Air Quality: Between the smelter and the pulp mill - or worse?
SO_2, cruise ships, and people who live in James Bay

DRAFT

For years, James Bay residents have been questioning the quality of the air while linking problems to cruise tourism.

In the 2009 James Bay Neighbourhood Association (JBNA) Quality of Life Survey, respondents identified emissions as a problem. Traffic emissions were ranked as the **third** highest priority requiring attention in James Bay. 71% of respondents stated traffic emissions had worsened in the past five years. Aircraft emissions were ranked as the **seventh** highest priority requiring attention by respondents to the JBNA Quality of Life Survey. Among the transportation categories requiring attention, cruise ship emissions were ranked **fourth**, after tourist bus volumes, tourist bus noise, and motorcycles.

The results of the 2009 air monitoring study come as no surprise to most James Bay residents – we have a problem.

The following discussion provides a summary of work undertaken to date to:
~ assess air quality,
~ compare James Bay 2009 air quality findings to air quality standards and pollution levels elsewhere,
~ assess air quality impacts on health,
~ identify other information gaps about emissions levels,
~ reduce air pollution,
and presents the views of several James Bay residents who commented on air quality in the recent Quality of Life Survey.

"We are forced to close all our windows throughout the day until midnight when the cruise ships finally leave (very loudly). It is evident- the amount of pollution they are pumping out."
(Montreal St resident: JBNA QoL survey)

The JBAQS and MAML Projects:

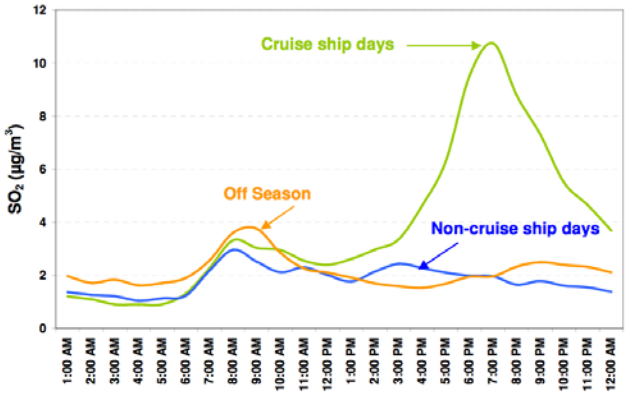
In response to on-going resident complaints about air quality, the James Bay Air Quality Study (JBAQS) was initiated in 2006. The **Vancouver Island Health Authority (VIHA)** sponsored studies aimed to ascertain general levels of pollutants in outdoor air through field monitoring and air quality dispersion modelling (CALPUFF model). Data was collected during the 2007 cruise-ship season and modelling was then completed and reported to the JBNA (see February 2009 James Bay Beacon). In general, field measurements were

limited to longer-term average concentrations of pollutants, SO_2 (sulphur dioxide), NO_2 (nitrogen dioxide), $PM_{2.5}$ and PM_{10} (particulate matter at 2.5 and 10 microns).

In addition, 2006 data from the CRD meteorological station on Topaz Ave was analysed. The schematic shows the relationship between SO_2 and cruise ships. 2006 typically saw cruise ships coming in sometime between 5-7 pm and leaving between 10 pm and midnight. A similar graph, created with 2009 data, would be expected to show a different timing of the correlation between cruise ships and SO_2 peaks.

2006 SO2 patterns
(JBAQS Phase I, page 60)

Figure 26. Average diurnal pattern of SO_2 at Topaz Station, 2006 on days with cruise ships, days without, and off season



The modelling suggested that short-term (24-hour) SO_2 concentrations may occasionally exceed World Health Organization (WHO) guidelines. The study recommended additional study of Volatile Organic Compounds (VOCs) as well as emissions from float planes, helicopters, and diesel buses.

JBAQS Phase II Predicted maximum 24-hour SO_2 concentrations (area within dashed line indicates exceedances of WHO guideline of 20 µg/m^3 for a 24-hour period).

