Environmental Report
BC Works 2015

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1. About this report

This Annual Environmental Report is provided to meet the reporting requirements under the multi-media permit from the provincial government of British Columbia. It is submitted to the provincial government and made available to the public.

In 1999, Rio Tinto's BC Works became the first industrial facility in British Columbia to obtain a multi-media environmental permit from the provincial government.

The multi-media permit comprehensively addresses multiple emissions, effluents and solid waste, sets limits and establishes monitoring and reporting requirements and is a key regulatory compliance benchmark for smelter operations.

The permit provides guidelines for a results-oriented environmental management approach. BC Works combines the permit guidelines with other proactive strategies to facilitate vigilant compliance monitoring and regular communications with public and private stakeholders.

The multi-media permit mandates annual reporting to measure performance against established permit standards. In addition to the permit reporting for BC Works, a summary report for compliance of the Kemano Operations environmental permits is provided.

A year of transition

2015 was a historic year for the Kitimat Smelter that saw the shut-down of the old Vertical Söderberg Stud (VSS) smelting operations and the start-up of the Modernised AP4X pre-bake smelter. The ramp of aluminium production is expected to be completed in the first half of 2016.

2015 also saw the successful completion of the 2013 SO_2 permit amendment appeal. The BC Environmental Appeal Board (BCEAB) dismissed the Appeal, upholding the SO_2 Permit Amendment in full. The BCEAB provided nine non-binding recommendations to the BC Ministry of Environment for consideration and Rio Tinto will be reviewing the recommendations in 2016.

In 2015, BC Works reported 4 non-compliances. A discussion of the non-compliances, their impacts and Rio Tinto responses are highlighted in Chapter 11 of this report.

The 2015 Annual Environmental Report is available online at www.riotintobcoperations.com. The website also provides information on key environmental performance indicators. Questions or comments are welcome and may be made through the contact page on the website.

2. Operational overview

Rio Tinto operates a multi-faceted industrial complex in northern British Columbia, which is one of the largest in the province. The operational footprint includes the Kitimat smelter, the power house at Kemano and the Nechako reservoir.

On 1 December, 2011 Rio Tinto authorized the modernisation of the BC Works with a total investment of US $4.8 billion. In 2015, it was fully built and substantively commissioned. In March 2016, the last of the 384 pots were energised and the plant is expected to be in full operation in 2017. 2015 was also a historic transition year with the shutdown of the last VSS potroom and start-up of the new smelter. This transition period from old to new smelting technology has resulted in very low emissions loadings for 2015.

The main raw material used at the smelter is alumina ore; large volumes of which are imported from international suppliers and delivered by ship. Alumina is composed of bonded atoms of aluminium and oxygen. An electrolytic reduction process is used to break the bond and produce aluminium.

The electrolytic reduction process takes place in the potroom buildings. These buildings house specially designed steel structures called pots. The pots function as electrolytic cells. They contain a molten bath or electrolyte made up mainly of highly conductive cryolite bath in which alumina ore is dissolved. Electricity flows through the electrolyte from an anode to a cathode. The electricity breaks the aluminium-oxygen bond. The heavier aluminium molecules sink to the bottom of the pot in the form of molten aluminium. Oxygen is combined with carbon from the anode to form carbon dioxide.

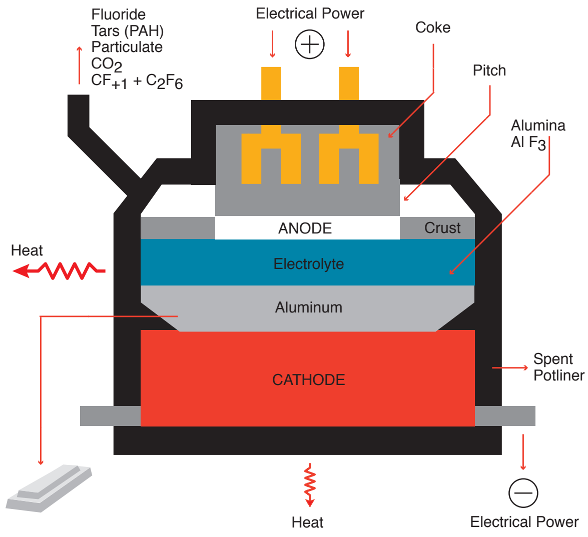
Our modernised smelter

The old VSS technology used a carbon anode that is baked in-situ. Electrical current was passed through the anode and into the molten bath to produce metallic aluminium (Figure 2.1). Fluoridised alumina ore was placed along the outer edge of the pot that would form a crust. This “sealed” the pot against a gas skirt where process gases were collected and taken to a dry scrubber to remove particulates and fluoride.

The new leading-edge AP40 technology in the modernised smelter.

The Söderberg technology from the old Kitimat smelter, which opened in 1954.

Figure 2.1 Aluminium manufacturing process of the APX technology.



The old process had significant fugitive emissions through inefficiencies of gas collection and also the emissions of the baking anode. On a scheduled routine basis, the crust would be broken to "feed" the pot alumina or tap the pot to remove the aluminium. Whenever the crust would be broken, fugitive emissions would be generated.

The new AP4X technology is a modern clean technology that is considered to be the best available technology for emission control. The AP4X technology uses anodes that are pre-baked in an anode baking furnace before they are used in the reduction process. This is how the modernised smelter is able to reduce polycyclic aromatic hydrocarbon emissions by 98 per cent. The new AP4X pots are under strong suction by a Gas Treatment Centre (GTC) that continuously draws process gas from each pot and filters the gas to remove particulates and fluorides. Each AP4X pot is enclosed by a series of hood cover plates that minimize the generation of fugitive emissions. Pot tending, feeding fresh aluminium and tapping metal from the pots are all done under strong gas collection from the GTC. Gaseous fluorides and particulates emissions will be reduced by 72 and 80 per cent, respectively, because of the gas collection and treatment system. The modernised smelter will reduce total air emissions discharge by 50 per cent. This overall reduction in air emissions is the difference between the contaminant loadings (PAH, fluoride, particulates, GHG & SO_2) produced by the old smelter annually and the forecasted loadings that will be generated by the new smelter.

Molten aluminium that is extracted from the pots is transported to the two casting centres (B & C) located within the smelter, where it is temporarily stored in holding furnaces. Various alloying materials (such as magnesium, copper, silicon and iron) are added to produce specific characteristics such as improved strength or corrosion resistance. The new "C" casthouse has a state-of-the-art water cooling and recycling system.

The aluminium is then poured into moulds and chilled with water, forming solid ingots of specified shapes and sizes. BC Works produces two types of ingots: value added sheet, and remelt ingots, which are sold to customers in North America and Asia resulting in a variety of end-use applications.

The smelter site also includes facilities that produce materials required for aluminium production including the on-site Anode Paste Plant, Anode Rodding Shop, Coke Calciner, Carbon Recycling and Anode Baking Furnace which produce materials used in the manufacturing and recycling of anodes. The new process also includes a bath recovery plant for the recycling of bath materials.

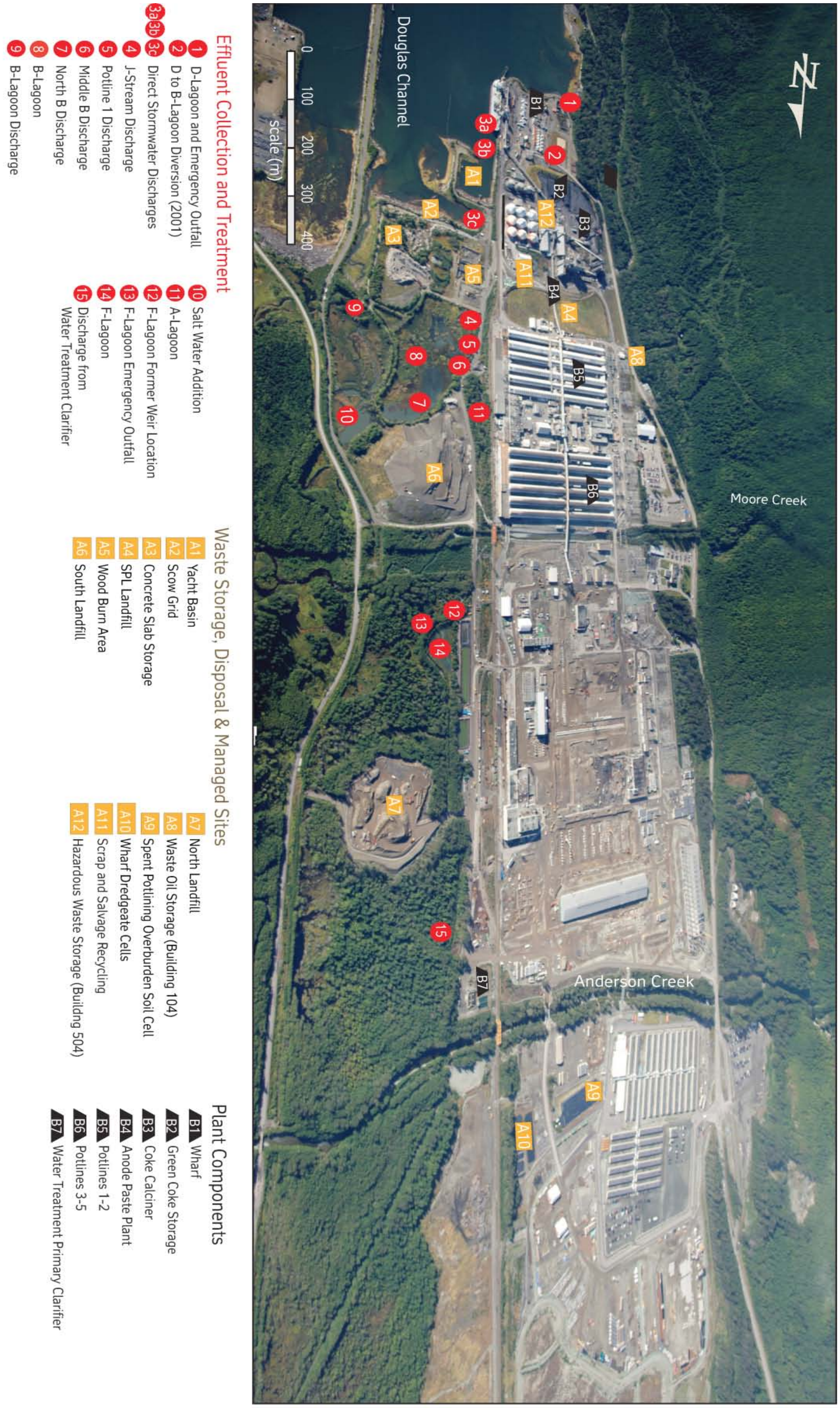
The electrolyte reduction process requires the use of large amounts of electricity. Electricity for BC Works is generated at the Kemano Operations' powerhouse, a 1,000 megawatt hydroelectric generating station located 75 kilometre southeast of Kitimat. This generating station uses water impounded in the 91,000 ha Nechako Reservoir in North-central British Columbia.

In addition to the process related facilities, there are a number of environmental facilities for waste management, stormwater management and managed sites. These environmental facilities are shown in Figure 2.2.

50%

The original smelter was challenged with environmental performance because of it's age and outdated technology. The modernised smelter will reduce total air emissions discharge by 50 per cent.

Figure 2.2
Kitimat
Environmental
operations.



3. Environmental management and certification

The foundation for environmental management throughout Rio Tinto's global operations is the Health, Safety and Environment (HSE) Policy. HSE directives establish corporate-wide standards on major environmental, health and safety topics.

The HSE Policy and the more specific requirements of the Rio Tinto Health, Safety, Environment and Quality (HSEQ) standards are put into practice at BC Works through a comprehensive, operation specific Risk Management System. The system is maintained through adherence to the HSEQ Management System's 17 elements encompassing the continuous improvement cycle of Plan, Do, Check and Review (PDCR).

Independent certification

Since 2001, BC Works' Risk Management System has been successfully certified under the demanding requirements of ISO 14001, an environmental program of the International Organization for Standardization (ISO). ISO 14001 provides independent verification that BC Works evaluates its environmental impacts, has procedures in place to address issues, and works continually to lighten its environmental footprint. In keeping with a corporate-wide commitment to a sustainable management approach, BC Works attains certification combining ISO 14001 standards (Environment) and the ISO 9001 standards (Product Quality). For Environment, this covers all Rio Tinto BC Works activities and locations where risks of our business are managed. For Quality, the scope is for the processes of manufacturing of aluminium ingot and shipping.

Audit program

Independent ISO compliance and conformance audits are conducted as a condition of certification. The internal and external Environment and Quality Management System surveillance audits took place in 2015 as planned. BC Works' integrated certification was successfully maintained.

Compliance with all environmental laws and regulations is the foundation of our environmental performance standards.

Health, Safety and Environment Policy – Aluminium

We care about people and the world we live in. We understand that effectively managing our HSE responsibilities is key to our long term success. That's why we are committed to Zero Harm by Choice. This entails preventing fatalities, injuries and illnesses while working proactively to protect the environment.




Our Health, Safety and Environment Policy

We strive to protect the environment and safeguard the health, safety and wellbeing not only of the people who work at our sites but of the communities in which we operate. We achieve this by continuously improving our HSE performance across the organisation, while complying with Rio Tinto HSE requirements and local HSE legislation.

AWARENESS: All our employees, contractors and other key stakeholders are aware of and understand the health, safety and environmental hazards and risks that affect our business and neighbouring communities.

- We openly communicate with our key stakeholders and ensure that our employees are actively involved in matters affecting our HSE performance.
- For all positions and functions, HSE roles and responsibilities are clearly defined within job descriptions and procedures, and our leaders ensure that appropriate resources are provided to improve performance and hold people accountable.

COMPETENCE: All our employees and contractors have the competencies to undertake their work safely while taking care of their health and minimising environmental impacts.

- We ensure that employees and contractors are knowledgeable about the HSE risks that affect their work, the safe practices to be followed and the controls to be applied. We expect them to stop their work whenever a risk cannot be adequately controlled.
- We have an effective HSE Management System in place that takes Human Performance into account, and we ensure that people are empowered to raise HSE concerns with management.
- Our leaders make sure that HSE issues are identified, assessed and managed. This includes assessing the risks associated with HSE workplace hazards and taking action to implement the required controls to avoid incidents.

COMPLIANCE: Our work activities comply with all legal and other HSE related requirements, and our employees are empowered to take action to minimise HSE risks.

- We adhere to Rio Tinto standards including "The way we work", HSEQ Management Systems and HSE performance standards.
- We report and investigate incidents and take corrective action to prevent their recurrence.
- We actively review and openly report on our HSE performance against published objectives and targets.
- We develop and communicate strategic action plans in line with Rio Tinto's HSE strategy to help us achieve these objectives and targets.
- We support and hold our contractors to the same HSE expectations and performance standards as our own employees.

EXCELLENCE: We are recognised for excellence in the way we manage HSE. We involve every employee in improving what we do in HSE.

- We learn from any mistakes and experiences related to major incidents so that we can prevent their recurrence.
- We encourage, develop, review and share HSE good practices both internally and externally
- Compliant with Rio Tinto HSE requirements, we continuously seek to minimise our environmental footprint by improving our energy efficiency and natural resource consumption as well as reducing, reusing and recycling materials to minimise waste and emissions.
- We also endeavour to protect biodiversity as well as identify and implement specific programmes to lower our greenhouse gas emissions.

Delivering our Health, Safety and Environment Policy by:

- Fostering a culture that does not tolerate threats to health, safety and the environment.
- Ensuring the real and active involvement of all employees and contractors.
- Holding our leaders accountable for improving HSE performance and providing the resources to do so.
- Supporting our teams with the right systems.

Alfredo Barrios, Chief executive, Aluminium
December 2014

4. Effluents

Surface runoff from the smelter site, originating as snowmelt and rain, accounts for most of the water discharge. Seasonal precipitation varies significantly and total discharges can be over 100,000 m^3 per day during fall and winter storms.

Sources and infrastructure

Whether water is in use at the smelter or accumulating through surface runoff, it collects contaminants from various sources. It is directed through underground drains and surface channels to one of six inflows into B-Lagoon that discharges into the Douglas Channel.

These six inflows into B-Lagoon are: F-Lagoon, D to B-Lagoon diversion, North B discharge, middle B discharge, Potline 1 discharge, and J-stream discharge (refer to effluent system and waste management map on Figure 2.2).

B-Lagoon consists of a primary and a secondary pond: Upper and Lower B-Lagoons. Designed to remove contaminants by sedimentation or settling and to smooth fluctuations of inflows and contaminant levels, B-Lagoon discharges effluent continuously into the Douglas Channel. In 2015, the average discharge rate was 32,000 m^3 per day.

The retention time for water in the lagoon is usually more than ten hours (confirmed by measurements conducted in 2005), but is reduced to about five hours during runoff events and heavy rainfall. Lagoon vegetation acts as an additional filter to reduce the impact of certain contaminants and is particularly effective during the summer months.

In addition to the B-Lagoon outfall, an emergency outfall accommodates significant inflow surges. F-Lagoon and D-Lagoon are also designed with emergency overflows in case of significant surge. In 2015, there were six overflow events at F-Lagoon and four overflow events at B-Lagoon, all within permit limits.

Discharge measurements related to permit requirements and additional monitoring are described below in the following 2015 performance section.

2015 performance

Effluent water quality monitoring

Effluent water quality is monitored annually for the following parameters: flow variability, dissolved fluoride, dissolved aluminium, TSS, cyanide, temperature, conductivity, hardness, toxicity, acidity and PAH. Of these parameters, dissolved fluoride, dissolved aluminium, and TSS are monitored for long term trends.

Flow variability

Variability in the flow from B-Lagoon into the Douglas Channel is mainly a function of precipitation. As shown in Figure 4.1, peak rain events and flows occurred in January to March and in September through December. The total amount of rainfall in 2015 (2,813 mm) was higher in 2015 comparing 2014 levels (2,665 mm).

Long-term trends

Dissolved fluoride, dissolved aluminium, and total suspended solids are the most meaningful performance indicators of plant effluent water quality. Average annual performance for these have been consistently maintained below permit levels (10 mg/L, 3 mg/L and 50 mg/L respectively) in recent years. Figure 4.2 illustrates the long-term trend performance.

In 2015 dissolved fluoride, dissolved aluminium and total suspended solids loads increased in comparison to 2014 and 2013 levels. Although there is an increase when compared to the previous few years the overall ten year trend is downward. The increase can most likely be attributed to the increased rainfall in 2015. Increase rainfall can mobilize materials more readily though the lagoon treatment system.

Dissolved fluoride

Dissolved fluoride originates mainly from the leaching of a landfill formerly used to dispose of spent pot lining. Information on the spent pot lining landfill is reported in Chapter 9, Groundwater monitoring. Other sources of fluoride are raw material losses and air emissions captured in runoff. The amount of precipitation and surface runoff can significantly influence the levels of dissolved fluoride.

Dissolved fluoride is monitored continuously through daily composite sampling and monthly grab sampling. Daily composite and grab samples are sent to an outside laboratory for analysis (refer to Chapter 12, Glossary for sample method definitions).

The permit specifies a maximum concentration of 10 mg/L of dissolved fluoride in effluent; this level was not exceeded in 2015. Average dissolved fluoride concentration for the year derived from composite sampling was 3.69 mg/L. This value is higher than in 2014. The long-term trend is illustrated in Figure 4.2. The 2015 composite and grab sampling results (Figure 4.3) profile the higher concentrations that occurred during the higher precipitation and surface run-off events during the year.

Dissolved aluminium

Aluminium metal at BC Works, such as finished products stored outside at the wharf, have a very low solubility and contribute little to the discharge of dissolved aluminium.

