

**TO:** CITY MANAGER

**DATE:** 2002 08 06

**FROM:** DIRECTOR ENGINEERING

**FILE:** 10 08 11 (01)

**SUBJECT: CHEVRON CANADA REFINERY AIR EMISSIONS - HUMAN HEALTH RISK ASSESSMENT STUDY**

**PURPOSE:** To inform Council on the findings of the Human Health Risk Assessment Study undertaken to determine possible health impacts of current air emissions from the Chevron Canada Refinery in North Burnaby.

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**RECOMMENDATION:**

1. **THAT** the Federal Minister of Environment and the B.C. Minister of Water, Land and Air Protection undertake a review of the Ambient Air Quality Objectives for Sulphur Dioxide.
2. **THAT** the B.C. Minister of Water, Land and Air Protection request that the Greater Vancouver Regional District consider taking measures to reduce air emissions of sulphur dioxide and volatile organic compounds from the Chevron Canada Refinery based on the findings of the Human Health Risk Assessment Study led by the Ministry.
3. **THAT** the Fraser Health Authority comment on any specific actions which may be needed to be taken by the public when ambient sulphur dioxide levels at nearby regional air quality stations exceed 100 parts per billion over a 10-minute period.
4. **THAT** the Greater Vancouver Regional District:
  - a) Require Chevron Canada Limited to develop a sulphur dioxide air emission reduction plan with specific time lines from current emission levels for their refinery located in Burnaby;
  - b) Require Chevron Canada Limited to develop a curtailment strategy for air emissions from their refinery in Burnaby when the sulphur dioxide readings at the nearby regional ambient air quality monitoring stations approach 100 parts per billion over a 10 minute period;
  - c) Store and Report sulphur dioxide readings from their ambient air quality monitoring stations near Chevron Canada Refinery as 10-minute average values;

- d) Monitor for manganese at the regional air quality monitoring stations as 24-hour averages for a period of one full year; and
  - e) Require consistent ship loading and barge loading procedures for gasoline from petrochemical facilities within the region by requiring all ships and barges to hook up to vapour recovery units and thereby reducing volatile organic compounds emissions.
- 5. **THAT** Environment Canada continue monitoring for ambient concentrations of Volatile Organic Compounds in Greater Vancouver.
  - 6. **THAT** the Ministry of Water, Land and Air Protection, as chair of the Chevron Canada Refinery Air Emissions Human Health Risk Assessment Project Advisory Committee, host a public forum to inform the public on the findings of this Human Health Risk Assessment Study.
  - 7. **THAT** City staff be authorized to participate in the public forum hosted by the B.C. Ministry of Water, Land and Air Protection.
  - 8. **THAT** a copy of the "Air Emissions from Chevron North Burnaby Refinery Human Health Risk Assessment" Report be made available at all public libraries in Burnaby.
  - 9. **THAT** copies of this report be forwarded to:
    - a) The Federal Minister of Environment;
    - b) The BC Minister of Water, Land and Air Protection;
    - c) The Fraser Health Authority;
    - d) The Greater Vancouver Regional District;
    - e) The Burnaby School Board;
    - f) The Environment and Waste Management Committee; and
    - g) Chevron Canada Limited.

## REPORT

### 1.0 BACKGROUND

Following a series of incidents at Chevron's Burnaby Refinery in late 1999 and early 2000, Chevron Canada Limited commissioned the following three environmental studies in June 2000:

- a) Environmental Compliance Audit - to review the refinery operations to ensure that Chevron is meeting its obligations under its permits;
- b) Public Safety Risk Assessment - to review the potential impact of the refinery on the community and the response to accidental release; and
- c) Perimeter Groundwater Monitoring Program - to determine if contaminants originating from the Chevron site are migrating, or may in the future migrate, via groundwater to Burrard Inlet.

The above studies were completed in 2001 and Council has been informed on the findings of the studies. A further update on follow-up action on the above study findings will be the subject of a separate report to Council.

In addition to the above studies, the B.C. Ministry of Water, Land and Air Protection (previously called the B.C. Ministry of Environment, Lands and Parks) led a Human Health Risk Assessment study to determine possible health impacts of air emissions from the Chevron Refinery. This study has now been completed.

The following report summarizes findings of the Human Health Risk Assessment Study and recommends actions for Council's consideration to address issues noted in the study.