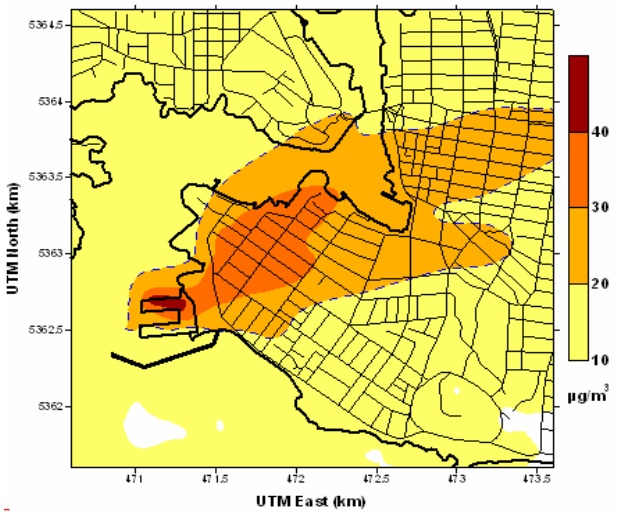
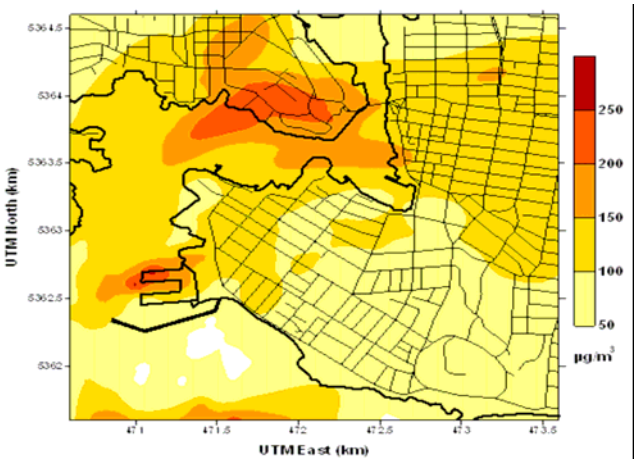


Figure 17. Maximum estimated 1-hour SO2 concentrations (µg/m^3)



The BC Ministry of the Environment (MoE) deployed its Mobile Air Monitoring Laboratory (MAML) in James Bay for the 2009 cruise-ship season. The MAML collected hourly air quality observations for a range of pollutants. From late May until the end of August, the MAML was located on Ladysmith St. east of Montreal St. by the community gardens, a location chosen where high levels of SO_2 (24-hour) were predicted by the model developed in Phase II. This location, upwind from the float plane runways and due east of the heliport, does not preclude capture of VOCs from Helijets, but could be expected to exclude VOC capture from other helicopters and float planes.

2009 MAML Project Results:

"We think cruise ships and their emissions are also worsening and top priority."

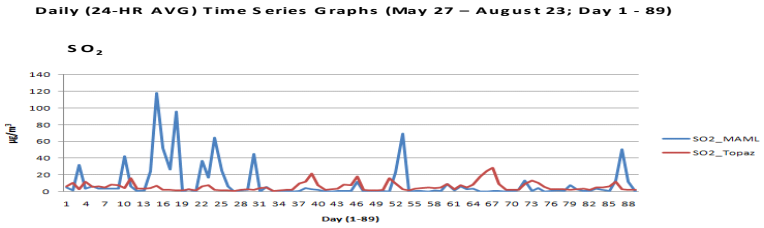
(Ladysmith St resident)

The MAML observations were reasonably consistent with the CALPUFF predictions with one major exception. 2009 SO_2 maxima were about three times predicted levels.

The highest 1-hour maximum SO_2 MAML readings were **448** µg/m^3(micrograms per cubic meter). One of these highpoints occurred on June 5, a typical Friday evening with two cruise ships in port from about 6 pm, leaving close to midnight.