In addition to its use as a raw material, alumina is also used in the scrubbing process to remove fluoride from smelter emissions. Some scrubbed alumina is released through the potroom basements and roofs . In this form, scrubbed alumina has a higher solubility and is a contributor to both dissolved aluminium and dissolved fluoride.

B-Lagoon is a large and well-vegetated area that is highly efficient in absorbing and processing effluent compounds.

In 2015, concentrations of dissolved aluminium did not exceed the maximum permit limit of 3.0 mg/L. The annual average of dissolved aluminium concentration was 0.17 mg/L (Figure 4.4).

Total suspended solids (TSS)

Solids that remain suspended in discharge from B-Lagoon include small amounts of materials used in industrial processes at the smelter and other naturally occurring substances like dust, pollen and silt. There is a proportional relationship between TSS levels and concentrations of both dissolved aluminium and polycyclic aromatic hydrocarbons (PAHs) because these contaminants are usually bound to suspended solids in water when entering the B-Lagoon system.

B-Lagoon is a large and well-vegetated area that is highly efficient in absorbing and processing effluent compounds. The permit specifies a concentration maximum of 50 mg per litre of TSS in effluent. Concentrations in 2015 were much lower than the permit level. The annual average concentration for the composite samples was 2.7 mg/L (Figure 4.5) which is consistent with previous years.

> Studies conducted in B-Lagoon demonstrate that the addition of salt water to the effluent reduces toxicity by increasing conductivity and hardness levels.

Cyanide

Cyanide is formed during the electrolytic reduction process and retained in the cathode lining material known as spent pot lining (SPL). In the past, material in the cathode was deposited on-site at the SPL landfill. Today, all generated SPL is shipped off-site to a secure landfill. Groundwater and the bottom of the SPL landfill lining interact, generating a leachate containing cyanide. The source of the cyanide in B-Lagoon is from the J-Stream outlet.

The permit specifies a maximum concentration of 0.5 mg per litre of strong acid dissociable cyanide (the more abundant, although less toxic form) in B-Lagoon. Concentrations are determined from the monthly grab samples. The permit level was not exceeded in 2015. Weak acid dissociable cyanide is also monitored, although there is no permit requirement (Figure 4.6).

Temperature

Water used for cooling is the major source of effluent at BC Works. B-Lagoon is designed to retain effluent long enough to ensure water temperatures are not elevated when discharged. The permit requires that the temperature of the lagoon discharge does not exceed 30°C. Temperatures were within permit requirements during 2015 (Figure 4.7).

Conductivity, hardness, salt water addition and toxicity

Since 1997, salt water has been pumped into B-Lagoon at the connection between the primary and secondary ponds. As per permit requirements, the addition of salt water is monitored and managed to maintain non-toxic discharges.

In 2008, an independent consulting firm conducted a review to examine the correlation between seawater addition rates, conductivity, hardness, and toxicity. The review was in fulfillment of section 8.2.5 of the multi-media permit requirement. Results confirmed that the addition of sea water was successful at reducing the toxicity of the B-Lagoon effluent.

The data also confirmed the best way to predict toxicity is via aluminium concentration, conductivity and pH. Conductivity and hardness are monitored on a continuous and daily composite basis respectively, even though there are no permit limits for either parameter (Figure 4.8). These measures provide information that ensures the salt water addition system is contributing to the reduction of toxicity at the B-Lagoon outfall.

Water toxicity is determined through the application of a bioassay test. The toxicity of water discharged from B-Lagoon is tested by exposing juvenile rainbow trout to the effluent in a certified laboratory under controlled conditions (96LC50 bioassay test). The permit requires quarterly monitoring with a survival rate of at least 50 per cent for trout tested. All effluent discharge bioassay tests at B-Lagoon passed during 2015.

Acidity

A variety of contaminants can influence the acidity of effluent, by either increasing or decreasing the pH levels. A pH level of 7.0 is neutral, and water sources found adjacent to BC Works (Anderson Creek and the Kitimat River) usually have a pH level slightly below neutral (i.e. acidic, rather than alkaline).

Acidity is monitored using a variety of methods (continuous, daily composite and monthly grab samples). Daily composite samples are provided to an external laboratory for analysis. The permit requires that the pH of the effluent is maintained between 6.0 and 8.5. The 2015 annual pH composite sample average was 7.4. All sample measurements were within the permit limits during 2015 (Figure 4.9).

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are a large family of chemical compounds (more than 4,000 have been identified) generated by the incomplete combustion of organic material.

Various operations at the smelter generate PAH in both particulate and gaseous forms. PAHs originate in discharges primarily from the VSS potroom roof dust captured in precipitation and surface runoff. Other sources include raw materials (green coke and pitch) handling.

PAHs are monitored using two methods: weekly analysis of composite and monthly grab samples. PAHs are also analysed from grab samples taken during special events. B-Lagoon discharges are monitored and analysed for 15 of the most common PAH compounds, although there are no permit levels for PAHs in effluent (Figure 4.10).

Figure 4.1
Flow variability, B-Lagoon 2015

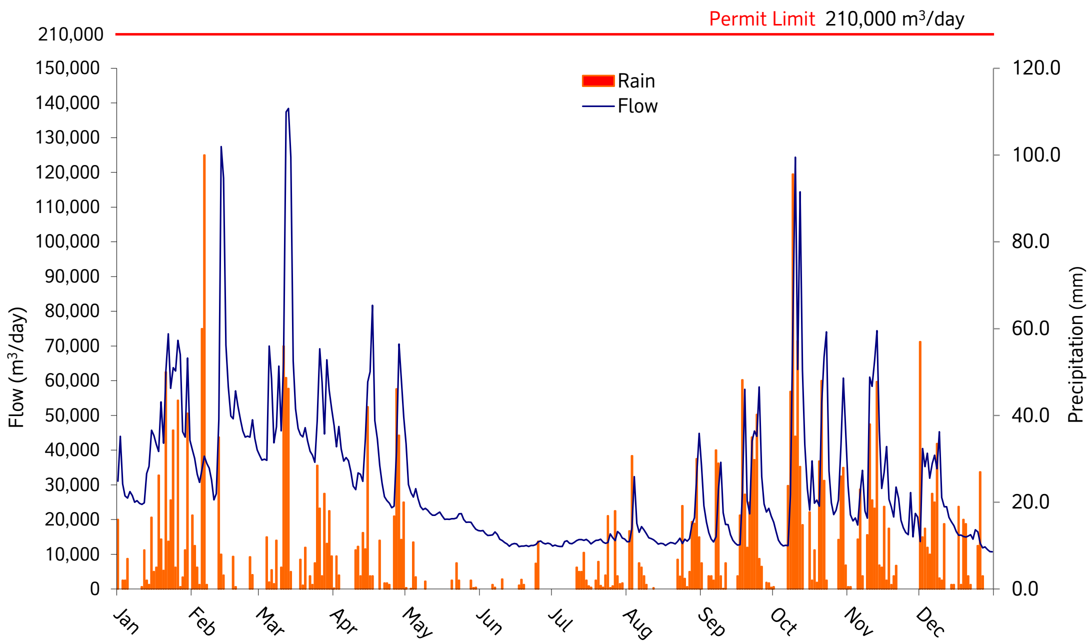


Figure 4.2
Dissolved Fluoride, Dissolved Aluminium and Total Suspended Solids, B-lagoon 2015

