Apr. 12, 2016

RWDI



Map Projection: NAD 1983 UTM Zone 10N. Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Predicted Ninety-Eighth Percentile Peak Daily 1-Hour Maximum NO_2
Without Ambient Background Value for 100% Rail Ties or Base Fuel

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³ (BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

True North

Using hourly ozone from Columneetza for OLM

Project #1500355

Drawn by: DJH

Figure: C

Approx. Scale: 1:160,000

Date Revised: Apr. 12, 2016

RWDI

ATTACHMENT 4

Summary Statistics of Model Results for Nearest Receptor to Columneetza Station

Contaminant	Averaging Period	Concentration ($\mu g/m^3$)
NO_2	Maximum 1-Hour	23.6
	98th Percentile of Daily Max 1-Hour	16.7
	Maximum Daily	3.24
	Annual Average	0.33
	Maximum 1-Hour with background	87.5
	98th Percentile of Daily Max 1-Hour with background	80.6
	Annual Average with background	16.8
$PM_{2.5}$	98th Percentile of Daily Average with background	20.5
	Annual Average with background	5.05
SO_2	Maximum 1-Hour	36.1
	99th Percentile of Daily Max 1-Hour	17.3
	Maximum Daily	2.96
	Annual Average	0.31

ATTACHMENT 5

SECONDARY FORMATION DISCUSSION

Secondary formation is usually not a concern for isolated sources and it is thus not typically included in the modelling required for a permit applications.

The reason secondary formation is likely not significant is because, due to a relatively isolated single source combined with typical reaction rates and transport times, the emissions will usually be dispersed before they have a chance to form appreciable amount of secondary Particulate Matter (PM).

Secondary formation is typically an issue in areas where there are numerous NO_x and SO_x sources such that elevated concentrations persist over distances which correspond to transport times that allow the reactions to proceed before the precursor NO_x and SO_x emissions have dispersed such as in a large metropolitan area like Vancouver where multiple sources are present over large areas. While secondary formation can and does occur to some extent for any releases of SO_x or NO_x, it is likely not greatly influence by any one particular source within a smaller airshed such as Williams Lake.

The CALPUFF model contains a simplified chemical scheme, MESOPUFF II, which can be used to demonstrate this effect. The simplified reaction rates are given by (Scire et. al.2000):

$$k_1 = 36\,R^{0.55}[O_3]^{0.71}S^{-1.29} + k_{1(aq)} \qquad (1)$$

$$k_{1(aq)} = 3\,x\,10^{-8}RH^4 \qquad (2)$$

$$k_2 = 1206[O_3]^{1.5}S^{-1.41}[NO_x]^{-0.33} \qquad (3)$$

$$k_3 = 1261[O_3]^{1.45}S^{-1.34}[NO_x]^{-0.12} \qquad (4)$$

Where:

k_1	is the SO_2 to SO_4 transformation rate (percent/hour)
$k_{1(aq)}$	is the aqueous phase of SO_2 to SO_4 transformation rate (percent/hour)
k_2	is the NO_x to HNO_3 + RNO_3 transformation rate (percent/hour)
k^3	is the NO_x to HNO_3 (only) transformation rate (percent/hour)
R	is the total solar radiation intensity (kw/m^2)
S	is a stability index ranging from 2 to 6 based on PG Class.
RH	is the relative humidity (percent)
$[O_3]$	is the background ozone concentration (ppm) and
$[NO_x]$	is the plume NO_x concentration (ppm)

Most of the time, typical reaction rates for Equation 1 through 4 are on the order of about 10% per hour or less. Higher reaction rates are possible during unstable conditions with higher ozone and strong solar radiation, particularly for the NO_x reactions.

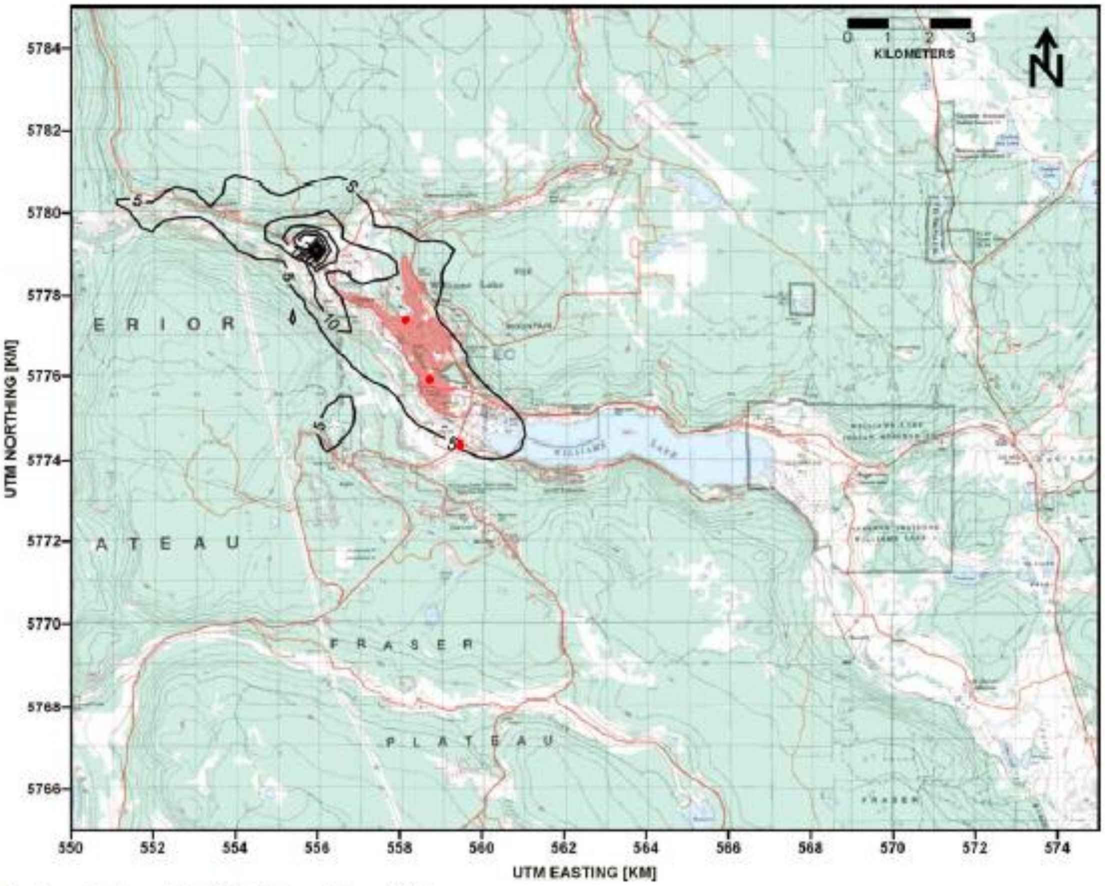
A wind speed of 1 m/s corresponds to a transport distance of 3.6km in one hour. Most of the influence of NO_2 and SO_2 from Atlantic power is seen within 2-3 km of the site which is within one hour's transport time for all but the very lowest wind speeds.

Most of the time, reaction rates will be less than 10% per hour and wind speeds will be greater than 1 m/s, which means that there is not sufficient time for the reactions to proceed before NO_x and SO_x from the facility have been dispersed.

While they do occur, higher conversion rates are dependent on a combination of high stability (PG class 1 or 2), solar radiation and high ambient ozone, all of which are daytime occurrences and do not persist at night. Therefore, while high conversion rates could occasionally influence peak hourly values, they would likely not have a great effect on 24-hour averages in this locale. For PM from Atlantic Power to be an issue would require the persistence of very low wind speeds combined with high conversion rates. Persistent low wind speed conditions do occur, for example during inversions, but they are usually also associated with wintertime stable PG classes and low solar influence that will mean lower conversion rates.

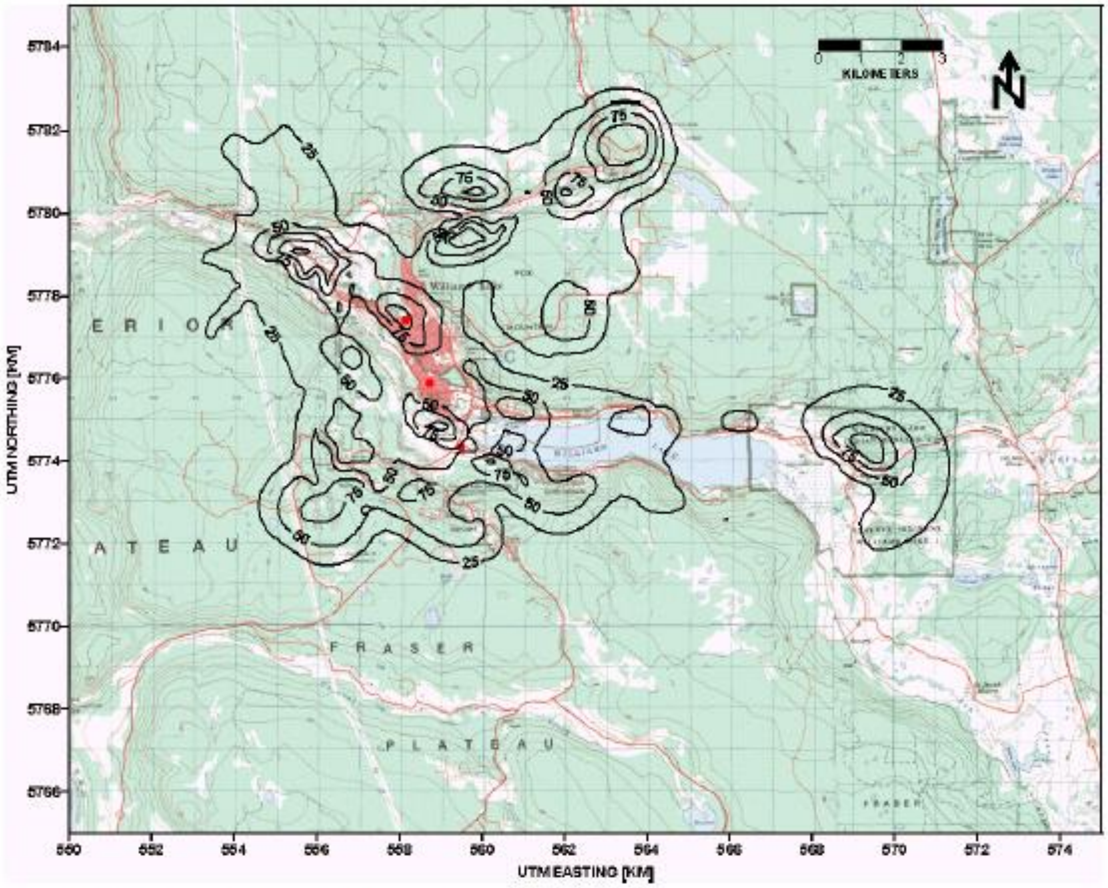
With regard to SO_4, the previous Williams Lake modelling confirms this. The maximum hourly predictions of SO_2 in that report are much higher than what is being predicted for even 100% rail ties, but Table 5-7 gives the max 24-hour increment due to SO_4 as less than 1 $\mu g/m^3$, and the annual increment as only 0.02$\mu g/m^3$. Also note that the 24-hour is the absolute maximum rather than the 98th percentile, and the conditions for secondary formation may not coincide with the peak for emissions of primary $PM_{2.5}$, so the increments are not necessarily additive.

The previous modelling for Williams Lake does suggest a potentially larger influence from NO_3, as shown in the peak values given in Table 5-7. However, there is reason to be careful in the interpretation of these results. Firstly, as has been noted previously, the use of rail ties as fuel will not significantly change NO_X emissions and thus will not change the values in the report. Secondly, as with SO_4, the 24-hour values are again the absolute maximum values rather than the 98th percentile. Lastly, the predictions themselves are somewhat curious. Table 5-7 suggest that secondary PM is dominated by production of NO_3. Reasonably, since NO_3 is dependent on precursor emissions of, NO_x, one would expect some correlation between NO_x or NO_2 predictions and those for NO_3. However, the results for PM in Figure B-27 (which according to Table 5-7 should be dominated by NO_3) show little correlation to the NO_2 patterns given in Figure B-8.



Contour Interval: 5, 10, 15,…. 50 μg/m^3

Figure B-27 Maximum Predicted 24-hour Concentrations of Secondary Particulate ($PM_{2.5}$) for the Williams Lake Airshed



Contour Interval: 25, 50, 75, 100, 125 μg/m^3

Figure B-8 Maximum Predicted 24-hour Concentrations of NO_2 for the Williams Lake Airshed

REFERENCES

Scire, J.C., Strimaitis D.G., Yamartino, R.J., 2000: A User's Guide for the CALPUFF Dispersion Model, Earth Tech Inc. (http://src.com/calpuff/download/CALPUFF_UsersGuide.pdf)

Jeff Lundgren
Technical Director/Principal
RWDI
Suite 280n -1385 West 6th Avenue,
Vancouver, BC
Via email

File:Atlantic Power 8808

Date: 4th May, 2016

Jeff:

On March 1st 2016, in a letter to Peter Lawrie I requested additional information regarding the Atlantic Power permit amendment application. In that letter I requested several items of information: isopleth maps of maximum annual $PM_{2.5}$ concentrations based on the current permitted stack limits, the NO_2, $PM_{2.5}$ and SO_2 statistics for the closest CALPUFF grid-point receptor to the Columneetza air station, and additional isopleth maps of maximum 1 hour NO_2 and SO_2 concentrations. In a phone conversation in early April we discussed my request and you informed me that an error had been found in the conversion to standard conditions of the NO_2 CEM data used to estimate the NO_2 emission rate, the error resulted in an overestimate of the emission rate used in the original modelling report dated September 8th, 2015. The error required reprocessing of the NO_2 data from the September report and recalculation of the statistics for maximum ambient concentrations.

On April 22nd I received a memorandum from you which included both the additional information I had requested and the revised NO_2 ambient statistics using the corrected emission rate. The memo has the subject heading *Supplementary Modelling Results and MOE Information Request* and RWDI reference #1500355. In addition, the memorandum included the results of two other changes: the correction of an error in stack base height which necessitated rerunning the CALPUFF model, and the use of hourly ozone measurements from the Columneetza air station to calculate NO_2 conversion rates rather than the maximum hour in the modelled year as had been done previously. I agree with both of these changes. They both result in more reliable estimates of maximum ground level concentrations used in the assessment of ambient impacts.

Although the modification of the Ozone Limiting Method using hourly ambient ozone measurements is not included in the *British Columbia Air Quality Dispersion Modelling Guideline,* it is an accepted technique to supply more refined estimates of ambient NO_2 concentrations. Its use is recommended when exceedances or high concentrations occur when using the standard OLM technique with the highest hourly ozone concentration for the period monitoring. When the hourly ambient ozone measurement method is applied the Ministry requires additional information to be supplied on the Ozone data used.

In order to validate the method used and complete my review of the supplementary modelling results, I will require the following information: a brief summary of the ozone data used (including summary statistics), a brief discussion of the representativeness of the ozone data in the area of concern, and a summary of the completeness of the ozone data during the period modelled with particular reference to periods of missing data that may lead to bias in the modelled NO_2 concentrations.

If there are any questions or concerns with this request please contact me directly.

Sincerely,

Ralph Adams.

Ralph Adams.
Air Quality Meteorologist
Monitoring, Assessment, and Stewardship
Environmental Protection

Cc: Peter Lawrie, Ministry of Environment, Prince George

CONSULTING ENGINEERS
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May 6, 2016

Mr. Ralph Adams
Air Quality Meteorologist
Ministry of the Environment
Southern Interior Region
Environmental Protection Division
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5

Re: Atlantic Power Permit Amendment Application
Williams Lake Power Plant
RWDI Reference No. 1500355

Email: ralph.adams@gov.bc.ca

Dear Mr. Adams,

RWDI AIR Inc. (RWDI) was retained by Atlantic Power to assist in the permit amendment application for the Williams Lake Power Plant (WLPP). RWDI provided a memorandum titled "*Supplementary Modelling Results and MOE Information Request"* with RWDI reference #1500355 dated April 22, 2016. The memorandum provided updated model results using hourly ambient ozone measurement data from the Columneetza Station for 2012 to determine the conversion of NO to NO_2 using the Ozone Limiting Method (OLM). RWDI completed this refined evaluation since using the annual maximum ambient ozone measurement value (that occurs during a summertime ozone episode) tends to overestimate the amount of ozone available during the rest of the year and thus would overestimate the rate of NO to NO_2 conversion for most of the year as well.

On May 4th, 2016, RWDI received a letter from the Ministry of the Environment with a follow-up request for additional information to the data provided in the April 22, 2016 memorandum. The letter requested the following:

Item 1: Brief summary of the ozone data used (including summary statistics);

Item 2: Brief discussion of the representativeness of the ozone data in the area of concern; and

Item 3: Summary of the completeness of the ozone data during the period modeled with particular reference to periods of missing data that may lead to bias in the modeled NO_2 concentrations.

The following sections address the requests:

Item 1: The maximum value (which was originally used to estimate ozone) is **83.8 ppb**. The annual average is **22.5 ppb**. The maximum, annual average and select percentiles for the data are shown in Table 1 below. Note the 90th percentile hourly ozone value **41.6 ppb**, meaning that more than 90 percent of the year, the observed ozone is less than half of the maximum value used in the original RWDI study. Thus, the effect of using the maximum rather than the hourly values means that the NO to NO_2 conversion was overestimated by approximately double for most of the year. During winter months (when ozone is lowest due to low temperature and lack of solar forcing *and* NO_x is highest due to reduced wintertime dispersion) the conversion of NO to NO_2 was likely overestimated by as much as a factor of 4 or higher.

Table 1: Maximum, Annual Average and Percentiles for Columneetza Ozone Concentration for 2012

Metric or Averaging Period	Ozone (ppb)
Maximum Hourly	83.8
98th Percentile Hourly	49.8
95th Percentile Hourly	45.6
90th Percentile Hourly	41.6
75th Percentile Hourly	32.8
Annual Average	22.5

The maximum values occur in July, when temperatures and solar forcing are highest and higher tropospheric ozone typically occurs. This indicates that photochemical production rather than stratospheric intrusion is the source of elevated ozone. The occurrence of higher values during the typical summer high ozone season also indicate that there is no local NOx source preventing higher ozone values due to NOx titration affecting the Columneetza monitor.

Item 2: Due the process of formation, specifically the time scales of the production mechanisms and the magnitude and spatial extent of precursor emission required to produce ozone before the precursors are able to disperse, ozone tends to be a regional issue and higher ozone values also tend to exist over wider distances than for other primary CACs. As such the Columneetza data are likely a good proxy for ozone over the entire Williams Lake area including at WLPP.

In fact, the highest ozone observations of July 8th also correspond to $PM_{2.5}$ concentrations in excess of 40-50 µg/m^3. This suggests that the peak ozone values could be due to forest fire emissions rather than any local emissions from Williams Lake. This make sense as the maximum value of 83 ppb is typical of ozone episodes in more populated areas such as the Lower Mainland, and typical values in smaller municipalities are typically much lower, unless there is some sort of a regional episode, such as forest fire providing sufficient ozone precursors.

Using a maximum ozone value, that is likely caused by a summertime forest fire, to represent regional ozone for all hours of the year will be overly conservative in terms of NO to NO_2 conversion. Using hourly ozone values measured at Columneetza will provide more representative NO_2 results.

Item 3: In the revised modeling, hourly ambient ozone measurement data from the Columneetza air quality station was used. The data set from this station was 95% complete for the hourly ozone values for the 2012 year. The missing values occur approximately once per day and should not have any meaningful influence on the distribution of ozone statistics. For missing hours, the annual average ozone value was used.

We trust this letter address the questions from the May 4th letter. Should you have any additional questions please do not hesitate to contact us directly.

Yours very truly,

RWDI AIR Inc.

Jeff Lundgren, M.Sc.
Technical Director/Principal

JRL/BCB/jo

APPENDIX 4

INTRINSIK - Assessment of Human Health Risks and Follow-up Commentary

ASSESSMENT OF THE HUMAN HEALTH RISKS ASSOCIATED WITH THE PROPOSED CHANGES IN THE EMISSIONS FROM THE WILLIAMS LAKE POWER PLANT

FINAL REPORT

January 12, 2016

Prepared For:

Atlantic Power Corporation
8835 Balboa Ave, Suite D
San Diego, CA
92123

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ASSESSMENT OF THE HUMAN HEALTH RISKS ASSOCIATED WITH THE PROPOSED CHANGES IN EMISSIONS FROM THE WILLIAMS LAKE POWER PLANT

Table of Contents

Page

List of Tables

List of Figures

List of Appendices

EXECUTIVE SUMMARY

Atlantic Power owns and operates the Williams Lake Power Plant, a 66 megawatt biomass-fuelled electricity generating facility that has been in operation since 1993. The WLPP consumes approximately 450,000 tonnes of biomass annually, with capacity to consume up to 600,000 tonnes. The WLPP primarily consumes wood residues from local sawmills, but currently operates under an environmental permit that allows the burning of up to 5% rail ties on an average annual basis. Atlantic Power is proposing to increase the volume of rail ties to 50%, but anticipates burning 15% to 25% rail ties on an average annual basis.

Atlantic Power commissioned Intrinsik to complete a screening-level HHRA based on the results of an air dispersion modelling study of the emissions from the proposed increase in the volume of rail ties to be consumed annually at the WLPP. The primary aim of the screening-level HHRA was to identify and understand the potential health risks posed to the area residents as a result of the proposed changes in the WLPP emissions. In order to do so, consideration was given to the nature of the emissions, the nature of the exposures that might occur (i.e., amount, frequency and duration), and the nature of the potential health effects that may occur following exposure to the chemicals contained in the emissions. By convention, the screening-level HHRA embraced a high degree of conservatism through the use of assumptions intentionally selected to represent worst-case or near worst-case conditions. Using this approach, any health risks identified in the screening-level HHRA were unlikely to be understated.

For the purposes of the screening-level HHRA, it was assumed that sensitive or susceptible individuals would be found on both a short-term and long-term basis at the location within the study area corresponding to the maximum point of impingement. The MPOI refers to the location at which the highest air concentration of each of the COPC would be expected to occur, and at which the exposure received by the people within the study area would be greatest. The choice of the MPOI location was meant to ensure that any potential health effects that could result from exposure to the chemical emissions associated with the WLPP, regardless of whether people might be exposed, would not be underestimated. The decision to use the MPOI to represent the location at which people would be found was made by default; that is, consideration was not given as to whether or not the MPOI location was suitable for a permanent residence.

The selection of the COPC was based on a multi-day test burn using 100% rail ties that was conducted in 2001 at the WLPP. The results of the test burn served as the basis of the emissions inventory developed by RWDI for the WLPP. Each of chemicals identified in the air dispersion modelling study was identified as a COPC in the screening-level HHRA, including Criteria Air Contaminants, metals, Polycyclic Aromatic Hydrocarbons and chlorinated compounds.

Since the chemicals will be emitted directly into the air, the primary pathway by which people could be exposed is *via* inhalation (i.e., breathing in chemicals). As a result, the inhalation pathway was the primary focus of the screening-level HHRA. Exposure through less obvious secondary pathways also could occur and needed to be explored as part of the screening-level HHRA. For example, the chemicals might fall-out or deposit from the air onto the ground and result in additional pathways of exposure (i.e., secondary pathways).

Potential health risks were determined by comparing the predicted maximum ground-level air concentrations of the COPC at the MPOI for averaging times associated with both short-term and long-term exposures with exposure limits established by regulatory and leading scientific authorities responsible for the protection of public health. These limits incorporate a high degree of protection to accommodate vulnerable members of the population in order to determine the potential health risks to the people living in the area or who might frequent the area for work, recreation or other purposes. In accordance with accepted HHRA protocol, the exposure limits were based on a COPC's most sensitive toxicological endpoint.

With very few exceptions, the health risk estimates for the non-cancer COPC at the MPOI were predicted to be below 1.0, indicating that estimated short-term and long-term inhalation exposures were less than the health-based exposure limits. Risk estimates less than or equal to 1.0 are associated with low health risk, and therefore adverse health effects would not be expected. The only exceedances of the limits at the MPOI were predicted for short-term inhalation exposure to NO_2 and SO_2 acting both singly and in combination as part of the respiratory irritants mixture. The predicted short-term NO_2 and SO_2 concentrations are unlikely to result in adverse health effects on their own or as part of a mixture due to:

- The conservatism incorporated in the predicted short-term ground-level air concentrations of NO_2 and SO_2;
- The areal extent of the predicted exceedances;
- The likelihood of an exceedance occurring; and,
- The levels of exposure that have resulted in observed adverse health effects in humans, as documented in the most recent scientific literature.

In all cases, the cancer risk estimates were predicted to be less than one in 100,000 (i.e., one extra cancer case in a population of 100,000 people), indicating that the chemical emissions from the WLPP burning 100% rail ties are associated with a negligible level of risk, as defined by BC MOE and Health Canada.

Concentrations of the COPC were predicted in soil and compared with BC's CSR numerical soil standards and background soil concentrations in the Cariboo Region. The predicted maximum concentrations of each of the COPC in soil were well below both the BC soil standards and regional background soil concentrations, suggesting that the proposed increase in the rail ties used to fuel the WLPP would not be expected to result in an increase in health risks to the neighbouring area.

ASSESSMENT OF THE HUMAN HEALTH RISKS ASSOCIATED WITH THE PROPOSED CHANGES IN EMISSIONS FROM THE WILLIAMS LAKE POWER PLANT

1.0 INTRODUCTION

Atlantic Power owns and operates the Williams Lake Power Plant (WLPP), a 66 megawatt biomass-fuelled electricity generating facility that has been in operation since 1993. The WLPP consumes approximately 450,000 tonnes of biomass annually, with capacity to consume up to 600,000 tonnes. The WLPP primarily consumes wood residues from local sawmills, but currently operates under an environmental permit that allows the burning of up to 5% rail ties on an average annual basis. Atlantic Power is proposing to increase the volume of rail ties up to 50%, but anticipates burning 15% to 25% rail ties on an average annual basis. The proposed increase in the volume of rail ties consumed necessitated an amendment to the current air permit. As a result, Atlantic Power retained RWDI Air Inc. (RWDI) to complete an air dispersion modelling study of the emissions from the proposed increase in the volume of rail ties to be consumed annually at the WLPP (RWDI 2015).

Atlantic Power implemented and continues to conduct public consultation to ensure that First Nations, local governments and community stakeholders are engaged throughout the amendment process, and to identify issues and concerns related to the proposed changes in fuel mixture at the WLPP. Feedback received during the consultation process included concerns over the potential risks presented by the proposed changes in fuel mixture to the health of people living in the area or who might frequent the area for work, recreation or other purposes. In response to these concerns, Atlantic Power commissioned Intrinsik Environmental Sciences Inc. (Intrinsik) to complete a screening-level human health risk assessment (HHRA) based on the results of the air dispersion modelling study completed by RWDI (2015).

The primary aim of the screening-level HHRA is to identify and understand the potential health risks posed to people living in the area or visiting the area that resulting from the changes in the WLPP emissions. The screening-level HHRA considered the nature of the emissions, the nature of the exposures that might occur (i.e., amount, frequency and duration), and the nature of the health effects that are known to occur following “over-exposure” to the chemicals contained in the emissions. By convention, the screening-level HHRA embraced a high degree of conservatism through the use of assumptions intentionally selected to represent worst-case or near worst-case conditions. Using this approach, any health risks identified in the screening-level HHRA are unlikely to be understated, but may be overstated.

This report describes the approach that was used, the findings that emerged and the conclusions that were reached as part of the screening-level HHRA for the proposed changes in the volume of rail ties consumed at the WLPP on an annual basis.

2.0 OBJECTIVES

The primary objectives of the screening-level HHRA are:

- To identify and understand the potential health risks that could result from short-term and/or long-term exposure to the chemical emissions from the proposed changes in fuel mix at the WLPP, with consideration given to the nature of the emissions, the nature of the exposures that might occur (i.e., amount, frequency and duration), and the nature of the health effects that may occur following exposure to the chemicals contained in the emissions.