The maximum 24-hour level of SO_2 measured was **122 µg/m^3,** on June 10th when three cruise ships, a freighter and a yacht were at Ogden point for parts of the 24-hour period. Two ships were in port for about 14 hours, one ship for about 2.5 hrs, and three ships for about 7.5 hours. The next highest 24-hour level of SO_2 was **99 µg/m^3,** on June 13th, a typical Saturday evening with three cruise ships in port from about 6 pm, leaving close to midnight.

(Note – Schematic below is from the interim report)



SO_2: What is it? Where does it come from?

"No. 1 problem is air pollution. It is so bad that metal ornaments etc. get tarnished about 3 times as quickly as anywhere else we have lived & I've reason to believe it has also affected the health of one of us." *(Dallas Rd resident – over 75 yrs old)*

Sulphur dioxide (SO_2) is a colourless gas, with a perceivable odour at higher concentrations. It is emitted into the air by the combustion of fuels containing sulphur and from industrial processes such as mineral smelting and natural gas processing. Natural sources of SO_2 include volcanic activity and vegetation decay.

Sulphur dioxide is a major component in acid rain and accounts for 70% of total acid rain generated. SO_2 emissions explain the observation of the Dallas Road resident who noticed that metals tarnished quickly. SO_2 also damages vegetation and rock/stone.

Fuel powered marine vessels are considered to be the main source of SO_2 in Victoria and James Bay in particular. Large marine vessels such as cruise ships and ferries are the main contributors. Phase l of the JBAQS examined Topaz data and cruise ship activity. SO_2 levels were found to peak when cruise ships were in port. This analysis is shown graphically on page 60 of the JBAQS Phase l Report (see link under News Bulletin on www.jbna.org). Other ships also contribute quantities of SO_2.

Effect of Air Pollution on Health:

"Toxic! What are the long-term effects on our health?" *(Michigan St resident)*

High doses of a pollutant over a short period of time may impact health differently than low doses of the same pollutant over longer periods of time. The level at which an individual may be affected by an air pollutant such as SO_2 is dependent upon the health of the individual and their vulnerability.

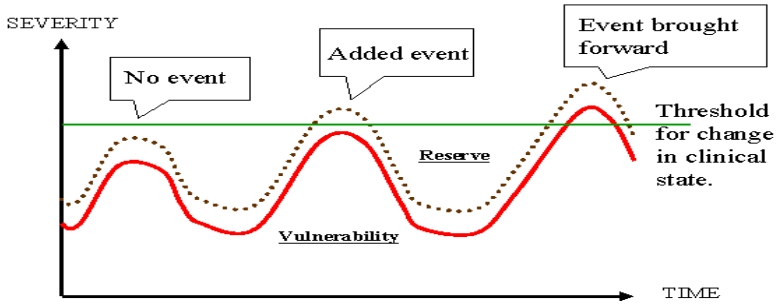
Asthmatics are particularly sensitive to short term high level exposures (1 hour); however, medium term (24 hour) exposure effects may include an increase in hospital admissions for asthmatics and those with heart disease or chronic obstructive pulmonary disease. Little is known about the long term effects of lower levels of SO_2.

Note: Following charts from Dr.Tom Kosatsky (BC Centre for Disease Control)Dec. 10, 2008.

Susceptible population with respiratory illness in James Bay

Consultation with a physician for Asthma or Acute & Chronic Obstructive Pulmonary Disease among residents of James Bay			
Diagnosis	Age Group	# Patients	% of Population
Asthma	≤ 15	41	5%
	≥ 65	91	3%
Acute & Chronic Obstructive Pulmonary Disease	≥ 65	259	8%

Source: BC Ministry of Health Services, Medical Services Plan, April 1- October 31, 2008



The role of air pollution in exacerbation of disease[4]

In his December, 2008, presentation, Dr Kosatsky of the BC Centre for Disease Control, stated that in his examination of hospital and medical records, he did not see a significant difference between the incidence of hospital admissions for James Bay residents and other residents in the area.

This is not surprising due to:
· the relatively small population in the most impacted area of James Bay,
· the dispersion of the plume to other nearby neighbourhoods are not fully understood, and
· there may be a "healthy worker syndrome" at play where vulnerable residents choose to relocate to other parts of the city.