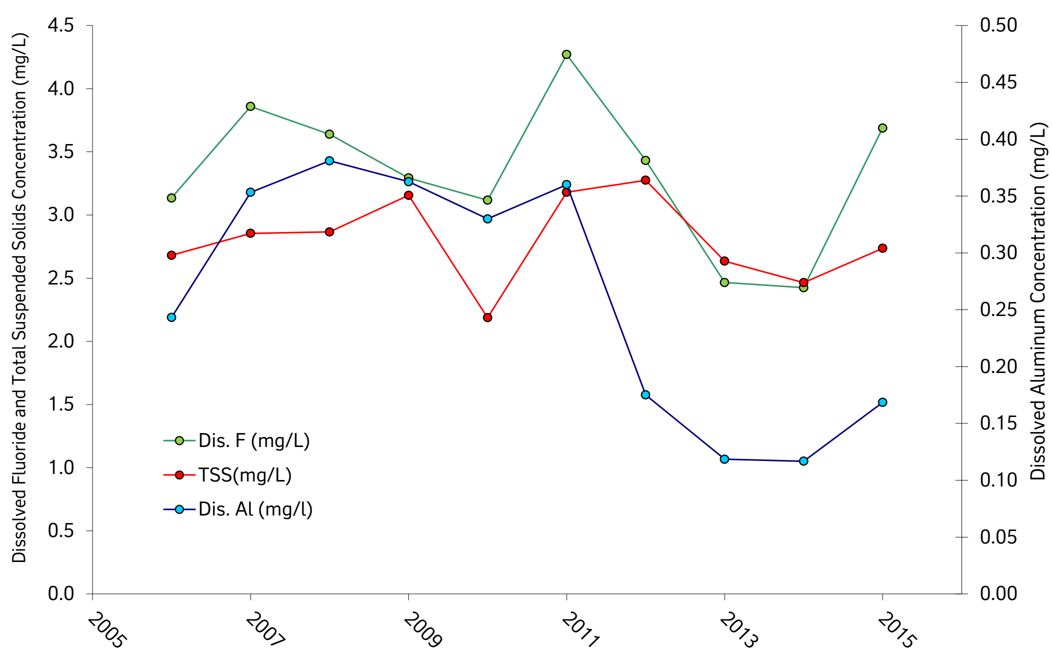


Figure 4.3 Dissolved fluoride, B-lagoon 2015

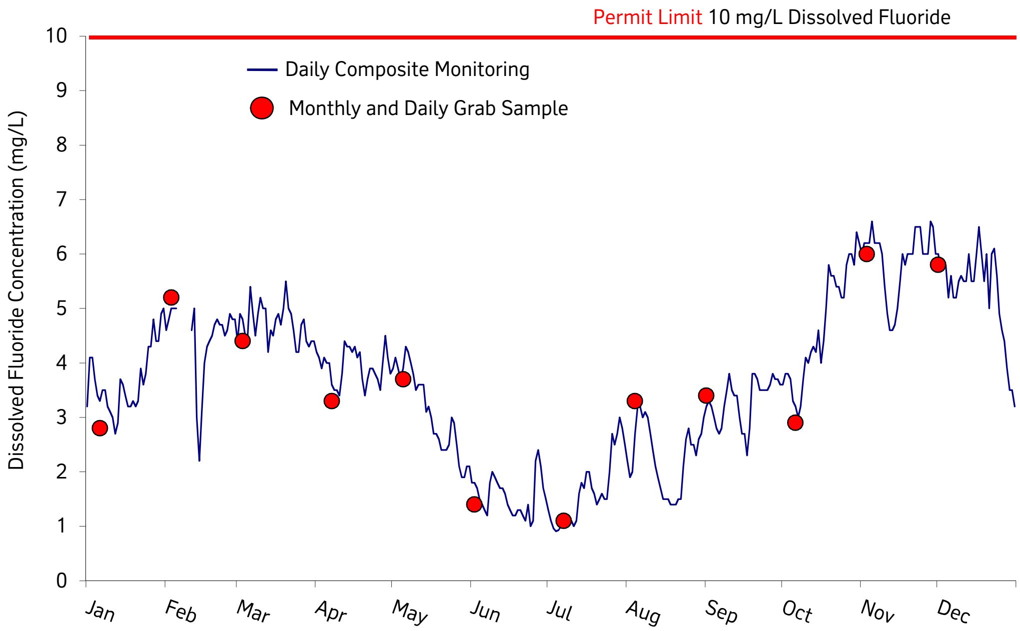


Figure 4.4 Dissolved Aluminium, B-lagoon 2015

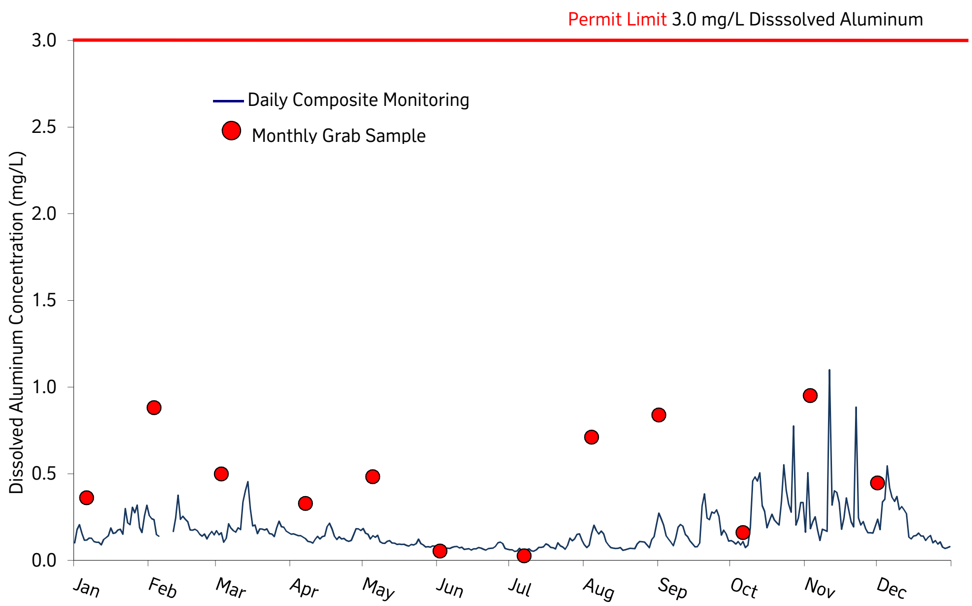


Figure 4.5 Total Suspended solids, B-lagoon 2015

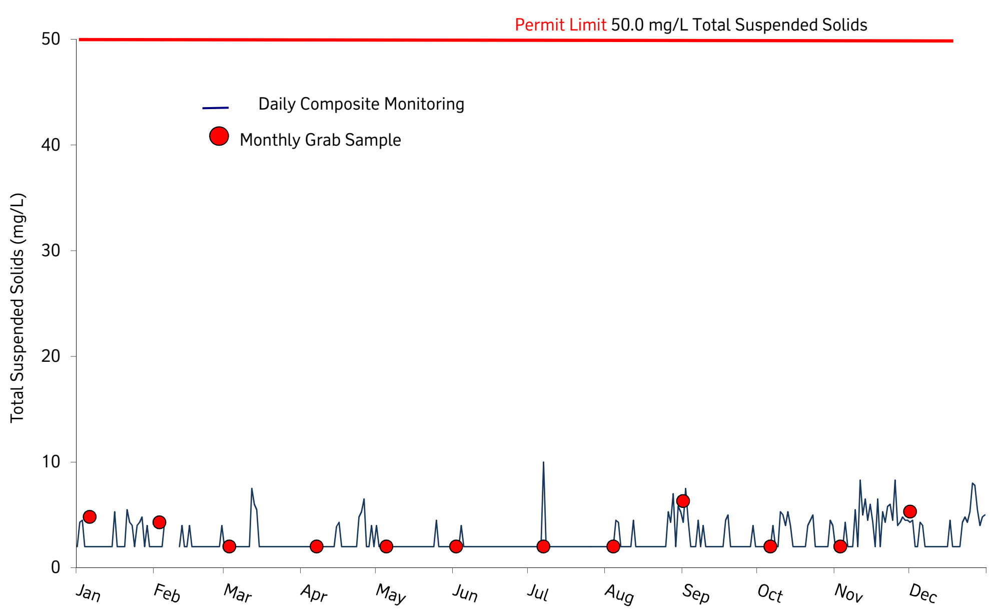


Figure 4.6
Cyanide, B-lagoon 2015

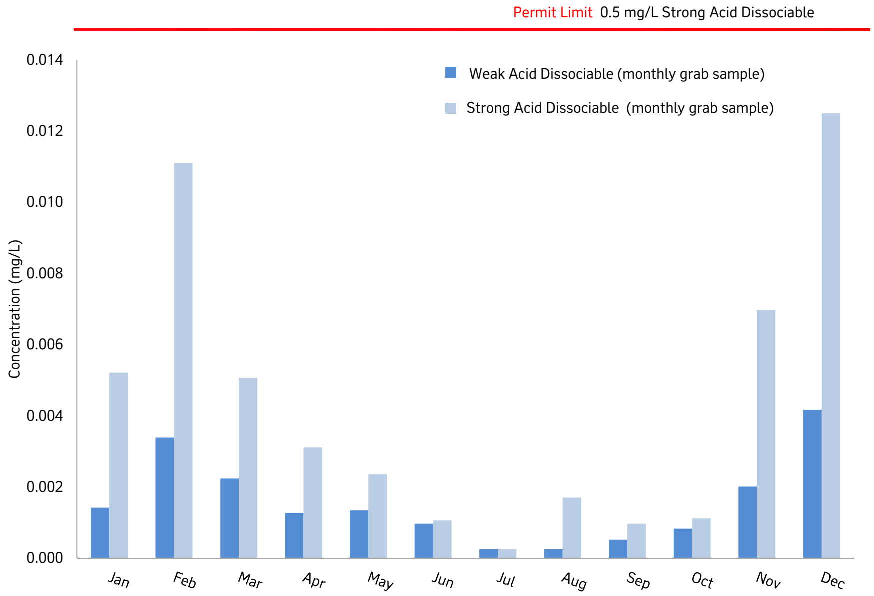


Figure 4.7
Temperature B-lagoon 2015

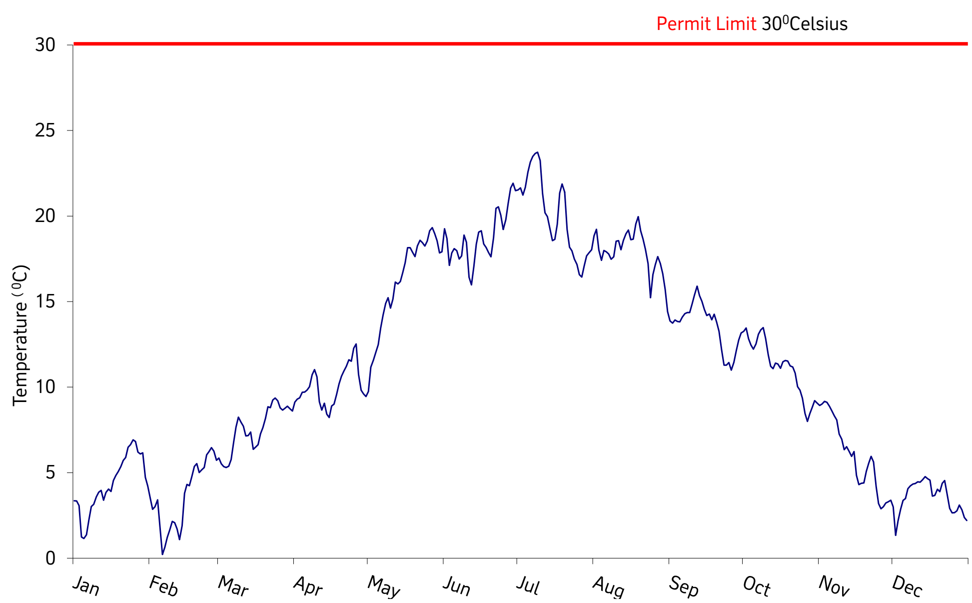


Figure 4.8
Conductivity and hardness, B-lagoon 2015

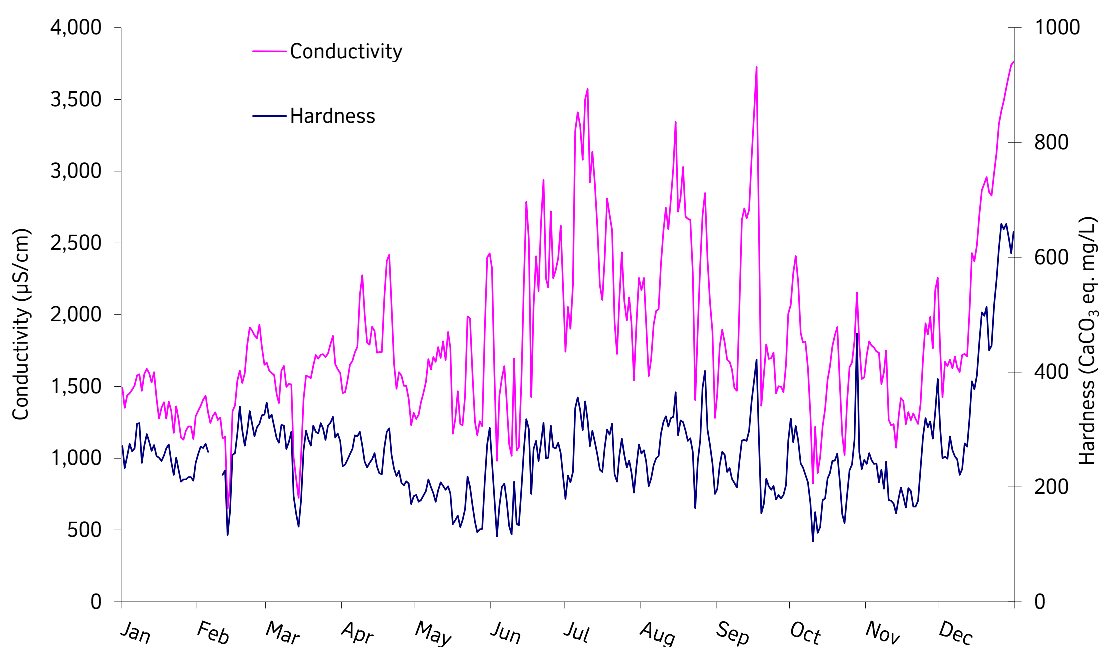


Figure 4.9
Acidity, B-lagoon 2015

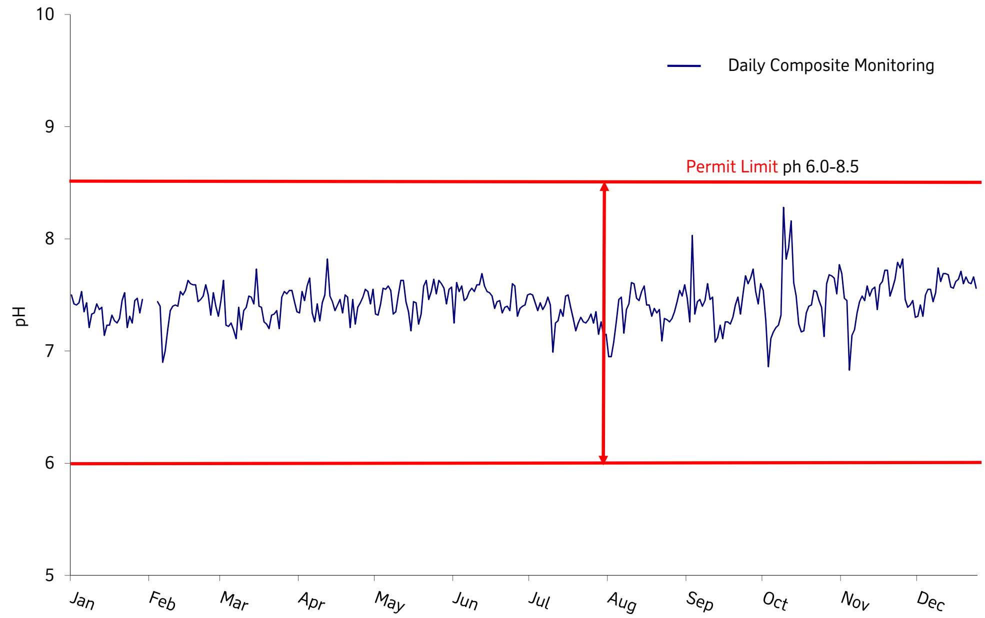
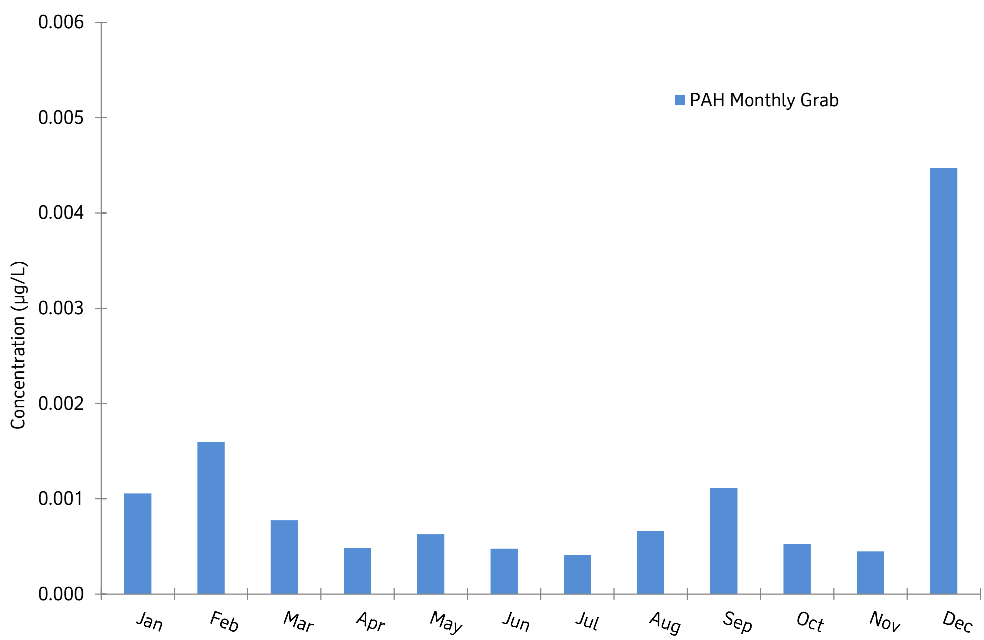


Figure 4.10
Polycyclic Aromatic Hydrocarbons, B-lagoon 2015



5. Emissions

This chapter describes the results of ongoing monitoring of various gaseous and particulate-matter in air emissions from BC Works. Performance results relate to type and source of emissions.

Emission types

The primary types of emissions monitored are gaseous fluoride (Fg), sulphur dioxide (SO_2), polycyclic aromatic hydrocarbons (PAHs), nitrogen oxides (NOx), total particulates, and greenhouse gases (GHGs). This chapter mainly focuses on the old smelter emissions as the new smelter will not be fully operational until 2016.

As per the permit requirements for the AP4X smelter, the compliance monitoring for the pre-bake emission points will start gradually in 2016.

Sources

Major sources of air emissions at BC Works include the potroom roofs and scrubbers, the Calcined Coke Plant, the Anode Paste Plant, and exhaust stacks. Wind-blown or nuisance dust (picked up from raw material storage piles, process ventilation systems and during raw material transportation) is another contributor to air emissions.

Pollution control equipment, situated at various locations in and around BC Works, includes the potroom dry scrubbers, the coke calciner pyroscrubber and the Anode Paste Plant dust collectors. Air emissions are collected and processed via these pieces of equipment to remove airborne pollutants.

Air quality monitoring

In addition to monitoring emissions, regular and extensive air quality and vegetation monitoring is conducted in the Kitimat valley. Information on these monitoring programs is detailed in Chapters 6 and 7.

2015 performance

Gaseous fluoride (Fg)

Three major sources contribute to fluoride emissions: the molten bath reduction process; coke and pitch density and quality; and alumina ore density, size and quality. Fluoride emissions were monitored at roof top locations on potroom lines 2A, 3B, and 4B (refer to the yellow dots on the potroom roof sampling locations on Figure 5.1). The last of the Soderberg technology was shutdown in October 2015.

The first pot of the modern AP4X prebake smelter began producing metal in June 2015. Since then more pots have been started sequentially. Compliance monitoring and reporting of the roof emissions (fluoride and particulate) will start in September 2016 when the process has stabilized.

The molten bath dissolves the alumina ore by an electrolytic reduction process through which aluminium is produced. The bath is composed primarily of sodium fluoride and aluminium fluoride and is the main source of fluoride emissions at BC Works. In the Soderberg process more than 80 per cent of fluoride emissions were collected and recycled back into the process, but some escapes did occur due to process upsets. The modern AP4X technology has strong gas suction and hoods on the pots, so the collection of emissions and recycling of emissions back into the process is much improved. Gas collection efficiency for the new smelter is greater than 98 per cent.

The gaseous fluoride emissions rate is tracked internally and showed an increase in 2015 compared to 2014 (Figure 5.2). This increase was due to the progressive closure of the old smelter and consequently, a lower aluminium production in 2015.

In preparation for the potlines idling, in 2008 the gaseous fluoride permit limit (including both potroom and dry scrubber emissions) was set by the Ministry at 50 tonnes of gaseous fluoride loading per month and replaced the rate measurement of gaseous fluoride per tonne of aluminium. The annual average fluoride emissions loading during 2015 was 11.6 tonnes gaseous fluoride per month compared to 24.3 tonnes gaseous fluoride per month in 2014.

This 52 per cent reduction in net fluoride emission loading is associated with the idling of Lines 2, 3 and 4. During 2015, there were no loading monthly exceedances of the gaseous fluoride emissions limit (Figure 5.3).

Gaseous fluoride is known to have negative impacts on the health of vegetation. The routine annual vegetation survey found the levels of fluoride in vegetation adjacent to the plant site were slightly higher than 2014 (refer to Chapter 7).

52%

The annual average fluoride emissions loading during 2015 was 11.6 tonnes gaseous fluoride per month compared to 24.3 tonnes gaseous fluoride per month in 2014, a 52 per cent reduction overall. This reduction was due to the progressive closure of the old smelter.

Sulphur dioxide (SO_2)

Sources of sulphur dioxide at BC Works include green coke and coal tar pitch. Both are raw materials used to manufacture anodes. Coke calcination is a process used to change green coke into a usable form. Sulphur dioxide emissions occur during calcination, baking of the anodes at the Anode Baking Furnace and the electrolytic reduction process through which aluminium is produced.

From 1993 to 1999, the permitted sulphur dioxide emission was set at 20.7 tonnes per day on an annual average. In 2000 the permitted sulphur dioxide emission was set at 27 tonne per day on annual average to reflect the quality challenges observed in the global coke market. In April 2013 the operation permit was updated to reflect the new SO_2 emission permit limit (42.0 tonnes per day on annual average) in preparation to the modernised smelter production increase. The SO_2 emissions decreased from 11.6 tonnes per day in 2014 to 8.3 tonnes per day in 2015 associated to a reduced metal production and calciner maintenance shutdowns. The emission levels remained well below the permit limit (Figure 5.4). Monthly average performance was also consistently below the permit limit (Figure 5.5).

Polycyclic aromatic hydrocarbons (PAHs)

PAH are produced by both industrial processes and various forms of combustion such as wood-burning stoves and forest fires. They occur in emissions from the VSS Smelter primarily as a by-product of anode paste manufacturing, anode baking and anode consumption.

For the Soderberg technology the multi-media environmental permit requires the monitoring of air emissions from representative potroom buildings for 15 of the most common PAHs. PAHs content in the emissions from BC Works was lower in 2015 at 49.1 tonnes per year compared to 110.6 tonnes per year in 2014 (Figure 5.6). Since the anodes for the AP4X technology are baked before being placed in the pot the PAH emissions are greatly reduced. A measurement campaign will be done once the pots are stable to confirm the low levels of PAH emissions.

In April 2008, an agreement regarding PAH was signed between Rio Tinto and Environment Canada. The purpose of this agreement was to set environmental performance objectives with respect to atmospheric emissions of PAH from Rio Tinto's Soderberg plants in BC (Kitimat) and Quebec (Shawinigan and Beauharnois). From 2008 to 2011, the environmental performance objective determined for BC Works was 0.8 kg per tonne of aluminium. The PAH performance agreement between Rio Tinto and Environment Canada ended in 2014. The PAH emissions rate (Figure 5.7) was higher in 2015 due to the progressive closure of the old smelter and the lower aluminium production.

Nitrogen oxides (NO_X)

Nitrogen oxides are produced through the operation of the smelter and the coke calciner. Nitrogen oxides are relevant to smog and other potential air quality concerns.

NO_X emissions are estimated using a combination of actual measurements and US-EPA emission factors. In 2013 the method of calculation of NO_X emissions for the annual environmental report changed to reflect the same calculation used for the National Pollutant Release Inventory (NPRI). Smelter-wide NO_X emissions for 2015 were estimated at 188 tonnes per year compared to 179 tonnes per year in 2014 (Figure 5.8). The coke calciner operated 181 days in 2015 almost the same as 184 days in 2014.

Table 5.1 Potroom dry scrubbers, annual stack tests 2015

Performance Measure	Scrubber Numbers	
	2	4
Date	7 May	7 Oct
Flow (m^3/min) Permit limit: 1,560 m^3/min	1203.3	855.5
Total Particulates (mg/m^3) Permit Limit: 70 mg/m^3	12.5	25.4
Particulate Fluoride (mg/m^3) Permit Limit : None	1.6	1.9
Gaseous Fluoride (mg/m^3) Permit Limit: None	1.3	<0.3
Sulphur Dioxide (mg/m^3) Permit Limit: None	301.5	12.3
Date		8 Oct
Polycyclic Aromatic Hydrocarbons (mg/m^3) Permit Limit: None	Not sampled	0.0300

Table 5.2 Potroom dry scrubbers, downtime, 2015

Percentage Downtime			
January	0.09%	**July**	No Occurrence
February	No Occurrence	**August**	No Occurrence
March	0.04%	**September**	No Occurrence
April	No Occurrence	**October**	No Occurrence
May	No Occurrence	**November**	Shut down
June	No Occurrence	**December**	Shut down

Total Particulate mg/m^3	71.7

Potroom dry scrubbers

The potrooms are a major source of emissions at BC Works, and the potroom dry scrubbers are therefore very important components of the plant's pollution control system. Continuous monitoring for gaseous fluoride is conducted on each potroom dry scrubber to ensure elevated emissions levels are promptly addressed. In the AP4X technology the scrubbers are replaced with Gas Treatment Centers (GTC).

The permit requires multi-faceted dry scrubber compliance tests on a regular basis on three of the six operating scrubbers. In 2015 due to idling of the potrooms, only two were tested. No non-compliances occurred (Table 5.1). There will be annual compliance testing of the GTCs starting in 2016.

When a dry scrubber stops functioning for any reason (downtime), gases are re-routed from the non-operating scrubber to two adjacent scrubbers. Occasionally, electrical or mechanical problems can result in dry scrubber downtime without interconnection to an adjacent unit. Such incidents are tracked as a percentage of total possible operating hours (Table 5.2). There were two occurrences of dry scrubber downtime in 2015.

Total particulate emissions

Total particulate emissions for 2015 were 1,345.1 tonnes compared to 2014 at 1,208.2 tonnes. This total includes all sources including the potroom roofs (Figure 5.11).

Potroom particulate emissions

Potroom roofs are the largest contributor of total particulate emissions. Particulate emission samples are taken at each of the representative potroom buildings using two sample positions on each building on a monthly basis (two sampling periods per month).

Monthly monitoring was implemented during Q3 of 2013 and was maintained in 2014 and 2015. Prior to that, quarterly monitoring was carried out.

The annual average of potroom particulate emissions was above the 7.5 kg particulate per tonne Al permit limit for 2015 (Figure 5.9). The annual average was 11.8 kg particulate per tonne Al which is an increase from 2014 at 8.2 kg particulate per tonne Al.

The increase in measured particulates in 2015 was due to the progressive closure of the old smelter. The idling of the potlines in preparation for the decommissioning of the VSS technology affected the air flow rates in the potrooms which are dependent on the heat generated by the pots. This change in airflow conditions led to an over sampling error (Figure 5.10).

Particulate emissions from the potroom roofs accounted for 95.9 per cent of total particulate emissions for BC Works in 2015 (Figure 5.11). One non-compliance was reported associated with the permitted particulate rate; details are described in Chapter 11.

Calcined Coke Plant

The two emission sources at the Calcined Coke Plant (the pyroscrubber and the cooler) are monitored relative to permit limits for particulate content. In 2015 the pyroscrubber and the cooler were tested and all results were compliant (Table 5.3).

Table 5.3 Calcined Coke Plant, annual stack test, 2015

Emissions Performance Measure	Calcined Coke Plant Pyroscrubber	Calcined Coke Plant Cooler
Particulates kg/hour	5.2 (Dec)	1.37 (Nov)
	4.8 (Dec)	1.35 (Nov)
Permit Limit	21.1	3.9
SO_2 kg/hour	85.9 (Dec)	0.48 (Nov)
	84.8 (Dec)	0.39 (Nov)
Permit Limit	n/a	n/a
NO_x kg/hour	20.4 (Dec)	n/a
	19.7 (Dec)	n/a
Permit Limit	n/a	n/a

Anode Paste Plant

Various emission sources at the Anode Paste Plant are controlled using dust collectors and a pitch incinerator. The dust collector discharge stacks are monitored relative to permit levels for total particulate content (Table 5.4). The pitch incinerator discharge is monitored relative to permit levels for total particulate and PAH content (Table 5.7). All these sources were in compliance with the permit in 2015.

Table 5.4 Anode Paste Plant, annual stack test, 2015

Source	Particulate Permit Limit (mg/m³)	Particulate Emissions (mg/m³)
Dust Collector DC10	120	14.1
Dust Collector DC11	120	14.4
Dust Collector DC12	120	12.1
Dust Collector DC13	120	31.7
Dust Collector DC14	120	9.3
Dust Collector FC 3	120	34.9
Dust Collector DC111	50	50.0

Natural gas consumption

Natural gas is widely used at BC Works in various applications where heat is required. Variables affecting usage levels include production levels and the availability of energy generated by the hydroelectric facility at Kemano Operations.

BC Works consumption rates and associated emissions are calculated using standards developed by the US Environmental Protection Agency (US-EPA). Plant-wide in 2015, consumption increased by 20.8 per cent (Table 5.5) due to the start-up of the AP4X technology.

Chlorine consumption

Chlorine was used during the process of casting aluminium ingots. The permit limit for chlorine consumption is 300 kg per day. This limit has not been exceeded since 1999. Over the past years, the use of chlorine was reduced and finally eliminated in April 2014.

Sulphur hexafluoride (SF_6) consumption

The was no SF_6 consumption in 2015 during the process of casting aluminium ingots. In 2013 the casting centers that used the SF_6 gas were shut down.

Other stack tests were completed in 2015 for casting operations (Table 5.6).

Greenhouse gas emissions

There are a number of sources of greenhouse gas (GHG) emissions at BC Works (Figure 5.12). Most emissions occur during the smelting process, and most smelting-related emissions are attributable to anode effects (Figure 5.13). An anode effect is a chemical reaction that occurs when the level of alumina in a pot falls below a critical level, resulting in reduced aluminium production and the generation of perfluorocarbons (PFCs) – a variety of gases with a high carbon dioxide equivalency.

BC Works GHG 2015 emissions increased to 4.89 tonnes of CO_2 equivalent, per tonne of aluminium production from 4.34 in 2014 (Figure 5.14 and 5.15). The increase was caused by running two technologies at the same time, as well as from the start-up of the AP4X line. The last three months of 2015 are below 4.34 tonnes.