### 2.0 CHEVRON CANADA REFINERY AIR EMISSIONS - HUMAN HEALTH RISK ASSESSMENT STUDY

A team of researchers from the School of Occupational and Environmental Hygiene at the University of British Columbia (UBC) was retained by the B.C. Ministry of Water, Land and Air Protection (BCWLAP) to assess the human health impact of air emissions from the Chevron Canada Refinery in North Burnaby.

The terms of reference for the study (see Attachment #1) were developed by the UBC research team and approved by the Project Advisory Committee consisting of representative from BCWLAP, Environment Canada, GVRD, Fraser Health Authority, Chevron Canada, City of Burnaby and community members.

To receive additional input from the community, a flyer (in English and Cantonese) was distributed to the North Burnaby residents. A web site was set up where residents could learn more about the project and provide input and insight to the research team. A hundred and sixty-five responses were received from the community.

The overall objective of the study was to perform an assessment of the potential human health impacts of current air emissions (scheduled or unscheduled) from the Chevron Canada Refinery, tank farm and associated facilities. The assessment was to be based on the health and exposure information available in the scientific literature and existing data on ambient air pollution concentrations near the Chevron Refinery.

Emissions modelling was not carried out. Evaluation of risks to nearby residents from sources other than breathing air pollutants from the operation of the refinery or tank farm was outside the scope of the study. In addition, evaluation of possible causes for elevated pollution levels and discussion of risk management options were also outside the scope of the study.

Standard risk assessment procedures were followed, modified by the need to address community concerns, not regulatory objectives.

Ambient concentrations of air pollutants monitored by the GVRD and Environment Canada were reviewed for 1998, 1999 and 2000. These data consisted of continuous daily monitoring results (stored as 1-hour averages) for particulate matter, nitrogen dioxide, carbon monoxide and ozone, and less frequent 24-hour average values on a 6-day rotation for each of 142 volatile organic compounds.

Concentrations of pollutants at two regional ambient air quality monitoring stations in North Burnaby T23 (located on Capitol Hill at Grosvenor Crescent) and T24 (located at Eaton Street and Madison Avenue) were compared to concentrations in other residential (North Vancouver, Kitsilano) and industrial (downtown Vancouver, Port Moody) neighbourhoods in the GVRD and to concentrations found at monitoring locations close to other refineries (Saint John, Montreal, Sarnia, Edmonton) in Canada. Where data were not available for either T23 or T24 stations, ambient air pollutant concentration data at T4 (located at Kensington Park) were used instead.

Where the regional ambient air monitoring station indicated elevated concentrations of pollutants in North Burnaby compared to elsewhere in the GVRD, a detailed review of existing scientific literature was carried out to identify potential health impacts of exposure to the pollutants at the levels seen in this community.

The study findings are noted below. For Council's information, a complete copy of the subject study is available in the Engineering Department or at UBC Website [www.interchg.ubc.ca/burnaby/](http://www.interchg.ubc.ca/burnaby/) for review.

## **2.1 Particulate Matter (PM10), Nitrogen Dioxide, Carbon Monoxide, Ozone**

Ambient concentrations of particulate matter (PM10), nitrogen dioxide and ozone (all monitored at Capitol Hill) and carbon monoxide (monitored at Kensington Park) were not elevated when compared to other GVRD residential locations. Concentrations of all of the above pollutants were also below the GVRD, Environment Canada and US guidelines.

Based on the similarity of ambient levels in North Burnaby to other residential areas in the GVRD, the UBC research team does not expect that the residents of North Burnaby would experience additional health consequences because of exposure to these compounds, compared to other GVRD residents.

## **2.2 Sulphur Dioxide**

Ambient air concentrations of sulphur dioxide monitored at Capitol Hill (T23) and the tank farm area (T24) averaged over a 24-hour period were not significantly elevated compared to other areas in the GVRD with the exception that in December 1999 the Federal Desirable Objective was exceeded on three days.

However, the proportion of days during which sulphur dioxide 1-hour peaks were detected were considerably higher at the Capitol Hill regional ambient air quality monitoring station than at any other monitoring locations including downtown Vancouver and the Port Moody industrial area. During the review of 2.5 years of data, there was 1 excursion over the Federal Acceptable Air Quality Objective (1-hour) and 21 excursions over the Federal Desirable Air Quality Objective (1-hour) at the Capitol Hill station on 7 different days. When compared to the Environment Canada monitoring stations close to four refineries across Canada, the frequency of peak sulphur dioxide concentrations in North Burnaby is higher than in two, but lower than the other two.