Current Air Quality Standards:

"The cruise ships stink and after it's dark they really pump out the pollutions so much that it is hard to breathe. Aren't there any laws against this?" *(Montreal St resident)*

As the ill-effects of pollutants become known and as technological advances are made, air quality standards are evolving. The level of pollutants considered to be acceptable is being reduced.

Victoria's air quality is routinely monitored at a location on Topaz Ave. The air quality measurements most often provided are the 1-hour, 24-hour, and annual levels. The Topaz Ave measurements were used extensively throughout the JBAQS to provide baseline and comparative information.

The World Health Organization (WHO) has led in the creation of air quality guidelines and now most countries and regions have standards. In 2005, the WHO developed a new, lower SO_2 24-hour guideline.

In November, 2009, the US Environmental Protection Agency announced its intent to create a 1-hour standard for SO_2 which is anticipated to be ⅓ to ½ of the current Canadian standard.

James Bay MAML/Topaz Maximum Levels & Air Quality Standards

	Maximum SO_2 Levels May 26 – Aug. 24, 2009 (µg/m^3)		**Standards/Guidelines (µg/m^3)**				
	MAML	Topaz	WHO	Can	BC	CRD	EPA proposed
10-minutes *(n=11,678)*	**599**	316	500				
1-hour *(n=1,962)*	**448**	170		450	450		135-265
24-hour *(n=87)*	**122**	29	20	150	160	125	

10-Min: WHO exceeded 3 times at MAML (June 5, 5 & 13)
1-hour: Lowest proposed EPA exceeded 50 times or 2.4% at MAML and once at Topaz
24-hour: WHO guideline exceeded 14 days out of 87 or 16% of the days at MAML and 3 days at Topaz or 3.5% of the days monitored.

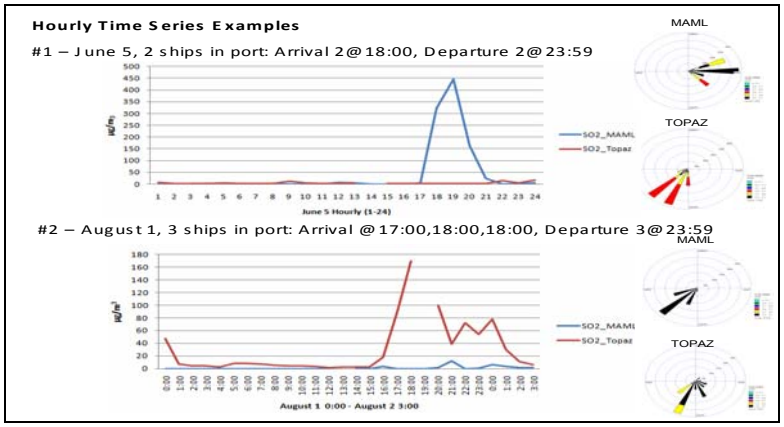
In James Bay, the 1-hour maximum peak measured by MAML was 448 µg/m^3 which did not exceed the Canadian/BC 1-hour standard of 450 µg/m^3. The maximum 24 hour concentration in James Bay was 122 µg/m^3, below the CRD/BC/Canadian standards of 125/160/150 µg/m^3, respectively, but far above the WHO standard of 20 µg/m^3. **From June through August, SO_2 24-hour values exceeded the WHO standard on 16% of the days monitored or 24% of the days when cruise ships were in port.**

Air Quality Beyond James Bay:

"Pollution from cruise ships is very visible from a west-facing apartment." *(Douglas St resident)*

The plume of gases and particulate matter from ship smokestacks can affect the whole of the City of Victoria. On an unusual day with a strong easterly wind, the plume could be over Esquimalt.

With different winds, the plume could bypass the Ladysmith/Montreal area but cause high measures of SO_2 at the Topaz monitoring facility. On August 1, with three ships in port, Topaz values were heightened while MAML recorded only a blip.