Table 5.5
Natural gas consumption and associated emissions

Year	Natural Gas Consumption m^3/yr	Associated Emissions for Natural Gas Use (tonnes/year)			
		Nitrogen Oxides	Total Particulates	Sulphur Dioxide	Carbon Monoxide
2001	24,719,317	39.55	3.01	0.24	33.22
2002	26,718,911	42.75	3.25	0.26	35.91
2003	26,412,184	42.26	3.21	0.25	35.50
2004	27,610,071	44.18	3.36	0.27	37.11
2005	24,423,744	39.08	2.97	0.23	32.83
2006	25,403,363	40.65	3.09	0.24	34.14
2007	25,837,200	41.34	3.14	0.25	34.73
2008	25,931,400	41.49	3.15	0.25	34.85
2009	24,013,100	38.42	2.92	0.23	32.27
2010	23,564,629	35.89	2.73	0.22	30.14
2011	20,864,400	33.38	2.54	0.20	28.04
2012	19,695,700	31.51	2.39	0.19	26.47
2013	19,492,700	31.19	2.37	0.19	26.20
2014	18,048,900	28.88	2.19	0.17	24.26
2015	22,801,400	36.48	2.77	0.22	30.65

Table 5.6
DC4 Casting bi-annual stack test, 2015

Emissions Performance Measure	28 September 2015	9 December 2015
NO_x mg/m^3	69.6	54.7
Chloride mg/m^3	0.2	0.2
Chlorine mg/m^3	0.1	0.1
Total Particulate mg/m^3	86.3	79.0

Table 5.7
Liquid pitch incinerator annual stack test, 2015

Emissions Performance	29 March 17 September
Polycyclic Aromatic Hydrocarbons (mg/m^3)	1.784
Total Particulate mg/m^3	71.7

Figure 5.1
Potroom roof
sampling locations

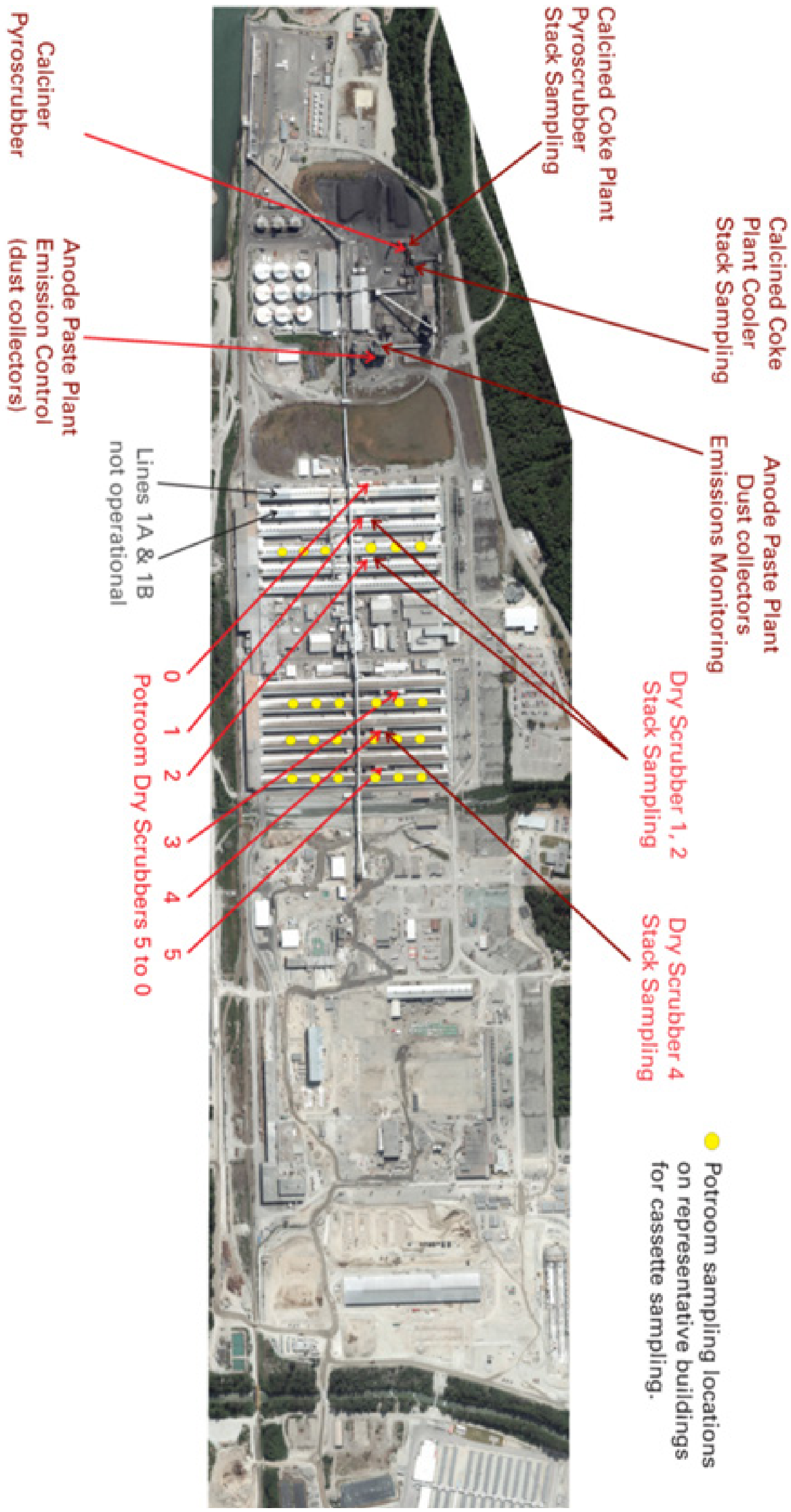


Figure 5.2
Gaseous fluoride emissions rate for VSS Smelter potroom roofs, 2000-2015

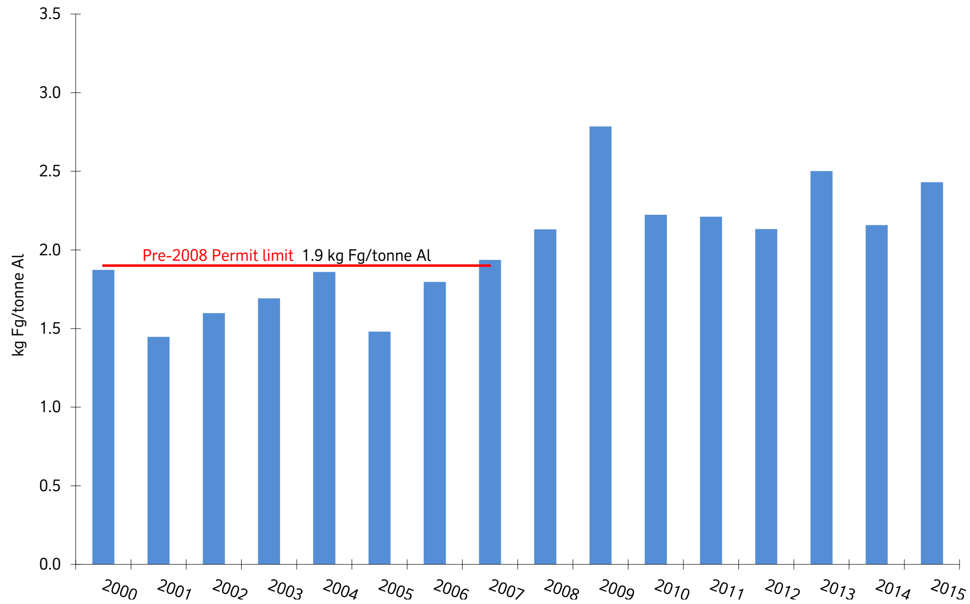


Figure 5.3
Gaseous fluoride emissions, loading measurement potroom roofs 2015.

Note: VSS Shutdown occurred in October.