- To address concerns raised by community stakeholders over the potential health risks associated with the proposed changes in fuel mix at the WLPP. Specific concerns include:

  - the potential health risks that could be presented to the most vulnerable populations, such as young children, the elderly, asthmatics and people with compromised immune systems;
  - the potential short-term (acute) and long-term (chronic) health risks that could be presented to people living in the area;
  - the potential risks to human health from exposure to the chemical emissions from the WLPP as a result of the proposed changes in fuel mix in combination with other sources of the chemicals in the study area (i.e., cumulative effects);
  - the potential risks of developing cancer (carcinogenic risks) as a result of exposure to the chemical emissions associated with increase in the burning of rail ties at the WLPP;
  - the potential health risks associated with exposure to dioxins, hydrocarbons and chlorophenols that will be emitted from the WLPP;
  - the potential health risks from exposure to the persistent and accumulative chemicals contained in the emissions from the WLPP, such as dioxins; and,
  - the potential risks of teratogenic (developmental) effects as a result of exposure to the chemical emissions associated with increase in the burning of rail ties at the WLPP.

  The intent was to integrate the concerns into the design of the screening-level HHRA.

3.0 PROJECT DESCRIPTION

The WLPP is located in an area designated for heavy industry in the northwest corner of the City of Williams Lake, British Columbia (BC). The City of Williams Lake is the largest urban centre between Kamloops and Prince George, with a population of approximately 11,150 within the city limits.

The WLPP is a 66 megawatt biomass-fuelled electricity generating facility that has been operating since 1993. The plant consumes approximately 450,000 tonnes of biomass annually, with capacity to consume up to 600,000 tonnes. The biomass consumed at the WLPP consists primarily of wood residues from local sawmills. The power supplied by the WLPP is sufficient to meet the demands of approximately 52,000 homes in BC. WLPP supplies its power to BC Hydro under a long-term electricity purchase agreement (EPA). The EPA with BC Hydro expires in 2018 with an option to renew; however, based on the recently announced reduction in the maximum timber harvest (Allowable Annual Cut) by the provincial government, together with the impacts of the Mountain Pine Beetle infestations and the increase in competition for biomass fibres, the long-term availability of sawmill and forest residues for use by the WLPP is expected to decline.

In order to supplement this reduction in traditional wood fibre, Atlantic Power is proposing to increase the volume of rail ties consumed at the WLPP. The WLPP currently operates under an environmental permit that allows for the burning of up to 5% rail ties on an average annual basis. Atlantic Power is proposing to increase the volume of rail ties up to 50%, but anticipates burning 15% to 25% rail ties on an average annual basis.

4.0 APPROACH

The overall approach taken in the screening-level HHRA will follow a conventional risk assessment paradigm (see Figure 4-1). The paradigm is recognized world-wide, and its use has been endorsed by both federal and provincial regulatory authorities, including Health Canada, Environment Canada, the Canadian Council of Ministers of the Environment (CCME), and BC Ministry of Environment (BC MOE). The paradigm consists of several steps, highlights of which are outlined below.

- Problem Formulation – This step is concerned with defining the scope and nature of the assessment, and setting practical boundaries on the work such that it is directed at the principal areas of concern. It includes the identification of the chemicals that could be emitted by the WLPP, the people potentially affected, and the pathways by which these people could be exposed. When characterizing the people who might be exposed, emphasis is placed on sensitive or susceptible individuals.
- Exposure Assessment – This step is concerned with estimating the level of exposure that people could receive to the chemicals of potential concern (COPC) *via* the various exposure pathways. The step often relies on ambient measurement as well as predictive modelling to arrive at the exposure estimates, with specific reliance on air dispersion modelling in the case of chemical emissions to air. Distinction is made between exposures of a short-term (or acute) nature extending over a few minutes to several hours and long-term (or chronic) exposures lasting for several months or years, possibly up to a lifetime.
- Toxicity Assessment – This step is concerned with identifying and understanding the potential health effects that can be caused by each of the COPC (acting either singly or in combination), and the conditions under which the effects can occur. A principal outcome of this step is the determination of the health-based guidelines (or exposure limits) for the COPC, which refer to the levels of exposure that would not be expected to cause health effects. The limits are typically based on guidelines, objectives or standards established by regulatory and leading scientific authorities responsible for the protection of public health, and incorporate a high degree of protection to accommodate vulnerable members of the population.
- Risk Characterization – This step is concerned with quantifying the potential health risks that could be presented to the local residents or general public by comparing the exposure estimates determined as part of the Exposure Assessment to the corresponding exposure limits identified in the Toxicity Assessment.

Details with respect to each of these steps are presented in the sections that follow.

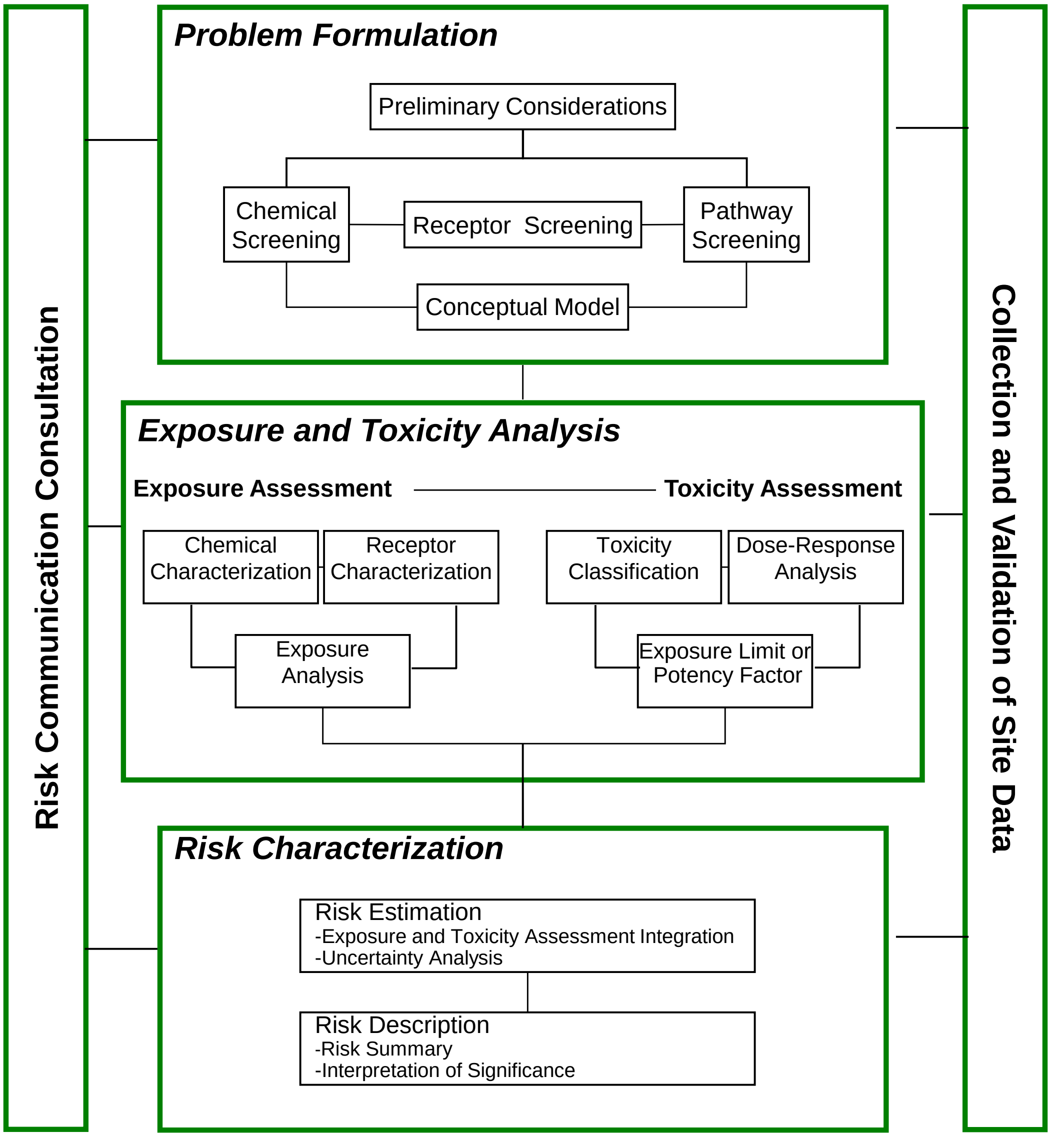


Figure 4-1 Risk Assessment Paradigm

4.1 Problem Formulation

This step is concerned with defining the scope and nature of the assessment, and setting practical boundaries on the work such that it is directed at the principal areas of concern. The Problem Formulation focuses on four major aspects:

1. Identification of the area potentially affected by the chemical emissions from the WLPP.
2. Identification of the COPC emitted from the WLPP that might contribute to potential health risks.
3. Characterization of the people who might be exposed to the COPC, with special attention directed at sensitive or susceptible individuals (e.g., infants and children, pregnant women, the elderly, individuals with compromised health).
4. Identification of the potential exposure pathways by which people might be exposed to the COPC.

Details on these four aspects are provided below.

4.1.1 Spatial Boundaries

Consistent with the spatial boundary identified and evaluated in the air quality modelling study for the WLPP, the screening-level HHRA evaluated the potential health risks within a 25 km by 25 km study area centred on the WLPP facility (RWDI 2015). Figure 1 of Appendix A shows the study area for the screening-level HHRA.

4.1.2 Identification of the Chemicals of Potential Concern

As indicated earlier, a principal outcome of the Problem Formulation step is the identification of the COPC associated with the WLPP. A multi-day test burn using 100% rail ties was conducted in 2001 at the WLPP. The results of the test burn served as the basis of the emissions inventory developed by RWDI for the WLPP (RWDI 2015). Each of chemicals identified in Table 4 of the air dispersion modelling study was identified as a COPC in the screening-level HHRA.

The COPC in the screening-level HHRA are listed in Table 4-1, arranged according to chemical category.

Table 4-1 Chemicals of Potential Concern for the Williams Lake Power Plant

Chemical Category	*Chemicals of Potential Concern*
Criteria Air Contaminants (CACs)	Nitrogen dioxide (NO_2)[1], particulate matter ($PM_{2.5}$ and PM_{10})[2], sulphur dioxide (SO_2), total particulate matter (TPM)
Metals	Antimony, arsenic, cadmium, chromium (total), chromium VI[3], cobalt, copper, lead, manganese, mercury, nickel, selenium, tellurium, titanium, vanadium, zinc
Polycyclic aromatic hydrocarbons (PAHs)	Total PAHs[4]
Chlorinated compounds	Dioxins and furans[4], chlorophenol, hydrogen chloride

Notes:

[1] Based on nitrogen oxides (NO_x) measurements.

[2] Based on TPM measurements.

[3] Chromium VI was not identified in the emissions inventory; however, it was assumed that chromium VI would make up 100% of total chromium emissions

[4] Congeners were not specified in Table 4 (RWDI 2015).

4.1.3 Characterization of the People Potentially at Risk

The people potentially at risk represent those people whose health might be adversely affected as a result of exposure to the chemical emissions originating from the WLPP. In this regard, consideration was given to:

- The people who are known or anticipated to spend time near the WLPP; and,
- The sensitivity or susceptibility of individuals in the study area (e.g., infants and young children, the elderly, pregnant women, individuals with compromised health).

In its air dispersion modelling study, RWDI superimposed a Cartesian nested grid over the study area (as per BC's Air Quality Dispersion Modelling Guidelines) and predicted ground-level air concentrations of the COPC at 1,724 locations throughout the study area centred on the WLPP. Receptor spacing for the Cartesian grid was as follows:

- 20-m spacing along the property fenceline;
- 50-m spacing within 500 m of the WLPP;
- 250-m spacing within 2 km of the WLPP;
- 500-m spacing within 5 km of the WLPP; and,
- 1,000-m spacing within 10 km of the WLPP.

Receptor locations are shown in Figure 1 of Appendix A.

For the purposes of the screening-level HHRA, it was assumed that sensitive or susceptible individuals would be found on both a short-term and long-term basis at the location within the study area corresponding to the maximum point of impingement (MPOI). The MPOI refers to the location at which the highest air concentration of each of the COPC would be expected to occur, and at which the exposure received by the people within the study area would be greatest. The choice of the MPOI location was meant to ensure that any potential health effects that could result from exposure to the chemical emissions associated with the WLPP, regardless of whether people might be exposed, would not be underestimated. The decision to use the MPOI to represent the location at which people would be found was made by default; that is, consideration was not given as to whether or not the MPOI location was suitable for a permanent residence.

4.1.4 Identification of Relevant Exposure Pathways

Exposure pathways refer to the various avenues by which the chemical emissions might "travel" from the WLPP to the people living in the area or frequenting the area for work, recreation or other purposes. Since the chemicals will be emitted directly into the air, the primary pathway by which people could be exposed is *via* inhalation (i.e., breathing in chemicals). As a result, the inhalation pathway was the primary focus of the screening-level HHRA.

Exposure through less obvious secondary pathways also could occur and needed to be explored as part of the screening-level HHRA. For example, the chemicals might fall-out or deposit from the air onto the ground and result in additional pathways of exposure (i.e., secondary pathways). Consideration of possible secondary pathways is discussed in Section 5.3 of the screening-level HHRA. This addresses the concerns raised regarding the potential health risk from exposure to the persistent chemicals associated with the WLPP emissions.

4.2 Exposure Assessment

Determination of potential ground-level air concentrations relied on both ambient measurements and the predictive exposure modelling described in the air dispersion modelling study completed by RWDI (2015). The former approach involved the monitoring of chemicals in ambient air in the study area. This approach was used in the air dispersion modelling study to characterize the representative background concentrations of the COPC in air. The second approach involved use of predictive models to estimate the air concentrations of the chemicals emitted from the WLPP. The representative background concentrations were added to the predicted ground-level air concentrations to arrive at an estimate of the cumulative exposure. Further details concerning each approach are provided below.

Measured concentrations of the COPC in the ambient air were obtained by RWDI from the Columneetza air quality monitoring station located in downtown Williams Lake (see Figure 1 of Appendix A). Ambient concentrations of NO_2, $PM_{2.5}$ and PM_{10} have been historically reported at the station. Consistent with BC MOE guidance for air dispersion modelling (BC MOE 2008), the 98th percentile of 1-hour and 24-hour air concentrations measured at the Columneetza air quality monitoring station between January 1, 2012 and December 31, 2012 were used to represent the short-term background air concentrations of NO_2, $PM_{2.5}$ and PM_{10} within the study area. Annual background air concentrations of NO_2 and $PM_{2.5}$ were based on the average of the hourly air concentrations measured at the station.

The background air concentrations assumed in the air dispersion modelling study are provided in Table 4-2.

Table 4-2 Representative Background Air Concentrations in the Study Area

Chemical of Potential Concern	***Averaging Period***	***Representative Background Air Concentration (µg/m³)***
NO_2	1-Hour	63.9
	Annual	16.5
$PM_{2.5}$	24-Hour	20.2
	Annual	5
PM_{10}	24-Hour	40.8

Predicted ground-level air concentrations were also evaluated in association with different averaging periods (i.e., 10-minute, 1-hour, 24-hour and annual) to allow for the assessment of both acute and chronic inhalation health risks. On a short-term basis, peak (1st highest) 10-minute, 1-hour and 24-hour ground-level air concentrations were used to evaluate the potential acute health risks. The exceptions being due to provincial and federal guidance for NO_2, $PM_{2.5}$ and SO_2:

- The 98th percentile of the yearly distribution of daily 1-hour maximum NO_2 concentrations was used to evaluate the potential acute health risks.
- The 98th percentile of the yearly distribution of daily $PM_{2.5}$ concentrations was used to evaluate the potential acute health risks.
- The 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations was used to evaluate the potential acute health risks.

Chronic health risks were assessed using the predicted maximum annual ground-level air concentration.

Predicted ground-level air concentrations of the COPC were provided for two emission scenarios:

- 100% rail ties burned annually
- 50% rail ties burned annually

Consistent with the screening-level approach, the choice of emission scenario to be evaluated in the screening-level HHRA needed to ensure that possible exposures were not underestimated or overlooked. As a result, the screening-level HHRA focused on the potential health risks that could result from the chemical exposures associated with the burning of 100% rail ties.

4.3 Toxicity Assessment

The Toxicity Assessment is concerned with identifying the types of health effects that can be caused by each of the caused by each of the COPC (acting either singly or in combination), with understanding the conditions under which the effects are likely to occur *vis-à-vis* the amount, frequency and duration of exposure. This information can then be compared to the exposures that might be received by people in order to gauge the nature and severity of any health effects that might result.

Reliance was placed on exposure limits developed or recommended by leading scientific or regulatory authorities as criteria (e.g., objectives, guidelines or standards) for the protection of human health. The use of regulatory limits is a common practice among practitioners of risk assessment. These limits typically embrace a high degree of conservatism, in direct recognition of the mandate of most of the authorities to protect public health, including the health of infants and children, the elderly, and individuals who might be especially vulnerable to chemical exposures.

The sources of the acute and chronic exposure limits are (in no order of preference):

- British Columbia Ministry of the Environment (BC MOE)
- Agency for Toxic Substances and Disease Registry (ATSDR)
- California’s Office of Environmental Health Hazard Assessment (OEHHA)
- Canadian Council of Ministers of the Environment (CCME)
- Health Canada and Environment Canada
- Netherlands National Institute of Public Health and the Environment (RIVM)
- Texas Commission on Environmental Quality (TCEQ)
- United States Environmental Protection Agency (US EPA)
- World Health Organization (WHO)

For inclusion in the HHRA, exposure limits were required to be:

- Protective of the health of the general public based on current scientific knowledge of the health effects associated with exposure to the chemical;

- Protective of sensitive individuals (i.e., infants and young children, the elderly, pregnant women, individuals with compromised health) through the incorporation of uncertainty or safety factors;
- Established or recommended by reputable scientific or regulatory authorities; and,
- Supported by adequate documentation.

When these criteria were satisfied by more than one objective, guideline or standard, the most scientifically defensible exposure limit was typically selected. Emphasis was given to regulatory limits that were health-based, and for which supporting documentation was available.

Exposure limits are often segregated into different categories in recognition of the fact that the appearance and nature of toxic responses are very much dependent on the frequency and duration of exposure. Two categories are commonly assigned:

- **Acute Exposure Limit**: refers to the amount, concentration or dose of a chemical that can be tolerated without evidence of adverse health effects on a short-term basis. These limits are routinely applied to conditions in which exposures extend over several hours or several days only.
- **Chronic Exposure Limit**: refers to the dose of a chemical that can be tolerated without evidence of adverse health effects on a long-term basis. These limits are routinely applied to conditions in which exposures extend over several months or years, possibly up to a lifetime.

Acute and chronic exposure limits were utilized in light of the need to address the potential health effects that could result from short-term and long-term exposure to the various chemical emissions associated with the WLPP.

Chronic exposure limits are further segregated into different categories in recognition of the fact that the toxic responses are very much dependent upon a chemical's mode of action or mechanism of toxicity. Two categories are commonly assigned:

- **Threshold Chemicals**: refer to chemicals that are generally non-carcinogenic chemicals. For these chemicals, a benchmark or threshold level must be exceeded for toxicity to occur. The degree of toxicity expressed then increases with increasing dose. For these chemicals, a no observed adverse effect level (NOAEL) can be identified. A NOAEL is the dose or amount of the chemical that results in no obvious response in the most sensitive test species and test endpoint. The NOAEL is often used as the starting point for the calculation of these limits. In some cases, a Benchmark Dose (BMD) is derived, which represents the dose associated with a specific magnitude of response (i.e., 5 or 10% incidence within the study population). In the derivation of exposure limits by leading scientific and regulatory authorities, uncertainty factors are then applied to lower the NOAEL or BMD by up to several thousand-fold, in part to accommodate the need to protect sensitive individuals. The limit is calculated as follows:

$$\text{Exposure Limit} = \frac{\text{NOAEL}}{\text{Uncertainty Factor(s)}}$$

  It is important to note that in most instances, no empirical evidence exists to suggest that adverse health effects might occur at levels of exposure at or near the exposure limit (i.e., the limits typically embrace sufficient margins-of-safety to accommodate modest excursions without threat of adverse health effects). Moreover, because of the conservatism involved, an exceedance of the exposure limit does not necessarily mean that health effects are certain or imminent.

- **Non-Threshold Chemicals:** refer to carcinogens, which are capable of producing cancer through one or more of a number of possible mechanisms (e.g., mutagenicity, cytotoxicity, inhibition of programmed cell death, mitogenesis [uncontrolled cell proliferation] and immune suppression) that, in theory, do not require the exceedance of a threshold (US EPA 2005). In general, tumorigenicity data from animals or human epidemiological studies are examined using mathematical models to determine the chemical specific Unit Risks (URs) or Slope Factors (SFs), which are in turn used to develop applicable exposure limits. Regulatory agencies such as Health Canada and the US EPA assume that any level of long-term exposure to carcinogenic chemicals is associated with some “hypothetical cancer risk”. As a result, relevant provincial and federal health authorities have specified an incremental (i.e., over and above background) lifetime cancer risk of one extra cancer case in a population of 100,000 people, which these agencies consider acceptable, tolerable or essentially negligible (BC MOE 2009, Health Canada 2012). The benchmark of an acceptable cancer risk is policy-based, and its interpretation by various regulatory health authorities may differ (CCME 2006).

The exact terminology by which exposure limits for airborne chemicals for which the primary avenue of exposure is inhalation will depend, in part, on the nature of the chemical, the nature of the exposure (i.e., amount, frequency and duration), and the regulatory jurisdiction involved. The inhalation limits for the COPC are described by one of two terms, specifically:

- **Reference Concentration (RfC):** refers to the safe level of an airborne chemical for which the primary avenue of exposure is inhalation. It is expressed as a concentration of the chemical in air (i.e., $\mu g/m^3$) and applies only to threshold chemicals.
- **Risk Specific Concentration (RsC)**: reserved for carcinogens and refers to the level of an airborne carcinogen for which the primary route of exposure is inhalation and that results in a negligible (i.e., regulatory acceptable) incremental increase in cancer (typically one in 100,000). It is expressed as a concentration of the chemical in air (i.e., $\mu g/m^3$).

A complete list of the inhalation exposure limits identified in the Toxicity Assessment for each of the COPC associated with the WLPP is presented in Table 4-3.

For those chemicals for which an exposure limit has not been developed or recommended by the various scientific or regulatory authorities, a surrogate chemical was identified. This step relied on the toxicological principle that states that the molecular structure of a chemical has a distinct bearing on its reactivity, biological activity and toxicity. The principle allows for the toxicity of a chemical for which little or no toxicological information exists to be predicted on the basis of information available on another chemical of similar molecular structure. The second chemical is termed a “surrogate”. For example, an exposure limit was not identified for chlorophenol, but an exposure limit was available for trichlorophenol, which was then adopted as a surrogate chemical. Therefore, chlorophenol was assessed using the exposure limits for trichlorophenol.

Table 4-3 Inhalation Exposure Limits for the Chemicals of Potential Concern

Chemical of Potential Concern	***Acute Exposure Limit***				***Chronic Exposure Limit***			
	Averaging Period	***Value (μg/m^3)***	***Critical Effect***	***Reference***	***Type***	***Value (μg/m^3)***	***Critical Effect***	***Reference***
Criteria Air Contaminants								
NO_2	1-Hour	188	Respiratory irritation	BC MOE 2015	RfC	60	Respiratory irritation	BC MOE 2015
PM_{10}	24-Hour	50	Mortality and morbidity	BC MOE 2015	—	—	—	—
$PM_{2.5}$	24-Hour	25	Mortality and morbidity	BC MOE 2015	RfC	8	Mortality and morbidity	BC MOE 2015
SO_2	10-Minute	500	Respiratory irritation	WHO 2000	—	—	—	—
	1-Hour	200	Respiratory irritation	BC MOE 2015				
TPM	24-hour	120	—	BC MOE 2015	RfC	60	—	BC MOE 2015
Metals and Metalloids								
Antimony	—	—	—	—	—	—	—	—
Arsenic	1-Hour	0.2	Developmental effects	OEHHA 2008, 2015	RsC	0.0016	Lung tumours	Health Canada 2010
Cadmium	24-Hour	0.03	Nasal and respiratory irritation	ATSDR 2012a, 2015	RfC	0.01	Kidney effects	ATSDR 2012a, 2015
					RsC	0.002	Lung tumours	OEHHA 2011
Chromium (total)	1-Hour	12	Respiratory irritation	TCEQ 2009a, 2015	RfC	0.14	Respiratory irritation	TCEQ 2009a, 2015
Chromium VI	—	—	—	—	RfC	0.1	Respiratory irritation	US EPA 1998, 2015
					RsC	0.00013	Lung tumours	Health Canada 2010
Cobalt	—	—	—	—	RfC	0.1	Respiratory irritation	ATSDR 2004, 2015
Copper	—	—	—	—	RfC	1	Respiratory irritation and immunological effects	RIVM 2001
Lead(1)	—	—	—	—	—	—	—	—

Chemical of Potential Concern	**Acute Exposure Limit**				**Chronic Exposure Limit**			
	Averaging Period	**Value (µg/m³)**	**Critical Effect**	**Reference**	**Type**	**Value (µg/m³)**	**Critical Effect**	**Reference**
Manganese	—	—	—	—	RfC	0.3	Neurological effects	ATSDR 2012b, 2015
Mercury	1-Hour	0.6	Developmental effects	OEHHA 2008, 2015	RfC	0.3	Neurological effects	US EPA 1995, 2015
Nickel	1-Hour	1.1	Respiratory irritation	TCEQ 2011, 2015	RfC	0.09	Respiratory irritation	ATSDR 2005, 2014
					RsC	0.0077	Lung tumours	Health Canada 2010
Selenium	—	—	—	—	RfC	20	Neurological effects, liver effects	OEHHA 2001, 2015
Tellurium	—	—	—	—	—	—	—	—
Titanium	—	—	—	—	RfC	0.1	Nasal and respiratory irritation	ATSDR 1997, 2015,
Vanadium	1-Hour	30	Respiratory irritation	OEHHA 2008, 2015	RfC	0.1	Respiratory irritation	ATSDR 2012c, 2015
Zinc	—	—	—	—	—	—	—	—
Polycyclic Aromatic Hydrocarbons								
Total PAHs(2)	—	—	—	—	RsC	0.00012	Lung tumours	WHO 2000
Chlorinated Compounds								
Chlorophenol(3)	—	—	—	—	RsC	0.5	Leukemia and lung tumours	OEHHA 2011
Dioxins and furans(4)	—	—	—	—	RfC	0.000003	Reproductive and developmental effects	US EPA 2012, 2015
Hydrogen chloride	1-Hour	660	Respiratory irritation	TCEQ 2009b, 2015	RfC	9	Nasal and respiratory irritation	OEHHA 2000, 2015

Notes:

— not available

[1] Based on the current state of the science, Health Canada and other regulatory health authorities (ACCLPP 2012, Cal EPA 2009, JECFA 2011, US EPA 2006, WHO 2009) no longer support the premise that lead is a threshold toxicant. Health Canada (2011) has concluded that lead should be considered a non-threshold substance. Accordingly, threshold-based TRVs are no longer recommended for use.

[2] Assumed to be benzo(a)pyrene.

[3] Assumed to be trichlorophenol

[4] Assumed to be 2,3,7,8-tetrachlorodibenzo-p-dioxin.

4.3.1 Chemical Mixtures

Given that chemical exposures rarely occur in isolation, the potential health effects associated with mixtures of the COPC were assessed in the screening-level HHRA. The chemicals within a mixture may interact in different ways such that toxicity may be altered, possibly becoming enhanced (i.e., additivity, synergism or potentiation), reduced (i.e., antagonism) or remaining unchanged. The assessment of the health effects of chemical mixtures is challenging by virtue of the infinite number of chemical combinations that are possible. Recent efforts have been made by several regulatory and leading scientific authorities to better understand the types of interactions involved and to develop methods for assessing mixtures (Boobis et al. 2011; European Commission 2012; Meek et al. 2011; Price et al. 2009; Price and Han 2011). These efforts have led to the following observations:

- Under certain conditions, chemicals can act in combination as a mixture in a manner that affects the overall level of toxicity.
- Chemicals with common modes of action can act jointly to produce combined effects that may be greater than the effects of each of the constituents alone. These effects are additive in nature.
- For chemicals having different modes of action, there is no robust evidence available to indicate that mixtures of such substances are of health or environmental concern provided the individual chemicals are present in amounts at or below their threshold dose levels.
- Interactions (including antagonism, potentiation and synergism) usually occur only at moderate to high dose levels (relative to the lowest effect levels), and are either unlikely to occur or to be of any toxicological significance at low or “environmentally relevant” exposure levels.
- If information is lacking on the mode(s) of action of chemicals in a mixture, it should be assumed by default that they will act in an additive fashion, with the manner and extent to which they may interact act determined on a case-by-case basis using professional judgment.