As the monitoring data showed increased frequency of sulphur dioxide peaks in the North Burnaby area compared to other locations in the GVRD, the research team carried out a comprehensive review of scientific literature to evaluate the evidence supporting various

exposure guidelines and air quality objectives for sulphur dioxide. A total of 46 relevant articles were retrieved and summarized. Based on the detailed review, the research team concluded that 10 minute excursions over 100 parts per billion of sulphur dioxide would likely be associated with exacerbations of respiratory symptoms among a subset of asthmatics engaged in moderate activity outdoors. Applying a US EPA method to the ambient air monitoring data it was estimated that 140 10-minute peak concentrations of sulphur dioxide occur each year (on 54 different days) in excess of this health-based comparison value. The "time of day" profile of sulphur dioxide peaks suggest that about 50% of these occur during the daytime hours.

Statistics Canada population data for two geographic areas (the neighbourhoods bounded by Burrard Inlet, Hastings Street, Boundary Road and Fell Avenue, and the North Burnaby areas within 2 km radius of the refinery) together with Canadian and GVRD asthma prevalence rates to predict the expected impact of these sulphur dioxide peaks on the residents were used to determine the proportion of North Burnaby residents who might experience exacerbations of asthma.

Based on the calculations, the UBC research team estimated that about 15 to 35 North Burnaby residents might experience exacerbations of asthma on any of about 25 to 30 days each year as a result of sulphur dioxide peaks in the Capitol Hill neighbourhood.

### **2.3 Total Reduced Sulphur**

Total reduced sulphur data (TRS) was reviewed from five regional monitoring stations. The frequency of TRS peaks was highest at the industry intensive Port Moody ambient air quality monitoring station (with 70% of values above detectable level) and second highest at the North Burnaby monitoring station adjacent to the tank farm (with 55% of values above detectable level). At the other locations, only 20% of values were detectable.

TRS compounds, which have a distinctive rotten egg odour, were elevated over the Federal Acceptable Air Quality Objective (1-hour) on 3% of all the monitoring days at the tank farm monitoring location and 1.2% of days at the Capitol Hill monitoring location compared to 4.5% of days at Port Moody and less than 1% on Burnaby Mountain and Kensington Park monitoring locations. On 11.5% of days at the tank farm monitoring location and 3.6% of days at the Capitol Hill monitoring location, the characteristic unpleasant odour of TRS compounds was present, for at least 1 hour at levels likely to be noticed by at least 50% of the population. This is compared to 18.4% of days at Port Moody and less than 1% of days elsewhere.

In the UBC research team's review of literature on epidemiological studies in communities exposed to ambient TRS compounds, it was noted that there is evidence that higher

concentrations - average levels about 10 times higher than in North Burnaby - may contribute to increased respiratory, nose and eye irritation.

Based on very limited evidence, it appears that TRS levels as seen in North Burnaby are unlikely to contribute directly to the development of irritant symptoms, but they are sufficiently high to contribute to odour annoyance. The research team was not able to determine whether this odour annoyance contributes to symptom perception or exacerbation.

## 2.4 Volatile Organic Compounds

Monitoring data for 142 volatile organic compounds (VOCs) were reviewed for 1999 and 2000 from Environment Canada's network of monitoring stations, including one location near the Chevron Refinery tank farm.

Average ambient concentrations of the VOCs characteristic of petroleum fuels were significantly elevated (over 5 times higher) in the area near the tank farm compared to other locations. This included all 44 alkanes tested, 29 of 33 alkenes, 22 of 24 aromatic compounds, and a mixture of individual compounds representative of gasoline vapour. Alkynes and halogenated compounds tended not to be elevated compared to other locations. Gasoline vapour concentrations were also significantly higher in North Burnaby compared to monitoring stations located in other Canadian communities with oil refineries.

The ambient concentrations of gasoline vapour were below levels shown to be linked to respiratory and eye irritation in animals but the size of the margin of safety for humans is unclear from the information available in the scientific literature. In contrast, more often than not, the ambient concentration of gasoline was higher than the level at which gasoline can be detected by smell, indicating a significant potential for odour annoyance.

A detailed review of all individual compounds showed that the average or maximum ambient concentration was at or near health-based comparison values for six compounds (trimethylbenzene, 1,3 butadiene, benzene, bromodichloromethane, 1,2 dichloroethane, and 1,4 dichlorobenzene). Of these, only two compounds, benzene and 1,3 butadiene, were found at levels that may result in a real health impact to the population. Benzene is a known human carcinogen and 1,3 butadiene is classified as a probable human carcinogen.