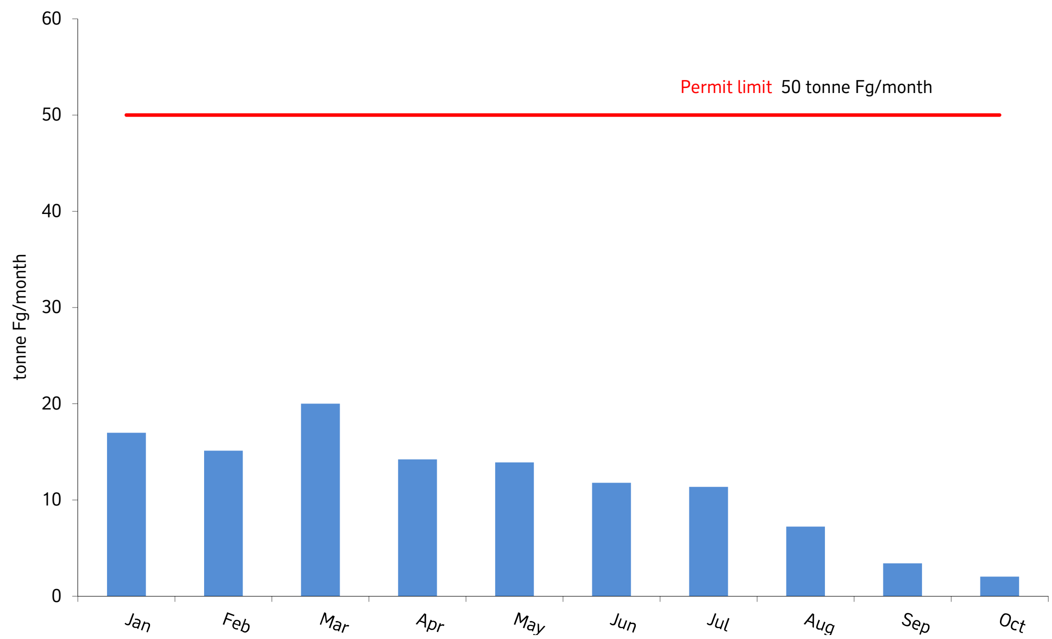


Figure 5.4
Annual average SO_2 emissions, BC Works 2005-2015

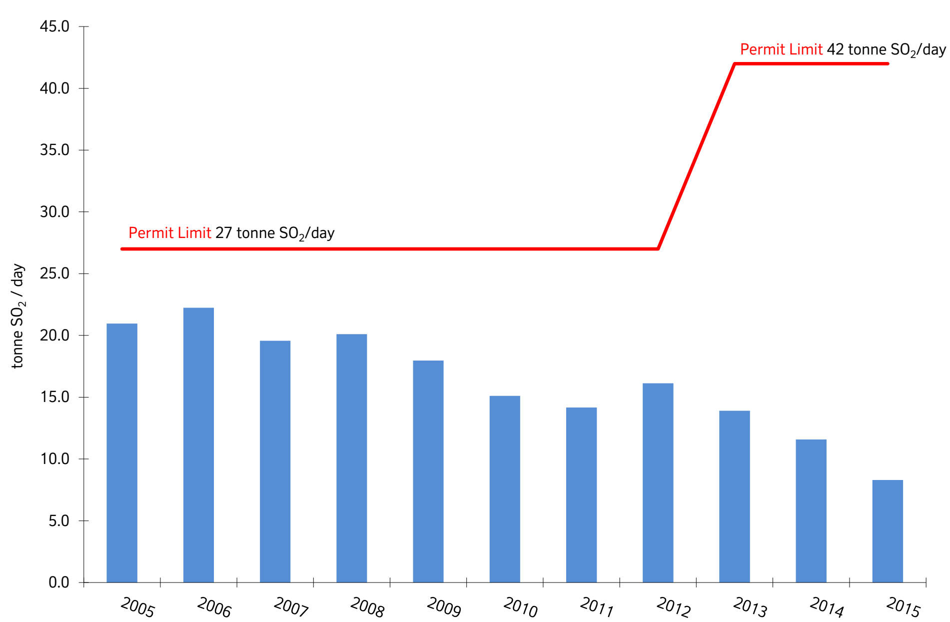


Figure 5.5
Monthly
SO_2 emissions,
BC Works 2015

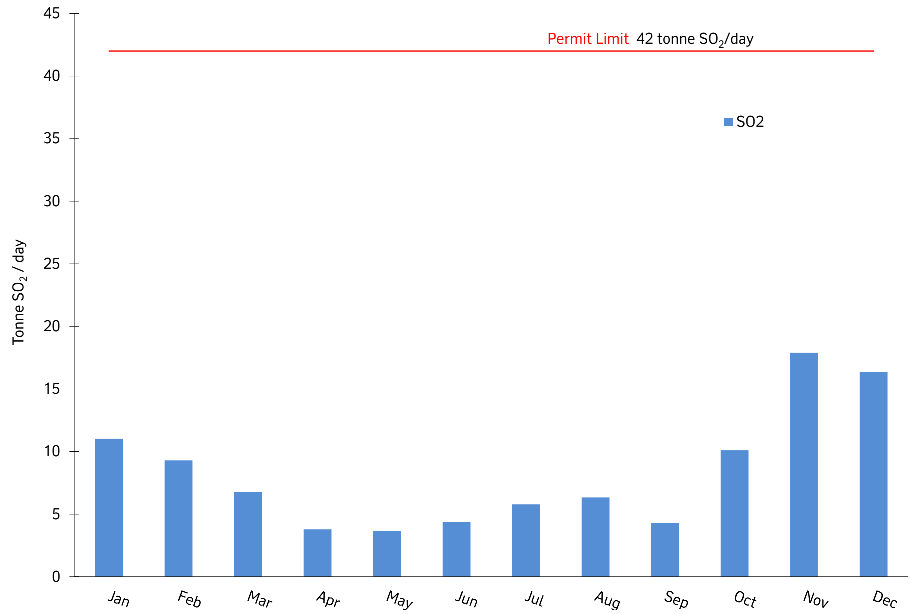


Figure 5.6
PAH emissions,
loading measurement
potroom roofs
2005-2015

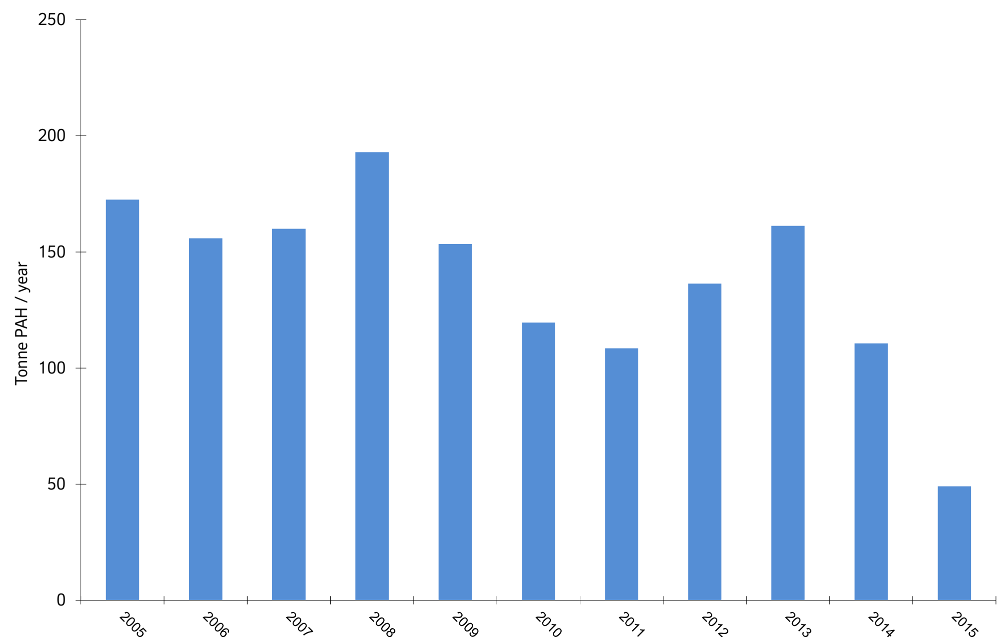


Figure 5.7
PAH emissions,
rate measurement
potroom roofs
2005-2015

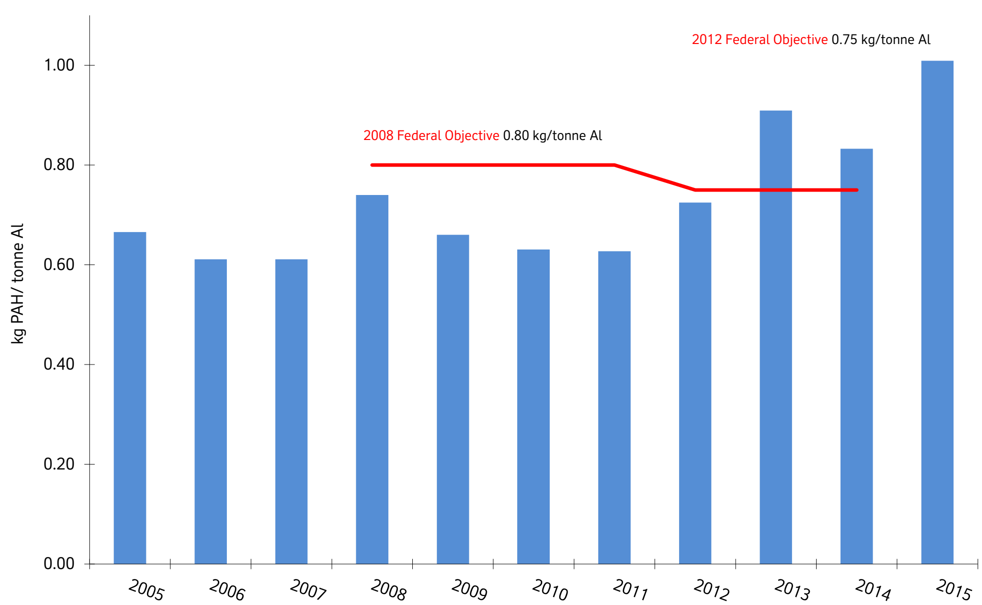


Figure 5.8 Nitrogen oxide emissions, BC Works

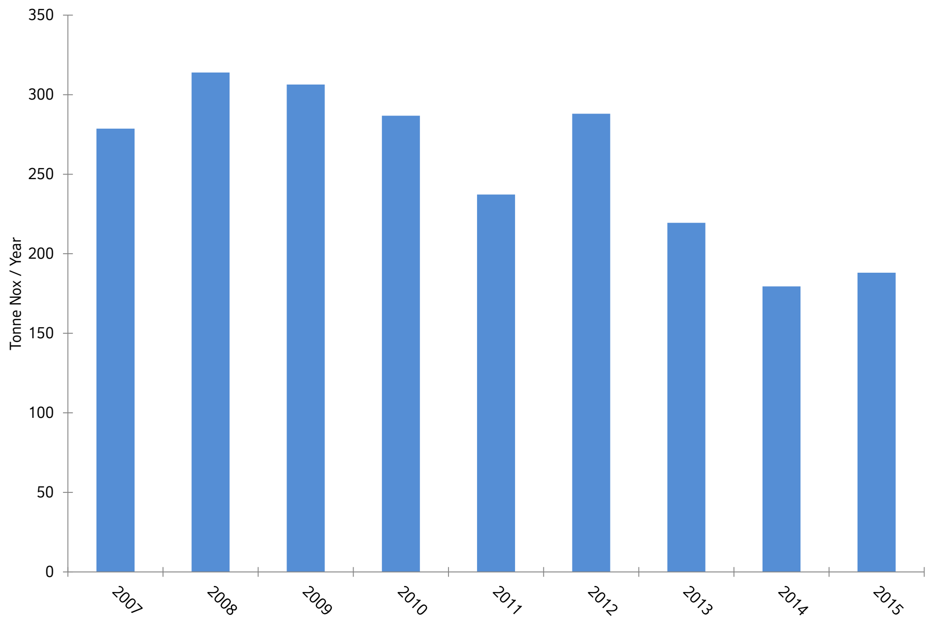


Figure 5.9 Particulate emissions potroom roof. Annual averages, 2001-2015

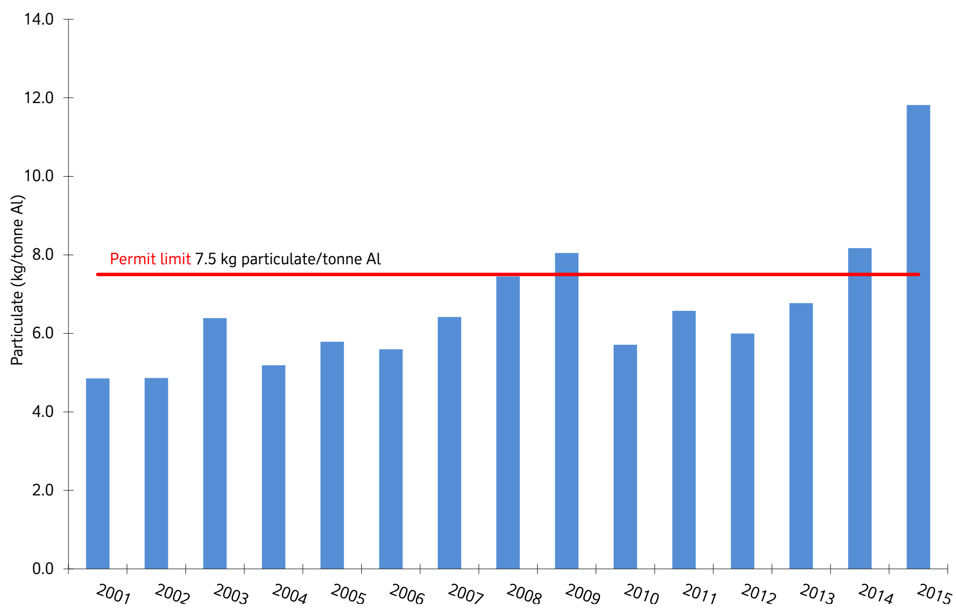


Figure 5.10 Particulate emissions quarterly results, 2015

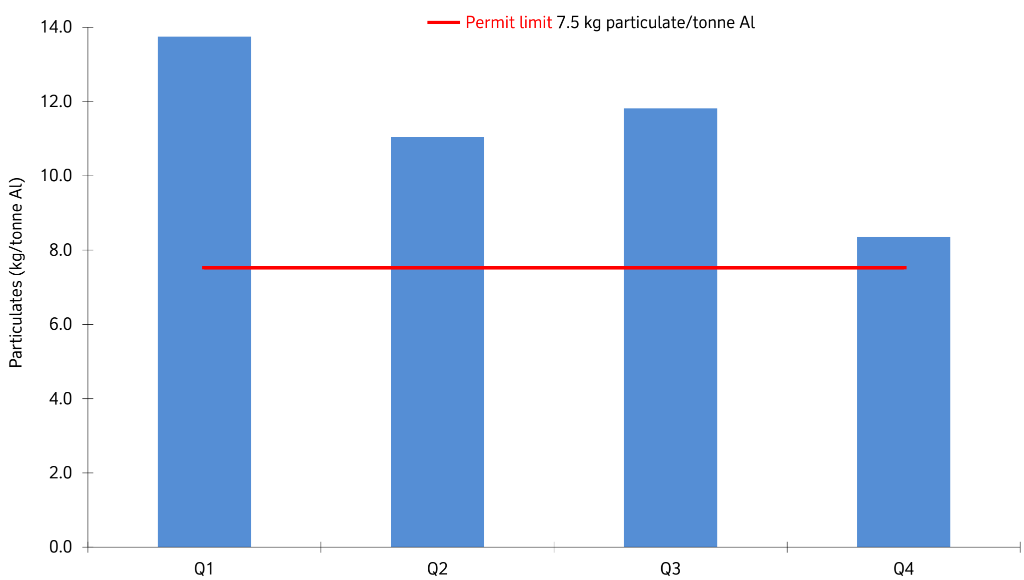


Figure 5.11 Particulate emissions distribution in 2015, BC Works

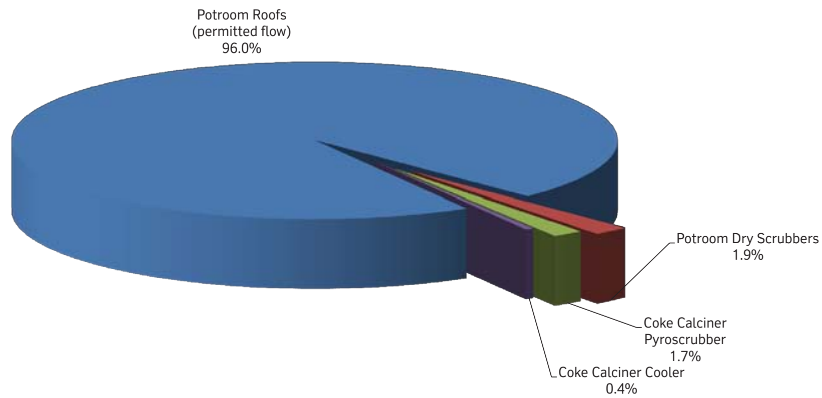


Figure 5.12 Total GHG emissions by Source, 2015

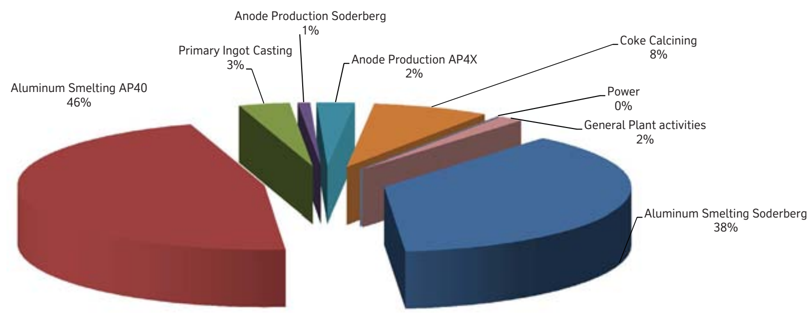


Figure 5.13 Breakdown of aluminium smelting GHG by Source, 2015

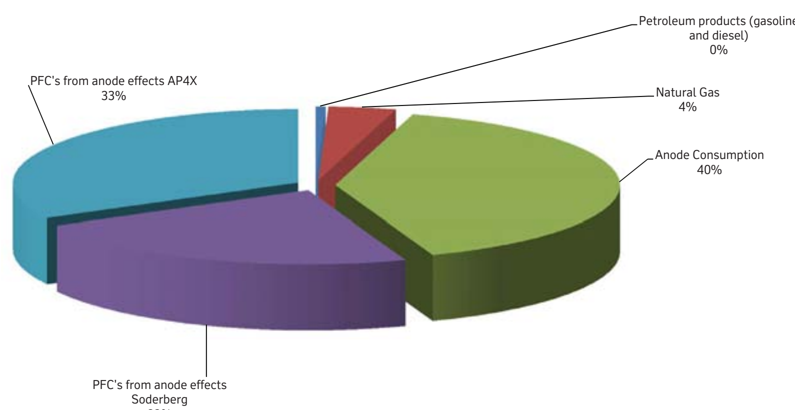


Figure 5.14
GHG emissions,
BC Works
2004-2015

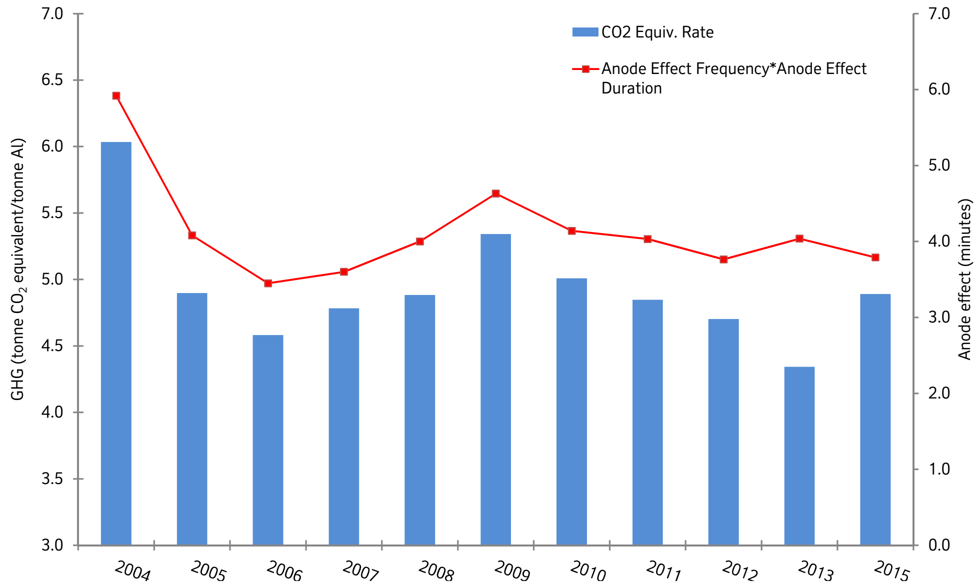
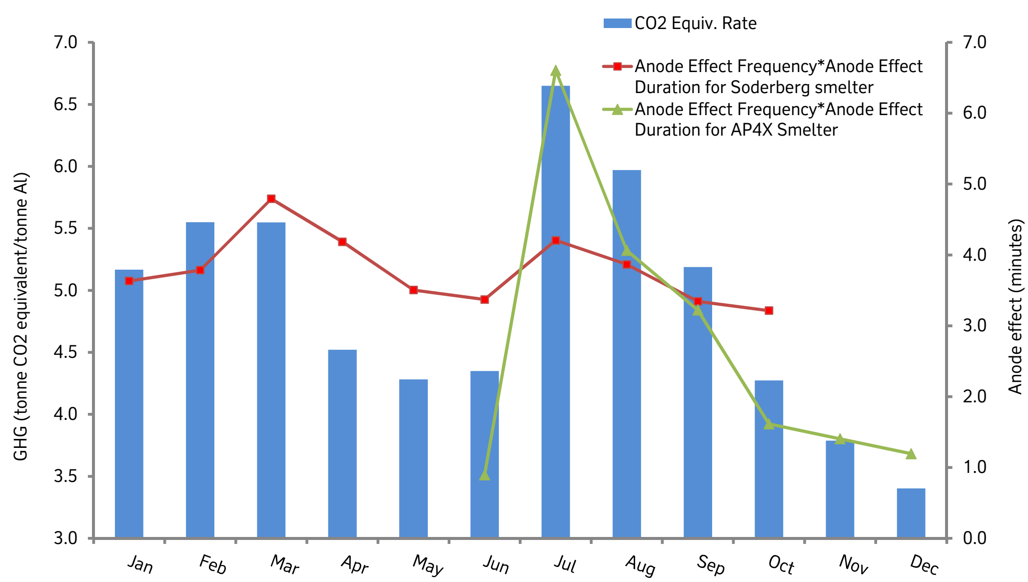


Figure 5.15
GHG emissions,
BC Works 2015



6. Air quality monitoring

BC Works conducts continuous ambient air quality monitoring at five stations in the lower Kitimat valley and one specialized station at Lakelse Lake. The monitoring parameters are illustrated in Table 6.1.

Network overview

Five air quality parameters are monitored: hydrogen fluoride (HF), sulphur dioxide (SO_2), polycyclic aromatic hydrocarbons (PAHs), and two levels of fine particulate matter. Particulate matter is referred to as PM_{10} and $PM_{2.5}$, and is measured against size thresholds of 10 and 2.5 microns, respectively.

Meteorological (weather) monitoring data are collected at all five air quality monitoring stations plus the Yacht Club station. Precipitation monitoring and analysis is undertaken using samples collected at the Haul Road and Lakelse Lake stations. The precipitation sampler was upgraded in 2013. The weather and the precipitation data provide additional insight into air quality data interpretation.

Table 6.1 Ambient air monitoring network

Ambient Air Network	Kitimat Smeltersite Road	Haul Road	Riverlodge	Whitesail	Kitamaat Village	Yacht Club	Lakelse Lake
Sulphur Dioxide (SO_2)	✓	✓	✓		✓		
Particulates ($PM_{2.5}$)	✓	✓	✓	✓	✓		
Particulates (PM_{10})			✓				
Polycyclic aromatic hydrocarbons (PAH)	✓	✓		✓	✓		
Hydrogen Fluoride (HF)	✓		✓		✓		
Rain chemistry		✓					✓
Meteorological monitoring	✓	✓	✓	✓	✓	✓	

The collected air quality data are used to compare regional air quality results with federal and provincial guidelines. These data are then analysed to:

- Track variations and trends in regional air quality.
- Assess the impact of specific emission sources.
- Assess and refine air quality management strategies.
- Support research on the impacts of air quality on property, vegetation and health.

Weather monitoring

Two new meteorological stations became operational in 2011, one at the Kitamaat Village station and the other at the Yacht Club located at the south end of the plant site. Each station measures temperature, wind direction and wind speed. Additionally, the Kitimat Smelter Road Station measures relative humidity.

The 2013 upgraded meteorological and weather monitoring data control program operated by BC Works is carried out to meet Ministry standards. In the event that air quality monitoring data indicate a problem on a particular date, weather data can provide insight into pollutant sources and other contributing factors.

Quality assurance and control

The validation of air quality data is conducted using a quality control/quality assurance process. The quality control component is to ensure that all instrument maintenance and operational guidelines for the instruments are being followed correctly and documented. Moreover, when summarizing air quality data a data completeness criteria of 75 per cent is applied as recommmended in Ministry of Environment guidance documents.

Air quality monitoring stations in the Kitimat valley are operated by an independent consultant. A technician performs weekly inspections and routine maintenance on the equipment. Air quality data are reviewed monthly, validated and submitted to the Ministry. In the event where remedial actions are required to ensure the validity of the data, this information is reported to the Ministry.

The quality assurance procedure is conducted by Ministry staff. This involves visits twice per year to the sites. A review of station and instrument documentation, condition and a reference audit calibration check on each instrument being operated under permit is completed.

The results of the quality control/quality assurance process are then used to validate the data collected by the Provincial Air Quality Monitoring network (www.env.gov.bc.ca/epd/bcairquality).

Table 6.2 Hydrogen fluoride monitoring, 2015

Station	Annual average of 24-hour concentrations (ppb)
Riverlodge	0.1
Kitamaat Village	0.01
Kitimat Smeltersite Road	0.8

*Classified as a fence line station fo HF: North of the operating smelter

Table 6.3 SO_2 monitoring, 2015

Station	2015 Annual Average of 24-hour Concentrations (ppb)	2014 Annual Average of 24-hour Concentrations (ppb)
Riverlodge	0.4	0.3
Haul Road	1.9	1.9
Kitamaat Village	0.4	0.3
Kitimat Smeltersite Road*	3.0	3.3
Whitesail station	0.4	NA

* Classified as a fence line station: North of the operating smelter

2015 monitoring results

Hydrogen fluoride (HF)

There are currently three Picarro analyzers (cavity ring down spectroscopy) operating in the network: Riverlodge, Kitamaat Village and Kitimat Smeltersite Road. The annual average measurement at Riverlodge was 0.1 parts per billion (ppb) and Kitamaat Village stations was 0.01 parts per billion (ppb). The Kitimat Smeltersite road station is located North of the operating smelter near the former KMP camp. The purpose of this station is to provide understanding on levels of emissions at the source for the camp workers. An annual average of 0.8 ppb was measured there (Table 6.2).

Sulphur dioxide (SO_2)

The SO_2 analyzers at the Haul Road, Riverlodge and Whitesail stations failed BC Ministry of Environment audit in September 2015. The errors found during the Ministry audit were due to the gas cylinder used for calibration. The calibration gas provided by the supplier was off specifications. The data from those stations was adjusted using a protocol provided by the Ministry of Environment.

The SO_2 24-hour concentrations observed in 2015 are similar to the concentrations observed in 2014 (Table 6.3).

Particulate (PM_{10} and $PM_{2.5}$)

Fine particulates have a wide variety of sources, both natural and human-caused. In northern BC, forest fires (prescribed and wild), beehive burners, emissions from fireplaces and wood burning stoves are among the major contributors to fine particulate emissions.

In addition to these primary particulate emissions, further contribution occurs due to gas emissions undergoing physical and chemical reactions. Emissions from BC Works, including sulphur dioxide and nitrogen oxides, are among the precursors to these secondary particulates.

Ambient air quality objectives established in 1995 defined the 24 hour limit for PM_{10} as 50 micrograms per cubic meter (μg/m^3). The ambient air quality criteria for $PM_{2.5}$ adopted in 2009 defined the 24-hour objective as 25μg/m^3.

Only the Kitimat Smeltersite Road station, which is considered a fence line station, had two exceedances of the $PM_{2.5}$ objective during 2015. (Table 6.4).

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are generated by the incomplete combustion of organic material. Various procedures at BC Works generate PAHs, in both dissolved and gaseous forms. They occur in emissions primarily as a by-product of the anode manufacturing process; other sources include vehicle exhaust and smoke from forest fires and wood-burning stoves.

Ambient air monitoring is conducted to test for the presence of some of the most common PAHs, although no permit limits exist. Sampling is done on a schedule that is coordinated with the National Air Pollution Surveillance (NAPS) to enable comparison of findings from different monitoring sites.

In 2015, total PAH showed a high degree of variability (Figure 6.1). This is typical when compared to previous years. The distribution of PAHs is largely consistent from one station to another, once the distance from the source is accounted for (Figure 6.2).

Table 6.4
PM_{10} and $PM_{2.5}$ Monitoring, 2015

Station	PM_{10}		$PM_{2.5}$	
	Annual average (of 24-hour concentration) μg/m^3	Days above reference level 50μg/m^3	Annual average (of 24-hour concentrations) μg/m^3	Days above Reference Level 25μg/m^3
Whitesail	-	-	5.0	0
Riverlodge	10.1	0	5.0	2
Haul Road	-	-	5	0
Kitamaat Village	-	-	6.5	0
Kitimat Smeltersite Rd*	-	-	6.2	2

* Classified as a fence line station: North of the operating smelter

Table 6.5
Geometric mean PAH concentrations, 2014 & 2015

Station	PAH Concentrations (ng/m^3) 2015	PAH Concentrations (ng/m^3) 2014
Haul Road	39	51
Whitesail	9	11
Kitamaat Village	15	11
Kitimat Smeltersite Rd	49	60

The geometric mean PAH concentration observed at Haul Road station was lower in 2015 (39 ng/m^3) than in 2014 (51 ng/m^3). At the Whitesail station, the PAH concentration was lower in 2015 (9 ng/m^3) compared to 2014 (11 ng/m^3). At the Kitamaat Village station PAH concentrations were slightly higher this year (15 ng/m^3) compared to 2014 (11 ng/m^3). Kitimaat Village has not been historically affected by the smelter plume due to its location and weather conditions in the Kitimat Valley. The slightly higher results in 2015 for Kitimaat Village were most likely associated with external sources, such as wood-burning stoves. PAH at the Smeltersite Road station (fence line station) was lower in 2015 (49 ng/m^3) than in 2014 (60 ng/m^3) (Table 6.5). This reduction is associated with the progressive idling of the Vertical Söderberg lines and the related reduction of the emission loads in 2015.

Rain chemistry

Precipitation samples are collected on a weekly basis from the Haul Road and Lakelse Lake stations. Rain chemistry monitoring has been conducted since 2000 and was expanded to include Lakelse Lake in 2013. Rainfall quantity is recorded. Samples are assessed for rain acidity and concentrations of 11 specific substances. Annual averages of weekly samples and the geometric mean measures are presented in Table 6.6 and Table 6.7.