Based on these observations and in accordance with guidance from Health Canada (2012), one approach to assessing chemical mixtures is to combine those chemicals which act through a common or similar toxicological mechanism and/or affect the same target tissues and/or organs in the body (i.e., share commonality in effect), and assume that the overall toxicity of the mixture is equivalent to the sum of the toxicities of the individual chemicals comprising the mixture. In other words, the chemicals are assumed to interact in an additive fashion (Health Canada 2012). This approach was adopted for the screening-level HHRA of the WLPP.

The chemical mixtures assumed in the screening-level HHRA are listed in Table 4-4. The critical endpoints of the exposure limits provided the basis for an individual chemical’s inclusion in a chemical mixture (see Table 4-3). For example, the acute inhalation exposure limit for NO_2 is based on its ability to cause respiratory irritation; therefore, NO_2 was included in the acute inhalation respiratory irritants mixture.

Table 4-4 Assumed Chemical Mixtures

Exposure Duration	***Critical Effect***	***Chemical Mixture Designation***	***Chemical Mixture Constituents***
Acute	Respiratory irritation	Respiratory irritants	Cadmium, chromium (total), hydrogen chloride, nickel, NO_2, $SO_2^{(1)}$, vanadium
	Developmental effects	Developmental toxicants	Arsenic, mercury
Chronic	Nasal irritation	Nasal irritants	Hydrogen chloride, titanium
	Respiratory irritation	Respiratory irritants	Chromium (total), chromium VI, cobalt, copper, hydrogen chloride, nickel, NO_2, titanium, vanadium
	Neurological effects	Neurotoxicants	Manganese, mercury, selenium
	Lung tumours	Lung carcinogens	Arsenic, cadmium, chlorophenol, chromium VI, nickel, total PAHs

Notes:

[1] The highest risk estimate of the averaging times (10-minute versus 1-hour) for SO_2 was used in the prediction of the potential health risks for the acute respiratory irritants mixture.

4.4 Risk Characterization

The Risk Characterization involves the comparison of the estimated exposures to selected health-based exposure limits to determine the potential health risks. In addition, sources of uncertainty and how these uncertainties were addressed are discussed.

The potential health risks are expressed as Risk Quotients (RQs) for the non-carcinogenic COPC and as Incremental Lifetime Cancer Risks (ILCRs) for the carcinogenic COPC.

4.4.1 Non-Cancer Risk Estimates

The RQs were calculated using the following equation:

$$\text{Risk Quotient} = \frac{\text{Exposure Estimate}(\mu g/m^3)}{\text{Exposure Limit }(\mu g/m^3)}$$

Interpretation of the RQ values proceeded as follows:

- **RQ ≤1.0**: indicates that the estimated exposure is less than or equal to the exposure limit (i.e., the assumed safe level of exposure). RQs less than or equal to 1.0 are associated with low health risks, even in sensitive individuals given the level of conservatism incorporated in the derivation of the exposure limit and the risk estimate.
- **RQ >1.0**: indicates that the exposure estimate exceeds the exposure limit. This suggests an elevated level of risk, the significance of which must be balanced against the degree of conservatism incorporated into the screening-level HHRA.

4.4.2 Cancer Risk Estimates

As previously mentioned, regulatory authorities such as BC MOE, Health Canada and the US EPA assume that any level of long-term exposure to carcinogenic chemicals is associated with some “hypothetical cancer risk”. On this basis, BC MOE (2009) and Health Canada (2012) have specified an incremental (i.e., over and above background) lifetime cancer risk of one in

100,000, which these authorities consider acceptable, tolerable or essentially negligible. Because this assumed “acceptable” cancer risk level was specifically developed to address cancer risks over and above background cancer incidence, a portion of which includes background exposure to environmental pollutants, background exposures were not included in the assessment of potential health risks for non-threshold (i.e., carcinogenic) chemicals.

For the purpose of the assessment, ILCRs were calculated for the carcinogenic COPC by comparing the predicted incremental levels of exposure associated with the WLPP to their respective exposure limits. The ILCRs were calculated as follows:

$$\text{Incremental Lifetime Cancer Risk} = \frac{\text{Incremental Exposure Estimate}(\mu g/m^3)}{\text{Carcinogenic Exposure Limit }(\mu g/m^3)}$$

Interpretation of these ILCR values was based on comparison of the ILCR against the BC MOE (2009) and Health Canada (2012) negligible risk level of one in 100,000 (i.e., one extra cancer case in a population of 100,000 people).

4.4.3 Assumptions and Uncertainties

In an attempt to ensure that health risks would not be underestimated, the screening-level HHRA incorporated assumptions intentionally selected to represent worst-case or near worst-case conditions. Table 4-5 presents a summary of the major assumptions applied in the screening-level HHRA and the associated uncertainties, arranged according to the steps of the risk assessment paradigm. Examination of the table shows that conservatism was introduced at virtually every step of the assessment, and extended to both the exposure and toxicity assessment of the HHRA.

Table 4-5 Major Assumptions Applied in the Screening-level Human Health Risk Assessment

Step of the Risk Assessment Paradigm	***Assumption***	***Uncertainty***
Problem Formulation	Chemicals listed in Table 4 of the air dispersion modelling study conducted by RWDI (2015), which served as the basis for the identification of the COPC, accurately reflect the chemical emissions inventory during the burning of rail ties.	The compounds identified by RWDI were based on a multi-day test burn using 100% rail ties at the WLPP. Considering that the emissions are based on empirical data, the uncertainty associated with this low.
Exposure Assessment	Air dispersion modelling incorporated meteorological data that represented conditions contributing to maximum predicted ground-level air concentrations of the COPC.	Meteorological data have some uncertainty, as meteorological conditions may vary around facilities like the WLPP. However, use of the meteorological data in the air quality study was in accordance with BC MOE guidance.
	Predicted ground-level air concentrations based on the test burn involving 100% rail ties are appropriate proxies for the chemical exposures that people might experience as a result of the proposed changes in fuel mix at the WLPP.	The actual percentage of rail ties expected to be burned as fuel at the WLPP will be significantly lower than the 100% assumed for the screening-level HHRA. This resulted in some of the health risks being overstated.

Step of the Risk Assessment Paradigm	***Assumption***	***Uncertainty***
	Representative background concentrations obtained from the Columneetza air quality monitoring station located in downtown Williams Lake accurate represents the background concentrations within the entire study area.	The adjustment for background may have resulted in some "double counting" of the plant emissions. As such, the incorporation of the background air data may have resulted in some of the health risks being overstated in the screening-level HHRA.
	Persons are found at the MPOI within the study area on a continuous basis, presenting the possibility that they could be exposed to the maximum predicted short-term and long-term ground-level air concentrations for the area.	This assumption most likely resulted in health risks being overstated in the screening-level HHRA.
Toxicity Assessment	Exposure limits were developed to be protective of sensitive and more susceptible individuals within the general population (e.g., infants and young children, the elderly, pregnant women, individuals with compromised health).	A considerable amount of conservatism is incorporated in the exposure limits. Limits are deliberately set to be protective of sensitive individuals. The limits were based on the most sensitive endpoints, and then adjusted to account for differences in sensitivity to chemicals among individuals. The use of uncertainty factors is already directed, in part, toward the protection of sensitive individuals.
	The findings from toxicity studies with laboratory rodents can be used to gauge the types of responses and health effects that the chemicals may cause in humans and the findings from the laboratory rodent studies can be used, in part, to determine exposure limits for the chemicals.	Laboratory rodents have traditionally served as suitable surrogate species for humans. The use of uncertainty factors accounts for the possible differences in responses to chemicals that might be observed between laboratory rodents and other species, such as humans. Recent evidence suggests that rodents might be more sensitive to certain effects than humans as a result of higher doses reaching the critical target site in rodents (e.g., nasal effects).
	In the absence of toxicity data for a number of the individual chemicals in the initial inventory, it was necessary to assume that structural similarity to the surrogate was a sufficient basis for the assumption of toxicological similarity. It is not known if this assumption is more or less conservative.	The exposure limits for surrogate chemicals adequately represent the toxicity of the chemicals being represented. A moderate level of uncertainty is associated with this assumption.
	Possible interactions of the COPC emissions from the WLPP, which might lead to enhanced toxicity, were adequately addressed in the assessment.	Consistent with Health Canada (2012) guidance, potential health risks associated with the COPC were considered to be additive if the exposure limit for the COPC had the same toxicological endpoint. In some instances, it is possible that components of a mixture may have different mechanisms of effect, contributing some uncertainty in the predicted risk estimates for mixtures.

5.0 RESULTS

As previously discussed, the potential health risks were predicted using the maximum air concentrations of the COPC at the MPOI. In recognition of the influence of exposure duration, the predicted risk estimates were segregated into acute and chronic risk estimates. The chronic risk estimates were further segregated according to non-carcinogenic and carcinogenic risk estimates.

The results discussion focuses on the risk estimates that exceed 1.0 (presented in bold in the tables), as these could signify potential health risks. Where risk estimates did not exceed 1.0 (i.e., where the predicted exposures were less than the exposure limits), the predicted risk values are presented in the tables but were not discussed further.

5.1 Predicted Acute Inhalation Health Risks

The predicted acute health risk estimates, expressed as RQs, are presented in Table 5-1. As shown in the table, the predicted RQs are less than 1.0 for each of the COPC and associated mixtures, with the exceptions of NO_2, SO_2 and the respiratory irritants mixture. The nature and severity of each exceedance is discussed in the following sections.

The interpretation of the results must necessarily consider the high degree of conservatism incorporated into the assessment both in terms of the exposure estimates that were developed and the level of protection afforded by the exposure limits. A number of conservative assumptions were incorporated into the screening-level HHRA such that the assessment reflects worst-case or near worst-case conditions with a low likelihood of occurrence. In some cases, the compounding of these conservative assumptions likely contributed to certain of the results representing nothing more than theoretical constructs of questionable practical meaning. Accordingly, the results presented below must be interpreted in the context of the high degree of conservatism that was embraced by the screening-level HHRA.

Table 5-1 Predicted Acute Inhalation Risk Quotients at the Maximum Point of Impingement

Chemical of Potential Concern[(1)]	***Averaging Period***	***Risk Quotient***[(2)(3)]
Criteria Air Contaminants		
NO_2[(4)]	1-Hour	**1.4**
PM_{10}[(4)]	24-Hour	0.82
$PM_{2.5}$[(4)]	24-Hour	0.82
SO_2	10-Minute	**1.4**
	1-Hour	**1.1**
TPM	24-hour	0.0041
Metals		
Arsenic	1-Hour	0.0089
Cadmium	24-Hour	0.0016
Chromium (total)	1-Hour	0.000059
Mercury	1-Hour	0.0015
Nickel	1-Hour	0.0028
Vanadium	1-Hour	0.0000080
Chlorinated Compounds		
Hydrogen chloride	1-Hour	0.23
Chemical Mixtures[(4)]		
Respiratory irritants	n/a	**3.0**
Developmental toxicants	n/a	0.010

Notes:

n/a not applicable

[1] Only those COPC for which an acute inhalation exposure limit could be identified are presented.

[2] An RQ equal to or less than 1.0 signifies that the estimated exposure is equal to or less than the exposure limit. Values in bold indicate an RQ greater than 1.0.

[3] Acute RQs were estimated using the predicted maximum (1st highest) ground-level air concentration

[4] Includes the representative background concentration presented in Table 4-2.

[5] Constituents of the chemical mixtures are listed in Table 4-4.

5.1.1 Nitrogen Dioxide

An acute RQ for NO_2 of 1.4 was predicted at the MPOI. The RQ is based on the comparison of the predicted 1-hour NO_2 concentration of 254 µg/m^3, which represents the 98th percentile of the yearly distribution of daily 1-hour maximum NO_2 concentrations at the MPOI, against the BC MOE Ambient Air Quality Objective (AAQO) of 188 µg/m^3 for NO_2.

The analysis and interpretation of the exceedance considered the following:

- The potential change in NO_2 emissions associated with the proposed increase in the percentage of rail ties in the fuel mix at the WLPP;
- The conservatism incorporated in the predicted ground-level air concentrations of NO_2, including the representative background concentration;
- The areal extent of the predicted exceedances of the BC MOE AAQO;
- The likelihood of an exceedance of the BC MOE AAQO occurring; and,
- The levels of exposure that have resulted in observed adverse health effects in humans, as documented in the most recent scientific literature.

Predicted ground-level air concentrations of NO_2 were calculated by RWDI based on the measured emissions of nitrogen oxides (NO_x) during the 2001 test burn. Although NO_x was measured during the test burn, RWDI notes that:

> "*NO_x emissions did not change significantly for the 100% rail tie fuel, and therefore, the background NO_x levels already account for the existing plant emissions. By adding the background to the estimated emissions, the NO_x contribution from the plant is likely double counted in some instances.*"

The MPOI refers to the location at which the predicted 98th percentile of the yearly distribution of daily maximum 1-hour air concentration of NO_2 would be expected to occur within the study area, and at which the exposures received by the people within the study area would be greatest. The choice of the MPOI location was meant to ensure that any potential health effects that could result from exposure to the NO_2 emissions associated with the WLPP, regardless of where people might be exposed, would not be underestimated. The decision to use the MPOI to represent the location at which people would be found was made by default; that is, consideration was not given as to whether or not people would likely be found at the MPOI location. As shown in Figure 2 of Appendix A, the MPOI is located adjacent to the fenceline in a forested area to the northwest of the WLPP. The isopleth also delineates the area within the study area where exceedances of the BC MOE AAQO were predicted. Exceedances of the BC MOE AAQO were predicted to occur within approximately 3 km to the northwest and approximately 0.8 km to the southeast of the WLPP. The area of exceedances consists primarily of forested area, but also includes heavy industrial areas and municipal parks. No exceedances were predicted within the multifamily residential area located to the southeast of the plant.

Frequency analysis of one full year of predicted ground-level air concentrations suggests that 1-hour air concentration of NO_2 are predicted to exceed 188 $\mu g/m^3$ up to 33% of the time in the forested area to the northwest of the WLPP, but only up to 5% of the time in the area to the southeast. The results of the frequency analysis are shown in Figure 3 of Appendix A.

Determination as to whether or not the predicted ground-level air concentration of NO_2 could adversely affect human health must consider the potential dose-response relationship for the compound. The known relationships between short-term exposure to NO_2 and the health effects reported in the published scientific literature are presented in Table 5-2. The overall weight of evidence suggests that acute health effects are not realized until a threshold has been exceeded and the magnitude of the effects amplify as the concentration increases.

Table 5-2 Potential Adverse Health Effects Associated with Short-term Exposure to Nitrogen Dioxide

Concentration in Air (µg/m³)	***Description of Potential Health Effects***$^{(1)}$
<190	No documented reproducible evidence (consistent and clinically significant) of adverse health effects among healthy individuals or susceptible individuals following short term exposure. Study results are variable and can be indiscernible from background or control groups.
190 to 560	Increased airway responsiveness, detectable by meta-analysis, among asthmatics. Large variability in both protocols and responses.
490	Allergen induced decrements in lung function and increased allergen induced airway inflammatory response among asthmatics. Most studies used non-specific airway challenges. No NO_2 induced change in lung function. No documented effects among healthy individuals.
560 to 760	Potential effects on lung function indices, including inconsistent changes FEV_1 (forced expiratory volume in 1 second) and FVC (forced vital capacity) among patients with chronic obstructive pulmonary disease (COPD) during mild exercise.
>1,100	Potentially clinically relevant effects in asthmatics.
1,900 to 3,700	Increased likelihood of inflammatory response and airway responsiveness among healthy individuals during intermittent exercise. Symptoms have not been detected by most investigators among healthy individuals. Asthmatics might experience small decrements in FEV_1.
>3,700	Changes in lung function, such as increased airway resistance, in healthy individuals

Notes:

Sources: Azadniv et al. (1998), Beil and Ulmer (1976), Blomberg et al. (1997, 1999), Cal EPA (2007), Devlin et al. (1999), Gong et al. (2005), Goodman et al. (2009), Jorres et al. (1995), Morrow et al. (1992), Nieding et al. (1979, 1980), Nieding and Wagner (1977), Vagaggini et al. (1996).

[1] The descriptions are mostly for the types of health effects that might be experienced among normal, healthy individuals following acute exposure to NO_2. Some descriptions refer to the types of symptoms that might occur among individuals with pre-existing eye or breathing disorders, such as asthma, bronchitis or COPD. The exact nature and severity of responses that might occur among individuals with pre-existing conditions will depend on several factors, including: i) the severity of the person's condition; ii) the age of the individual; iii) the level of management of the disorder, including the availability and use of medications; iv) the person's level of physical activity; and, v) external environmental factors such as temperature and humidity. The symptoms that could be experienced by these individuals could be more or less severe that those described because of these factors.

Although some studies have reported mild respiratory effects in asthmatics at concentrations in the range of 190 to 560 µg/m³, due to the absence of a clear dose-response relationship and statistical uncertainty in the studies the findings do not reflect the general acute effects associated with NO_2 exposure. A meta-analysis of short-term NO_2 exposure and airway hyper-responsiveness in asthmatics suggests that there is no evidence that NO_2 causes clinically relevant effects in asthmatics at concentrations up to 1,100 µg/m³ (Goodman et al. 2009). The predicted maximum and 98th percentile 1-hour NO_2 concentrations at the MPOI of 311 µg/m^3 and 254 µg/m^3, respectively, are well below this concentration.

Based on the above rationale, the predicted short-term NO_2 air concentrations are not expected to adversely affect the health of people living in the area or frequenting the area for work, recreation or other purposes.

5.1.2 Sulphur Dioxide

Acute RQs of 1.4 and 1.1 were predicted for SO_2 at the MPOI on a 10-minute and hourly basis, respectively. The 10-minute RQ is based on the comparison of the predicted maximum 10-

minute SO_2 concentration of 699 µg/m^3 to the WHO AAQO of 500 µg/m^3, while the 1-hour RQ is based on the comparison of the 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations of 226 µg/m^3 against the BC MOE AAQO of 200 µg/m^3.

The analysis and interpretation of the exceedances considered the following:

- The potential change in SO_2 emissions associated with the proposed increase in the volume of rail ties in the fuel mix at the WLPP;
- The conservatism incorporated in the predicted ground-level air concentrations of SO_2;
- The areal extent of the predicted exceedances of the BC MOE AAQO;
- The likelihood of an exceedance of the BC MOE AAQO occurring; and,
- The levels of exposure that have resulted in observed adverse health effects in humans, as documented in the most recent scientific literature.

Predicted ground-level air concentrations of SO_2 were calculated by RWDI for each of the two emission scenarios discussed previously: 100% rail ties and 50% rail ties. Consistent with the screening-level approach, the choice of the emission scenario to be evaluated in the screening-level HHRA needed to ensure that possible exposures were not underestimated or overlooked. On this basis, the screening-level HHRA focused on the potential health risks that could result from the chemicals exposures associated with the burning of 100% rail ties.

Atlantic Power, however, is only proposing to increase the volume of rail ties to 50%. The maximum 10-minute SO_2 concentration and 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations for the 50% rail tie scenario were predicted to be 186 µg/m^3 and 113 µg/m^3, respectively. Based on the 50% rail tie scenario, SO_2 concentrations are not expected to exceed either the World Health Organization 10-minute air quality guideline or the BC MOE 1-hour AAQO.

Furthermore, the MPOI for the 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations is located along the fenceline and into the forested area immediately to the northwest of the WLPP. Specifically, exceedances of the WHO and BC MOE air quality criteria under the 100% rail tie scenario were predicted to occur within approximately 0.2 km of the WLPP to the northwest. No exceedances were predicted to the southeast of the plant.

Frequency analysis of one full year of predicted ground-level air concentrations suggests that 1-hour air concentration of SO_2 are predicted to exceed the 200 µg/m^3 objective less than 0.05% of the time in the forested area to the northwest of the WLPP and remain below the objective more than 99.95% of the time.

Determination as to whether or not the predicted ground-level air concentration of SO_2 could adversely affect human health must consider the potential dose-response relationship for the compound. A summary of the potential adverse effects associated with short-term exposure to SO_2 as discussed in the scientific literature is presented in Table 5-3.

Table 5-3 Potential Adverse Health Effects Associated with Short-term Exposure to Sulphur Dioxide

Concentration in Air (µg/m³)	***Description of Potential Health Effects(1)***
<250	No documented reproducible evidence of adverse health effects among healthy individuals or susceptible individuals(2) following short term exposure.
250 to 530	Possible modest, transient changes in lung function indices, detectable by spirometry, among asthmatics during moderate to strenuous exercise. Changes characterized by increased airway resistance and/or reduced air conductance. All changes fully reversible and strictly sub clinical in nature, with no evidence of wheezing, shortness of breath or other clinical signs. No documented effects among healthy individuals.
530 to 1,300	Increased airway resistance and potential bronchoconstriction in asthmatic or sensitive individuals engaged in moderate exercise. Bronchoconstriction with or without attendant clinical signs depending on severity of asthmatic condition. Typically, no effects on lung function in healthy individuals.
1,300 to 2,600	Increased resistance in airways and difficulties breathing may be experienced by healthy individuals (in addition to asthmatics and sensitive individuals). Sore throat and the ability to taste and smell SO_2 may also be apparent. Effects in asthmatics and other sensitive individuals may also include wheezing, dyspnea, and bronchoconstriction.
2,600 to 13,000	Odour is detectable. Increased resistance in airways, decreased lung volume, reduced bronchial clearance, and evidence of lung irritation (increased macrophages in lung fluid) were observed at this exposure level. Headache, coughing, throat irritation, nasal congestion, increased salivation may be evident, and some symptoms may persist for several days after exposure. Mucociliary transport in the nasal passages may also be impaired, potentially leading to nasal congestion. Respiratory effects may be more severe in asthmatics and sensitive individuals.
13,000 to 26,000	Increased resistance in airways, decreased respiratory volume, difficulties breathing, and lung irritation were reported at this exposure level. Nasal, throat, and eye irritation, nosebleeds, coughing, potentially accompanied by erythema of trachea and bronchi may occur. Respiratory effects may be more severe in asthmatics and sensitive individuals.
26,000 to 130,000	Symptoms of more severe respiratory irritation may appear, such as burning of nose and throat, sneezing, severe airway obstruction, choking, and dyspnea. Exposure may result in damage to airway epithelium that may progress to epithelial hyperplasia, an increased number of secretory goblet cells, and hypertrophy of the submucosal glands. A condition known as Reactive Airway Dysfunction Syndrome (RADS) may arise in the concentration ranges (as well as above) as a result of bronchial epithelial damage. Chronic respiratory effects may develop. Eye irritation, watery eyes, and skin eruptions (rashes) may be evident. Respiratory effects may be more severe in asthmatics and sensitive individuals.
130,000 to 260,000	Increased airway resistance and potential bronchoconstriction in asthmatic or sensitive individuals engaged in moderate exercise. Bronchoconstriction with or without attendant clinical signs depending on severity of asthmatic condition. Typically no effects on lung function in healthy individuals.
>260,000	Immediately dangerous to life and health. Chemical bronchopneumonia and asphyxia were reported at high levels of exposure. Death may result from severe respiratory depression at concentrations of approximately(2) 600,000 µg/m³.

Notes:

Sources: NIOSH (1974), WHO (1979), ATSDR (1998), Cal EPA (1999), WHO (2000).

[1] Note that the descriptions pertain largely to the types of health effects that might be experienced among normal, healthy individuals following acute exposure to SO_2. Some descriptions refer to the types of symptoms that might occur among individuals with pre-existing eye and/or breathing disorders, such as asthma, bronchitis or COPD. The exact nature and severity of responses that might occur among these latter individuals will depend on several factors, including: i) the severity of the person's condition; ii) the age of the individual; iii) the level of management of the disorder, including the availability and use of medications; iv) the person's level of physical activity; and/or, v) external environmental factors such as temperature and humidity. The symptoms that could be experienced by these individuals could be more or less severe that those described because of these factors.

[2] Includes individuals suffering from respiratory disorders, such as asthma, bronchitis, and COPD.

As noted in Table 5-3, at SO_2 concentrations within the range of 530 to 1,300 µg/m^3 (which includes the predicted maximum 10-minute SO_2 concentration of 699 µg/m^3), reversible changes in the respiratory tracts of asthmatics have been recorded during exercise, but not in healthy individuals. Sulphur dioxide can act as a direct irritant of the respiratory system. Thus, people with breathing difficulties are often at higher risk of experiencing adverse effects following exposure. The airways of these individuals may already be irritated, making them particularly sensitive to the irritant action of SO_2. Asthmatics are known to be especially responsive to SO_2 and may show symptoms at lower concentrations than non-asthmatics. However, clear respiratory responses were not observed in a study in which non-exercising asthmatics were briefly exposed to SO_2 concentrations of 1,300 µg/m³ (Sheppard et al. 1981; Linn et al. 1983). There is some potential variability in the nature of responses and at what concentrations they may occur. The level of sensitivity will vary among individuals depending on the nature of the asthmatic condition, the level of physical activity and the pattern of breathing (i.e., oral *vs*. nasal). While at rest, most people breathe mainly through the nose, which acts as a scrubber that removes SO_2 from the air and prevents the gas from penetrating into the deeper airways and lungs where it can cause damage. However, during exercise, breathing occurs primarily through the mouth; therefore, very little scrubbing occurs, which can allow more SO_2 to reach the lungs. Typically, a respiratory response to SO_2 is immediate, occurring within the first few minutes of exposure and usually reaching maximum levels within 5 to 10 minutes. After this time, the response may either stabilize or decline, particularly if the exposure has ceased.

At the MPOI, the 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations (226 µg/m^3 for the 100% rail tie scenario) is lower than 250 µg/m^3, the concentration below which no documented, reproducible evidence of adverse health effects among healthy individuals or susceptible individuals following short-term exposure have been reported. Also at the MPOI, the maximum hourly SO_2 concentrations for the 50% rail tie scenario are all less than 250 µg/m^3.

Based on the above rationale, the predicted short-term SO_2 air concentrations are not expected to adversely affect the health of people living in the area or who might frequent the area for work, recreation or other purposes.

5.1.3 Respiratory Irritants Mixture

The predicted acute RQ for the respiratory irritants mixture is 3.0. The COPC included in the respiratory irritants mixture include:

- Cadmium
- Chromium (total)
- Hydrogen chloride
- Nickel
- NO_2
- SO_2
- Vanadium

The COPC contributing most of the risk are NO_2 (57%) and SO_2 (40%). The remaining mixture components combined for less than 3% of the mixture risk.

As discussed above, the predicted short-term NO_2 and SO_2 concentrations are unlikely to result in adverse health effects on their own due to:

- The conservatism incorporated in the predicted short-term ground-level air concentrations of NO_2 and SO_2;
- The areal extent of the predicted exceedances;
- The likelihood of an exceedance occurring; and,
- The levels of exposure that have resulted in observed adverse health effects in humans, as documented in the most recent scientific literature.

Depending on the concentrations of NO_2 and SO_2 to which an individual is exposed, the modes of action for NO_2 and SO_2 within the respiratory tract can differ, which may result in the combined RQs for the respiratory irritants mixture being further overstated. For example, NO_2 is relatively insoluble in water and can be inhaled deeply into the lungs, acting as a deep-lung irritant; whereas, SO_2 is readily soluble in water and, at low concentrations, would be readily absorbed by the moist mucous membranes lining the upper respiratory tract, effectively removing it from the airstream such that it would not penetrate deep into the lungs and alveolar spaces (Calabrese 1991). Clinical studies where both healthy and asthmatic subjects were exposed to both NO_2 and SO_2 in controlled environments have not found evidence that the combination increased respiratory symptoms relative to exposure to either gas on its own (Linn 1980, Rubinstein 1990, Sandstrom 1995). However, if SO_2 concentrations are sufficiently high for it to overwhelm the moist mucous membranes lining the upper respiratory tract, allowing it to penetrate to the lungs and alveolar spaces, then the potential effects of co-exposure to NO_2 and SO_2 on the respiratory tract may be additive. Potential bronchoconstriction has been reported in asthmatic or sensitive individuals engaged in moderate exercise at SO_2 concentrations as low as 530 $\mu g/m^3$. As such, co-exposure to NO_2 and SO_2 may have additive effects at SO_2 concentrations above this level. The predicted maximum 10-minute SO_2 concentration at the MPOI was 669 $\mu g/m^3$, which is within the range of concentrations at which additive effects could occur (i.e., > 530 $\mu g/m^3$).