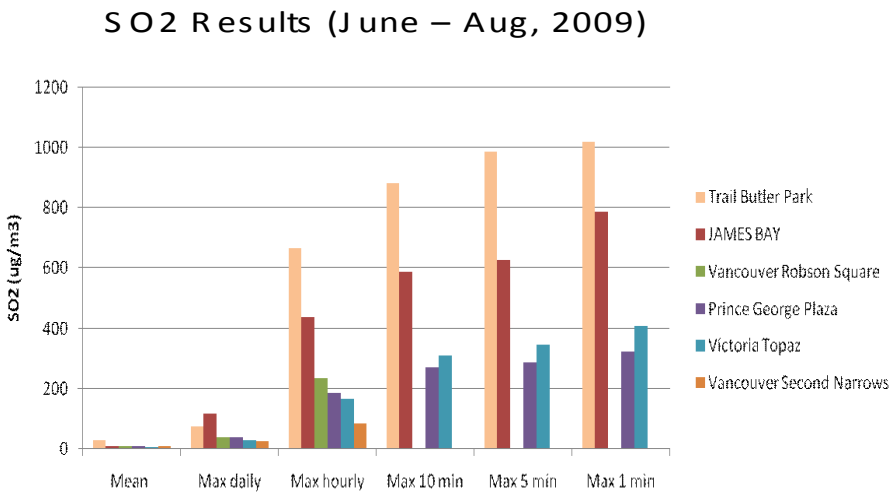
MAML monitored air quality at one location in James Bay, but another location may have led to different readings. Meteorological conditions can greatly impact the dispersion of the plume, but with a west-south-west prevailing wind, the pollutants are generally affecting air quality somewhere in the James Bay area.

The MAML was positioned within the area predicted to receive the highest levels of 24-hour SO_2 concentrations in Phase II of the JBAQS. The prediction map for 1-hour SO_2 concentrations was quite different. The area with the maximum SO_2 concentration was predicted to be the Songhees area. This area was also predicted to receive the highest levels of NO2 (other than the Ogden berths).

Comparing Air Quality in BC & Alberta:

"As we have not lived in the community long enough for most comparisons, but have noted the air quality – dust debris is more evident than our previous residence." *(Avalon Rd resident)*

BC: In addition to comparing MAML James Bay measures with Topaz values, MAML SO_2 measures were compared to measures from Trail Butler Park, Vancouver Robson Square, Prince George Plaza, and Vancouver Second Narrows.



On a maximum daily basis, SO_2 measurements recorded in James Bay this past summer are 1.6 times higher than those recorded at Trail Butler Park, 3 times those recorded at Vancouver Robson Square and Prince George Plaza, 4 times those recorded at Victoria Topaz, and 5 times those recorded at Vancouver Second Narrows. On a maximum hourly basis, measurements recorded in James Bay are exceeded by those recorded at Trail Butler Park, but are considerably higher than those recorded at the other four sites. The five-fold difference between the James Bay measurements and those recorded at Vancouver Second Narrows on both a maximum daily and maximum hourly basis is surprising, since Vancouver Second Narrows is, due to prevailing westerly winds, down-wind of the Vancouver dockyards.

Ft McMurray: There are several air monitoring sites in or near Ft McMurray, Alberta (see www.casadata.org). In 2007, the number of 1-hour SO_2 exceedences (>450 $\mu g/m^3$) was four for Mannix, two for Millenium, and one exceedance each for Mildred Lake, Lower Camp, and Buffalo View Point. In 2004, Mannix had eleven exceedances. In the past 5½ years the Mannix site experienced two 24-hour exceedances. The other sites, none.

The ship illustrated in the photograph at the beginning of this report housed about 1850 passengers, which is slightly smaller than the typical capacity of the cruise ships which called at Ogden Point this past summer. However, the two ships diverted to Victoria from their Mexico itinerary housed about 3,100 passengers, and the new generation of cruise ships, under construction, will house 3,800 passengers.

During the 2009 Victoria cruise season, the maximum SO_2 measured, 448 $\mu g/m^3$, was 2 $\mu g/m^3$ below the exceedence level of 450 $\mu g/m^3$. James Bay does not yet have the SO_2 exceedance levels periodically experienced in the Alberta tar sands, but more and bigger ships are on the way!