There are no permit levels or objectives for monitoring. High levels of acidity (i.e. a low pH) and concentrations of certain substances are characteristic of the condition referred to as 'acid rain'. Long-term vegetation monitoring (refer to Chapter 7 – Vegetation monitoring) in the Kitimat valley has confirmed an absence of this type of damage.

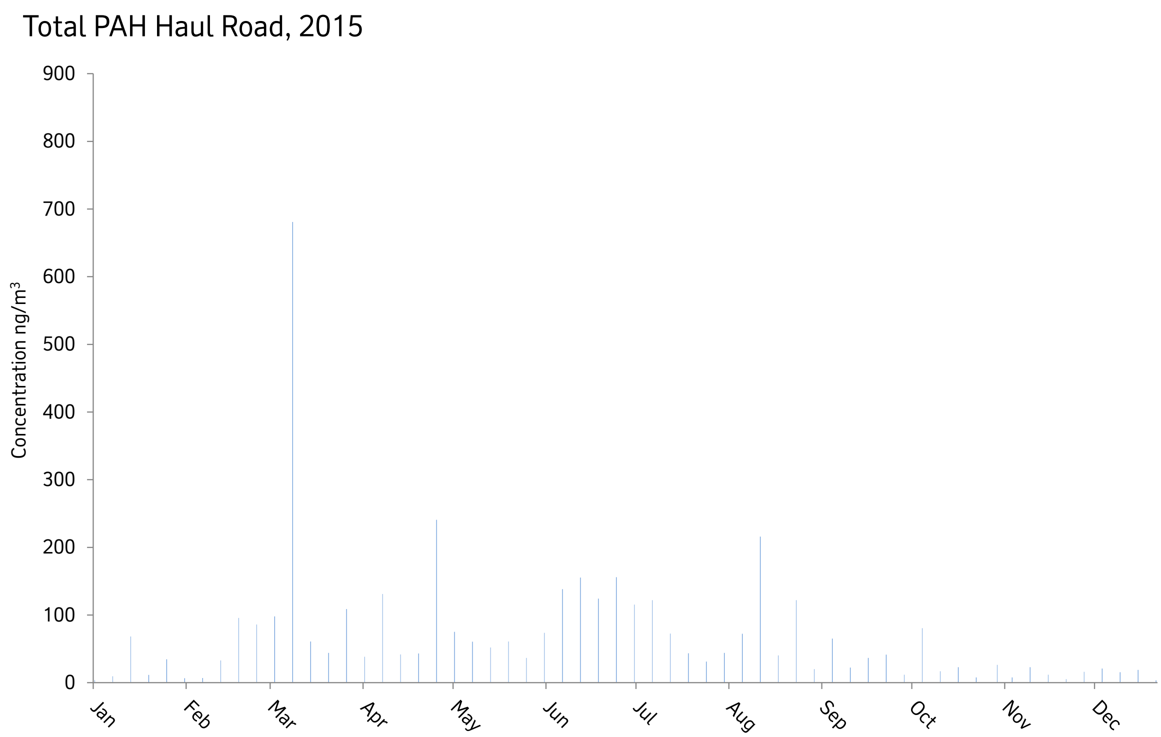
Table 6.6 Rain chemistry monitoring - Haul Road Station, 2007-2015

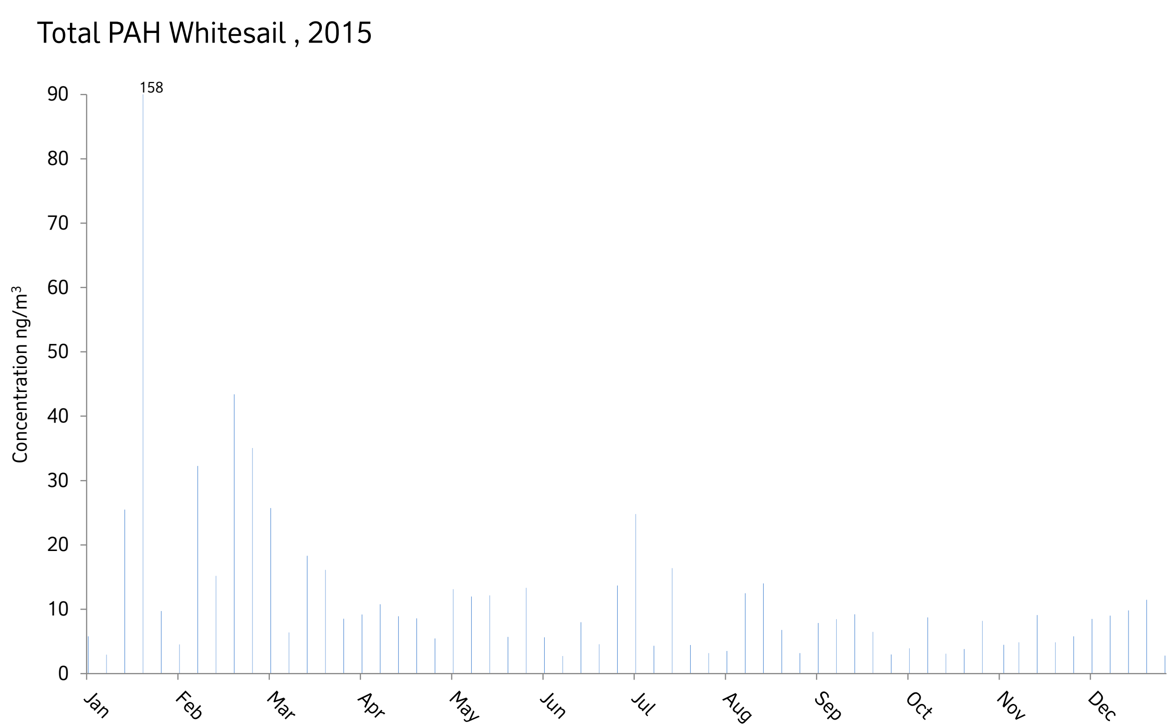
	Parameter		2007	2008	2009	2010	2011	2012	2013	2014	2015
Precipitation	Precipitation Depth (mm)	Average	52.1	44.1	30.0	33.2	43.6	18.1	47.8	55.1	57.2
		Geomean	27.2	25.3	11.1	10.6	24.7	13.4	29.5	25.2	27.9
Acidity	Rain (pH)	Average	4.9	4.9	5.4	5.3	5.1	5.1	4.4	4.7	4.6
		Geomean	4.9	4.9	5.3	5.3	5.0	5.1	4.3	4.6	4.6
	Acidity (to pH 8.3) $CaCO_3$ (mg/L)	Average	7.1	7.3	6.0	6.8	5.2	5.5	4.4	3.5	2.2
		Geomean	6.3	6.3	5.0	4.8	3.5	4.0	3.2	2.7	1.9
	Acidity - Free (μeq/L)	Average	30.6	27.9	12.5	12.1	17.6	18.5	24.5	15.3	9.0
		Geomean	13.4	12.2	4.4	4.9	8.5	7.7	16.7	7.6	5.1
	Alkalinity - Total $CaCO_3$ (mg/L)	Average	1.1	1.8	2.2	1.5	0.5	0.6	0.3	0.7	3.7
		Geomean	0.6	1.2	1.7	1.2	0.4	0.4	0.3	0.7	1.0
Concentration of Specific Substances (mg/L)	Chloride (Cl)	Average	0.3	1.0	1.0	1.1	0.6	1.2	0.3	0.4	0.3
		Geomean	0.3	0.9	0.9	1.0	0.5	0.8	0.2	0.2	0.2
	Fluoride (F)	Average	1.6	2.3	2.4	1.6	1.6	1.7	1.9	0.6	0.4
		Geomean	1.4	2.0	1.7	0.9	1.1	1.3	1.4	0.4	0.3
	Sulphate (SO_4)	Average	2.9	3.8	5.2	3.0	1.4	1.9	1.4	1.2	1.5
		Geomean	2.2	2.9	3.2	1.8	1.0	1.5	1.1	0.7	0.8
	Ammonia Nitrogen (NH4)	Average	0.09	0.10	0.14	0.12	0.08	0.08	0.05	0.06	0.06
		Geomean	0.07	0.08	0.08	0.07	0.04	0.07	0.04	0.04	0.03
	Nitrate Nitrogen (N03)	Average	0.06	0.05	0.07	0.06	0.03	0.05	0.16	0.16	0.22
		Geomean	0.04	0.04	0.05	0.05	0.02	0.04	0.13	0.13	0.13
	Total Dissolved Phosphate (PO_4)	Average	0.02	0.03	0.04	0.01	0.01	0.02	0.01	0.01	0.01
		Geomean	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.00
	Aluminium (D-Al)	Average	0.39	0.57	0.62	0.41	0.49	0.46	0.46	0.15	0.08
		Geomean	0.31	0.45	0.37	0.22	0.31	0.34	0.24	0.10	0.06
	Calcium (D-Ca)	Average	0.43	0.67	0.69	0.30	0.15	0.26	0.22	0.08	0.09
		Geomean	0.27	0.46	0.45	0.20	0.10	0.20	0.11	0.06	0.05
	Magnesium (D-Mg)	Average	0.05	0.08	0.08	0.10	0.04	0.05	0.06	0.03	0.03
		Geomean	0.04	0.08	0.07	0.09	0.03	0.04	0.04	0.02	0.02
	Potassium (D-K)	Average	0.20	0.20	0.40	0.32	0.16	0.34	0.16	0.02	0.02
		Geomean	0.11	0.20	0.22	0.19	0.06	0.15	0.06	0.01	0.01
	Sodium (D-Na)	Average	1.12	1.29	2.10	1.17	0.74	1.33	0.54	0.31	0.28
		Geomean	0.85	1.11	1.51	0.75	0.55	1.03	0.36	0.22	0.18

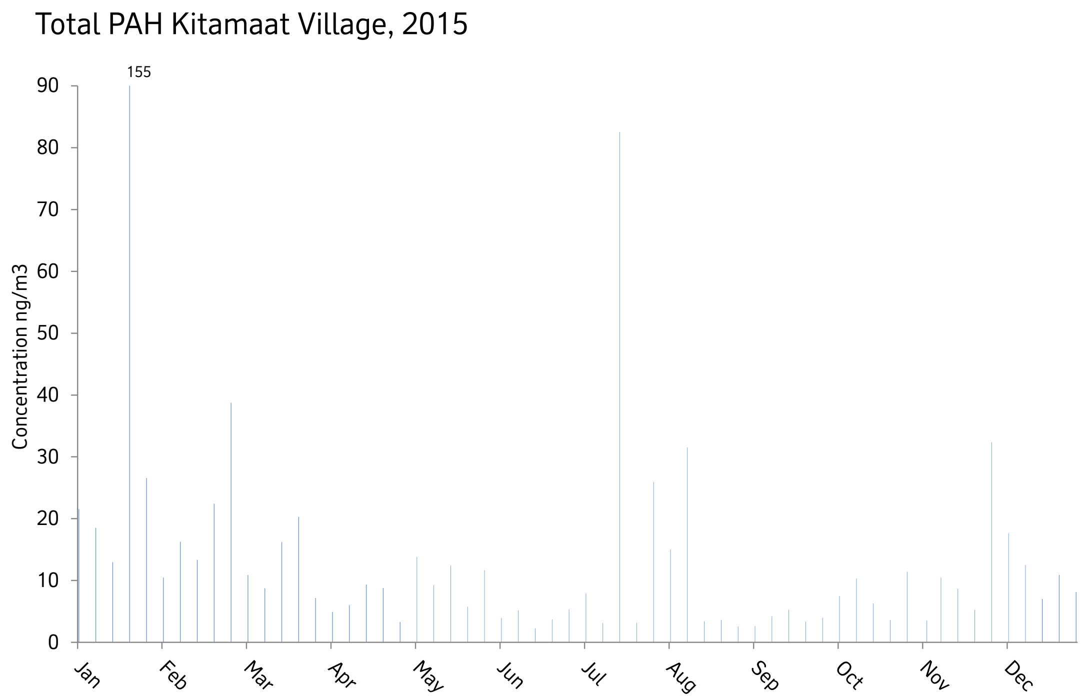
Table 6.7
Rain chemistry monitoring - Lakelse Lake Station, 2013-2015

	Parameter		2013	2014	2015
Precipitation	Precipitation Depth (mm)	Average	23.6	32.0	30.5
		Geomean	11.4	14.2	15.1
Acidity	Rain (pH)	Average	5.1	5.2	5.2
		Geomean	5.1	5.2	5.2
	Acidity (to pH 8.3) $CaCO_3$ (mg/L)	Average	1.0	1.8	0.7
		Geomean	0.9	1.2	0.7
	Acidity - Free (µeq/L)	Average	5.3	9.9	3.6
		Geomean	4.5	3.3	2.7
	Alkalinity - Total $CaCO_3$ (mg/L)	Average	0.8	0.9	1.8
		Geomean	0.8	0.8	1.1
Concentration of Specific Substances (mg/L)	Chloride (Cl)	Average	0.09	0.15	0.13
		Geomean	0.05	0.10	0.08
	Fluoride (F)	Average	0.03	0.20	0.02
		Geomean	0.03	0.03	0.01
	Sulphate (SO_4)	Average	0.46	0.39	0.28
		Geomean	0.35	0.22	0.19
	Ammonia Nitrogen (NH4)	Average	0.06	0.13	0.03
		Geomean	0.02	0,02	0.00
	Nitrate Nitrogen (N03)	Average	0.16	0.16	0.22
		Geomean	0.13	0.13	0.13
	Total Dissolved Phosphate (P)	Average	0.02	0.08	0.00
		Geomean	0.00	0.00	0.00
	Aluminium (D-Al)	Average	0.004	0.026	0.010
		Geomean	0.004	0.007	0.008
	Calcium (D-Ca)	Average	0.04	0.04	0.06
		Geomean	0.03	0.03	0.03
	Magnesium (D-Mg)	Average	0.01	0.02	0.01
		Geomean	0.01	0.01	0.01
	Potassium (D-K)	Average	0.05	0.05	0.02
		Geomean	0.02	0.01	0.01
	Sodium (D-Na)	Average	0.05	0.09	0.07
		Geomean	0.03	0.06	0.04

Figure 6.1
Total PAH, 2015 ambient air stations






Total PAH Kitamaat Village, 2015
155
90
80
70
60
50
40
30
20
10
0
Concentration ng/m3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