However, concentrations greater than 530 $\mu g/m^3$ were only predicted to occur on a 10-minute basis in the forested area immediately to the northwest of the WLPP (i.e., within approximately 0.15 km of the fenceline), with no exceedances predicted in the residential area to the southeast of the plant. Frequency analysis of one full year of predicted ground-level air concentrations indicates that 10-minute air concentrations of SO_2 are predicted to exceed 530 $\mu g/m^3$ less than 0.05% of the time in the forested area to the northwest of the WLPP and remain below the objective more than 99.95% of the time. This suggests that these exceedances of 530 $\mu g/m^3$ are unlikely to occur and the assumption of additivity in the assessment of the respiratory irritants mixture, particularly the effects of NO_2 and SO_2, is likely conservative.

5.2 Predicted Chronic Inhalation Health Risks

The predicted chronic health risk, expressed as RQs for the non-carcinogenic COPC and ILCRs for the carcinogenic COPC, are presented in Table 5-4 and Table 5-5, respectively. As shown in Table 5-4, the predicted chronic RQs are less than 1.0 for each of the COPC and associated mixtures. Similarly, the predicted ILCRs are less than 1 in 100,000, indicating that chemical emissions from the WLPP burning 100% rail ties are associated with a negligible level of risk, as defined by BC MOE (2009) and Health Canada (2012).

Table 5-4 Predicted Chronic Risk Quotients at the Maximum Point of Impingement

Chemical of Potential Concern(1)	***Risk Quotient***(2)
Criteria Air Contaminants	
NO_2(3)	0.48
$PM_{2.5}$(3)	0.63
TPM	0.0013
Metals	
Cadmium	0.00076
Chromium (total)	0.000071
Chromium VI	0.0001.0
Cobalt	0.000018
Copper	0.00011
Manganese	0.00088
Mercury	0.000042
Nickel	0.00048
Selenium	0.00000065
Titanium	0.00017
Vanadium	0.000034
Chlorinated Compounds	
Dioxins and furans	0.000041
Hydrogen chloride	0.23
Chemical Mixtures(4)	
Nasal irritants	0.23
Respiratory irritants	0.70
Neurotoxicants	0.00092

Notes:

[1] Only those COPC for which a chronic RfC could be identified are presented.

[2] An RQ equal to or less than 1.0 signifies that the estimated exposure is equal to or less than the exposure limit.

[3] Includes the representative background concentration presented in Table 4-2.

[4] Constituents of the chemical mixtures are listed in Table 4-4.

Table 5-5 Predicted Chronic Incremental Lifetime Cancer Risks at the Maximum Point of Impingement

Chemical of Potential Concern(1)	*Incremental Lifetime Cancer Risks*(2) *(per 100,000)*
Metals	
Arsenic	0.016
Cadmium	0.0038
Chromium VI	0.077
Nickel	0.0057
Polycyclic Aromatic Hydrocarbons	
Total PAHs	0.017
Chlorinated Compounds	
Chlorophenol	0.0000063
Chemical Mixtures(3)	
Lung carcinogens	0.12

Notes:

[1] Only those COPC for which a chronic RfC could be identified are presented.

[2] An ILCR equal to or less than 1.0 signifies an ILCR that is below the benchmark ILCR of 1.0 in 100,000 (i.e., within the generally accepted limit deemed to be protective of public health).

[3] Constituents of the chemical mixtures are listed in Table 4-4.

5.3 Consideration of Secondary Pathways of Exposure

Apart from the assessment of the potential health risks related to the exposures to the chemical emissions that may occur *via* the primary pathway of inhalation, consideration also was given to the risks that may have occurred as a result of chemical fall-out or deposition from the air onto the ground, resulting in additional pathways of exposure (i.e., secondary pathways). In order to evaluate the potential health risks associated with possible secondary pathways, it was necessary to identify those COPC emitted by the WLPP that, although only emitted into air, could deposit nearby and possibly persist or accumulate in the environment in sufficient quantities for people to be exposed *via* alternate pathways. For this purpose, two categories of chemicals emitted from the WLPP were identified:

1. The gaseous chemicals, which are unlikely to contribute to human exposure *via* secondary pathways (e.g., NO_2, SO_2, hydrogen chloride). In addition, the health effects of these gaseous chemicals are strictly related to inhalation (i.e., act at the point of contact). Accordingly, these COPC were not considered further *via* secondary pathways.
2. The non-gaseous chemicals, which may deposit in the vicinity of the WLPP, and persist or accumulate in the environment in sufficient quantities for people to be exposed *via* secondary pathways (i.e., metals, PAHs and chlorinated compounds). The COPC were thus considered further *via* secondary pathways.

For the purpose of the screening-level HHRA, concentrations of the non-gaseous chemicals (i.e., metals, PAHs and chlorinated compounds) were predicted in soil and compared with BC's Contaminated Sites Regulation (CSR) numerical soil standards and background soil concentrations in the Cariboo Region (Gov BC 2014). Specifically, the predicted maximum annual average air concentrations of the non-gaseous COPC associated with the WLPP were assumed to deposit onto the ground at the MPOI over an 80 year period (i.e., the lifespan of a person, as per Health Canada 2012). As shown in Table 5-6, the predicted maximum concentrations of each of the non-gaseous COPC in soil are well below both the BC soil standards and regional background soil concentrations. This suggests that the proposed increase in the rail ties used to fuel the WLPP would not be expected to result in an increase in health risks to the neighbouring areas.

Table 5-6 Comparison of Predicted Maximum Soil Concentrations with Contaminated Site Soil Standards and Regional Background Soil Concentrations

Chemical of Potential Concern	*Predicted Maximum Soil Concentration (mg/kg)*	*CSR Residential Soil Standard (mg/kg)*		*Measured Background Soil Concentration*[(3)] *(mg/kg)*
		Generic[(1)]	*Matrix*[(2)]	
Metals				
Antimony	0.015	20	—	4.0
Arsenic	0.030	—	100/15	10
Cadmium	0.0090	—	3/1.5-1,000[(3)]	0.45
Chromium (total)	0.012	—	60[(4)]	150
Chromium VI	0.012	—	100[(5)]	—
Cobalt	0.0021	50	—	30
Copper	0.13	—	15,000/250-350,000[(3)]	65
Lead	0.26	—	400/100-4,000[(3)]	9.5
Manganese	0.31	—	—	750
Mercury	0.015	—	15[(5)]	0.025
Nickel	0.052	100	—	150
Selenium	0.015	3	—	4.0
Tellurium	0.038	—	—	—
Titanium	0.020	—	—	2,500
Vanadium	0.0040	200	—	100
Zinc	0.85		10,000/150-15,000[(3)]	85
Polycyclic Aromatic Hydrocarbons				
Total PAHs	0.000048	1[(6)]	5[(5)(7)]	0.0010
Chlorinated Compounds				
Dioxins and furans	0.0000000042	—	0.00035[(5)]	—
Chlorophenol	0.0000031	0.5	100/1-750,000[(3)]	0.010

Notes:

[1] Generic Numerical Soil Standards for Residential Land Use, BC Contaminated Sites Regulation, Schedule 4. http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_06.

[2] Matrix Numerical Soil Standards for Residential Land Use, BC Contaminated Sites Regulation, Schedule 5. http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_07. CSR matrix numerical soil standards are presented for: intake of contaminated soil/groundwater used for drinking water.

[3] Depending on the pH.

[4] Matrix Numerical Soil Standard was only available for groundwater used for drinking water.

[5] Matrix Numerical Soil Standard was only available for intake of contaminated soil.

[6] Assumed to be benz(a)anthracene. Generic standard was not available for benzo(a)pyrene.

[7] Assumed to be benzo(a)pyrene.

[8] Assumed to be pentachlorophenol.

6.0 SUMMARY AND CONCLUSIONS

Atlantic Power owns and operates the Williams Lake Power Plant, a 66 megawatt biomass-fuelled electricity generating facility that has been in operation since 1993. The WLPP consumes approximately 450,000 tonnes of biomass annually, with capacity to consume up to 600,000 tonnes. The WLPP primarily consumes wood residues from local sawmills, but currently operates under an environmental permit that allows the burning of up to 5% rail ties on an average annual basis. Atlantic Power is proposing to increase the volume of rail ties to 50%, but anticipates burning 15% to 25% rail ties on an average annual basis.

Atlantic Power commissioned Intrinsik to complete a screening-level HHRA based on the results of an air dispersion modelling study of the emissions from the proposed increase in the volume of rail ties to be consumed annually at the WLPP. The primary aim of the screening-level HHRA was to identify and understand the potential health risks posed to the area residents as a result of the proposed changes in the WLPP emissions. In order to do so, consideration was given to the nature of the emissions, the nature of the exposures that might occur (i.e., amount, frequency and duration), and the nature of the potential health effects that may occur following exposure to the chemicals contained in the emissions. By convention, the screening-level HHRA embraced a high degree of conservatism through the use of assumptions intentionally selected to represent worst-case or near worst-case conditions. Using this approach, any health risks identified in the screening-level HHRA were unlikely to be understated.

For the purposes of the screening-level HHRA, it was assumed that sensitive or susceptible individuals would be found on both a short-term and long-term basis at the location within the study area corresponding to the maximum point of impingement. The MPOI refers to the location at which the highest air concentration of each of the COPC would be expected to occur, and at which the exposure received by the people within the study area would be greatest. The choice of the MPOI location was meant to ensure that any potential health effects that could result from exposure to the chemical emissions associated with the WLPP, regardless of whether people might be exposed, would not be underestimated. The decision to use the MPOI to represent the location at which people would be found was made by default; that is, consideration was not given as to whether or not the MPOI location was suitable for a permanent residence.

The selection of the COPC was based on a multi-day test burn using 100% rail ties that was conducted in 2001 at the WLPP. The results of the test burn served as the basis of the emissions inventory developed by RWDI for the WLPP. Each of chemicals identified in the air dispersion modelling study was identified as a COPC in the screening-level HHRA, including Criteria Air Contaminants, metals, Polycyclic Aromatic Hydrocarbons and chlorinated compounds.

Since the chemicals will be emitted directly into the air, the primary pathway by which people could be exposed is *via* inhalation (i.e., breathing in chemicals). As a result, the inhalation pathway was the primary focus of the screening-level HHRA. Exposure through less obvious secondary pathways also could occur and needed to be explored as part of the screening-level HHRA. For example, the chemicals might fall-out or deposit from the air onto the ground and result in additional pathways of exposure (i.e., secondary pathways).

Potential health risks were determined by comparing the predicted maximum ground-level air concentrations of the COPC at the MPOI for averaging times associated with both short-term and long-term exposures with exposure limits established by regulatory and leading scientific authorities responsible for the protection of public health. These limits incorporate a high degree of protection to accommodate vulnerable members of the population in order to determine the potential health risks to the people living in the area or who might frequent the area for work, recreation or other purposes. In accordance with accepted HHRA protocol, the exposure limits were based on a COPC's most sensitive toxicological endpoint.

With very few exceptions, the health risk estimates for the non-cancer COPC at the MPOI were predicted to be below 1.0, indicating that estimated short-term and long-term inhalation exposures were less than the health-based exposure limits. Risk estimates less than or equal to 1.0 are associated with low health risk, and therefore adverse health effects would not be expected. The only exceedances of the limits at the MPOI were predicted for short-term inhalation exposure to NO_2 and SO_2 acting both singly and in combination as part of the respiratory irritants mixture. The predicted short-term NO_2 and SO_2 concentrations are unlikely to result in adverse health effects on their own or as part of a mixture due to:

- The conservatism incorporated in the predicted short-term ground-level air concentrations of NO_2 and SO_2;
- The areal extent of the predicted exceedances;
- The likelihood of an exceedance occurring; and,
- The levels of exposure that have resulted in observed adverse health effects in humans, as documented in the most recent scientific literature.

In all cases, the cancer risk estimates were predicted to be less than one in 100,000 (i.e., one extra cancer case in a population of 100,000 people), indicating that the chemical emissions from the WLPP burning 100% rail ties are associated with a negligible level of risk, as defined by BC MOE and Health Canada.

Concentrations of the COPC were predicted in soil and compared with BC's CSR numerical soil standards and background soil concentrations in the Cariboo Region. The predicted maximum concentrations of each of the COPC in soil were well below both the BC soil standards and regional background soil concentrations, suggesting that the proposed increase in the rail ties used to fuel the WLPP would not be expected to result in an increase in health risks to the neighbouring area.

7.0 REFERENCES

Advisory Committee for Childhood Lead Poisoning Prevention. 2012. Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf

ATSDR (Agency for Toxic Substances and Disease Registry). 1997. Toxicological Profile for Titanium Tetrachloride. US Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, GA. September 1997.

ATSDR (Agency for Toxic Substances and Disease Registry). 1998. Toxicological Profile for Sulphur Dioxide. Prepared by Sciences International, Inc. under subcontract to: Research Triangle Institute under contract No. 205-93-0606. Prepared for US Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, GA. December 1998.

ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Toxicological Profile for Cobalt. US Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, GA. April 2004.

ATSDR (Agency for Toxic Substances and Disease Registry). 2005. Toxicological Profile for Nickel. US Department of Health and Human Services. Public Health Service. Atlanta, GA. August 2005.

ATSDR (Agency for Toxic Substances and Disease Registry). 2012a. Toxicological Profile for Cadmium. US Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, GA. September 2012.

ATSDR (Agency for Toxic Substances and Disease Registry). 2012b. Toxicological Profile for Manganese. US Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, GA. September 2012.

ATSDR (Agency for Toxic Substances and Disease Registry). 2012c. Toxicological Profile for Vanadium. US Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, GA. September 2012.

ATSDR (Agency for Toxic Substances and Disease Registry). 2015. Minimal Risk Levels (MRLs) for Hazardous Substances. US Department of Health and Human Services, Public Health Service. Atlanta, GA. Available at: http://www.atsdr.cdc.gov/mrls/mrllist.asp

Azadniv, M., Utell, M.J., Morrow, P.E., Gibb, F.R., Nichols, J., Roberts, N.J. Jr., Speers, D.M., Torres, A., Tsai, Y., Abraham, M.K., Voter, K.Z. and Frampton, M.W. 1998. Effects of nitrogen dioxide exposure on human host defense. Inhal Toxicol 10(6): 585-601.

BC MOE (British Columbia Ministry of Environment). 2008. British Columbia Air Quality Dispersion Modelling Guideline. Copies of this document are available from: www.bcairquality.ca/assessment/dispersion-modelling.html

BC MOE (British Columbia Ministry of Environment). 2009. Technical Guidance on Contaminated Sites. Environmental Quality Standards. http://www.env.gov.bc.ca/epd/remediation/guidance/technical/pdf/tg03.pdf

BC MOE (British Columbia Ministry of Environment). 2015. B.C. Ambient Air Quality Objectives – Updated October 30, 2015. http://www.bcairquality.ca/reports/pdfs/aqotable.pdf

Beil, M. and Ulmer, W.T. 1976. Wirkung von NO_2 im MAK-Bereich auf Atemmechanik und bronchiale Acetylcholinempfindlichkeit bei Normalpersonen [Effect of NO_2 in workroom concentrations on respiratory mechanics and bronchial susceptibility to acetylcholine in normal persons]. Int. Arch. Occup. Environ. Health 38: 31-44.

Blomberg, A., Krishna, M.T., Bocchino, V., Biscione, G.L., Shute, J.K., Kelly, F.J., Frew, A.J., Holgate S.T. and Sandstrom. T. 1997. The inflammatory effects of 2 ppm NO_2 on the airways of healthy subjects. Am J Respir Crit Care Med 156: 418-424.

Blomberg, A., Krishna, M.T., Helleday, R., Söderberg, M., Ledin, M.C., Kelly, F.J., Frew, A.J., Holgate, S.T. and Sandström. T. 1999. Persistent airway inflammation but accommodated antioxidant and lung function responses after repeated daily exposure to nitrogen dioxide. Am. J. Respir. Crit. Care Med. 159: 536-543.

Boobis, A., Budinsky, R., Collie, S., Crofton, K., Embry, M., Felter, S., Hertzberg, R., Kopp, D., Mihlan, G., Mumtaz, M. Price, P., Solomon, K., Teuschler, L., Yang, R. and Zeleski, R. 2011.

Critical analysis of literature on low-dose synergy for use in screening chemical mixtures for risk assessment. Critical Reviews in Toxicology 41(5):369-383

Cal EPA (California Environmental Protection Agency). 1999. Air Toxics Hot Spots Program Risk Assessment Guidelines Part I: Determination of Acute Reference Exposure Levels for Airborne Toxicants. Air Toxicology and Epidemiology Section, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. March 1999.

Cal EPA (California Environmental Protection Agency). 2007. Review of the California Ambient Air Quality Standard For Nitrogen Dioxide: Technical Support Document. California Environmental Protection Agency Air Resources Board and Office of Environmental Health and Hazard Assessment. Available at: http://www.arb.ca.gov/research/aaqs/no2-rs/no2tech.pdf

Cal EPA (California Environmental Protection Agency). 2009. Revised California Human Health Screening Level for Lead (Review Draft). Office of Environmental Health Hazard Assessment, Sacramento, CA, USA. Available at: http://oehha.ca.gov/risk/pdf/LeadCHHSL51809.pdf

Calabrese, E.J. 1991. Multiple Chemical Interactions. Toxicology and Environmental Health Series. Chelsea, MI: Lewis Publishers Inc.

CCME (Canadian Council of Ministers of the Environment). 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. Winnipeg, MB. ISBN – 10 1-896997-45-7 PDF.

Devlin, R.B., Horstman, D.P., Gerrity, T.R., Becker S. and Madden, M.C. 1999. Inflammatory response in humans exposed to 2.0 ppm nitrogen dioxide. Inhalation Toxicol. 11: 89-109.

European Union. 2012. Toxicity and Assessment of Chemical Mixtures. ISSN 1831-doi:10.2772/, ISBN 978-92-79-ND- Scientific Committee on Health and Environmental Risks (SCHER), Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), and Scientific Committee on Consumer Safety (SCCS). European Commission DG Health & Consumers Directorate D: Health Systems and Products Unit D3 – Risk Assessment Office: B232 B-1049 Brussels. November 2011.

Gong, H., Jr., Linn, W.S., Clark, K.W., Anderson, K.R., Geller, M.D. and Sioutas, C. 2005. Respiratory responses to exposures with fine particulates and nitrogen dioxide in the elderly with and without COPD. Inhalation Toxicol. 17: 123-132.

Goodman, J.E., Chandalia, J.K., Thakali, S. and Seeley, M. 2009. Meta-analysis of nitrogen dioxide exposure and airway hyper-responsiveness in asthmatics. Critical Reviews in Toxicology 39(9):719-742

Gov BC (Government of British Columbia). 2014. Environmental Management Act, Contaminated Sites Regulation, Schedule 5 Numerical Soil Standards. BC Reg 375/96. Available at: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_07

Health Canada. 2010. Federal Contaminated Site Risk Assessment in Canada. Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical Specific Factors Version 2.0. Contaminated Sites Division. Safe Environments Programme. September 2010.

Health Canada. 2011. [DRAFT] Human Health State of the Science Report on Lead. Ottawa, ON, Canada. Available at http:// www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/dhhssrlrpecscepsh/index-eng.php

Health Canada. 2012. Federal Contaminated Site Risk Assessment in Canada. Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0. Prepared by Contaminated Sites Division Safe Environments Program. Draft for Comment. 2010, revised 2012. ISBN: 978-1-100-1761-0 Cat.: H128-1/11-632E-PDF

JECFA (Joint FAO/WHO Expert Committee on Food Additives). 2011. World Health Organization Food Additive Series: 64 – Safety Evaluation of Certain Food Additives and Contaminants. Prepared by the seventy-third meeting of JECFA, Join FAO-WHO Expert Committee on Food Additives. ISBN 9789241660648.

Jorres, R., Nowak, D., Grimminger, F., Seeger, W., Oldigs, M. and Magnussen, H. 1995. The effect of 1 ppm nitrogen dioxide on bronchoalveolar lavage cells and inflammatory mediators in normal and asthmatic subjects. Eur. Respir. J. 8: 416-424.

Linn, W.S., Jones, M.P., Bailey, R.M., Kleinman, M.T., Spier, C.E., Fischer, D.A. and Hackney, J.D. 1980. Respiratory effects of mixed nitrogen dioxide and sulfur dioxide in human volunteers under simulated ambient exposure conditions. Environmental Research 22:431-438

Linn, W.S., Shamoo, D.A., Spier, C.E., Valencia, L.M., Anzar, U.T., Venet T.G. and Hackney. J.D. 1983. Respiratory effects of 0.75 ppm sulphur dioxide in exercising asthmatics: influence of upper-respiratory defenses. Environmental Research 30: 340-348.

Meek, M.E., Boobis, A.R., Crofton, K.M., Heinemeyer, G., Van Raaij, M. and Vickers, C. 2011. Risk assessment of combined exposure to multiple chemicals: A WHO/IPCS framework. Regulatory Toxicology and Pharmacology 60:S1-S14.

Morrow, P.E., Utell, M.J., Bauer, M.A., Smeglin, A.M., Frampton, M.W., Cox, C., Speers D.M. and Gibb, F.R. 1992. Pulmonary performance of elderly normal subjects and subjects with chronic obstructive pulmonary disease exposed to 0.3 ppm nitrogen dioxide. Am Rev Respir Dis 145: 291-300.

Nieding, G. von and Wagner, H.M. 1977. Experimental studies on the short-term effect of air pollutants on pulmonary function in man: two-hour exposure to NO_2, O_3 and SO_2 alone and in combination. In: Kasuga, S., N. Suzuki, T. Yamada, G. Kimura, K. Inagaki and K. Onoe (eds.). Proceedings of the fourth international clean air congress, May, Tokyo, Japan. Tokyo, Japan: Japanese Union of Air Pollution Prevention Associations. P.p. 5-8.

Nieding, G. von, Wagner, H.M., Krekeler, H., Loellgen, H., Fries, W. and Beuthan, A. 1979. Controlled studies of human exposure to single and combined action of NO_2, O_3 and SO_2. Int. Arch. Occup. Environ. Health 43: 195-210.

Nieding, G. von, Wagner, H.M., Casper, H., Beuthan, A. and Smidt, U. 1980. Effect of experimental and occupational exposure to NO2 in sensitive and normal subjects. In: Lee, S. D. (ed.). Nitrogen oxides and their effects on health. Ann Arbor, MI: Ann Arbor Science Publishers, Inc. P.p. 315-331.

NIOSH (National Institute for Occupational Safety and Health). 1974. Criteria for a Recommended Standard - Occupational Exposure to Sulphur Dioxide. US Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute of Occupational Safety and Health. DHHS (NIOSH) Publication No. 74-111.

OEHHA (California Office of Environmental Health Hazard Assessment). 2000. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. Determination of Noncancer Chronic Reference Exposure Levels. *Hydrogen chloride (page 309)*. Available at: http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD3_final.pdf

OEHHA (California Office of Environmental Health Hazard Assessment). 2001. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. Determination of Noncancer Chronic Reference Exposure Levels. *Selenium and Selenium Compounds (other than Hydrogen Selenide) (page 476)*. Available at: http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD3_final.pdf

OEHHA (California Office of Environmental Health Hazard Assessment). 2008a. Technical Support Document for Determination of Noncancer Reference Exposure Levels. Inorganic Arsenic (Pg. 68) Reference Exposure Levels. Available at: http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD1_final.pdf#page=68

OEHHA (California Office of Environmental Health Hazard Assessment). 2008b. TSD for Noncancer RELs. Elemental Mercury. Appendix D1. December 2008. Available at: http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD1_final.pdf#page=214

OEHHA (California Office of Environmental Health Hazard Assessment).. 2008c. TSD for Noncancer RELs Acute Toxicity Summary for Vanadium Pentoxide. Appendix D2. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Branch. June 2008. Available at: http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD2_final.pdf#page=298

OEHHA (California Office of Environmental Health Hazard Assessment). 2011. Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Branch. Appendix B. Chemical-specific summaries of the information used to derive unit risk and cancer potency values. Updated 2011. Available at: http://www.oehha.ca.gov/air/hot_spots/2009/AppendixB.pdf

OEHHA (California Office of Environmental Health Hazard Assessment). 2015. Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. Sacramento, CA. Available at: http://www.oehha.ca.gov/air/allrels.html. Last updated: June 2014. Accessed: December 2015.

Price, P.S. and Han, X. 2011. Maximum cumulative ratio (MCR) as a tool for assessing the value of performing a cumulative risk assessment. Int J Environ Res Public Health 8:2212-2225; doi:10.3390/ijerph8062212

Price, P.S., Hollnagel, H.M. and Zabik, J.M. 2009. Characterizing the noncancer toxicity of mixtures using concepts from the TTC and quantitative models of uncertainty in mixture toxicity. Risk Analysis, 29(11):1534-1548. DOI: 10.1111/j.1539-6924.2009.01300.x

RIVM (National Institute of Public Health and the Environment). 2001. Re-evaluation of human toxicological maximum permissible risk levels. RIVM Report 711701 025. March 2001.

Rubinstein, I., Bigby, B.G., Reiss, T.F. and Boushey, H.A. Jr. 1990. Short-term exposure to 0.3 ppm nitrogen dioxide does not potentiate airway responsiveness to sulfur dioxide in asthmatic subjects. Am Rev Respir Dis 141;381-385

RWDI 2015. Atlantic Power Corporation Williams Lake Power Plant – Air Dispersion Modelling Study. RWDI# 1500355. September 8, 2015.

Sandstrom, T. 1995. Respiratory effects of air pollutants: experimental studies in humans. Eur Respir J. 8(6):976-995

Sheppard, D., Saisho, A., Nadel, J.A. and Boushey, H.A. 1981. Exercise increases sulphur dioxide-induced bronchoconstriction in asthmatic subjects. Am. Rev. Respir. Dis. 123: 486–491.

TCEQ (Texas Commission on Environmental Quality). 2009a. Chromium. All Compounds Except Hexavalent Chromium. CAS Registry Numbers: Trivalent Chromium (16065 83 1) Elemental Chromium (7440 47 3). Development Support Document. Final, October 2009. http://www.tceq.state.tx.us/assets/public/implementation/tox/dsd/final/october09/chromium3_16065 83 1.pdf

TCEQ (Texas Commission on Environmental Quality). 2009b. Fact Sheet Hydrogen Chloride (CAS 3: 7647-01-0) Available at: http://www.tceq.texas.gov/assets/public/implementation/tox/dsd/facts/hydrogen_chloride.pdf

TCEQ (Texas Commission on Environmental Quality). 2011. Nickel and Inorganic Nickel Compounds. (CAS Registry Numbers: Nickel: 7440-02-0, Nickel Sulfate: 7786-81-4, Nickel Subsulfide: 12035-72-2, Nickel Oxide: 1313-99-1, Nickel Chloride: 7718-54-9). Development Support Document Final, June 01, 2011. Prepared by McCant, D.D., Haney, J.T. Jr. and Grant, R.L. , Toxicology Division, Chief Engineer's Office, Texas Commission on Environmental Quality. Available at: http://www.tceq.state.tx.us/assets/public/implementation/tox/dsd/final/june11/nickel_&_compounds.pdf

TCEQ (Texas Commission on Environmental Quality). 2015. Final Development Support Documents (DSDs). Available at: http://www.tceq.state.tx.us/implementation/tox/dsd/final.html

US EPA (United States Environmental Protection Agency). 1995. IRIS Mercuric chloride ($HgCl_2$) (CASRN 7487-94-7) Reference Dose for Chronic Inhalation Reference Concentration (RfC) and Oral Exposure (RfD). Cincinnati, OH: United States Environmental Protection Agency. Available at: http://www.epa.gov/iris/subst/0692.htm#reforal

US EPA (United States Environmental Protection Agency). 1998. Toxicological Review of Hexavalent Chromium (CAS No. 18540-29-9). In Support of Summary Information on the Integrated Risk Information System (IRIS). August 1998. Available at: http://www.epa.gov/ncea/iris/toxreviews/0144tr.pdf .

US EPA (United States Environmental Protection Agency). 2005. Guidelines for Carcinogen Risk Assessment. United States Environmental Protection Agency. Risk Assessment Forum, Washington, DC. EPA/630/P-03/001F. March 2005.