Gaps in Emissions Knowledge:

"The noise & air pollution from float planes makes this an unpleasant part of town in which to live." *(Montreal St resident)*

"*There is one problem not covered and it is a major one in my neighbourhood. Helicopter Fuel Rain: I am not speaking of exhaust, but unburned fuel that rains down on my neighbourhood and me, especially when a light breeze is blowing from the heliport across the street to my home…. I can feel it fall on my skin and I can see it on my windows … to say nothing of the smell. The cancerous consequences of this scare the crap out of me, to be blunt … there is nothing I can do about it but leave James Bay, and I love it here.*"
(St Lawrence St resident)

Helicopters and float planes as emission sources in the James Bay community were not the focus of the JBAQS or 2009 MAML monitoring. However, the JBAQS Phase II report recognises VOCs as a significant information gap.

The air quality impact of emissions from buses in James Bay may be another gap. It is not known if bus effects were picked up by MAML.

The Road Ahead:
"Cruise ships way too many! And it seems it will get worse! Yikes…" *(Government St resident)*

VIHA: The VIHA sponsored team released a 2009 air quality report in February 2010. Results from the 2009 MAML monitoring study will be sent to Dr. Tom Kosatsky, Associate Director of Environmental Health Services, of the BC Centre for Disease Control. VIHA continues to support further assessments.

BC Hydro: Although Vancouver has reduced fuel emissions through the use of shore power (plugging in the ships while in port), BC Hydro has stated that the power-grid to Victoria is insufficient to support similar mitigative action in Victoria.

CRD: The CRD air quality report from the Topaz monitoring station for the year 2008 was released in November, 2009. The CRD study states "*SO_2 from cruise ships unequivocally has the greatest effect on ambient concentrations of this contaminant at the Topaz site.*" The report recognizes that the contaminant levels at any one place within the city are greatly affected by the wind. It further states "*Perhaps of greater concern is the factor of 5 difference between predicted and observed SO_2 concentrations reported in the JBAQS modelling analysis between concentrations at Ogden Point and at Topaz. If this factor difference were to hold true for the impact of cruise ship emissions in 2008, the 130 $\mu g/m^3$ impact level at the Topaz site would translate into an hourly averaged SO_2 concentration at Ogden of about 650 $\mu g/m^3$*" and "*may be high enough in the James Bay community to be of concern for human health impacts*".

EPA/USA/Canada: The United States and Canada are in discussions concerning the EPA (US Environmental Protection Agency) initiative to reduce pollution created by ships that use bunker fuels with high sulphur content when in or close to port.

~ The EPA proposal would require the sulphur content of fuels to be reduced from 1.6%-2% in current use along the West Coast, to 1.0% by 2012 and to 0.1% **by 2015**. If this proposal is implemented, Victoria may expect much cleaner air **in 6 years time**.

~ The 2007 North-West Ports Clean Air Strategy called for the signatory ports of Seattle, Tacoma, and Vancouver to use 1.5% sulphur fuels by 2010 when in, or close to, these ports.

GVHA: The GVHA is committed to 'growing cruise tourism' by increasing the number of cruise ships and bringing the super-sized ships into Victoria harbour.

"The emissions aren't good but I'm ok with the tourists." *(Toronto St resident)*
"I am tired of hearing how much these cruise ships mean to the City economy; little of it is returned to James Bay; we are just being whored out to other interests." *(San Jose Ave resident)*

Phase I & II reports are now available on the VIHA web-site. http://www.viha.ca/mho/publications

For discussion on WHO 2005 Standards, see:
http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf

Note: Much or most of the discussion and all graphs and charts were obtained from Phases I & II JBAQS Study reports, Phase III presentation slides, and the James Bay MAML Project Overview.

September 29, 2009

Note:
The Celebrity Mercury, pictured, was not in port during the MAML monitoring period. Scheduled visits were May 8 and eight days between September 20 and October 14, 2009.