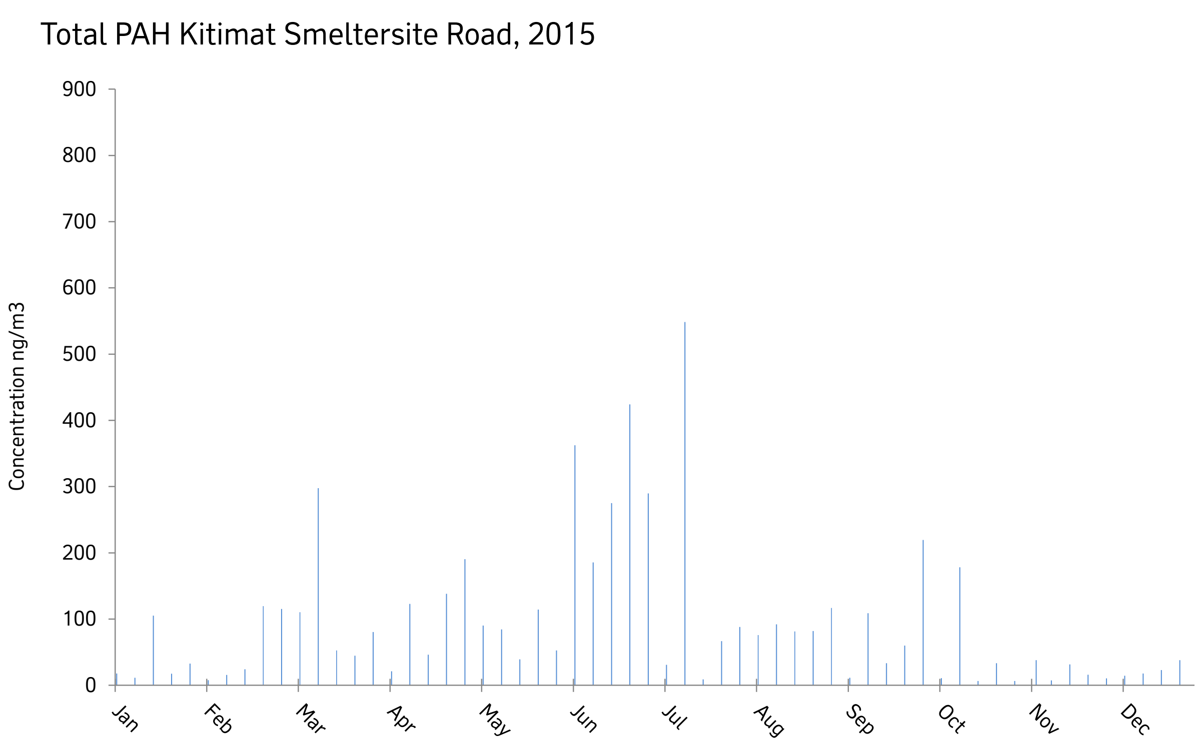
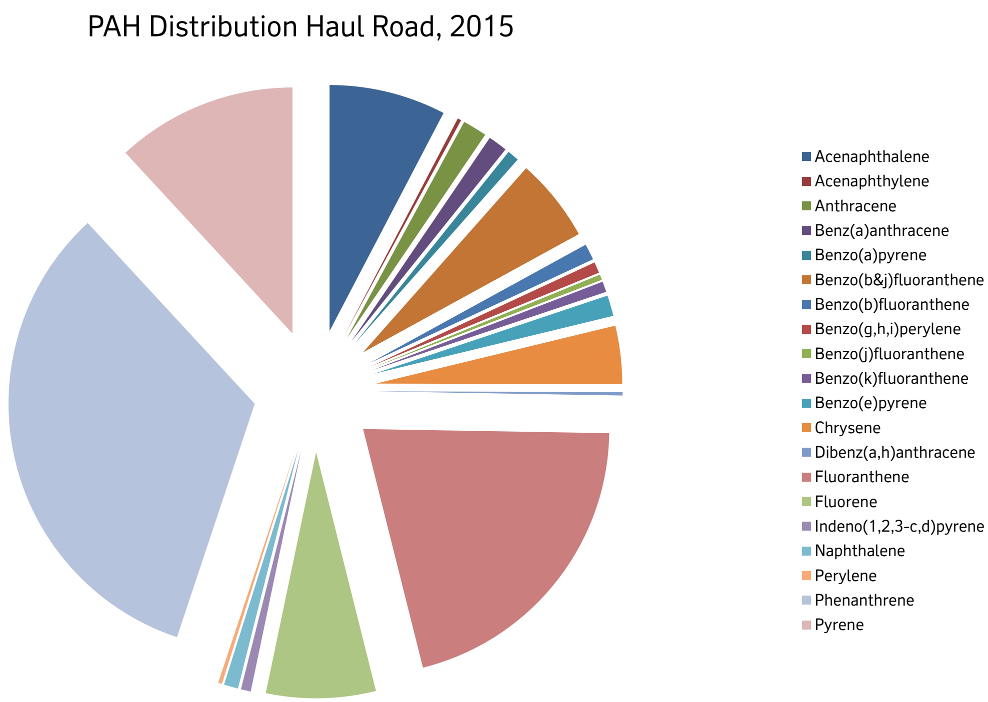
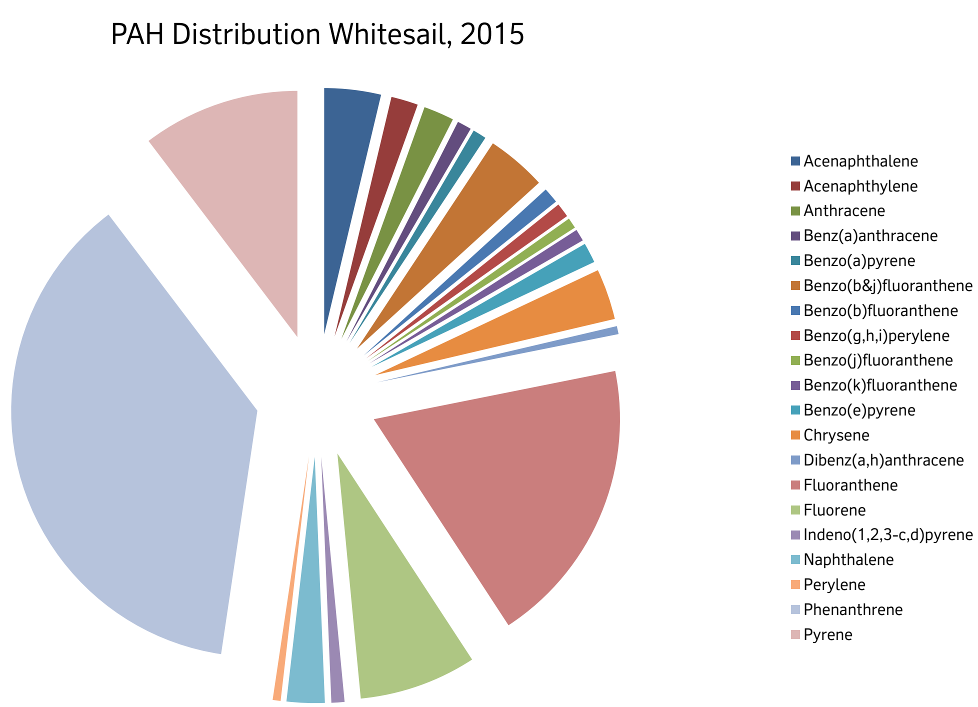
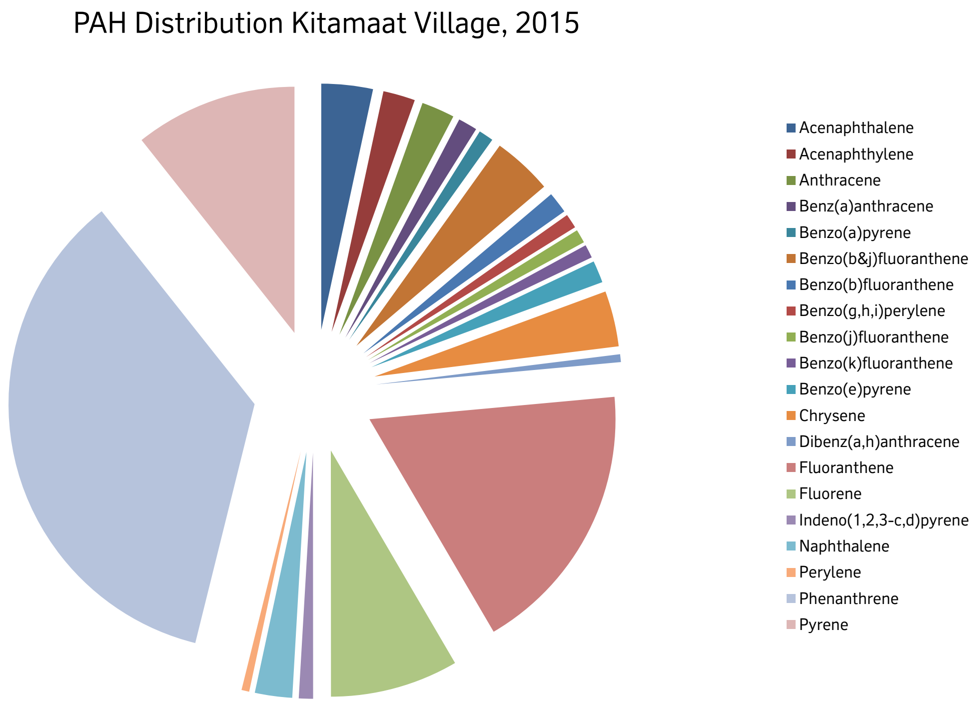
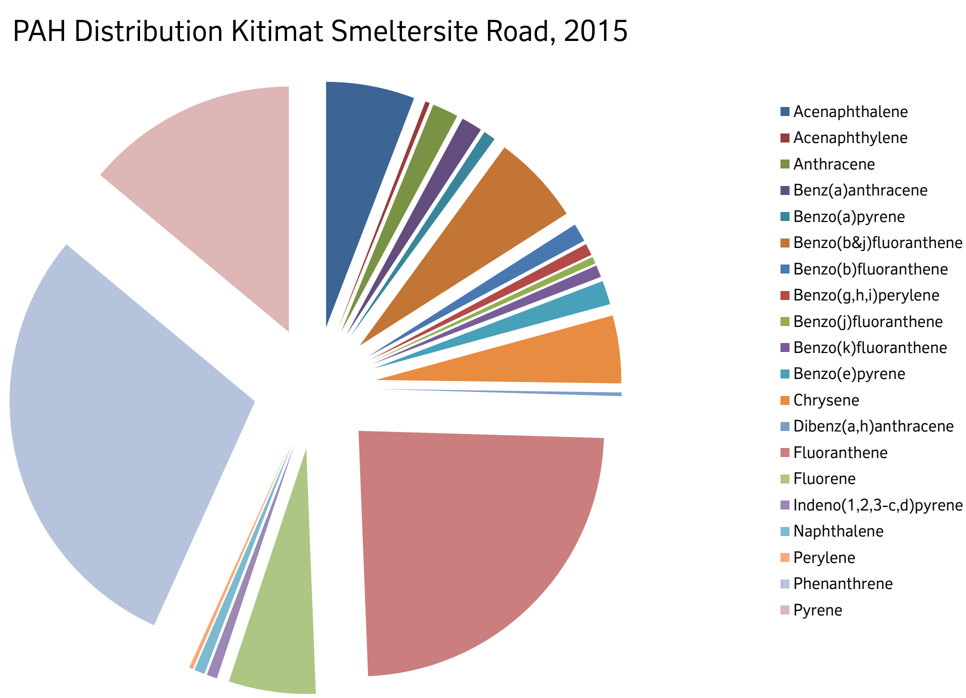

Total PAH Kitimat Smeltersite Road, 2015
900
800
700
600
500
400
300
200
100
0
Concentration ng/m3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Figure 6.2
PAH distributions, 2015






PAH Distribution Kitamaat Village, 2015
Acenaphthalene
Acenaphthylene
Anthracene
Benz(a)anthracene
Benzo(a)pyrene
Benzo(b&j)fluoranthene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(j)fluoranthene
Benzo(k)fluoranthene
Benzo(e)pyrene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-c,d)pyrene
Naphthalene
Perylene
Phenanthrene
Pyrene


PAH Distribution Kitimat Smeltersite Road, 2015
Acenaphthalene
Acenaphthylene
Anthracene
Benz(a)anthracene
Benzo(a)pyrene
Benzo(b&j)fluoranthene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(j)fluoranthene
Benzo(k)fluoranthene
Benzo(e)pyrene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-c,d)pyrene
Naphthalene
Perylene
Phenanthrene
Pyrene

7. Vegetation monitoring

The vegetation monitoring and assessment program consists of two parts: first, an annual collection of current year foliage of western hemlock, followed by an analysis of the concentration of fluoride and sulphur content in needle tissue; and second, on a biennial basis, a survey of vegetation in the vicinity of Operations to document the health and condition of vegetation.

Introduction

The annual collection has been conducted since 1970, giving BC Works one of the largest historical databases of this type in British Columbia. The data provides long-term and comparable measures of fluoride and sulphur absorption in vegetation, both of which are found in emissions from BC Works. The purpose of the monitoring and assessment program is to:

- Document the general growing conditions in the Kitimat area during the year of the inspection.
- Provide an assessment of the overall health of vegetation in the area, including documenting significant occurrences of insects and diseases.
- Document the concentration of fluoride and sulphur content in vegetation.
- Document the extent and severity of injury to vegetation associated with emissions (gaseous fluoride) from the BC Works.
- Provide early warning of changes in conditions.

In 2010 changes were made to the vegetation monitoring and assessment program based on Dr. John Laurence's (plant pathologist consultant) recommendations. The results of that investigation centred on the effectiveness of the monitoring program. Changes to the program were made in three areas:

- Changes to sample site locations.
- Standardization of sampling protocols.
- Increased quantitative assessment and documentation of the vegetation condition during biennial visual inspections.

Collection of western hemlock for foliar analysis is now conducted along directional transects away from the center of BC Works. The directional transects allow an estimation of the maximum concentrations of fluoride and sulphur in foliage as well as the reduction in deposition with distance from the smelter. Sample harvesting is usually conducted at 37 sites at the end of the growing season by gathering the current year's growth. This is done because vegetation is more sensitive to fluoride and sulphur emissions in the spring, when new tissue is tender and growing rapidly.

The sampling program focuses on hemlock because it is evenly distributed throughout the valley and is a reliable indicator for vegetative absorption of emissions. This year's samples were collected by an independent consultant and analysed at Rio Tinto's Vaudreuil Analytical Laboratory in Quebec.

One of the significant improvements made to the sampling methodology was to conduct the sample collection in a shorter time frame. In 2011, one more site was added to the usual 37 sites bringing the total number of sampling sites to 38. In 2015 all 38 samples were collected over five days. They were then refrigerated in their collection bags until processing. Field sampling occurred between 31 August and 4 September.

2015 monitoring results

Fluoride content

There is a strong correlation between fluoride concentrations in hemlock and fluoride emissions from the potroom roofs at BC Works. In 2015, fluoride concentration in hemlock samples averaged 31 ppm, which is slightly higher than the 29 ppm observed in 2014 (Figure 7.1).

On a monthly basis, gaseous fluoride emissions from BC Works did not exceed the permit limit of 50 tonne per month (Figure 7.2). All of the Soderberg operating areas were idled by 15 October, 2015. There were no non-compliances relative to the gaseous fluoride emissions in 2015.

Sulphur content

Vegetation can absorb higher concentrations of sulphur than fluoride before visual damage can be detected. Annual averages of sulphur concentrations in vegetation in the Kitimat-Terrace area have remained relatively uniform, with little variance across the sample area and have rarely been found above background levels.

The average sulphur concentration in hemlock for 2015 was 0.08 per cent which was the same as in 2014 (Figure 7.3).

Qualitative assessment

In addition to annual vegetation sampling, the multi-media permit also requires that a qualitative assessment of vegetation condition in the Kitimat valley be conducted by an external expert every second year.

The biennial qualitative inspection was conducted during the 2015 sampling season and reported in 2015. Some of the observations reported are as follows.

- The condition of vegetation in the vicinity of the smelter was better than that observed in 2014, perhaps due to reduced operations related to the idling of the Soderberg technology. Injury to sensitive vegetation caused by hydrogen fluoride was not observed at any sampling or observation site.
- There were no remarkable insect outbreaks, disease epidemics or other stress factors affecting vegetation.
- No unusual conditions were observed on ornamental vegetation in Kitimat.

Figure 7.1
Western hemlock fluoride content and gaseous fluoride emissions, potroom roofs 2004- 2015

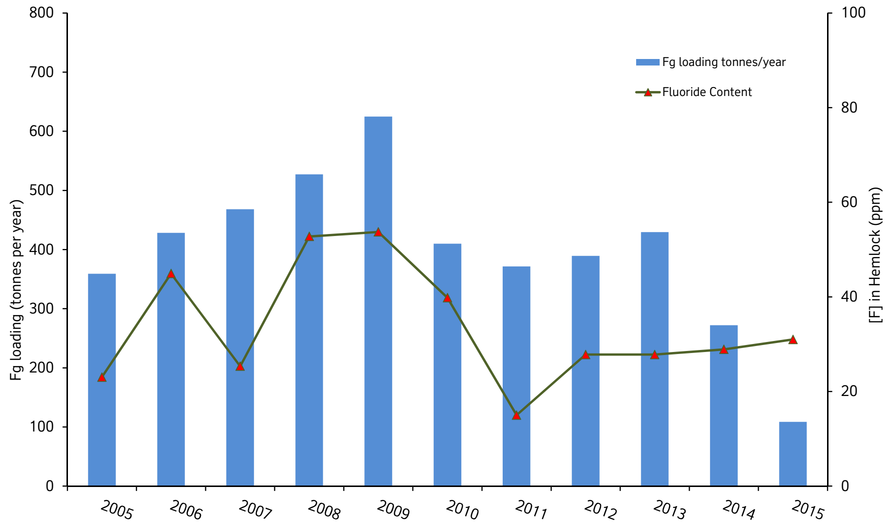


Figure 7.2
Gaseous fluoride loading, potroom roofs, 2015

Note: VSS shutdown occurred in October.

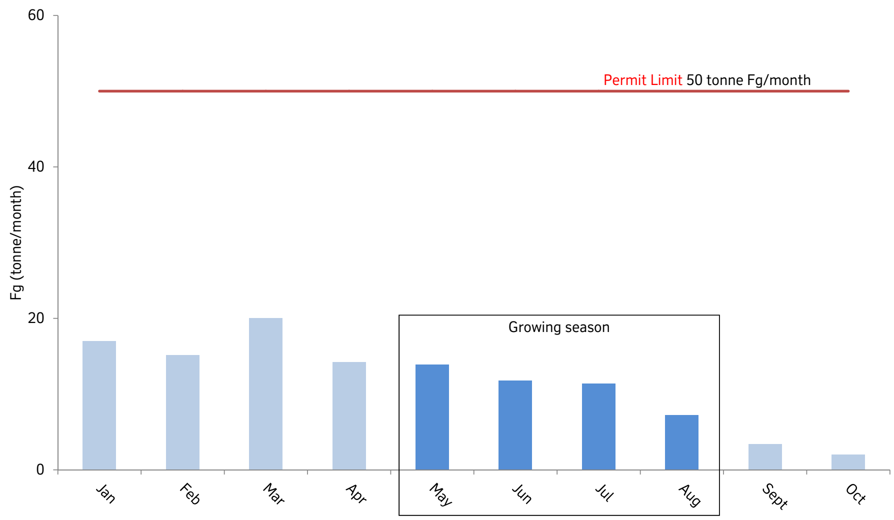
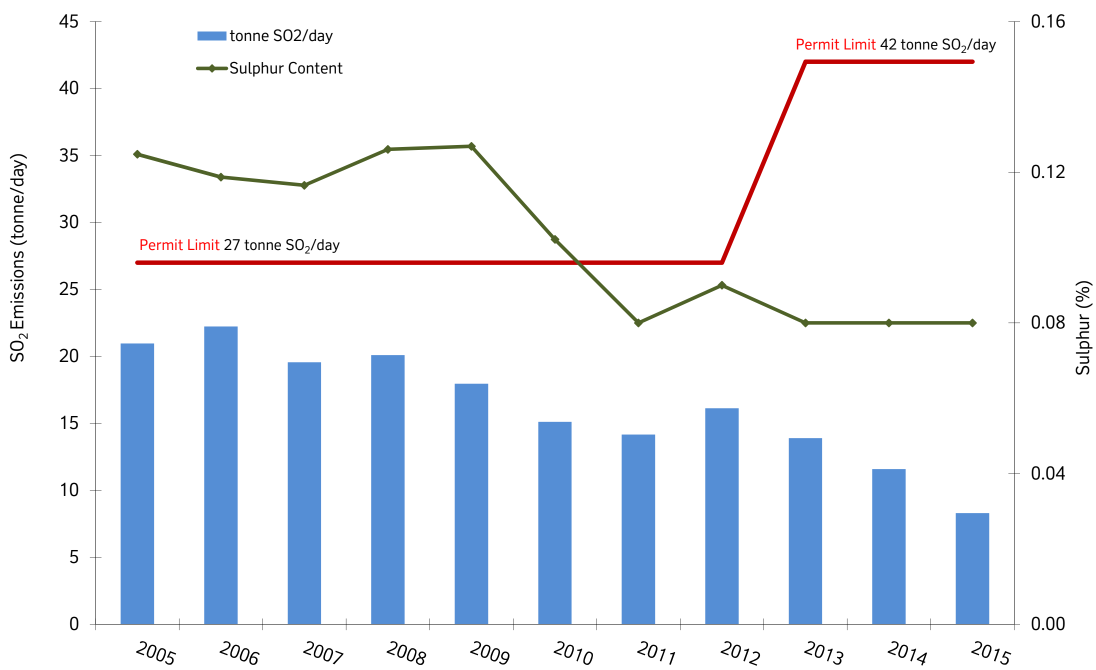


Figure 7.3
Western hemlock sulphur dioxide emissions, BC Works, 2005-2015



8. Waste management

The operation of the smelter results in the generation of various solid and liquid wastes.

Introduction

In August 2010, the multimedia permit was amended to allow for the disposal of KMP non-hazardous related wastes into the south landfill.

The amendment is inclusive of the design, operation and closure phases. The appropriate procedures for handling, storage and disposal of these wastes are in place and are reviewed as changes in operations occur.

Waste management procedures ensure full compliance with requirements related to regulated hazardous wastes and additional materials deemed to be hazardous by BC Works.

Opportunities for waste reduction and for improvements in waste handling are assessed and implemented on a continuous basis. In particular, opportunities to recover, reuse, and recycle waste materials are pursued whenever feasible. On-going practices include reducing raw material usage, thus reducing demand on the landfill and contributing to reducing the overall impact on the environment.

Waste management activities are tracked and reported. All waste types including those disposed at the South Landfill (i.e. inert industrial waste, asbestos materials, contaminated soil, and putrescibles), monthly wood waste and hazardous waste externally disposed or sent for recycling are reported in compliance with the permit requirements.

2015 performance

Spent potlining

Spent potlining (SPL) is one of the most significant hazardous waste materials produced at BC Works, and its disposal presents a challenge throughout the aluminium industry.

During 2015 no SPL was generated and shipped off-site for both treatment and permanent disposal in a secure landfill; compared to the 253 tonnes disposed in 2014. The reduction is associated to the idling of Pot Lines 1-5 (VSS Technology) for start-up of the Modernised Smelter.

Asbestos and refractory ceramic fibres (RCF)

Asbestos and refractory ceramic fibres (a less hazardous substitute to asbestos) are used for insulation. These materials are considered by BC Works to be sufficiently hazardous to require special disposal methods.

In 2015, 56 m^3 of asbestos and ceramic fibers materials were collected and disposed associated with smelter maintenance and major equipment overhaul activities as part of the modernisation activities. The material was disposed of at the South Landfill. No asbestos or ceramic fibers materials were sent to the North Landfill in 2015 (refer to BC Works map Figure 2.1 for waste storage, disposal and managed sites).

Wood waste

Wood waste is collected from around the smelter site on a regular basis and sent to a wood containment area. Wood is burned once sufficient volumes have accumulated at the containment area. In 2015, due to the elevated amount of wood generated by the KMP, Kitimat Operations used Air Curtain Incinerators under a separate authorization from MOE. A total of 20,646 m^3 of wood waste was burned during the year using the Air Curtain Incinerators. No open burns were conducted in 2015.

Landfill management

The South Landfill is the main landfill for smelter operations. It has been operational since the plant opened and is expected to be open until full capacity. Incoming waste streams included: industrial waste, putrescible waste, contaminated soils, asphalt and asbestos contaminated materials which include soil and concrete.

A survey is carried out once a year for reconciliation of the forecasted disposed volumes. The total volume of materials disposed at the South Landfill in 2015 was 9,045 m^3, which corresponds to 13,571 metric tonnes.