US EPA (United States Environmental Protection Agency). 2006. National Ambient Air Quality Standards. Air Quality Criteria for Lead. Available at http://cfpub.epa.gov/ncea/dfm/recordisplay.cfm?deid=158823

US EPA (United States Environmental Protection Agency). 2012. Reference Dose for Chronic Oral Exposure. http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showQuickView&substance_nmbr=1024

US EPA (United States Environmental Protection Agency). 2015. Integrated Risk Information System (IRIS) database on-line search. A-Z List of Substances. Available at: http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList&list_type=alpha&view

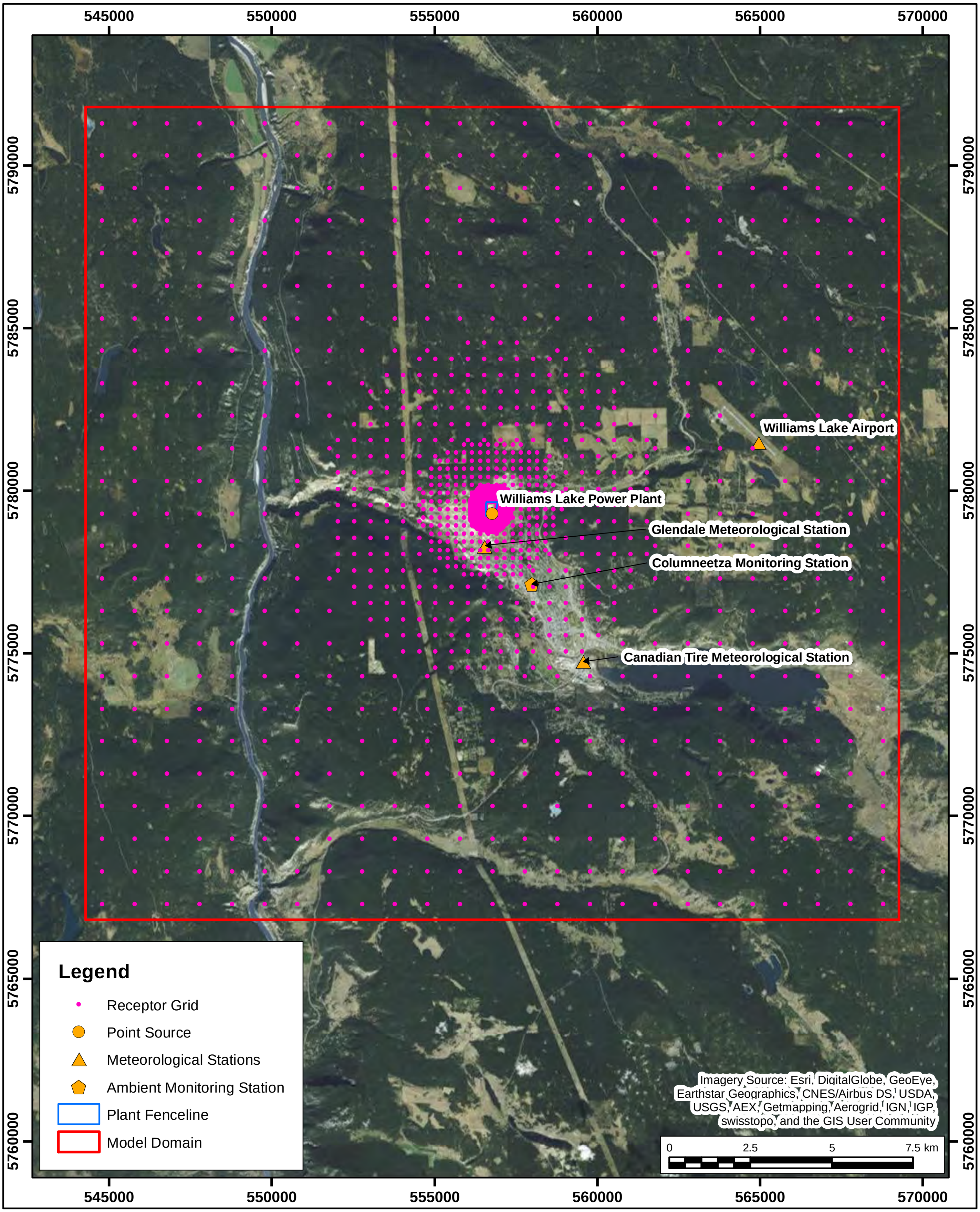
Vagaggini, B., Paggiaro, P.L., Giannini, D., Di Franco, A., Cianchetti, S., Carnevali, S., Taccola, M., Bacci, E., Bancalari, L., Dente, F.L. and Giuntini, C. 1996. Effect of short-term NO2 exposure on induced sputum in normal, asthmatic and COPD subjects. Eur Respir J 9: 1852-1857.WHO 1979– SO2

WHO (World Health Organization). 2000. Air Quality Guidelines for Europe, Second Edition. World Health Organization, Regional Office for Europe, Copenhagen. WHO Regional Publications, European Series, No. 91. ISBN 92 890 1358 3 ISSN 0378-2255

WHO (World Health Organization). 2009. Blood Lead Levels in Children. Factsheet 4.5, European Environment and Health Information System. Available at http://www.euro.who.int/_data/assets/pdf_file/0003/97050/4.5.-Levels-of-lead-in-childrens-blood-EDITING_layouted.pdf

APPENDIX A

RWDI FIGURES



Model Domain with Receptor Grid

Map Projection: NAD 1983 UTM Zone 10N.

Williams Lake Power Plant - Williams Lake, BC

True North

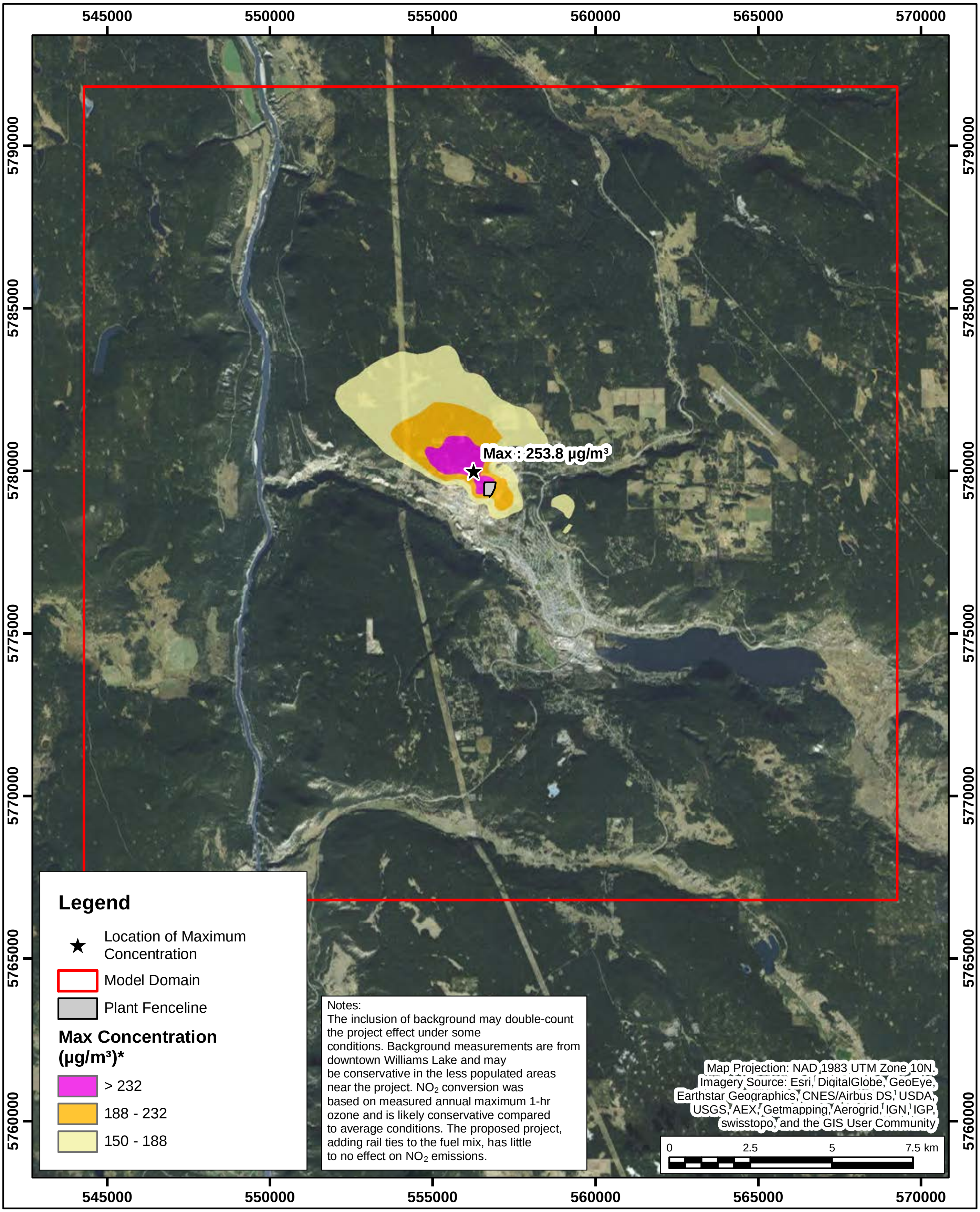
Project #1500355

Drawn by: NBN

Figure: 1

Approx. Scale: 1:160,000

Date Revised: June 29, 2015



Notes:
The inclusion of background may double-count the project effect under some conditions. Background measurements are from downtown Williams Lake and may be conservative in the less populated areas near the project. NO_2 conversion was based on measured annual maximum 1-hr ozone and is likely conservative compared to average conditions. The proposed project, adding rail ties to the fuel mix, has little to no effect on NO_2 emissions.

Map Projection: NAD 1983 UTM Zone 10N.
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Predicted Ninety-Eighth Percentile Peak Daily 1-Hour Maximum NO_2 Including Ambient Background Value for 100% Rail Ties or Base Fuel

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³ (BC MOE 2014)

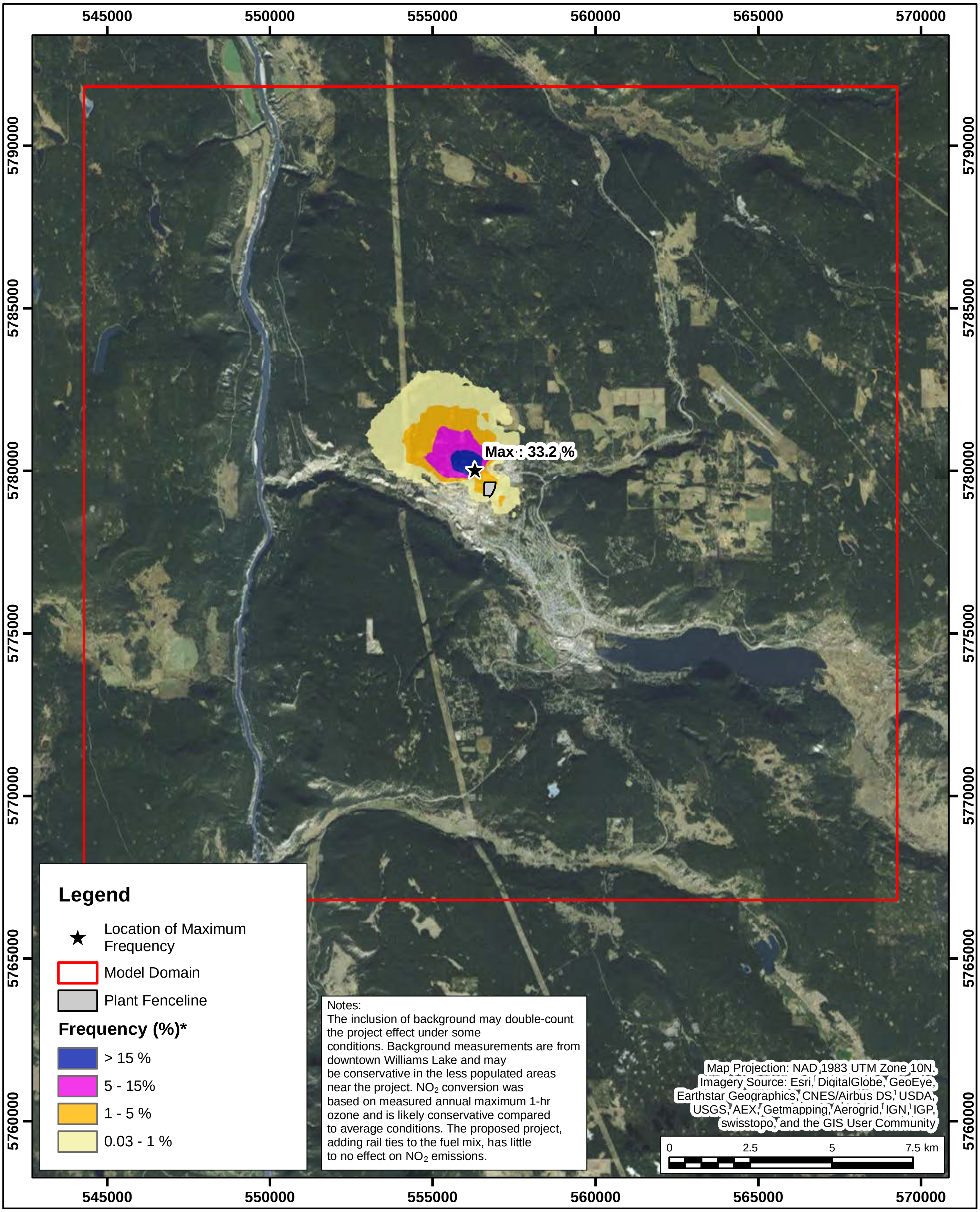
Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by: NBN	Figure: 2
Approx. Scale:	1:160,000
Date Revised:	Sept. 4, 2015

RWDI



Notes:
The inclusion of background may double-count the project effect under some conditions. Background measurements are from downtown Williams Lake and may be conservative in the less populated areas near the project. NO_2 conversion was based on measured annual maximum 1-hr ozone and is likely conservative compared to average conditions. The proposed project, adding rail ties to the fuel mix, has little to no effect on NO_2 emissions.

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Predicted Frequency of Exceedance of 1-Hour NO_2 Objective Including Ambient Background Value

*1-hr NO_2 Interim Provincial Air Quality Objective = 188 µg/m³ (BC MOE 2014)

Williams Lake Power Plant - Williams Lake, BC

True North

Project #1500355

Drawn by: NBN	Figure: 3
Approx. Scale:	1:160,000
Date Revised:	Sept. 4, 2015

RWDI

Karen Phillipps

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Human Health Toxicology and Risk Assessment Specialist

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EDUCATION

2006. M.Sc., University of Guelph

2001. B.Sc., (Hon), University of Guelph

14 Years of Experience

2006 – Present:
Scientist, Intrinsik Environmental Sciences

2001 - 2006
Toxicologist, GlobalTox International Consultants Inc.

Affiliations

Diplomate of the American Board of Toxicology (DABT). 2009

Member of the Society of Toxicology (SOT) and the Risk Assessment and Mixtures Specialty Sections of SOT

Member of the Alberta Society for Toxicology (ASHT)

Areas of Expertise

- Toxicology
- Human Health Risk Assessment
- Ecological Risk Assessment
- Municipal wastewater
- International Health Impact Assessment

Karen Phillipps is a Senior Scientist with Intrinsik. Ms. Phillipps has over 14 years of experience in toxicology and risk assessment consulting, and has been responsible for environmental risk assessments, exposure modelling, technical report writing, toxicological literature reviews, and project management. She has been actively involved in human health risk assessments related to environmental impact assessments associated with proposed oil, gas and mining projects in Alberta; human and livestock health risk assessments related to sour gas projects, contaminated sites in Ontario and Western Canada, evaluations of chemical, food and pharmaceutical products as well as occupational exposures.

She has completed and managed multiple risk assessments in Alberta, British Columbia and Ontario, including human health and ecological risk assessments in support of environmental impact assessments for oil, gas and mining projects in Alberta. Ms. Phillipps has also conducted and management risk assessments involving municipal wastewater, air quality emissions and detailed toxicological reviews. She also has knowledge of international health impact assessment paradigms through recent work.

Karen obtained her B.Sc. in Biomedical Toxicology and her M.Sc. in Food Safety and Toxicology from the University of Guelph. In 2009, she obtained the internationally-recognized certification as a Diplomate of the American Board of Toxicology (DABT). She was successfully recertified under the DABT program in 2014.

Landmark Projects

- Teck Resources Inc. (On-going). Technical support and completion of reports in relation to human health and ecological risk assessment in relation to the proposed Teck Frontier oil sands mine in northern Alberta..
- Toxicological and report preparation technical support in association with human health risk assessments completed for a National Energy Board Application for the proposed Kinder Morgan Trans Mountain Expansion Project. TERA Environmental/Kinder Morgan Canada. (On-going).
- British Columbia Ministry of Health (2012-2014) – Health assessment of oil and gas activity in northeast British Columbia Comprehensive, multi-stage project that included a literature review of human studies, a screening-level risk assessment involving a qualitative risk-ranking matrix, a detailed human health risk assessment, review of regulatory frameworks relating to oil and gas and human health, and a compilation of recommendations to the various Ministries within the BC Government.
- Pinnacle Pellet. (2014). Provided technical expertise at a public forum regarding fine particulate matter hazards and exposure in association with a proposed wood pellet facility in British Columbia.
- Screening level risk assessment in relation to the use of recycled wastewater for irrigation. Harmony Development/Urban Systems. (2014)
- OSUM Corp. (2012-2013). Completion of human health and ecological risk assessments in support of a proposed cyclical steam project in northern Alberta.
- MPE Engineering Ltd. (2011). Completion of a human health and ecological risk assessment for a wastewater discharge in Longview Alberta.
- Devon Canada. (2010). Evaluation of sulphur dioxide concentrations from an existing gas processing plant in association with potential impacts to humans and livestock.
- TOTAL Exploration and Production Canada. (2007-2009). Completion of human health and livestock health risk assessments in support of a proposed bitumen Upgrader.

Karen Phillipps

Senior Scientist
Human Health Toxicology and Risk Assessment Specialist

Landmark Projects

- Town of Strathmore. (2007-2009). Actively involved in public consultation and the scoping and completion of a human health risk assessment related to a wastewater discharge to the Bow River from the Town of Strathmore, upstream of an aboriginal community.. Activities included engaging appointed members of the Siksika Nation and regulatory stakeholders in the scoping of the work, in the collection of information for use in the risk assessment, and in the communication of results.
- Pembina Pipelines Ltd. (2009). Assessment of human and livestock risks in relation to drinking water consumption by humans and livestock in response to a release of crude oil to an Alberta River upstream of a recreational area.
- Confidential Client. (2008). Review of benzene toxicity and exposure, and probabilistic modelling in association with an evaluation potential human health impacts from an accidental benzene release from an industrial facility.
- Bromine Science and Environmental Forum. Participated in a critical, independent peer-review of a governmental risk assessment of Hexabromocyclododecane, which involved a detailed evaluation of all supporting risk assessment methodology and toxicological data.
- Health Canada Contaminated Sites Division. (2004). Review of current governmental and non-governmental approaches in evaluating chemical mixtures in a quantitative risk assessment.
- Health Canada Existing Substances Division. (2004). Evaluation of substances classified as Generally Regarded as Safe (GRAS) and associated classification and methodological approaches.
- City of Guelph (2001). Involvement in public consultation relating to the use of cosmetic pesticides within the City of Guelph; including the communication of technical information to a community working group and the preparation of a public report.
- Health Canada Drinking Water Bureau. (2001). Assisted in literature review and update of toxicological supporting documentation for the Canadian Drinking Water Criterion for trihalomethanes.

Publications

- Knafla, A., Phillipps, K.A., Brecher, R.W., Petrovic, S., Richardson, M. Development of a Dermal Cancer Slope Factor for Benzo(a)pyrene. Regul Toxicol Pharmacol 2006; 45(2):159-68.
- Repaso-Subang, T., Phillipps, K.A., Brecher, R.W. Chapter 9 – Polychlorinated Terphenyls. Health Risks of Persistent Organic Pollutants from Long Range Transboundary Air Pollution. World Health Organization (WHO), Geneva. 2003.

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26 May 2016

Terry Shannon
Director – Environmental, Health and Safety
Atlantic Power Corporation
8835 Balboa Avenue, Suite D
San Diego, CA 92123

RE: Commentary on the Supplementary Air Dispersion Modelling Results for the Proposed Changes to the Fuel Mix at the Williams Lake Power Plant from a Public Health Perspective

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Dear Mr. Shannon,

You asked that Intrinsik Environmental Sciences Inc. (Intrinsik) review RWDI's supplemental information for the "Air Dispersion Model Study for Atlantic Power Williams Lake Power Plant" (RWDI 2015) and comment on the implications, if any, on the conclusions of the screening level human health risk assessment (SLHHRA) entitled "Assessment of the Human Health Risks Associated with the Proposed Changes in Emissions from the Williams Lake Power Plant" (Intrinsik 2016). As described in RWDI's memorandum to the BC Ministry of Environment (MOE) dated April 22, 2016, the air dispersion modelling results were updated to reflect the following changes:

- The stack base elevation used in the modelling was corrected from 646 meters above sea level (masl) to 657 masl.
- The nitrogen oxide (NOx) emission rate derived from the 2001 stack test was corrected to use the standard flow rate, rather than the actual flow rate used previously.
- NOx to nitrogen dioxide (NO_2) conversion was refined to use hourly ozone rather than the annual one-hour maximum in the ozone limiting calculation.
- The total particulate matter (TPM) emission rate derived from the 2001 stack test was updated to use the permitted maximum emission rate for TPM.

More details with respect to the supplementary air dispersion modelling can be found in "Supplementary Modelling Results and MOE Information Request Atlantic Power, Williams Lake Power Plant" (RWDI 2016).

Consistent with the "Air Dispersion Model Study for Atlantic Power Williams Lake Power Plant", the supplemental air dispersion modelling examined two emission scenarios: 100% rail ties and 50% rail ties. You'll recall that the original SLHHRA relied on the air dispersion modelling results for the 100% rail ties scenario. The findings of that assessment indicated that, with very few exceptions, estimated short-term and long-term inhalation exposures were less than the health-based exposure limits. The only "exceedances" of the exposure limits at the maximum point of impingement (MPOI) were predicted for short-term inhalation exposure to NO_2 and SO_2 acting both singly and in combination as part of the respiratory irritants mixture. However, based on the available weight of evidence, the predicted NO_2 and SO_2 concentrations were not expected to result in adverse health effects on their own or as part of a mixture (Intrinsik 2016).

Since Atlantic Power is only proposing to increase the volume of rail ties up to 50% on an infrequent basis and in reality only anticipates burning 15 to 25% rail ties on an average annual basis, the 100% rail ties scenario that formed the basis of the original SLHHRA represents a hypothetical scenario that will not be realized. In order to provide additional perspective opposite the high degree of conservatism incorporated into the original SLHHRA, the air dispersion modelling results for the 50% rail ties scenario were used in this review. As it represents a more realistic scenario, we feel that consideration of the 50% rail ties case offers a more meaningful assessment of the potential health risks associated with the change at the Williams Lake Power Plant.

The 50% rail ties scenario only influences the predicted ground-level air concentrations for those chemicals of potential concern (COPC) that would be emitted from the Williams Lake Power Plant in appreciable quantities during the burning of rail ties and not during the burning of wood waste (i.e., sulphur dioxide [SO_2], metals and metalloids, polycyclic aromatic hydrocarbons [PAHs] and chlorinated compounds). However, the predicted ground-level air concentrations for NO_2 and particulate matter (PM), which would be emitted in the same quantities when burning rail ties or wood waste, remain the same regardless of the scenario under consideration.

The predicted ground-level air concentrations of the COPC at the MPOI based on the supplementary air dispersion modelling for the 50% rail ties scenario are presented in Table 1, together with the corresponding concentrations predicted previously as part of the "Air Dispersion Model Study for Atlantic Power Williams Lake Power Plant" (RWDI 2015) for the 100% rail ties scenarios. As described, the predicted ground-level air concentrations of the COPC for the 100% rail ties scenario formed the basis of the original SLHHRA. Comparison of the predicted COPC air concentrations reveals that the revised concentrations are consistently lower than those used in the SLHHRA, with the exceptions of PM_{10}, $PM_{2.5}$ and TPM.

As shown in the table, the revised PM concentrations are higher than those assessed in the SLHHRA. The observed increase in the predicted air concentrations of particulate matter can be attributed to the updated emission rate for TPM in the air dispersion model. Specifically, the TPM emission rate was updated at the request of the BC MOE from the emission rate derived from the 2001 stack test to the permitted maximum stack gas concentration for TPM (50 mg/m^3). Despite the increase in predicted PM concentrations, the predicted 24-hour and annual ground level air concentrations of PM at the MPOI remain below the applicable objectives. Furthermore, the plant annual average stack gas concentration for the last 12 years is 5.4 mg/m^3, which is almost 90 % below the permitted maximum stack gas concentration of 50 mg/m^3.

Table 1 Predicted Air Concentrations of the COPC Associated with the Williams Lake Power Plant at the Maximum Point of Impingement

Chemical of Potential Concern(1)	***Averaging Period***	***Predicted Air Concentration(2) ($\mu g/m^3$)***	
		Revised 50% Scenario	***Original SLHHRA***
Criteria Air Contaminants			
NO_2	1-Hour	149(4)(5)	254(4)(5)
	Annual	21(4)	29(4)
PM_{10}	24-Hour	47(4)	41(4)
$PM_{2.5}$	24-Hour	24(4)(6)	20(4)(6)
	Annual	5.8(4)	5.1(4)
SO_2	10-Minute	344	699
	1-Hour	93.5(7)	226(7)
TPM	24-hour	7.7	0.50
	Annual	1.3	0.078
Metals and Metalloids			
Arsenic	1-Hour	0.00088	0.0018
	Annual	0.000012	0.000025
Cadmium	24-Hour	0.000022	0.000049
	Annual	0.0000036	0.0000076
Chromium (total)	1-Hour	0.00035	0.00071
	Annual	0.0000048	0.000010
Chromium VI(8)	Annual	0.0000048	0.000010
Cobalt	Annual	0.00000085	0.0000018
Copper	Annual	0.000053	0.00011
Manganese	Annual	0.00013	0.00026
Mercury	1-Hour	0.00044	0.00090
	Annual	0.0000060	0.000013
Nickel	1-Hour	0.0015	0.0031
	Annual	0.000021	0.000044
Selenium	Annual	0.0000062	0.000013
Titanium	Annual	0.0000080	0.000017
Vanadium	1-Hour	0.00012	0.00024
	Annual	0.0000016	0.0000034
Polycyclic Aromatic Hydrocarbons			
Total PAHs	Annual	0.0000010	0.0000021
Chlorinated Compounds			
Chlorophenol	Annual	0.0000015	0.0000031
Dioxins and furans	Annual	0.000000000058	0.00000000012
Hydrogen chloride	1-Hour	72	144
	Annual	0.98	2.1

[1] Only those COPC and averaging times for which an exposure limit was identified in the SLHHRA are presented. Exposure limits were provided in Table 4-3 of the SLHHRA.

[2] Represents the maximum predicted 1-hour and 24-hour air concentrations and predicted annual average air concentrations, unless otherwise noted.

[3] Served as the basis of the risk estimates in the SLHHRA.

[4] Includes the representative background concentration presented in Table 4-2 of the SLHHRA.

[5] Represents the 98th percentile of the yearly distribution of daily 1-hour maximum NO_2 concentrations.

[6] Represents the 98th percentile of the yearly distribution of daily $PM_{2.5}$ concentrations.

[7] Represents the 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations.

[8] Chromium VI was not identified in the emissions inventory; however, for the purpose of the assessment, it was assumed that chromium VI would make up 100% of total chromium emissions.

Consistent with the SLHHRA, quantification of the potential inhalation health risks that could be presented to the local residents or general public was accomplished through the comparison of the predicted air concentrations presented in Table 1 to the corresponding exposure limits identified in the SLHHRA (and reproduced in Table 2 though Table 4 for comparison purposes). As well, in recognition of the fact that people are rarely exposed to chemicals in isolation, but rather exposed to mixtures of chemicals, the predicted health risk estimates for those chemicals which act through a common or similar toxicological mechanism and/or affect the same target tissues and/or organs as a group were combined. In other words, the chemicals were assumed to interact in an additive fashion. This approach to assessing chemical mixtures is consistent with recent observations reported by several leading scientific and regulatory authorities (Boobis et al. 2011, European Commission 2012, Meek et al. 2011, Price et al. 2009, Price and Han 2011) as well as guidance provided by Health Canada (Health Canada 2010).