Based on the ambient monitoring data for outdoor concentrations and estimated indoor concentrations for these pollutants from scientific literature, the UBC research team calculated the predicted number of cancers among area residents that could be attributable to the exposures to benzene and 1,3 butadiene from the refinery and tank farm to be less than one excess cancer over a period of about 70 years among all residents of the area. To put these numbers in context, the lifetime probability (i.e., over about 70 years), among all

Canadians, of developing lung cancer is 8.8 in 100 for men and 5.3 in 100 for women. Similar rates for developing leukemia are 1.4 in 100 in men and 1 in 100 for women.

The research team also reviewed ambient concentration data for the current gasoline additive methyl tertiary butyl ether (MTBE), and its proposed substitute, iso-octane. MTBE data were available for between 3 and 13 days of monitoring at various locations. Iso-octane data were available for the full 2 year period. Based on the review, it was noted that average MTBE concentrations were significantly higher near the tank farm compared to other locations.

However, the average values at Chevron tank farm location were 6 times lower than the California EPA 1 in 100,000 upper bound cancer risk estimates.

This suggests that the cancer risk to North Burnaby residents associated with exposure to MTBE, if any, is likely to be extremely small (even smaller than that identified for benzene and 1,3 butadiene).

With respect to iso-octane, the ambient concentrations of iso-octane were elevated compared to elsewhere in the GVRD, but the levels were 50-100 times lower than the health based comparison value derived from the literature review. The research team did not estimate the change in ambient concentrations of iso-octane that may accompany the increased volume to be stored and transferred on the Chevron site. However, according to the research team the levels would have to increase considerably before iso-octane concentration would reach a level of concern.

## **2.5 Metals**

Two metals (manganese and vanadium) associated with petroleum processing elsewhere were considered. However, no neighbourhood data were available. Based on the review of other studies, the research team felt that ambient monitoring data for manganese would be helpful to rule this out as a health concern.

Given that no ambient monitoring data are available for vanadium in the North Burnaby area, the research team felt that of the available data, the PM<sub>10</sub> concentrations are probably the best indicator. The relatively low ambient PM<sub>10</sub> concentrations, along with the absence of any documented coal or intensive residual oil burning in the area make it relatively unlikely that vanadium is present in higher concentrations than one would expect in urban areas.

## **2.6 Review of Results of Petrochemical Community Epidemiological Studies**

The UBC research team review of 26 epidemiological studies from other refinery communities provided results completely consistent with the results of this risk assessment.



Lung cancer rates were elevated in some communities, but only in the most highly polluted petrochemical industry areas or among workplace populations. There was little, if any evidence, of a link between leukemia and community exposure to oil refinery emissions or between cancers at other sites and oil refinery emissions. The results were not consistent across studies and no convincing evidence of excess cancers of any particular type emerges from the studies. The studies with the strongest methodologies did not find associations with community residence and either lung cancer or leukemia. These findings are consistent with the very small number of predicted excess cancers estimated from this risk assessment.

There was no evidence of an association between residence in a community near to petrochemical industry and adverse pregnancy outcomes.

A small number of studies did find an increase in odour complaints and, to a lesser extent, irritative symptoms, in association with residence nearby to oil refineries. These findings are consistent to the conclusions presented earlier in this study with respect to sulphur dioxide and total reduced sulphur exposures in North Burnaby.

## **2.7 Study Recommendations**

Based on the findings, the following recommendations are made by the UBC research team with respect to monitoring and reporting contaminants in order to facilitate assessments of health impacts:

- a) Since the GVRD already collects sulphur dioxide data on a minute-by-minute basis, this information should be reported and stored as 10-minute average values, to facilitate future assessments of health impacts;
- b) If MTBE continues to be present at the refinery site, it would be useful to add MTBE to the panel of VOCs monitored regularly, in order to determine, more fully, the potential for an impact on health;
- c) Given the elevated VOC concentrations, continuation of the VOC monitoring will be useful for future assessments; and
- d) Given the presence of manganese in gasoline and the high gasoline vapour concentrations near the tank farm, it would be useful to perform some ambient monitoring for manganese (24-hour averages) at the GVRD monitoring stations in order to compare North Burnaby concentrations with those elsewhere in the GVRD. This should be done for a full year to be useful for health assessment purposes.