9. Groundwater monitoring

Long-term initiatives are underway with objectives to further reduce groundwater contamination and identify disposal and treatment options for stored materials.

Introduction

A variety of monitoring programs are conducted relating to groundwater quality and flow in the vicinity of BC Works' landfill sites that are, or have the potential to be, a source of contamination.

In 2015, these efforts focused on the spent potlining landfill and the dredgeate short-term storage cells.

2015 monitoring results

Spent potlining landfill

The spent potlining landfill is comprised of three separate subsections formerly used to dispose of spent potlining (SPL). The landfill is located south of Potroom 1A and north of the Anode Paste Plant (refer to BC Works map Figure 2.1).

Prior to 1989, approximately 460,000 m^3 of SPL were disposed of at the landfill site as per permit limits. The landfill was decommissioned in the fall of 1989 and initially capped with a low permeability cover. Over the next decade the three subsections were capped with polyvinyl chloride (PVC) liners. The capping significantly reduced surface water infiltration, thus reducing contaminant loading into the environment.

Groundwater monitoring has been carried out in accordance with the requirements of the multi-media permit and the SPL management plan. The existing program consists of a quarterly monitoring program where selected wells are visited to monitor water level trends. In addition to monitoring water levels a geochemical sampling campaign that occurs in the fall of each year also occurs as part of the annual program. The information collected is used to assess groundwater quality for any significant changes in chemistry that may exceed previous year's results.

Estimated groundwater flux for 2015 (354,026 m^3/year) was higher than 2014 (327,291 m^3/year) and on the high range of flux values from previous years' estimates. For 2015, fluoride, cyanide, aluminium and iron loading were estimated at 22,673 kg/yr, 281 kg/yr, 791 kg/yr and 430 kg/yr, respectively. Loading values were lower in 2015 due to lower concentrations of contaminants from previous years.

The 2015 loading estimates for fluoride, SAD cyanide, aluminium, and iron were lower than the 2014 loading estimates and within the range of estimates from previous years.

Dredgeate cells and SPL overburden cell

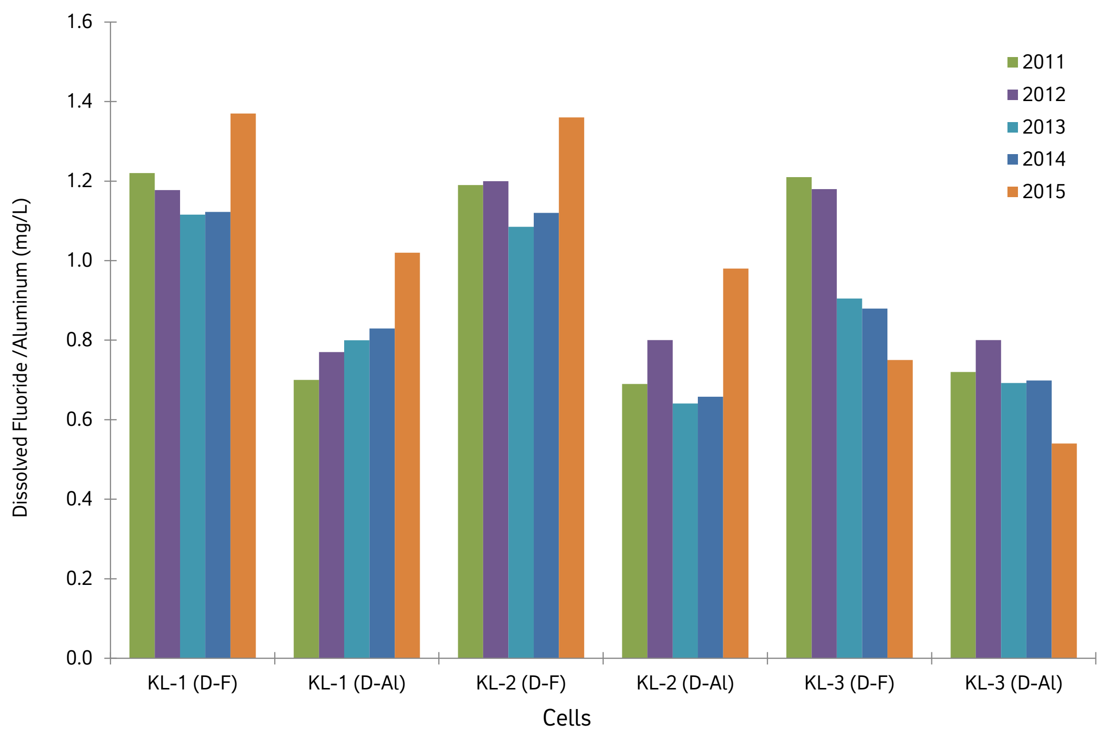
The wharf dredgeate cells consist of two lined cells located north of Anderson Creek. They contain approximately 2,000 m^3 of ocean sediment dredged from the wharf berthing area in 1995. This sediment was removed during a normal dredging operation and required special disposal because of the presence of PAHs in the form of solid pitch (pencil pitch). BC Works no longer receives pitch in this form. Maintenance of these cells has included liner replacement in one cell (2003) and liner upgrading in the other (2004).

Three wells were used to monitor groundwater in the area surrounding the wharf dredgeate cells. They are referred to as KL-1, KL-2 and KL-3 and are located to the West, South and East of the cells respectively. Groundwater sampling was conducted on a quarterly basis in 2015. The samples were analysed for dissolved fluoride and dissolved aluminium. The 2015 contaminant monitoring results are slightly elevated when compared to historical trends with the exception of KL-3 which is lower. (Figure 9.1).

The SPL overburden cell is located west of the wharf dredgeate cells. The SPL material is composed of approximately 10,500 m^3 of overburden material that came from the eastern lobe of the SPL landfill in 1996. The overburden cell was originally lined with a Claymax liner that has since been replaced several times, with a synthetic liner most recently in 2010.

Both the wharf dredgeate cells and SPL overburden cell have a double membrane lining system that collects water between the primary and the secondary liners. This water is tested and pumped out on a regular basis. In 2015 approximately 67.0 m^3 were pumped out from the six pumps.

Figure 9.1 Dissolved fluoride & aluminium, wharf dredgeate monitoring cells



10. Kemano permits

BC Works Kemano facility is the hydroelectric power station that supplies electricity to BC Works.

Introduction

Up until 2000, Kemano Operations included a town site with a resident population of 200 to 250 people. At that time the powerhouse was automated which reduced the operations and maintenance personnel to rotating crews of 20 to 30 people.

2015 performance

In 2015, BC Ministry of Environment conducted a compliance inspection on all Kemano permits. All permits were found to be compliant.

Kemano effluent discharge

The Kemano sewage treatment plant and several septic tanks in the area surrounding

Kemano have effluent discharge permits. The discharges consist of treated sewage and are subject to permit requirements with respect to Biological Oxygen Demand (BOD) levels and concentrations of TSS. BOD is an indirect measure of the concentration of biodegradable matter, while TSS is a direct measure of suspended solids. Prior to 2006, effluent results were analysed monthly to establish a baseline. Since then, the permit requires only quarterly sampling. In 2015 all effluent discharge permit measurements were in compliance (Figure 10.1).

Kemano emission discharge

An incinerator is used to burn municipal-type waste generated by rotating crews while residing at Kemano Operations. The incinerator is a double-chambered, fuel-fired, forced air unit. The permit requires that the exhaust temperature of the incinerator remain above 980°C and in 2015 permit requirements were in compliance.

Kemano landfill

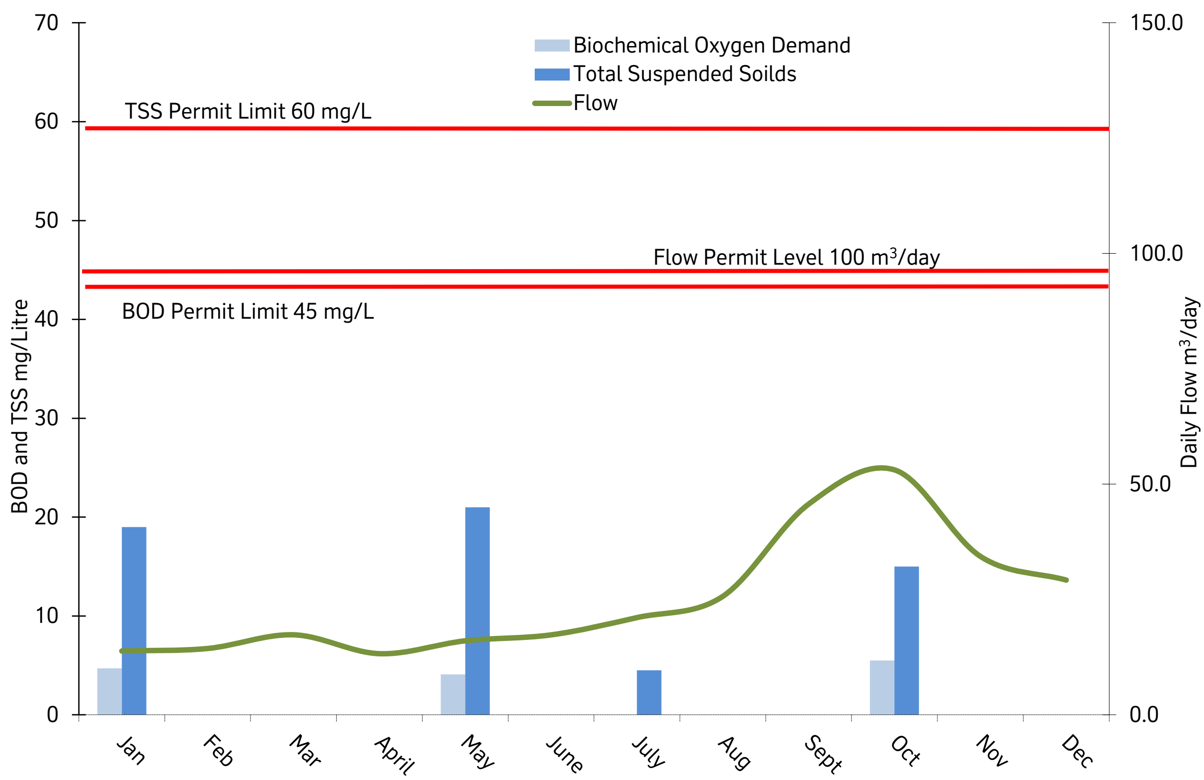
Non-combustible refuse and ash from the incinerator is buried in a landfill near Kemano. The landfill permit limits the amount of material to an annual maximum of 300 m^3. In 2015 10.1 m^3 of refuse was buried.

Treated sludge from the sewage treatment plant, septic tanks and biological containers are also deposited in the same landfill. Filtration ponds are used to de-water the sludge before disposal. The permit allows for disposal of up to 900 m^3 of treated sludge per year. In 2015 342 m^3 of sludge was disposed which is a slight increase from the 265.4 m^3 in 2014. This increase can be explained by the increase in population through 2015.

Seekwyakin camp effluent discharge

Seekwyakin construction camp, located three kilometres north of Kemano, was historically used by West Fraser Timber Co. Ltd. and BC Works. Effluent sewage discharges from the camp require a permit when the camp has more than 25 residents. In 2015, Seekwyakin camp saw very little activity and usage remained well below 25 residents.

Figure 10.1 Effluent discharge, Kemano 2015.



11. Summary of non-compliance and spills

In 2015, there were a total of four non-compliances for Kitimat and zero non-compliance for Kemano.

2015 performance

Non-compliance summary

These non-compliances are summarized with a brief description of their causes and the corrective actions that are either being assessed or implemented at the time this report was prepared (Table 11.1).

Spill summary

Spills at BC Works are first reported to the Plant Protection department and subsequently to the Environmental Services Department. Regulatory requirements are in place to report certain types of spills to the Ministry of Environment (referred to as "reportable" spills), depending on the nature and volume of the substance spilled. In 2015, five spills were reported to the Ministry (Table 11.2).

Spill-related awareness and prevention is a major focal point throughout BC Works. Immediate containment and minimization of potential environmental damage is the first priority. Specially equipped response teams are available when required. If appropriate, other agencies are informed and their cooperation enlisted.

Root cause analysis of reportable spills is conducted to prevent recurrence, and a system is maintained for recording and reviewing all spills and their frequency by type. This ensures that appropriate corrective actions are identified and tracked through to completion.

No known environmental damage was associated with any of the spills reported during 2015.

Table 11.1 Summary of non-compliances, 2015

Non-Compliance	Occurrence date	Impact	Permit Requirement	Cause	Implemented Corrective Actions
Roof particulate emissions	January, February, March, April June, July August and September	Jan: 9.2 kg/ Tonne Al Feb:10.6 kg/ Tonne Al Mar:21.4 kg/ Tonne Al Apr:13.8 kg/ Tonne Al Jun:12.0 kg/ Tonne Al Jul:10.1 kg/ Tonne Al Aug:14.8 kg/ Tonne Al Sep 10.5 kg/ Tonne Al	7.5 kg/Tonne Al Particulate emissions	Progressive idling of the VSS Lines impacted the potroom air flow inducing oversampling of Particulate emissions.	Short term: Detailed investigation - completed Interim: ECP (Escalation Control Plan) focus on: - Best operational practices - Metal management - Left over studs management Long term: Modernised smelter start-up and complete VSS idling - complete in October 2015
Failure to collect the grab sample during F-Lagoon overflow	14 February	No grab sample collected	Grab sample at F-Lagoon during overflow event	Misunderstanding of procedures	Short term: Detailed investigation - completed Interim: Sampling procedures revised with personnel. Long term: Installation of an automated sampler at F-Lagoon - completed
Grizzly bear in the South Landfill (putrescible waste area)	17 June	Human wildlife interaction	No bear in South Landfill putrescible area	Inadequate bear fence for conditioned grizzly bear	Short term: Improve waste segregation onsite Long term: Complete upgrade of the bear fence - completed
DCF-111 unauthorized bypass	18 June	5 seconds bypass	No bypass authorized	Compressed air shutdown	Short term: Detailed investigation - completed Corrective action: Shutdown of equipment with idling of the VSS smelter - completed

Table 11.2 Summary of reportable spills, 2015

Occurrence	Substance	Amount	Environmental Media	Causes	Corrective Actions
10 March	Sewage	34,100 litres	Storm sewer	Manholes not labelled properly	Review contingency plans and discharge locations for emergency situation
19 March	Sewage	500 litres	Gravel	Pump failure	Area cleaned by specialist
23 March	Hydraulic oil	2 litres	Marine	Barge ramp hydraulic cylinder leaking	Repair faulty equipment
12 April	Sewage	Undetermined	Drain	Water leaked into sewage tank and started pumping into a secondary tank which overflowed to drain	Water was shut off and the spill was cleaned by a specialist
10 October	Sewage	100 litres	Soil	Lift station overflow due to excessive inflows	Engineered improvement to lift station

12. Glossary

Anode
One of two electrodes (the positive electrode) required to carry an electric current into the molten bath, a key component of the electrolytic reduction process that transforms alumina ore into aluminium.

Anode effects
A chemical reaction that occurs when the level of alumina in a pot falls below a critical level, resulting in reduced aluminium production and the generation of perfluorocarbons (PFCs) – a variety of gases with a high carbon dioxide equivalency.

Anode paste
One of the materials used to manufacture anodes, composed of calcined coke and coal tar pitch.

AP4X
Pre-bake aluminium smelting technology used in the Kitimat modernised smelter.

Attrition index
An index used to express alumina strength; the higher the value, the weaker the alumina.

Carbon dioxide equivalency (CO_2e)
This is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential as the emission, when measured over a specified time period.

Carbon out
Removal of carbon fragments that have fallen off the anode or have formed points on part of the anode.

Cassette sampling
A sampling procedure for air emissions where contaminants are collected using filters placed at regular intervals along the length of a potroom.

Cathode
One of two electrodes (the negative electrode) required to carry an electric current into the molten bath; a key component of the electrolytic reduction process that transforms alumina ore into aluminium.

Coke calcination/calcined coke
A process involving the use of high temperatures to drive off volatile matter found in green coke, thus producing calcined coke for use in anode manufacturing.

Composite sample
A composite sample is treated as a single sample, despite being made up of multiple temporally discrete samples. For example, all effluent composite samples are taken over 24 hours during which a 50mL sample is collected every 10 minutes.

Dredgeate
Any material removed by dredging.

Dry scrubber
Pollution control equipment used to remove contaminants (in gaseous or particulate forms) from air emissions.

Effluent (B-lagoon)
Water discharge flowing out of the B-Lagoon outfall after treatment in the B-Lagoon system.

Electrolyte
A chemical compound that provides an electrically conductive medium when dissolved or molten.

Electrolytic reduction
This process uses electricity to remove oxygen molecules from aluminium oxide to form aluminium metal.

Exception pot
A pot that is not operating within the normal range and could result in openings in the alumina sealing. Exception pots are associated with increased fluoride emissions.

Fugitive dust
Solid airborne particulate matter that is emitted from any source other than a stack or a chimney.

Geometric mean
A geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values. The geometric mean is often used when comparing different items when each item has multiple properties that have different numeric ranges.

Green coke
The raw form of coke received at BC Works, which is calcined for use in the manufacture of anodes; a by-product of oil refining.

Grab sample
A grab sample is a discrete sample used to collect information for a specific or a short time. Variability of this data is much higher than a composite sample.

Leachate
A liquid which results from water collecting contaminants as it passes through waste material.

Leftover metal
Metal which accumulates in a pot when the schedule to remove the metal is not followed.

Loading
Loading is the emitted amount of a contaminate in a given time period.

Low magnitude pot
An exception pot which has had an anode effect with a magnitude of 25 volts or less.

Maximum allowable level
This level provides adequate protection against pollution effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.

Maximum desirable level
This level is the long-term goal for air quality programs and provides a basis for the federal government's antidegradation policy for unpolluted parts of the country.

Maximum tolerable level
This level denotes time-based concentrations of air contaminants beyond which appropriate action is required to protect the health of the general population.

Ministry
The British Columbia Ministry of Environment; to which BC Works reports on compliance with its permit requirements.

Off-light pot
Pots which have gone for a long period of time (generally 40 hours) without an anode effect.

Piezometer
A small diameter water well used to measure the hydraulic head of groundwater in aquifers.

Pitch
One of the materials from which anodes are made, and a by-product of metallurgical coke production.

Polycyclic aromatic hydrocarbons (PAHs)
A group of aromatic hydrocarbons containing three or more closed hydrocarbon rings. Certain PAH are animal and/or human carcinogens.

Pots/potrooms
Pots are large, specially designed steel structures within which electrolytic reduction takes place. The 588 pots at BC Works are housed within 5 pot lines (1C, 2A, 2B, 2C, 3A, 3B, 4A, 4B, 5A and 5B)

Process correction
Accessing the condition of exception or sick pots and bringing them back to normal operating conditions.

Putrescible waste
Waste that rots which can be easily broken down by bacteria, for example food and vegetable waste.

Pyroscrubber
A combustion-based system that controls dust emissions from the coke calciner.

Retention time
The average time a drop of water takes to move through a lagoon from inlet to outlet.

Scow grid
A dry dock for flat bottomed vessels (scows) formed from a series of piles and sills.

Sick pot
A pot that has an elevated bath temperature and cannot be sealed properly or is uncovered.

Spent pot lining (SPL)
Lining from the inside of pots, composed of refractory bricks and carbon that has deteriorated to the point where it needs to be replaced.

Stud
Studs constructed of steel are inserted vertically into the anode to conduct the flow of electricity through the anode and into the electrolyte.

Total suspended solids (TSS)
A water quality measurement that refers to the dry weight of particles trapped by a filter, typically of a specified pore size.

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