The predicted health risk estimates for the COPC acting either singly or in combination as a chemical mixture are expressed as Risk Quotients (RQs) for the non-carcinogenic COPC and as Incremental Lifetime Cancer Risks (ILCRs) for the carcinogenic COPC. Accordingly, the revised risk estimates are segregated below into non-carcinogenic RQs and carcinogenic ILCRs, with the former further segregated into acute and chronic RQs. For the purpose of this review, the discussion focuses on the predicted health risk estimates that notably changed from those assessed in the SLHHRA, and those that exceed 1.0 (presented in bold in the tables) as these could signify potential health risks.

The revised acute inhalation RQs for the MPOI are presented in Table 2, together with the acute inhalation RQs predicted in the original SLHHRA. As shown in the table, the revised RQs are less than 1.0 for each of the COPC and associated mixtures, with the exception of the respiratory irritants mixture. The nature and severity of this exceedance is discussed below.

Table 2 Acute Risk Quotients for the COPC Associated with the Williams Lake Power Plant at the Maximum Point of Impingement

Chemical of Potential Concern[1]	*Averaging Period*	*Exposure Limit (µg/m³)*	*Risk Quotient*[2]	
			Revised 50% Scenario	*Original SLHHRA*
Criteria Air Contaminants				
NO_2	1-Hour	188	0.79[3]	**1.4**[3]
PM_{10}	24-Hour	50	0.93	0.82
$PM_{2.5}$	24-Hour	25	0.94[4]	0.82[4]
SO_2	10-Minute	500	0.69	**1.4**
	1-Hour	200	0.47[5]	**1.1**[5]
TPM	24-hour	120	0.064	0.0041
Metals and Metalloids				
Arsenic	1-Hour	0.2	0.0044	0.0089
Cadmium	24-Hour	0.03	0.00073	0.0016
Chromium (total)	1-Hour	12	0.000029	0.000059
Mercury	1-Hour	0.6	0.00073	0.0015
Nickel	1-Hour	1.1	0.0014	0.0028
Vanadium	1-Hour	30	0.0000040	0.0000080
Chlorinated Compounds				
Hydrogen chloride	1-Hour	660	0.11	0.23
Chemical Mixtures[6]				
Respiratory irritants	n/a	n/a	**1.6**	**3.0**
Developmental toxicants	n/a	n/a	0.0051	0.010

n/a Not applicable

[1] Only those COPC for which an acute inhalation exposure limit could be identified are presented (see Table 4-3 of the SLHHRA).

[2] Risk quotients were estimated using the maximum predicted 1-hour and 24-hour ground-level air concentrations, unless otherwise noted. An RQ equal to or less than 1.0 signifies that the predicted air concentration is equal to or less than the exposure limit. Values in bold indicate an RQ greater than 1.0.

[3] Based on the 98th percentile of the yearly distribution of daily 1-hour maximum NO_2 concentrations.

[4] Based on the 98th percentile of the yearly distribution of daily $PM_{2.5}$ concentrations.

[5] Based on the 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations.

[6] Constituents of the chemical mixtures are listed in Table 4-4 of the SLHHRA.

The most notable changes were to the predicted acute inhalation RQs for NO_2 and SO_2, which decreased below the benchmark RQ of 1.0 (see Table 2). In the case of NO_2, the predicted acute inhalation RQ decreased from 1.4 in the SLHHRA to 0.79 based on the results of the supplementary air dispersion modelling. This indicates that the predicted 98th percentile of the yearly distribution of daily 1-hour maximum NO_2 concentrations at the MPOI is no longer projected to exceed the BC MOE Ambient Air Quality Objective (AAQO) of 188 µg/m³ for NO_2. The supplementary analysis shows that the likelihood of a person experiencing adverse health effects from the short-term exposure to NO_2 associated with the proposed changes at the WLPP is low.

The revised acute inhalation RQs for 10-minute and 1-hour SO_2 also decreased and are now below 1.0 (see Table 2). Specifically, the revised RQs for 10-minute and 1-hour SO_2 decreased from 1.4 and 1.1 in the SLHHRA to 0.67 and 0.47, respectively. This indicates that the 99th percentile of the yearly distribution of daily 1-hour maximum SO_2 concentrations at the MPOI is predicted to be lower than the BC MOE AAQO of 200 µg/m³ for SO_2 and the predicted maximum 10-minute SO_2 concentration is lower than the World Health Organization (WHO) 10-minute air quality guideline of 500 µg/m³.

The revised acute inhalation RQ for the respiratory irritants also decreased from the SLHHRA, but remained above 1.0 at the MPOI. The primary chemical contributors to the revised health risk estimate continue to be NO_2 (50%) and SO_2 (43%), with the remaining mixture components (i.e., cadmium, chromium [total], hydrogen chloride, nickel and vanadium) responsible for less than 7% of the mixture risk. Depending on the concentrations of NO_2 and SO_2 to which an individual is exposed, the modes of action for NO_2 and SO_2 within the respiratory tract can differ, which may result in the combined RQ for the respiratory irritants mixture being overstated. For example, NO_2 is relatively insoluble in water and can be inhaled deeply into the lungs, acting as a deep-lung irritant; whereas, SO_2 is readily soluble in water and, at low concentrations, would be readily absorbed by the moist mucous membranes lining the upper respiratory tract, effectively removing it from the airstream such that it would not penetrate deep into the lungs and alveolar spaces (Calabrese 1991). Clinical studies where both healthy and asthmatic subjects were exposed to both NO_2 and SO_2 in controlled environments have not found evidence that the combination increased respiratory symptoms relative to exposure to either gas on its own (Linn 1980, Rubinstein 1990, Sandstrom 1995).

However, if SO_2 concentrations are sufficiently high for it to overwhelm the moist mucous membranes lining the upper respiratory tract, allowing it to penetrate to the lungs and alveolar spaces, then the potential effects of co-exposure to NO_2 and SO_2 on the respiratory tract may be additive. Potential bronchoconstriction has been reported in asthmatic or sensitive individuals engaged in moderate exercise at SO_2 concentrations as low as 530 µg/m³. As such, co-exposure to NO_2 and SO_2 may have additive effects at SO_2 concentrations above this level. The predicted maximum 10-minute SO_2 concentration at the MPOI was 343 µg/m³, which is below the range of concentrations at which additive effects could occur (i.e., > 530 µg/m³). This suggests that the assumption of additivity in the assessment of the respiratory irritants mixture, particularly the effects of NO_2 and SO_2, is likely conservative.

Based on the above, the supplementary air dispersion modelling continues to show that the likelihood of a person experiencing adverse health effects from the short-term exposure to NO_2

or SO_2 individually or combined as part of the respiratory irritants mixture as a result of the proposed changes at the Williams Lake Power Plant is low.

The revised chronic inhalation risk estimates, expressed as RQs for the non-carcinogenic COPC and ILCRs for the carcinogenic COPC, at the MPOI are presented in Table 3 and Table 4, respectively, together with the corresponding risk estimates predicted in the SLHHRA. Consistent with the SLHHRA, the revised RQs are less than 1.0 for each of the COPC and associated mixtures. Similarly, the predicted ILCRs are less than 1 in 100,000, indicating that chemical emissions from the Williams Lake Power Plant burning 50% rail ties are associated with a negligible level of risk, as defined by BC MOE (2009) and Health Canada (2012).

Table 3 Chronic Risk Quotients for the COPC Associated with the Williams Lake Power Plant at the Maximum Point of Impingement

Chemical of Potential Concern (1)	***Exposure Limit (µg/m³)***	***Risk Quotient*** (2)	
		Revised 50% Scenario	***Original SLHHRA***
Criteria Air Contaminants			
NO_2	60	0.35	0.48
$PM_{2.5}$	8	0.73	0.63
TPM	60	0.021	0.0013
Metals and Metalloids			
Cadmium	0.01	0.00036	0.00076
Chromium (total)	0.14	0.000034	0.000071
Chromium VI	0.1	0.000048	0.00010
Cobalt	0.1	0.0000085	0.000018
Copper	1	0.000053	0.00011
Manganese	0.3	0.00042	0.00088
Mercury	0.3	0.000020	0.000042
Nickel	0.9	0.00023	0.00048
Selenium	20	0.00000031	0.00000065
Titanium	0.1	0.000080	0.00017
Vanadium	0.1	0.000016	0.000034
Chlorinated Compounds			
Dioxins and furans	0.000003	0.0.000019	0.000041
Hydrogen chloride	9	0.11	0.23
Chemical Mixtures (3)			
Nasal irritants	n/a	0.11	0.23
Respiratory irritants	n/a	0.46	0.70
Neurotoxicants	n/a	0.00044	0.00092

n/a Not applicable

[1] Only those COPC and averaging times for which a chronic inhalation exposure limit could be identified are presented (see Table 4-3 of the SLHHRA.

[2] Risk quotients were estimated using the maximum predicted annual average ground-level air concentrations. An RQ equal to or less than 1.0 signifies that the predicted air concentration is equal to or less than the exposure limit.

[3] Constituents of the chemical mixtures are listed in Table 4-4 of the SLHHRA.

Table 4 Chronic Incremental Lifetime Cancer Risks for the COPC Associated with the Williams Lake Power Plant at the Maximum Point of Impingement

Chemical of Potential Concern(1)	***Exposure Limit (µg/m³)***	***Incremental Lifetime Cancer Risks***(2) ***(per 100,000)***	
		Revised 50% Scenario	***Original SLHHRA***
Metals and Metalloids			
Arsenic	0.0016	0.0074	0.016
Cadmium	0.002	0.0018	0.0038
Chromium VI	0.00013	0.037	0.077
Nickel	0.0077	0.0027	0.0057
Polycyclic Aromatic Hydrocarbons			
Total PAHs	0.00012	0.0083	0.017
Chlorinated Compounds			
Chlorophenol	0.5	0.0000030	0.0000063
Chemical Mixtures(3)			
Lung carcinogens	n/a	0.057	0.12

n/a Not applicable

[1] Only those COPC for which an inhalation unit risk could be identified are presented (see Table 4-3 of the SLHHRA).

[2] Incremental Lifetime Cancer Risks were estimated using the maximum predicted annual average ground-level air concentrations. An ILCR equal to or less than 1.0 signifies that the predicted air concentration is equal to or less than the benchmark ILCR of 1 in 100,000 (i.e., within the generally accepted limit deemed to be protective of public health).

[3] Constituents of the chemical mixtures are listed in Table 4-4 of the SLHHRA.

In addition to the assessment of the potential health risks related to the primary pathway of exposure (i.e., inhalation), consideration also was given in the SLHHRA to the risks that may occur as a result of chemical deposition from the air onto the ground, resulting in additional pathways of exposure (i.e., secondary pathways). Concentrations of the metals, PAHs and chlorinated compounds were predicted in soil and compared with BC's Contaminated Sites Regulation (CSR) numerical soil standards and background soil concentrations in the Cariboo Region (Gov BC 2014). Specifically, the predicted maximum annual average air concentrations of the non-gaseous COPC associated with the WLPP were assumed to deposit onto the ground at the MPOI over an 80 year period (i.e., the lifespan of a person, as per Health Canada 2012). The predicted maximum concentrations of each of the non-gaseous COPC in soil were determined to be well below both the BC soil standards and regional background soil concentrations. Since the predicted maximum annual average air concentrations of the non-gaseous COPC based on the supplementary air dispersion modelling are lower than those assessed in the SLHHRA, it is reasonable to conclude that the predicted maximum concentrations of each of the non-gaseous COPC in soil would also be well below both the BC soil standards and regional background soil concentrations. This continues to suggest that the proposed increase in the rail ties used to fuel the Williams Lake Power Plant is not expected to result in an increase in health risks to the neighbouring areas.

Based on the above, it is the opinion of Intrinsik that the results of the supplementary air dispersion modelling for the Williams Lake Power Plant do not affect the conclusions of the SLHHRA in that they continue to show a low potential for adverse health effects as a result of the proposed change in fuel mix at the plant.

Should you require additional details or clarification of any point, please feel free to contact me at (403) 237-0275.

Sincerely,
INTRINSIK ENVIRONMENTAL SCIENCES

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REFERENCES

Boobis, A., Budinsky, R., Collie, S., Crofton, K., Embry, M., Felter, S., Hertzberg, R., Kopp, D., Mihlan, G., Mumtaz, M. Price, P., Solomon, K., Teuschler, L., Yang, R. and Zeleski, R. 2011. Critical analysis of literature on low-dose synergy for use in screening chemical mixtures for risk assessment. Critical Reviews in Toxicology 41(5):369-383

Calabrese, E.J. 1991. Multiple Chemical Interactions. Toxicology and Environmental Health Series. Chelsea, MI: Lewis Publishers Inc.

European Commission. 2012. Scientific Committee on Health and Environmental Risks (SCHER), Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), and Scientific Committee on Consumer Safety (SCCS). Toxicity and Assessment of Chemical Mixtures. European Commission DG Health & Consumers Directorate D: Health Systems and Products Unit D3 - Risk Assessment Office: B232 B-1049 Brussels. November 2011.

Gov BC (Government of British Columbia). 2014. Environmental Management Act, Contaminated Sites Regulation, Schedule 5 Numerical Soil Standards. BC Reg 375/96. Available at: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_07

Health Canada. 2012. Federal Contaminated Site Risk Assessment in Canada. Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0. Prepared by Contaminated Sites Division Safe Environments Program. Draft for Comment. 2010, revised 2012. ISBN: 978-1-100-1761-0 Cat.: H128-1/11-632E-PDF

Intrinsik (Intrinsik Environmental Sciences Inc.). 2016. Assessment of the Human Health Risks Associated with the Proposed Changes in the Emissions from the Williams Lake Power Plant: Final Report. January 12, 2016.

Krewski, D., Jerrett, M., Burnett, R.T., Ma, R., Hughes, E., Shi, Y., Turner, M.C., Pope, C.A. III, Thurston, G., Calle, E.E. and Thun, M.J. 2009. Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality. HEI Research Report 140. Health Effects Institute, Boston, MA

Linn, W.S., Jones, M.P., Bailey, R.M., Kleinman, M.T., Spier, C.E., Fischer, D.A. and Hackney, J.D. 1980. Respiratory effects of mixed nitrogen dioxide and sulfur dioxide in human volunteers under simulated ambient exposure conditions. Environmental Research 22:431-438

Meek, M.E., Boobis, A.R., Crofton, K.M., Heinemeyer, G., Van Raaij, M. and Vickers, C. 2011. Risk assessment of combined exposure to multiple chemicals: A WHO/IPCS framework. Regulatory Toxicology and Pharmacology 60:S1-S14.

Pope, C.A. III and Dockery, D.W. 2006. Health effects of fine particulate air pollution: lines that connect. J Air & Waste Manage Assoc 56:709-742

Pope, C.A. III, Ezzati, M. and Dockery, D.W. 2009. Fine-particulate air pollution and life expectancy in the United States. N Eng J Med 360:376-386.

Price, P.S. and Han, X. 2011. Maximum cumulative ratio (MCR) as a tool for assessing the value of performing a cumulative risk assessment. Int J Environ Res Public Health 8:2212-2225; doi:10.3390/ijerph8062212.

Price, P.S., Hollnagel, H.M. and Zabik, J.M. 2009. Characterizing the noncancer toxicity of mixtures using concepts from the TTC and quantitative models of uncertainty in mixture toxicity. Risk Analysis, 29(11):1534-1548. DOI: 10.1111/j.1539-6924.2009.01300.x

Rubinstein, I., Bigby, B.G., Reiss, T.F. and Boushey, H.A. Jr. 1990. Short-term exposure to 0.3 ppm nitrogen dioxide does not potentiate airway responsiveness to sulfur dioxide in asthmatic subjects. Am Rev Respir Dis 141;381-385.

RWDI (RWDI Air Inc.). 2015. Atlantic Power Corporation Williams Lake Power Plant – Air Dispersion Modelling Study. RWDI# 1500355. September 8, 2015.

RWDI. 2016. Memorandum to Ralph Adams entitled Supplementary Modelling Results and MOE Information Request Atlantic Power, Williams Lake Power Plant, Williams Lake, British Columbia. April 12, 2016.

Sandstrom, T. 1995. Respiratory effects of air pollutants: experimental studies in humans. Eur Respir J. 8(6):976-995

APPENDIX 5

Current Permit PA 8808

November 20, 2012

Tracking Number: 268330
Authorization Number: 8808

REGISTERED MAIL

Atlantic Power Preferred Equity Ltd.
4455 Mackenzie Avenue North
Williams Lake BC V2G 4R7

Dear Permittee:

Enclosed is Amended Permit 8808 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the permit. An annual fee will be determined according to the Permit Fees Regulation.

This permit does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the permittee. This permit is issued pursuant to the provisions of the *Environmental Management Act* to ensure compliance with Section 120(3) of that statute, which makes it an offence to discharge waste, from a prescribed industry or activity, without proper authorization. It is also the responsibility of the permittee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this permit will be carried out by staff from the Southern Interior Region - Cariboo. Plans, data and reports pertinent to the permit are to be submitted to the Regional Manager, Environmental Protection, at Ministry of Environment, Regional Operations, Southern Interior Region - Cariboo, Suite 400 - 640 Borland St., Williams Lake, BC V2G 4T1.

Ministry of Environment
Environmental Protection Division
Suite 400 - 640 Borland St.
Williams Lake, BC V2G 4T1
Southern Interior Region - Cariboo
Telephone: (250) 398-4530
Facsimile: (250) 398-4214

Yours truly,

Douglas Hill

Douglas J. Hill, P.Eng.
for Director, *Environmental Management Act*
Southern Interior Region - Cariboo

Enclosure

cc: Environment Canada

MINISTRY OF ENVIRONMENT

PERMIT

8808

Under the Provisions of the Environmental Management Act

Atlantic Power Preferred Equity Ltd.

4455 Mackenzie Avenue North
Williams Lake BC V2G 4R7

is authorized to discharge emissions to the air from an electrical power generating plant located at 4455 Mackenzie Avenue North in Williams Lake, British Columbia, subject to the terms and conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may lead to prosecution.

This Permit supersedes and amends all previous versions of Permit 8808 issued under Part 2, Section 14 of the *Environmental Management Act*.

1. AUTHORIZED DISCHARGES

1.1 This section applies to the discharge of air contaminants from a **BIOMASS FUELLED BOILER**. The site reference number for this discharge is E218415.

1.1.1 The maximum rate of discharge is 110 m^3/second, on a dry basis.

1.1.2 The authorized discharge period is continuous.

1.1.3 The characteristics of the discharge shall be equivalent to or better than:

Total Particulate Matter *corrected to 8% O_2	Maximum: 50 mg/m^3*
Nitrogen Oxides *1 hour average, as NO2, corrected to 8% O_2	Maximum: 320 mg/m^3*

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(most recent)

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for Director, *Environmental Management Act*
Southern Interior Region - Cariboo

Opacity	Maximum:	10 %*

*Opacity determined by continuous in-stack opacity measurement. Opacity shall not be exceeded for more than 10% of the operating time for each day of operation.

1.1.4 The authorized works are a biomass fired boiler, multi-clones, a five field electrostatic precipitator and related appurtenances approximately located as shown on the attached Site Plan.

1.1.5 The location of the facilities from which the discharge originates and the point of discharge is Lot B of District Lot 72 Cariboo District Plan PGP35292 (Parcel Identifier: 017-247-276).

1.2 This section applies to the discharge of air contaminants from **WATER COOLING TOWERS**. The site reference number for this discharge is E218417.

1.2.1 The rate of discharge is estimated to be 5,800 m^3/second.

1.2.2 The authorized discharge period is continuous.

1.2.3 The characteristics of the discharge shall consist of water droplets including dissolved minerals naturally present and water conditioning additives for pH control and prevention of algal growth, water vapour and air.

1.2.4 The authorized works are three cooling towers, piping and related appurtenances approximately located as shown on the attached Site Plan.

1.2.5 The location of the facilities from which the discharge originates and the point of discharge is the same as Section 1.1.5 above.

1.3 This section applies to the discharge of air contaminants from an **ASH SILO VENT**. The site reference number for this discharge is E218419.

1.3.1 The maximum rate of discharge is variable and intermittent.

1.3.2 The authorized discharge period is continuous.

1.3.3 The characteristics of the discharge are of the nature of an ash silo vent at a biomass fuelled electrical generating facility.

1.3.4 The authorized works are mechanical conveyors, piping, an ash silo, vent and related appurtenances approximately located as shown on the attached Site Plan.

1.3.5 The location of the facilities from which the discharge originates and the point of discharge is the same as Section 1.1.5 above.

1.4 This section applies to the discharge of air contaminants from **MISCELLANEOUS VENTS**. The site reference number for this discharge is E218418.

1.4.1 The maximum rate of discharge is variable and intermittent.

1.4.2 The authorized discharge period is continuous.

1.4.3 The characteristics of the discharge are of the nature of steam and water safety relief vents at a biomass fuelled electrical generating facility.

1.4.4 The authorized works are fans, piping, vents and related appurtenances approximately located as shown on the attached Site Plan.

1.4.5 The location of the facilities from which the discharge originates and the point of discharge is the same as Section 1.1.5 above.

2. GENERAL REQUIREMENTS

2.1 Standard Conditions

For the administration of this permit all gaseous volumes shall be converted to standard conditions of 293.15 K and 101.325 kPa with zero percent moisture.

2.2 Maintenance of Works and Emergency Procedures

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for Director, *Environmental Management Act*
Southern Interior Region - Cariboo

The authorized works shall be inspected regularly and maintained in good working order. In the event of an emergency or condition beyond the control of the Permittee which prevents effective operation of the authorized works or leads to an unauthorized discharge, the Permittee shall take appropriate remedial action and notify the Director immediately. The Director may reduce or suspend operations to protect the environment until the authorized works has been restored, and/or corrective steps taken to prevent unauthorized discharges.

2.3 Bypasses

Any bypass of the authorized works is prohibited unless the approval of the Director is obtained and confirmed in writing.

2.4 Process Modifications

The Director shall be notified prior to implementing changes to any process that may adversely affect the quality and/or quantity of the discharge. Despite notification under this section, permitted levels must not be exceeded.

2.5 Disposal of Ash

The residue of combustion shall be removed from the boiler regularly and shall be disposed of on a site and in a manner approved by the Director.

2.6 Water Vapour

The Permittee shall provide additional works or take the necessary steps to reduce the effects of water vapour discharged to the air if, in the opinion of the Director, conditions develop which may interfere with visibility or the normal conduct of transport or business.

2.7 Authorized Fuel

The authorized fuel is untreated wood residue unless authorized below or the approval of the Director is obtained and confirmed in writing.

2.7.1 The incineration of wood residue treated with creosote and/or a creosote-pentachlorophenol blended preservative (treated wood) is authorized subject to the following conditions:

- The treated wood component shall not exceed 5% of the total biomass fuel supply calculated on an annual basis;
- The treated wood waste shall be well mixed with untreated wood waste prior to incineration;
- The incineration of wood residue treated with metal derived preservatives is prohibited;
- The Permittee shall measure and record the weight of treated wood residue received. The source of treated wood shall be recorded.

- The Permittee may request authorization to increase the proportion of treated wood residue incinerated by submitting a request in writing to the Director.

2.7.2 The incineration of hydrocarbon contaminated wood residues originating from accidental spills is authorised provided that written approval in accordance with section 52 of the Hazardous Waste Regulation has been received by the responsible party for disposal of the waste by incineration. The Permittee shall maintain a record of the quantity, date received, and identity of the responsible party of hydrocarbon contaminated wood residues originating from accidental spills.

2.7.3 Vegetative residues (i.e. green foliage, invasive weeds, diseased plants, etc.), seedling boxes, and paper records are authorized as fuel provided such materials constitute less than 1% of the daily feed into the boiler. Non-biomass contaminants (e.g. plastic, glass metal) shall not exceed 1% of the daily feed into the boiler.

2.8 **Fuel Stockpile Fire Prevention and Control**

The Permittee shall maintain a Fire Prevention and Control Plan which documents plans and procedures to prevent and control spontaneous combustion of stockpiled hog fuel. Amendments to the Plan shall be submitted to the Director within 30 days of adoption.

2.9 **Fugitive Dust Control**

Fugitive dust created within the operational area shall be suppressed. If fugitive dust becomes a concern, the Director will, in consultation with the Permittee, evaluate the sensitivity of the receiving environment, the contribution of the sources, plus any other pertinent information. The

Director may require development and submission of a Fugitive Dust Management Plan or additional control measures on fugitive dust sources.

2.10 Storm Water Management

The Permittee shall maintain a Storm Water Management Plan which documents plans and procedures to control site runoff and protect water quality of receiving waters. The Plan shall include, but not be limited to, a description of surface water flow patterns, water quality characteristics, measures to control and manage site runoff, and ongoing monitoring and reporting. Amendments to the Plan shall be submitted to the Director within 30 days of adoption. The Director may require the Permittee to implement additional measures to control, monitor or assess water discharges from the operational area.

3. MONITORING AND REPORTING REQUIREMENTS

3.1 Discharge Monitoring

The Permittee shall monitor the boiler emissions authorized in section 1.1 in accordance with the following monitoring program:

Parameter	Frequency	Method
Particulate	Annually	manual in-stack sampling
Opacity	Continuous	continuous emission monitor
Nitrogen oxides	Continuous	continuous emission monitor

The Director may modify the monitoring program by providing written direction to the Permittee.

3.2 Operating Conditions

The Permittee shall sample the emissions from the boiler in section 1.1 under normal operating conditions. The Permittee shall record the operating conditions of the boiler in terms of steam load (lb/hr) for the sampling period and for the ninety day period prior to the sampling event.

3.3 Sampling Procedures

Sampling is to be carried out in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual may be purchased from the Queen's Printer Publications Centre, P. O. Box 9452, Stn. Prov. Gov't. Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409) or via the internet at www.crownpub.bc.ca. A copy of the manual is also available for review at all Environmental Protection offices.

The continuous emission monitors shall be maintained and audited in accordance with Environment Canada’s EPS 1/PG/7 Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation.

3.4 Reporting

The required records of treated wood residue received under section 2.7.1 and of hydrocarbon contaminated wood residues originating from accidental spills under section 2.7.2 shall be maintained and submitted to the Director, annually. The report shall be submitted by January 30th annually for the preceding calendar year.

The continuous emission monitoring (CEM) data collected as required by section 3.1 shall be submitted in a format using suitable summary statistics as approved by the Director, on a monthly schedule. The CEM monthly data shall be submitted within 30 days of the end of the reported month. All CEM data shall be maintained by the permittee for inspection.

The annual particulate monitoring data required by section 3.1 and the operating condition records required under section 3.2 shall be maintained and submitted, suitably tabulated, to the Director, within 60 days of completion of the manual stack sampling event.

SITE PLAN

Date issued: February 20, 1991
Date amended: November 20, 2012
(most recent)

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APPENDIX 6

Source Path Receptor

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
PCP Treated Ties	Chlorophenols	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	1.2.6 2.2 2.4.3
PCP Treated Ties	Fugitive Dust	Storage, Raw Material	Air	Material Handling	Inhalation	Dedicated storage area Low dust emissions from whole ties	Observable dust emissions	1.8.1.8 2.4.4
PCP Treated Ties	Nuisance Odour	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	1.5.2 2.2 2.4.3
PCP Treated Ties	PAH	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	2.2 2.4.3
PCP Treated Ties	PCDD/PCDF	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	1.2.6 2.2 2.4.3
PCP Treated Ties	Petroleum Carrier	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	2.2 2.4.3
PCP Treated Ties	Chlorophenols	Storage, Raw Material	Water	Leaching & Runoff	Water contamination	Dedicated storage area for whole RRT Limited leaching from used, whole RRT Stormwater Management Plan	Stormwater monitoring results	1.2.6 2.4.1 2.4.3
PCP Treated Ties	PCDD/PCDF	Storage, Raw Material	Water	Leaching & Runoff	Water contamination	Dedicated storage area for whole RRT Limited leaching from used, whole RRT	Stormwater monitoring results	1.2.6 2.4.1 2.4.3

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
						Stormwater Management Plan		
PCP Treated Ties	Petroleum Carrier	Storage, Raw Material	Water	Leaching & Runoff	Water contamination	Dedicated storage area for whole RRT Limited leaching from used, whole RRT Stormwater Management Plan	Stormwater monitoring results	2.4.1 2.4.3
PCP Treated Ties	Chlorophenols	Shredding	Air	Volatization and Fire	Inhalation	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	1.2.6 2.4.3
PCP Treated Ties	Fugitive Dust	Shredding	Air	Material Handling	Inhalation	Engineered dust control measures at shredder	Visible dust emissions, accumulation of dust buildup	1.8.1.8 2.5
PCP Treated Ties	Nuisance Odour	Shredding	Air	Volatization and Fire	Inhalation	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	2.4.3 2.5.3

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
PCP Treated Ties	PAH	Shredding	Air	Volatization and Fire	Inhalation	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	2.4.3 2.5.3
PCP Treated Ties	PCDD/PCDF	Shredding	Air	Volatization and Fire	Inhalation	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	1.2.6 2.4.3 2.5.3
PCP Treated Ties	Petroleum Carrier	Shredding	Air	Volatization and Fire	Inhalation	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	2.4.3 2.5.3
PCP Treated Ties	Chlorophenols	Shredding	Water	Leaching & Runoff	Water contamination	Shredding system will be protected from precipitation.	Leakage of liquids from the shredding system.	1.2.6 2.4.1

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
PCP Treated Ties	PCDD/PCDF	Shredding	Water	Leaching & Runoff	Water contamination	Shredding system will be protected from precipitation.	Leakage of liquids from the shredding system.	1.2.6 2.4.1
PCP Treated Ties	Petroleum Carrier	Shredding	Water	Leaching & Runoff	Water contamination	Shredding system will be protected from precipitation.	Leakage of liquids from the shredding system.	2.4.1
PCP Treated Ties	Fugitive Dust	Shredded Material Storage	Air	Material Handling	inhalation	All shredded material will be stored in a bin.	Leakage of dust from storage bin.	1.8.1.8
PCP Treated Ties	Nuisance Odour	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Minimization of shredded RRT inventory Enclosed storage for shredded ties Utilization within 3 days Fire suppression system	Shredded ties in storage vessel Observable odour Fire	2.4.3
PCP Treated Ties	PAH	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Minimization of shredded RRT inventory Enclosed storage for shredded ties Utilization within 3 days Fire suppression system	Shredded ties in storage vessel Observable odour Fire	2.4.3
PCP Treated Ties	PCDD/PCDF	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Minimization of shredded RRT inventory Enclosed storage for shredded ties Utilization within 3 days Fire suppression system	Shredded ties in storage vessel Observable odour Fire	1.2.6 2.4.3

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
PCP Treated Ties	PCP	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Minimization of shredded RRT inventory Enclosed storage for shredded ties Utilization within 3 days Fire suppression system	Shredded ties in storage vessel Observable odour Fire	1.2.6 2.4.3
PCP Treated Ties	Petroleum Carrier	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Minimization of shredded RRT inventory Enclosed storage for shredded ties Utilization within 3 days Fire suppression system	Shredded ties in storage vessel Observable odour Fire	2.4.3
PCP Treated Ties	TCP	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Minimization of shredded RRT inventory Enclosed storage for shredded ties Utilization within 3 days Fire suppression system	Shredded ties in storage vessel Observable odour Fire	1.2.6 2.4.3
PCP Treated Ties	Chlorophenols	Incineration	Flue gas	Pass through and de novo formation.	Inhalation	Boiler operating conditions result in efficient destruction of chlorophenols. Combined emissions from pass through and denovo formation are 10% of limit from BCMSW.	Third party stack test.	1.2.6 1.6.5 2.7 4.1.1 4.2.1

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
PCP Treated Ties	Chlorophenols	Incineration	Flue gas	de novo formation.	Inhalation	Boiler operating conditions result in efficient destruction of chlorophenols. Combined emissions from pass through and denovo formation are 10% of limit from BCMSW.	Third party stack test.	1.2.6 1.6.5 2.7 4.1.1 4.2.1
PCP Treated Ties	HCl and other acid gases	Incineration	Flue gas	In-situ formation	Inhalation	High velocity, high elevation release	Third party stack test	4.1.1 4.2.1
PCP Treated Ties	NOx	Incineration	Flue gas	In-situ formation	Inhalation	NOx emissions were not impacted by 100% RRT.	Continuous emission monitor	1.8.4 2.7 4.1.1 4.2.1
PCP Treated Ties	Particulate Matter	Incineration	Flue gas	Incomplete combustion	Inhalation	The electrostatic precipitator results in low particulate emissions. Particulate emissions were lower when 100% RRT.	Continuous opacity monitor Third party stack testing	1.8.2.1 4.1.1 4.2.1
PCP Treated Ties	PCDD/PCDF	Incineration	Flue gas	Pass through, precursor and de novo formation.	Inhalation	Boiler operating conditions result in efficient destruction of PCDD/PCDF. Combined emissions from pass through and denovo formation are 3.4% of limit from BCMSW.	Third party stack test	1.2.6 1.8.5.4 2.7 4.1.1 4.2.1 4.2.3
PCP Treated Ties	SO2	Incineration	Flue gas	In-situ formation	Inhalation	High velocity, high elevation release	Third party stack test	1.8.3 4.1.1 4.2.1

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
PCP Treated Ties	TCP	Incineration	Flue gas	Incomplete combustion	Inhalation	Boiler controls ensure complete combustion	Boiler operating records	1.2.6 2.7 4.1.1 4.2.1
PCP Treated Ties	TRS	Incineration	Flue gas	Incomplete combustion	Inhalation	Boiler controls ensure complete combustion	Record of odour events and complaints	2.7
PCP Treated Ties	Metals	Incineration	Ash	System ash removal and disposal	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	3.1.1 3.1.8 4.1.4
PCP Treated Ties	PCDD/PCDF	Incineration	Ash	Precursor and de novo deposition with flyash.	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	1.2.6 3.1.1 3.1.8 3.1.9 4.2.4
PCP Treated Ties	PCP	Incineration	Ash	System ash removal and disposal	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	1.2.6 4.1.1 4.2.4
PCP Treated Ties	pH	Incineration	Ash	System ash removal and disposal	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	3.1.1 3.1.6 4.2.4
PCP Treated Ties	TCP	Incineration	Ash	System ash removal and disposal	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	3.1.1 4.2.4
Creosote Treated Ties	Fugitive Dust	Storage, Raw Material	Air	Material Handling	Inhalation	Dedicated storage area Low dust emissions from whole ties	Observable dust emissions	1.8.1.8 2.4.4

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
Creosote Treated Ties	Nuisance Odour	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	1.5.2 2.2 2.4.3
Creosote Treated Ties	PAH	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	2.2 2.4.3
Creosote Treated Ties	Petroleum Carrier	Storage, Raw Material	Air	Volatization and Fire	Inhalation Fire	Dedicated storage area Low volatization from used, whole RRT Fire suppression system	Observable odour Fire	1.5.3 2.2 2.4.3
Creosote Treated Ties	PAH & PAH Analogues including napthalene	Storage, Raw Material	Water	Leaching & Runoff	Water contamination	Dedicated storage area for whole RRT Limited leaching from used, whole RRT Stormwater Management Plan	Stormwater monitoring results	2.4.1 2.4.3
Creosote Treated Ties	Phenolics (Tar Acids)	Storage, Raw Material	Water	Leaching & Runoff	Water contamination	Dedicated storage area for whole RRT Limited leaching from used, whole RRT Stormwater Management Plan	Stormwater monitoring results	2.4.1 2.4.3
Creosote Treated Ties	Tar Bases (N-containing compounds)	Storage, Raw Material	Water	Leaching & Runoff	Water contamination	Dedicated storage area for whole RRT Limited leaching from used, whole RRT Stormwater Management Plan	Stormwater monitoring results	2.4.1 2.4.3
Creosote Treated Ties	Fugitive Dust	Shredding	Air	Material Handling	Inhalation	Engineered dust control measures at shredder	Visible dust emissions, accumulation of dust buildup	1.8.1.8 2.5

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
Creosote Treated Ties	Nuisance Odour	Shredding	Air	Volatization and Fire	Inhalation Fire	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	2.4.3 2.5.3
Creosote Treated Ties	Petroleum Carrier	Shredding	Air	Volatization and Fire	Inhalation Fire	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	2.4.3 2.5.3
Creosote Treated Ties	PAH	Shredding	Air	Volatization and Fire	Inhalation Fire	Similar systems were visited by Atlantic Power staff and no issues with off-gassing were apparent. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected.	Industrial Hygiene surveys to assess employee exposure Occurrence of fire	2.4.3 2.5.3
Creosote Treated Ties	PAH & PAH Analogues including napthalene	Shredding	Water	Leaching & Runoff	Water contamination	Shredding system will be protected from precipitation.	Leakage of liquids from the shredding system.	1.5.3 2.4.1
Creosote Treated Ties	Phenolics (Tar Acids)	Shredding	Water	Leaching & Runoff	Water contamination	Shredding system will be protected from precipitation.	Leakage of liquids from the shredding system.	2.4.1

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
Creosote Treated Ties	Tar Bases (N-containing compounds)	Shredding	Water	Leaching & Runoff	Water contamination	Shredding system will be protected from precipitation.	Leakage of liquids from the shredding system.	2.4.1
Creosote Treated Ties	Fugitive Dust	Shredded Material Storage	Air	Material Handling	Inhalation	Dust control measures at shredder, enclosed storage of shredded ties.	Observable dust at shredder	1.8.1.8
Creosote Treated Ties	Nuisance Odour	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Shredded RRT will be stored in an enclosed bin. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system	Observed odour in the area of the storage bin. Occurrence of fire	1.8.1.8 2.2 2.4.3
Creosote Treated Ties	PAH	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Shredded RRT will be stored in an enclosed bin. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system	Observed odour in the area of the storage bin. Occurrence of fire	2.2 2.4.3
Creosote Treated Ties	Phenolics (Tar Acids)	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Shredded RRT will be stored in an enclosed bin. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are not expected. Fire suppression system	Observed odour in the area of the storage bin. Occurrence of fire	2.2 2.4.3
Creosote Treated Ties	Petroleum Carrier	Shredded Material Storage	Air	Volatization and Fire	Inhalation Fire	Shredded RRT will be stored in an enclosed bin. Due to the highly weathered nature of the RRT, high concentrations of gaseous compounds are	Observed odour in the area of the storage bin. Occurrence of fire	2.2 2.4.3

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
						not expected. Fire suppression system		
Creosote Treated Ties	HCl and other acid gases	Incineration	Flue gas	In-situ formation	Inhalation Acidification of soil	High velocity, high elevation release	Third party stack test	4.1.1 4.2.1
Creosote Treated Ties	NOx	Incineration	Flue gas	In-situ formation	Inhalation	NOx emissions were not impacted by 100% RRT.	Continuous emission monitor	1.8.4 2.7 4.1.1
Creosote Treated Ties	PAH	Incineration	Flue gas	Incomplete combustion	Inhalation	PAH emissions were not impacted by 100% RRT.	Third party stack test	2.7 4.1.1
Creosote Treated Ties	Particulate Matter	Incineration	Flue gas	Incomplete combustion	Inhalation	The electrostatic precipitator results in low particulate emissions. Particulate emissions were lower when 100% RRT.	Continuous opacity monitor Third party stack testing	1.8.2.1 4.1.1
Creosote Treated Ties	PCDD/PCDF	Incineration	Flue gas	Pass through, precursor and de novo formation.	Inhalation Bioaccumulation	Boiler operating conditions result in efficient destruction of PCDD/PCDF. Combined emissions from pass through and denovo formation are 3.4% of limit from BCMSW.	Third party stack test	1.8.5.4 2.7 4.1.1 4.2.1 4.2.3
Creosote Treated Ties	SO2	Incineration	Flue gas	In-situ formation	Inhalation Acidification of soil	High velocity, high elevation release	Third party stack test	1.8.3 4.1.1 4.2.1

Source Path Receptor - Atlantic Power Renewal Project

Source	Contaminant of concern	Activity	Path	Mechanism	Risk	Mitigation Method	Metric of Performance	TAR Main Reference
Creosote Treated Ties	TRS	Incineration	Flue gas	Incomplete combustion	Inhalation Nuisance	Boiler controls ensure complete combustion	Record of odour events and complaints	2.7
Creosote Treated Ties	Metals	Incineration	Ash	System ash removal and disposal	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	3.1.1 3.1.8 4.2.4
Creosote Treated Ties	PCDD/PCDF	Incineration	Ash	Precursor and de novo deposition with flyash.	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	3.1.1 3.1.8 3.1.9 4.2.3
Creosote Treated Ties	pH	Incineration	Ash	System ash removal and disposal	Water contamination	Ash deposits will be covered to prevent infiltration and leaching.	Landfill inspections Leachate analysis	3.1.1 3.1.6 4.2.4 5.6.1
Pentachlorophenol Treated Ties								
PCP=Pentachlorophenol								
TCP=Tetrachlorophenol								
TRCP=Trichlorophenol								
PCDD/PCDF=Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans								
Creosote Treated Ties								
PAH=Polyaromatic Hydrocarbons								
TRS=Total Reduced Sulphur Compounds								
BCMSW= BG Guideline for Emissions from Municipal Solid Waste Combustion								

APPENDIX 7

RWDI – Best Achievable Technology Study

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Atlantic Power Corporation
Williams Lake Power Plant
Williams Lake, British Columbia

Final Report

Best Achievable Technology Study
RWDI #1500355
May 17, 2016

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EXECUTIVE SUMMARY

The Williams Lake Power Plant (WLPP) is a biomass-fired generating facility located at Williams Lake, British Columbia. The biomass consumed at WLPP currently consists of wood waste from sawmill operations. WLPP consumed rail ties up to 4% of the total annual fuel supply between 2004-2010, and the current air permit allows up to 5%. WLPP is proposing to supplement the wood waste fuel with shredded rail ties to compensate for reduced wood waste supplies. Atlantic Power Corporation (Atlantic Power) retained RWDI AIR Inc. (RWDI) to complete a best achievable technology (BAT) study for acid gas emissions (SO_2, HCl, and NOx) from the power plant to inform an upcoming Ministry of the Environments (MOE) Permit 8808 amendment request to increase the amount of rail ties allowed for use as fuel at WLPP up to 50%. On an annual basis, WLPP is expected to use approximately 25% rail ties which would result in lower SO_2 and HCl emissions from the plant than what was analyzed herein. The plant is also expected to only operate 75% of the year, but may operate 50% of the year further reducing annual emissions of pollutants.

Maximum predicted 1-hour SO_2 and NO_2 and 24-hour HCl concentrations from WLPP did not exceed the B.C. AAQOs. Although a BAT study is not required as there were no exceedances of the AAQOs predicted, B.C. MOE has requested a BAT study for WLPP.

As both wet scrubbing and dry scrubbing can achieve control efficiencies that reduce SO_2 and HCl, both systems are possibilities for treating the flue gas from WLPP; however, the water demand of the wet system is not ideal at a location where water is limited such as the City of Williams Lake. Dry scrubbing offers lower cost and avoids the additional water use, and it will be the highest ranked system for WLPP. With respect to NO_2 controls, SCR generally provides a higher level of control, but is also significantly more expensive than SNCR.

From a cost perspective, and in consideration of water restrictions, the best ranked add-on control system is that provided by Vendor B, which includes an integrated dry scrubber and SCR unit. While SNCR is identified as the more cost effective option if only NO2 were considered, the integrated nature of this system does mitigate the cost differential.

The best ranked add-on system costs are far above the cost of removal for these emissions from other sources. Given that, then the recommended BAT for WLPP is emission control limits. The requested permit amendment seeks an increase of the amount of rail ties allowed for use as fuel at WLPP up to 50% from 5%. The 50% limit would ensure the potential acid gas emissions do not exceed the quantities evaluated herein. The current WLPP air permit includes a NO_x emission limit which will remain in place. The MOE could consider adding an SO_2 stack emissions limit to the revised permit to further ensure that the SO_2 emissions are at or below the quantities evaluated herein.

TABLE OF CONTENTS

Tables

Figures

1. INTRODUCTION

The Williams Lake Power Plant (WLPP) is a 66 MW biomass-fired generating facility located at Williams Lake, in south central British Columbia (B.C.). The biomass consumed at WLPP currently consists of wood waste from sawmill operations. WLPP consumed rail ties at a rate of up to 4% of the total annual fuel supply between 2004 and 2010, and the current air permit allows up to 5%. WLPP is proposing to supplement the wood waste fuel with shredded rail ties to compensate for reduced wood waste supplies. RWDI completed an air dispersion modelling study in 2015 of changes in the emissions from the power plant due to the inclusion of rail ties in the fuel mix, to inform an upcoming Ministry of the Environments (MOE) Permit 8808 amendment request to increase the amount of rail ties allowed to be used as fuel at WLPP up to 50%.

The contaminants of interest in the air dispersion modelling study were those identified during a 2001 stack testing program at WLPP, with the power plant combusting 100% rail ties. Emissions for particulate matter (TPM), sulphur dioxide (SO_2), hydrogen chloride (HCl), dioxins and furans, PAHs, and metals (Pb, Sb, Cu, Mn, V, Zn, As, Cr, Co, Ni, Se, Te, Ti, Cd and Hg) were measured during that test. PM_{10} and $PM_{2.5}$ values were derived from the TPM measurements using published emission factors. Oxides of nitrogen (NOx) values were obtained from the permanently installed Continuous Emissions Monitoring (CEMs) system, and dispersion modelling results for NO_x were converted to nitrogen dioxide (NO_2) using the ozone limiting method as recommended by the *Guidelines for Air Dispersion Modelling in British Columbia* (B.C. MOE 2008). The emission levels measured during the 2001 test were below the project's air permit limits, and the particulate and NOx emissions did not change significantly with the rail tie test. The RWDI air dispersion modelling study evaluated 100% rail ties and 50% rail ties (the permit request basis).

Although a BAT study is not required as there were no exceedances of the AAQOs predicted, B.C. MOE has requested a BAT study for WLPP.

1.1 Scope

This report is a best achievable technology (BAT) review of available acid gas control technology (SO_2, HCl and NO_2, specifically). The intent of this review is to assess the general suitability of each technology to the site conditions and to performance expectation criteria, as requested by B.C. MOE for WLPP. The BC MOE Fact Sheet (January 2012) for BAT assessments includes 6 steps, each of which will be addressed in this report:

1. Identify all technologies.
2. Eliminate technically infeasible options.
3. Evaluate the reliability of each option in terms of the probability that the technology will operate according to its specifications.
4. Rank options by control effectiveness in terms of relative discharge intensity.
5. Rank cost effectiveness of each option in terms of dollars per unit of emission reduction.
6. Recommend which option is the BAT.

The SO_2 and HCl control systems reviewed in this study are:

- Wet scrubbing; and
- Dry scrubbing.

NO_2 control systems reviewed in this study include:

- Non-selective catalytic reduction; and
- Selective catalytic reduction.

These are the standard technologies used in the electric power industry for control of these emissions.

This review describes the advantages and disadvantages of each system, acid gases reduction efficiency and order-of-magnitude capital and operating costs, and is presented to Atlantic Power Corporation for their consideration.

Air Quality Summary:

The impacts of emissions from WLPP were assessed using an air dispersion modelling study conducted over a 25 km by 25 km study area surrounding the facility using CALPUFF 6.42 driven with three-dimensional meteorological files developed using the CALMET pre-processor. This is a recommended approach under the *Guidelines for Air Dispersion Modelling in British Columbia* (British Columbia Ministry of Environment [B.C. MOE] 2008) for studies of this type.

CALPUFF predicted concentrations at and beyond the plant property line were compared to existing B.C. ambient air quality objectives (AAQOs). Predicted concentrations of those contaminants without relevant B.C. objectives were compared to Ontario ambient air quality criteria (AAQC) to provide a context of potential impacts. To provide a more refined prediction, the OLM NO_x to NO_2 conversion was calculated using the hour by hour ozone concentration from the Columneetza station, which is a more refined and more rigorous method of estimating the resulting NO_2 concentrations.

Maximum predicted 1-hour SO_2 and NO_2 and 24-hour HCl concentrations from WLPP did not exceed the B.C. AAQOs, as presented in **Table 1**. Implementation of BAT will not change the conclusion that WLPP is not expected to cause exceedances of B.C. AAQOs.

Table 1: Modelling Results (April 12, 2016 Update) of Contaminants with B.C. AAQOs with Background Concentrations for 50% RRTs

Contaminant	Averaging Period	Maximum Predicted Concentration (µg/m³)	Background Concentration (µg/m³)	Predicted + Background Concentration (µg/m³)	Air Quality Objective (µg/m³)
Sulphur Dioxide	1 Hour	93.7	--	93.7	200
Nitrogen Dioxide	1 Hour	85.2	63.9	149	188
Hydrogen Chloride	24 Hour	11.8	--	11.8	20 [1]

Note: [1] Based on Ontario Ambient Air Quality Criteria
Source: B.C. Ministry of Environment, 2016**.** Ontario Ministry of the Environment, 2012.

Based on a range of expected future operations between 75% and 50% of the year, the range of expected annual emissions is provided below.

Table 2: Emission Rate Estimates for Various Rail Tie Firing Rates and Operating Scenarios

Contaminant	Hourly Emission Rate Firing 100% Rail Ties (g/s)	Annual Emission Rate Firing 50% Rail Ties	
		75% Operations (tonnes/a)	50% Operations (tonnes/a)
Sulphur Dioxide	22.6	267.3	178.2
Oxides of Nitrogen	24.8	586.6	391.0
Hydrogen Chloride	7.8	92.4	61.6

2. PROCESS DESCRIPTION

WLPP is a biomass-fueled electricity generation station with maximum energy output of 72 MW gross. Electricity is generated through steam generation and turbine operation using a Babcock and Wilcox boiler.

The biomass consumed at WLPP currently consists of approximately 450,000 tonnes of wood waste from sawmill operations, but the plant has a capacity to burn up to approximately 600,000 tonnes. WLPP consumed rail ties at a rate of up to 4% of the total annual fuel supply between 2004 and 2010, and the current air permit allows up to 5%. WLPP is proposing to supplement the wood waste fuel with shredded rail ties by up to 50% to compensate for reduced wood waste supplies, resulting in changes in the emissions from the power plant due to the inclusion of rail ties in the fuel mix. Future operations are expected to range between 50% and 75% of the year (450,000 tonnes per year).

Combustion of the wood waste fuel generates flue gas containing particulate matter (TPM, PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), hydrogen chloride (HCl), oxides of nitrogen (NO_X), dioxins and furans, PAHs, and metals (Pb, Sb, Cu, Mn, V, Zn, As, Cr, Co, Ni, Se, Te, Ti, Cd and Hg). The flue gases are first treated by multicyclones, then through an electrostatic precipitator (ESP) to remove particulate matter prior to discharge through a stack.

Stack testing results from 2001 have been provided by Atlantic Power for the WLPP. Dispersion modeling based on pollutant loading from the stack testing showed an increase in SO_2 and HCl concentrations at and beyond the plant property line. There was no significant change in NO_x emissions. Control technologies are evaluated in the following sections for SO_2, HCl and NO_x emissions mitigation, per the MOE request.

2.1 Plant Location

WLPP is located three kilometres north-northwest of the City of Williams Lake, B.C. The City of Williams Lake distributes potable water to residents and business through five deep wells at the west end of Williams Lake (The City of Williams Lake, 2016a). Concerns for water shortage in the city has led to water conservation efforts including Bylaw 1792 which restricts lawn sprinkling (The City of Williams Lake, 2016b). Control technologies were reviewed with consideration for the limited availability of water in the area.

The City of Williams Lake has a sewage treatment facility that processes five million litres per day on average. Wastewater that enters the sewage treatment facility undergoes primary and secondary treatment before discharge into the Fraser River (The City of Williams Lake, 2011).

3. IDENTIFICATION OF CONTROL TECHNOLOGIES

Sulfur dioxide and hydrogen chloride control technologies were reviewed and a brief technical overview is provided for each technology.

3.1 Sulphur Dioxide and Hydrogen Chloride

3.1.1 Wet Scrubbing

Wet scrubbing encompasses several different technologies, all of which contact contaminant-laden flue-gas with an alkaline sorbent and water slurry in a counter-current, vertically-oriented spray, tray or packed tower.

All wet scrubbing systems create a cooler, fully saturated flue gas, which may potentially cause corrosion problems inside the stack and associated duct-work. Lining of existing stacks and ductwork or construction of new, corrosion resistant stacks and duct-work is required. Reheating the flue gas downstream of the flue gas desulfurization (FGD) unit is normally employed to minimize the visible plume, and to enhance dispersion characteristics of the plume by increasing the buoyancy of the flue gas. Flue gas reheat is not used to control the corrosiveness of the flue gas, and is not a recommended option unless issues with plume visibility and plume rise are a concern (Singer, J.G., 1991).

The majority of wet scrubbing systems are limestone forced oxidation (LSFO) systems. LSFO scrubbers are applicable to high sulphur fuels, and deliver control efficiencies in excess of 95% (Srivastava, R.K., 2000). These systems introduce air into the absorbent slurry to encourage controlled oxidation of the reaction products to calcium sulphate, in a location other than the absorber or piping system. The location of choice is normally the reaction tank or in an additional hold tank.

LSFO systems require compressors / blowers to introduce air into the absorbent slurry, which increases the overall cost of the system. Benefits of LSFO technology include formation of a stable and potentially marketable product (gypsum), and smaller dewatering equipment compared to a traditional natural oxidation system (MikroPul Filters, 2001).

An alternative to wet-limestone FGD systems, ammonia scrubbing provides similar scrubbing efficiency and applications as more traditional wet-scrubbing systems, but provides an alternate solution for effluent treatment. Key benefits of ammonia scrubbing are the applicability to high sulphur fuels, removal efficiency of greater than 95%, and production of an aqueous solution of ammonium sulphate, which can be processed to make fertilizer (MikroPul Filters, 2001).

An additional benefit is the increased removal of acid gasses such as sulphur trioxide and hydrogen chloride. Also, ammonia FGD systems show improved removal of sulphuric acid mist, which is often emitted as a respirable fine particulate and may create a visible plume.

As will be shown later in this report, wet scrubbing is shown to be an economically ineffective means of controlling SO_2, and as such a detailed technical assessment of the technology and its suitability for WLPP was not undertaken. We are not aware of any small biomass plants retrofitted with a wet scrubber system.

3.1.2 Dry Scrubbing

Dry scrubbing encompasses four different technologies, each of which contact combustion gases with an alkaline sorbent to produce a dry waste product. The dry waste product is similar to fly ash from a coal-fired boiler, and must be collected through a particulate control device. Two dry scrubbing technologies that are applicable to WLPP include duct sorbent injection (DSI) and the furnace sorbent injection process (FSI).

3.1.2.1 Duct Sorbent Injection (DSI)

Duct sorbent injection systems achieve SO_2 and HCl removal through injection of alkaline sorbents, such as hydrated lime or sodium bicarbonate, into the hot flue gas downstream of the boiler. DSI systems are applicable to WLPP, with published SO_2 and HCl removal efficiencies 80% (IEA Clean Coal Centre, 2010a). The primary benefits of DSI systems is the reduced capital cost stemming from the absence of an absorber vessel and associated auxiliary systems such as pumps and reaction vessels, and less water consumption than wet scrubbers.

The driving mechanism for DSI systems is dry sorption, although some units employ a separate water spray either upstream or downstream of the sorbent injection point to humidify the flue gas and enhance SO_2 removal. The position of the water injection is optimized to increase the interaction between sorbent particles and water droplets. The use of pulverized limestone as the sorbent in DSI systems necessitates a bag-house for particle removal which would be economically ineffective for WLPP given the units existing high efficiency electrostatic precipitator (ESP) (Srivastava, R.K., 2000).

3.1.2.2 Furnace Sorbent Injection (FSI)

Furnace sorbent injection systems remove SO_2 by injecting dry calcium carbonate directly into the furnace in the region above the flame. Control efficiencies for this process range from 25% to 50%, but information on applicability is limited due to the low number of installations of this technology (MikroPul Filters, 2001).

In FSI systems, the sorbent particles are exposed to temperatures in excess of 1,000ºC, which causes decomposition of the sorbent particles into porous solids, increasing the available surface area for reactions to take place. SO_2 reacts to form calcium sulphate, which is carried out of the furnace with the flue-gas, along with any un-reacted sorbent particles (MikroPul Filters, 2001). These particles are collected in a bag-house, which further enhances control efficiency, as in DSI systems (Davis, W.T., 2000). Again, the use of a bag-house for particle removal would be economically ineffective for WLPP given the units existing high efficiency.

Additional options for this process include humidification of the flue gas to improve reagent utilization, and ex-situ reactivation and re-injection of spent sorbent. The re-injection of sorbent occurs downstream of the boiler and air pre-heater and can be considered a hybrid of DSI and FSI techniques (MikroPul Filters, 2001).

As will be shown later in this report, dry scrubbing is shown to be an economically ineffective means of controlling SO_2, and as such a detailed technical assessment of the technology and its suitability for WLPP was not undertaken.

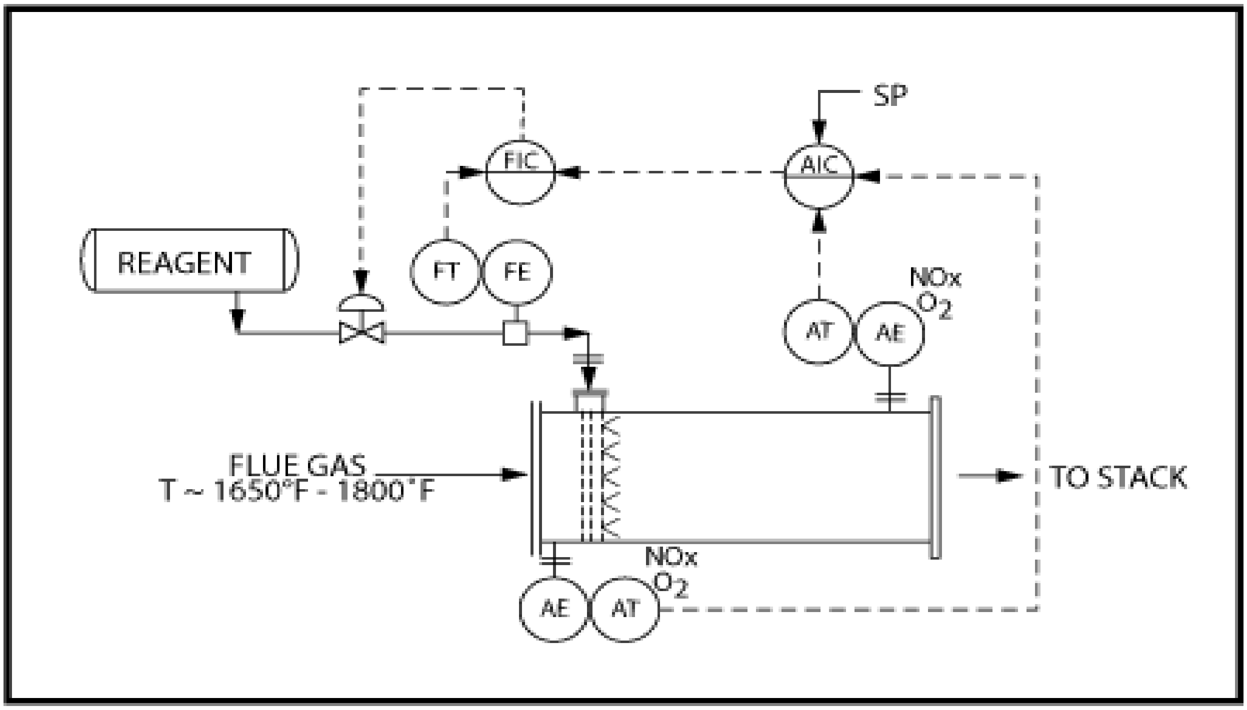
3.2 Nitrogen Dioxide

Nitrogen dioxide control technologies were reviewed and a brief technical overview is provided for each technology.

3.2.1 Selective Non-Catalytic Reduction (SNCR)

Selective Non-Catalytic Reduction technologies control NO_2 emissions through injection of a reagent, commonly ammonia or urea, into the flue gas in the boiler to react with NO_2 to form nitrogen, carbon dioxide and water (IEA Clean Coal Centre, 2010b). A simple process flow diagram of a SNCR is shown in **Figure 1**. Ammonia and urea molar ratio to NO_X ranges between 1.0-1.5 and 0.5-0.75, respectively (Process Combustion Corporation, 2014). Typical control efficiencies range between 30% and 50%, (US EPA, 2002).

Figure 1: Selective Non-Catalytic Reduction Process Flow



Source: Process Combustion Corporation 2014.

Optimal operating temperatures in SNCR technologies range between 870^oC and 1,200^oC for effective reaction between NO_2 and the reagent (Process Combustion Corporation, 2014). Control efficiencies decrease as temperature increase above 1,000^oC due to decomposition of ammonia. Control efficiencies may also drop due to ammonia slip where the NO_2 reaction with ammonia is incomplete or passes through SNCR unreacted when temperature is below 1,000^oC (IEA Clean Coal Centre, 2010b). Ammonia slip may cause formation of ammonium sulfates which can plug or corrode downstream components, cause ammonia absorption into fly ash which may affect disposal or reuse of the ash, or increase plume visibility (US EPA, 2003a). Urea can be used in place of ammonia as a reagent at lower molar ratio; however, nitrous oxide (N_2O) is generated at greater amounts compared to ammonia based SNCR, at up to 10% of the NO_X reduced.

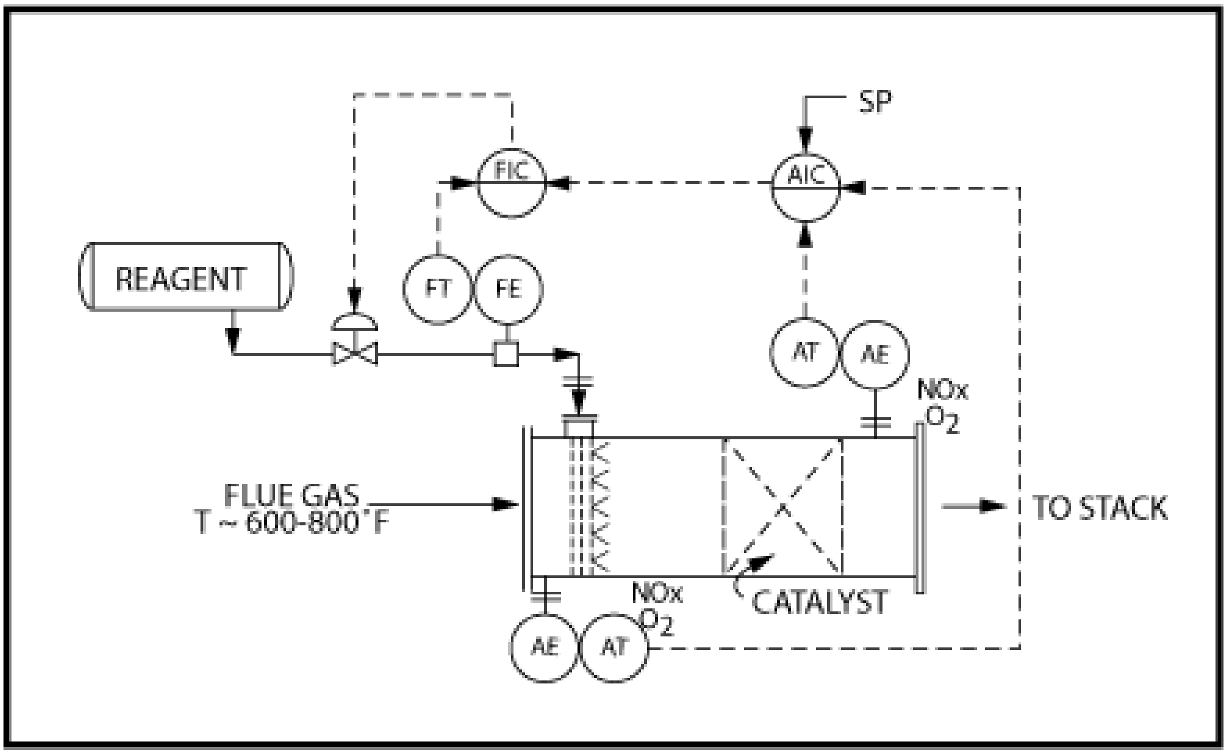
Enhancers or additives can be added to the reagent to reduce the temperature needed for the reaction to occur. A minimum residence time of 0.3 second is needed to achieve moderate SNCR effectiveness, but residence times greater than one second is ideal (IEA Clean Coal Centre, 2010b). SNCR is most effective at NO_2 loading of 200 ppm to 400 ppm (US EPA, 2003a).

As will be shown later in this report, SNCR is shown to be an economically ineffective means of controlling NOx, and as such a detailed technical assessment of the technology and its suitability for WLPP was not undertaken.

3.2.2 Selective Catalytic Reduction (SCR)

Selective Catalytic Reduction technologies remove NO_2 by injecting an alkaline reagent into the flue gas and passing the reagent-flue gas mixture through a catalyst bed. A simple process flow diagram of a SCR is shown in **Figure 2**. Ammonia is the most common reagent used in SCR at an ammonia/NO_X ratio between 0.8-1.2, less than that of SNCR technologies (Process Combustion Corporation, 2014). The chemical reactions are similar to SNRC, generating nitrogen, carbon dioxide and water. SCR can reduce NO_2 loading as low as 20 ppm with greater than 70% control efficiency (US EPA, 2003b).

Figure 2: Selective Catalytic Reduction Process Flow



Source: Process Combustion Corporation 2014.

The temperature in a SCR reactor is controlled through the mixture of the flue gas exiting the economizer and economizer bypass flue gas. In contrast to SNRC, the catalyst reduces the operational temperature range to between 165^{o}C and 600^{o}C, with the optimal range between 300^{o}C and 400^{o}C (Process Combustion Corporation, 2014) (IEA Clean Coal Centre, 2010c). Ammonia slip may occur when operating temperatures are below the optimal range. Ammonia is injected at sufficient distance upstream of the catalyst to ensure the flue gas and reagent are thoroughly mixed. Catalyst geometry can range widely depending on the process design, but may be arranged as flat plates, honeycombs or modular tubes. The catalyst can have different compositions based on the boiler fuel type, the flue gas and the process design (IEA Clean Coal Centre, 2010c). Common catalysts used are composed of titanium, zeolite, vanadium, iron or activated carbon. Typical catalyst life is between three to five years (Process Combustion Corporation, 2014).

The use of biomass fuel represents a unique challenge to the designers of SCR catalysts since the useful life of the SCR catalyst can be significantly reduced relative to coal or natural gas fuels. In some cases, complete catalyst deactivation can occur within several thousand hours of operation. This can avoided by firing lower rates of biomass (e.g., 20% or less) which is not possible at WLPP, or through special design considerations, such as operation of the SCR at low temperatures and removal of poisoning species prior to the SCR unit. Careful selection of catalyst is also paramount (Haldor Topsoe, 2010).

As will be shown later in this report, SCR is shown to be an economically ineffective means of controlling NOx, and as such a detailed technical assessment of the technology and its suitability for WLPP was not undertaken.

Sections 3 and 4 provide a description of the technologies and estimated control effectiveness. The technologies will be ranked based on cost factors in Section 5. These sections complete Steps 3 and 4. As noted, a detailed evaluation of the reliability of each option in terms of the probability that the technology will operate according to its specifications was not undertaken due to the economic ineffectiveness.

4. APPLICABILITY TO WILLIAMS LAKE POWER PLANT

Current wet and dry scrubbing technologies are reported to achieve greater than 90% control of SO_2 and HCl, although few, if any, installations are for units as small as WLPP and for biomass units.

With respect to NO_2, both SNCR and SCR technologies are capable of control efficiencies of 65-90%.

Information specific to WLPP is available from two vendors that requested to remain anonymous for pricing confidentiality purposes. For this report, the two vendors will be addressed as Vendor A and Vendor B. The Vendor A system is a wet scrubber and SNCR system, while the Vendor B system is a dry scrubber system with integrated SCR. The systems suggested by both vendors considered the flue gas composition, flue gas flow rates and the current WLPP design. However, detailed engineering has not been completed and as such, the effectiveness of the control systems would need to be further reviewed, as well as the site specific costs to modify the existing equipment to integrate any new equipment. Neither vendor identified similar installations to WLPP (size, fuel type, retrofit application, and boiler technology) with the exception of Vendor A for an SCR system. As noted in Section 4.1.2 an SCR system was installed at a biomass facility in Quebec, however no details are available regarding the rationale for the SCR system.

Limited space for equipment location, access for construction, and access for labor would be significant factors for any retrofit installations at WLPP. Generally, older units of smaller generating capacity will incur high costs due to limited access (as well as penalties due to economies-of-scale).

Wet/dry scrubbing and SNCR/SCR process equipment demands can include water, auxiliary power, steam, and compressed air. The availability of these consumables at an existing facility is constrained, and additional infrastructure to supply and distribute these consumables may be necessary. A major cost can be the requirement to provide new power distribution infrastructure including transformers, switchgear and/or “motor control centers”. The performance of the unit is also degraded if additional auxiliary electric or steam demands increase.

The retrofit of environmental controls will change the chemical composition and temperatures of the flue gas. These changes would need to be studied in detail to assess the suitability of these controls at WLPP. The cost estimates and control effectiveness estimates used in the economic analysis are assumed to be best case, and a more detailed analysis would raise the installation costs, increase the performance penalties to the unit, and lower control effectiveness.

The retrofit of environmental controls will also change the static pressure within the ductwork, which may require upgrades to fans, new fan motors, upgraded electrical systems, and strengthening of ductwork, ESPs, and boiler walls. The upgrade and strengthening of ductwork and boiler walls is necessary to prevent collapse or implosion.

For wet scrubbers, the need to treat process discharge water varies depending on permitted limits.

4.1 Wet Scrubber with SCR or SNCR (Vendor A)

4.1.1 Wet Scrubber

The Vendor A system utilizes a spray tower wet scrubber with counter-current flow of the flue gas and sorbent. The tower contains several spray zones, allowing absorption by utilizing recirculated alkaline liquid at the flue gas inlet. With this design, the system is able to remove up to 95% of SO_2 and HCl, according to the vendor's proposal. An effectiveness of 90% was assumed to be the basis for a commercial guarantee. The spray tower would be between 11.3 metres and 16.2 metres tall and diameter of 6.2 metres. The system would require up to 462 kW of electricity and 300 litres of water per minute.

The proposed stack parameters and existing WLPP stack parameters are presented in **Table 3**. In comparison to existing conditions, the proposed flow rate would provide less vertical plume momentum and stack exit temperature would provide less plume buoyancy that promotes dispersion. The lower stack height would also result in less dispersion of pollutants in the plume. Although the wet scrubber is claimed to have SO_2 and HCl control efficiency of up to 95%, the reduced potential of the WLPP exhaust to disperse would result in less than 95% reduction in ground-level ambient concentrations. In addition, predicted ambient concentrations of SO_2, HCl and NO_2 show there were no exceedances of ambient air quality objectives with no wet scrubbers and SNCR system installed. Reduction of SO_2, HCl and NO_2 emissions by 95% would reduce concentrations, but are not necessary to meet the AAQOs.

Table 3: Stack Parameters Comparison

Stack	Stack Height (m)	Inner Diameter (m)	Exit Temperature (^{o}C)	Exit Flow Rate (m^3/s)
WLPP Existing Stack	60.7	3.5	143	110
Vendor A Wet Scrubber	50.6	3.4	64.3	93.6

The system designed by Vendor A is estimated at a cost of $6,000,000 for 70% removal efficiency and $6,450,000 for 95% removal efficiency for the vendor's equipment supply only. The cost does not include support structures, commissioning and training, and other auxiliary equipment which may potentially be an additional $5,700,000 based on the 95% control option, for a total of $12,150,000. Installation is estimated at 75% of the total equipment cost, adding $9,112,500 for a total of $21,262,500. The cost of operation and maintenance is partly dependent on sorbent cost and disposal, as well as auxiliary power, but an overall annual O&M factor of 10% of the capital cost is assumed, adding $2,126,250 in annual costs. Thus, assuming a conservative interest estimate of 8%, the annualized cost over 10 years is $5,294,990. Note: all costs in this report are US$.

If the costs are distributed equally between SO_2 and HCl reduction, the costs of removal are therefore approximately:

- $10,500/tonne-$SO_2$ (assuming 95% removal); and
- $30,200/tonne-HCl (assuming 95% removal).

4.1.2 Selective Catalytic Reduction System

Vendor A proposed two possible options for NO_2 control. The first option listed here is an SNRC technology is designed for 65% control efficiency using ammonia as the reagent. Aqueous ammonia (19.5 wt.%) average consumption was estimated at approximately 480 litres per hour. The capital cost is estimated at $3,150,000 for only the vendor's equipment. Vendor A has specific experience with the type of boiler unit at WLPP, and has installed similar equipment at a facility in Quebec that also uses rail ties as a fuel source. No issues have been reported regarding the performance of the system.

Support structures, commissioning and training, and other auxiliary equipment are estimated at $5,700,000, for a total of $9,900,000. Installation is estimated at 75% of the total equipment cost, adding $7,425,000 for a total of $17,325,000. The cost of operation and maintenance is partly dependent on reagent cost and disposal, as well as auxiliary power, but an overall annual O&M factor of 10% of the capital cost is assumed. Thus, assuming a conservative interest estimate of 8%, the annualized cost over 10 years is $4,314,436.

The costs of NO_2 removal are therefore approximately $8,200/tonne-$NO_2$ (assuming 90% removal).

4.1.3 Selective Non-Catalytic Reduction System

Vendor A also proposed an SNCR for NO_2 control. The SNRC technology is designed for 65% control efficiency using ammonia as the sorbent. The capital cost is estimated at $700,000. No specific examples of biomass applications were provided for this option.

Support structures, commissioning and training, and other auxiliary equipment are estimated at $1,400,000, for a total of $2,100,000. Installation is estimated at 75% of the total equipment cost, adding $1,050,000 for a total of $3,150,000. The cost of operation and maintenance is partly dependent on reagent cost and disposal, as well as auxiliary power, and the estimated annual operating cost is $902,000. Thus, assuming a conservative interest estimate of 8%, the annualized cost over 10 years is $1,371,000.

The costs of NO_2 removal are therefore approximately $3,598/tonne-$NO_2$ (assuming 65% removal).

4.2 Dry Scrubber and Integrated SCR System (Vendor B)

The Vendor B uses DSI technology with a ceramic catalyst filter system to first remove SO_2 and HCl. Dry calcium or sodium-based sorbents are injected in the duct upstream of the filters to remove SO_2 and HCl. The reaction between the sorbent and SO_2 and HCl create solid particles captured on the filters along with unreacted sorbent and flue gas particulates. The vendor guarantees typical removal of 75% for SO_2, HCl and NO_2, but the system can achieve up to 95% control of SO_2 and NO_2, and 99% control of HCl if necessary. The vendor has indicated that they provide boiler MACT compliance for biomass and wood-fired units, although a specific listing of installed units was not provided.

Included in the design is NO_2 control through SCR technology. The catalytic ceramic filters developed by Vendor B are manufactured with nano-catalysts embedded in the walls of the filters. The nano-catalysts are protected from blinding from catalyst poisons such as SO_2 and HCl by the filter material, extending catalyst life by at least 5 years. NO_2 control efficiency in excess of 90% is quoted for this system. Stack parameters were not provided by Vendor B for comparison with the existing WLPP stack for dispersion comparison. Similar to the system presented by Vendor A, reduction of SO_2, HCl and NO_2 emissions by 75% would reduce concentrations, but are not necessary to meet the AAQOs as dispersion modeling showed no predicted exceedances.

Based on discussion with Vendor B, capital cost of the system is expected to be at least $11,249,885 for the vendor’s equipment supply alone.

Support structures, commissioning and training, and other auxiliary equipment are estimated to be similar to that of the wet scrubber option ($5,700,000), for a total of $16,949,885. Installation is estimated to be lower however, as Vendor B provides a modular system. Installation is estimated at 30% of the total equipment cost, adding $5,084,966 for a total of $22,034,851. The cost of operation and maintenance is partly dependent on reagent cost and disposal, as well as auxiliary power, but an overall annual O&M factor of 10% of the capital cost is assumed. Thus, assuming a conservative interest estimate of 8%, the annualized cost over 10 years is $5,487,328.

If the costs are distributed equally between SO_2, HCl and NO_2 reduction, the costs of removal are therefore approximately:

The costs of SO_2, HCl and NO_2 removal are approximately:

- $9,200/tonne-$SO_2$ (assuming 75% removal);
- $26,500/tonne-HCl (assuming 75% removal); and
- $4,200/tonne-$NO_2$ (assuming 75% removal).

5. COMPARISON OF OPTIONS

As both wet scrubbing and dry scrubbing can achieve control efficiencies that reduce SO_2 and HCl, both systems are possibilities for treating the flue gas from WLPP; however, the water demand of the system is not ideal at a location where water is limited such as the City of Williams Lake. Dry scrubbing offers a lower cost and avoids the additional water use, and it will be the highest ranked system for WLPP. With respect to NO_2 controls, SCR generally provides a higher level of control, but is also significantly more expensive than SNCR. If a high level of control is not critical, the SNCR is generally the better option.

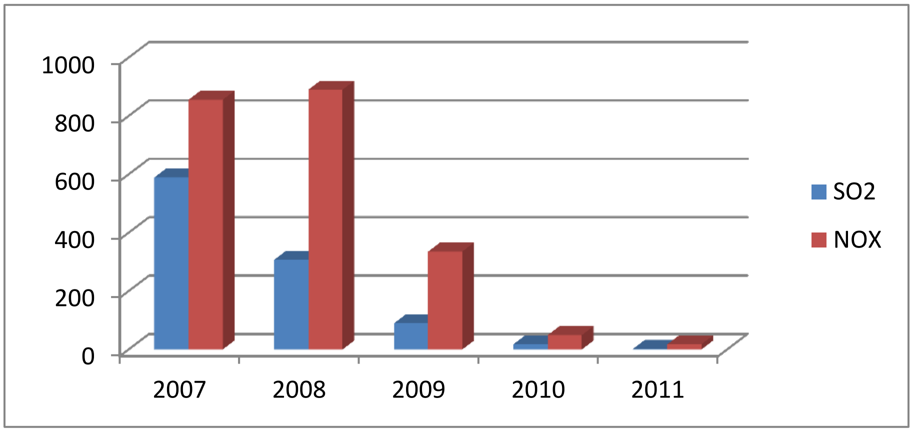
From a cost perspective, and in consideration of water restrictions, the best ranked add-on control costs are those provided by Vendor B, which includes an integrated SCR unit. While SNCR is identified as the more cost effective option, the integrated nature of this equipment does mitigate the cost differential. Thus, the costs per tonne for the best ranked option are below:

- $9,200/tonne-$SO_2$;
- $26,500/tonne-HCl; and
- $4,200/tonne-$NO_2$.

Each of these costs would increase by approximately 30% if the plant operates at 50% of the year instead of 75%, the low and high end of the range of future expected operations. These costs are far above the cost of removal for these emissions from other sources. The following graph is based on data provided by the U.S. Energy Information Administration (EIA, 2012), and shows the allowance prices which are used as a proxy for removal costs. Recent pricing is very low, but even the highest costs per tonne of pollutant removed over the past 10 years are well below the removal costs for WLPP.

Given that add-on controls at WLPP are not cost effective compared to other sources of these emissions, then the recommended BAT for WLPP is emission control limits. The requested permit amendment seeks an increase of the amount of rail ties allowed for use as fuel at WLPP up to 50% from 5%. The 50% limit would ensure the potential acid gas emissions do not exceed the quantities evaluated herein. The current WLPP air permit includes a NOx emission limit which will remain in place. The MOE could consider adding an SO_2 stack emissions limit to the revised permit to further ensure that the SO_2 emissions are at or below the quantities evaluated herein.

Figure 3: SO_X and NO_X Emissions Allowance Prices ($US per tonne)



6. CONCLUSIONS AND RECOMMENDATIONS

RWDI completed a BAT analysis including a review of $SO_{2,}$ HCl and NO_2 control technologies available to WLPP. The separate dispersion modeling study of the WLPP predicted no exceedance of B.C. ambient air quality objectives; however, the BAT review was requested by B.C. MOE.

Dispersion modelling conducted for WLPP showed the plant is able to achieve compliance of the B.C. AAQOs based on using 50% rail ties and operating at full capacity. Implementation of control technology systems are not required in order to maintain compliance with B.C. AAQOs.

Based on the review of SO_2 and HCl control technologies, wet scrubbing will cause a greater demand for water in the City of Williams Lake when the scrubber is operational. Given the lower cost of dry scrubbing technology and to be aligned with the city's water conservation efforts and eliminate wet system needs such as pumps, dry scrubbing is the best ranked of the add-on controls for WLPP.

The best ranked add-on system costs are far above the cost of removal for these emissions from other sources. Given that, the recommended BAT for WLPP is emission control limits. The requested permit amendment seeks an increase of the amount of rail ties allowed for use as fuel at WLPP up to 50% from 5%. The 50% limit would ensure the potential acid gas emissions do not exceed the quantities evaluated herein. The current WLPP air permit includes a NO_x emission limit which will remain in place. The MOE could consider adding an SO_2 stack emissions limit to the revised permit to further ensure that the SO_2 emissions are at or below the quantities evaluated herein.

7. REFERENCES

B.C. MOE. 2008. *Guidelines for Air Quality Dispersion Modelling in British Columbia*, Environmental Protection Division, Environmental Quality Branch, Air Protection Section. Victoria, British Columbia. March 2008.

B.C. MOE. 2016. British Columbia Ambient Air Quality Objectives.

CCME (Canadian Council of Ministers of the Environment). 1999. *Canadian National Ambient Air Quality Objectives: Process and Status.* 8 pp.

The City of Williams Lake. 2011. *The City of Williams Lake Official Community Plan, Chapter 8 – Infrastructure and Municipal Services*. 8 pp.

The City of Williams Lake. 2016a. *2015 Drinking Water Quality Annual Report – Final Report.* The City of Williams Lake. March 2016.

The City of Williams Lake. 2016b. *Water Conservation.* Website: http://www.williamslake.ca/274/Water-Conservation. Accessed: April 2016.

Davis, W.T., 2000. *Air Pollution Engineering Manual, Second Edition.* Air & Waste Management Association, John Wiley & Sons, Inc., Toronto.

Haldor Topsoe, 2010. *SCR DeNOx catalyst considerations when using biomass in power generation*. Presented at Power Plant Air Pollutant Control "MEGA" Symposium, Washington DC, USA, 2010.

IEA Clean Coal Centre. 2010a. *Sorbent Injection Systems for SO_2 Control*. Website: http://www.iea-coal.org.uk/site/ieacoal/databases/ccts/sorbent-injection-systems-for-so2-control. Accessed: April 2016.

IEA Clean Coal Centre. 2010b. *Selective non-catalytic reduction (SNCR) for NOx control*. Website: http://www.iea-coal.org.uk/site/ieacoal/databases/ccts/selective-non-catalytic-reduction-sncr-for-nox-control. Accessed: April 2016.

IEA Clean Coal Centre. 2010c. *Selective catalytic reduction (SCR) for NOx control*. Website: http://www.iea-coal.org.uk/site/ieacoal/databases/ccts/selective-catalytic-reduction-scr-for-nox-control. Accessed: April 2016.

MikroPul Filters. 2001. Personal communication.

Ontario Ministry of the Environment. 2012. *Summary of Standards and Guidelines to support Ontario Regulation 419/05 – Air Pollution – Local Air Quality.* Standards Development Branch, Ontario Ministry of the Environment. April 2012.

Process Combustion Corporation. 2014. *Post-Combustion NOx Reduction… SNCR or SCR?.* Website: http://www.pcc-sterling.com/products/thermal-oxidizers/scr-sncr/. Accessed: April 2016.

Singer, J.G., 1991. *Combustion Fossil Power, Fourth Edition*.

Srivastava, R.K., 2000. *Controlling SO_2 Emissions: A Review Of Technologies (EPA/600/R-00/093)*. National Risk Management Research Laboratory, US Environmental Protection Agency, Research Triangle Park, North Carolina.

US EIA , 2012. *Emissions allowance prices for SO_2 and NO_X remained low in 2011*. Website: http://www.eia.gov/todayinenergy/detail.cfm?id=4830. Accessed: May 11, 2016.

US EPA. 2002. *EPA Air Pollution Control Cost Manual, Section 4 Chapter 1. EPA 452/B-02-001.* 51 pp.

US EPA. 2003a. *Air Pollution Technology Fact Sheets - Selective Non-Catalytic Reduction*. 4 pp.

US EPA. 2003b. *Air Pollution Technology Fact Sheets - Selective Catalytic Reduction*. 5 pp.