### 3.0 STAFF COMMENTS

Staff has found the subject report to be comprehensive and a critical element in prioritizing the key issues with respect to impacts of air emissions from Chevron Canada Refinery on neighbouring residents. The Project Advisory Committee, chaired by the Ministry of Water, Land and Air Protection, allowed for a good dialogue between various stakeholders. It is to be noted that the subject report has undergone a peer review process and these reviewers were largely in agreement with the conclusions noted in the study. In addition, comments from the GVRD, City, Chevron (both from Chevron Canada and from scientific staff at Chevron Texaco Energy and Research Technology, Richmond, California), BRACE and several individuals were also received and incorporated where applicable.

In reviewing the findings of the study, staff would comment as follows:

#### 3.1 Sulphur Dioxide Emissions

Based on the findings of the subject study and the findings of the Environmental Compliance Audit report undertaken by Dillon Consulting Ltd. which, in part, noted that, from an emissions factors (i.e., the quantity of pollutant emitted per unit of operating capacity) basis, Chevron Refinery had higher Sulphur dioxide, VOC and MTBE emissions factors (for the year 1996) when compared to selected refineries in California, staff would recommend that:

- ▶ The Federal Minister of Environment and B.C. Minister of Water, Land and Air Protection undertake a review of the Ambient Air Quality Objectives for Sulphur Dioxide;
- ▶ The B.C. Minister of Water, Land and Air Protection request the Greater Vancouver Regional District to consider taking measures to reduce air emissions of sulphur dioxide from Chevron Canada Refinery based on the findings of the Human Health Risk Assessment Study led by the Ministry;
- ▶ The Fraser Health Authority comment on any specific actions which may be needed to be taken by the residents of North Burnaby when ambient sulphur dioxide levels at nearby regional air quality stations exceed 100 parts per billion over a 10-minute period; and
- ▶ The Greater Vancouver Regional District:
  - a) Require Chevron Canada Limited to develop a sulphur dioxide air emission reduction plan with specific time lines from current emission levels for their refinery located in Burnaby;

- b) Require Chevron Canada Limited to develop a curtailment strategy for air emissions from their refinery in Burnaby when the sulphur dioxide readings at the nearby regional ambient air quality monitoring stations approach 100 parts per billion over a 10 minute period; and
- c) Store and Report sulphur dioxide readings from their ambient air quality monitoring stations near Chevron Canada Refinery as 10-minute average values.

For Council's background information, attached (see Attachment #2) are responses from the GVRD and Chevron to questions raised by the City on the Preliminary Plan Application and air emissions amendments application filed by Chevron Canada Limited for their low sulphur fuels project. According to the GVRD, they anticipate making a decision on the noted application in September, 2002. As noted in a staff report to Council on May 27, 2002, staff will be forwarding a separate final report to Council on the Preliminary Plan Approval Application (PPA #02-116) filed by Chevron Canada Limited for low sulphur fuels project upon completion of a full review by City Departments and outside agencies of the information provided.

### **3.2 Volatile Organic Compounds**

It is noted that in order to reduce VOC emissions from the refinery and tank farm area, Chevron is moving toward a full compliance by 2004 with the CCME Code of Practice for Above Ground Storage Tanks for Controlling VOC's from Above Ground Storage Tanks. In addition, the Leak Detection and Repair (LDAR) program in Area 1 and Area 2 has been implemented with the intent of further reducing VOC fugitive emissions. With respect to the marine vessel and tank truck loading and unloading facilities, Vapour Recovery Units (VRU) are in operation during the transfer of materials. However, it is also understood that not all ships or barges are capable of hooking up to the VRU. In order to address this, staff would recommend that:

- ▶ The B.C. Minister of Water, Land and Air Protection request, the Greater Vancouver Regional District to consider taking measures to reduce air emissions of volatile organic compounds from Chevron Canada Refinery based on the findings of the Human Health Risk Assessment Study led by the Ministry;
- ▶ The Greater Vancouver Regional District requires consistent ship loading and barge loading procedures for gasoline from petrochemical facilities within the region by requiring all ships and barges to hook up to vapour recovery units and thereby reducing volatile organic compounds emissions; and

- ▶ Environment Canada continue monitoring for ambient concentrations of Volatile Organic Compounds in Greater Vancouver.

### **3.3 Metals**

Staff concur with the study conclusion on metals and recommend that the:

- ▶ Greater Vancouver Regional District monitor for manganese at the regional air quality monitoring stations as 24-hour averages for a period of one full year.

### **3.4 MTBE**

It is understood from Chevron officials that MTBE will no longer be present at the refinery after this year. As such, there may not be a need to add MTBE to the panel of VOCs monitored regularly by Environment Canada in the GVRD.

### **3.5 Communication of Study Findings to North Burnaby Residents**

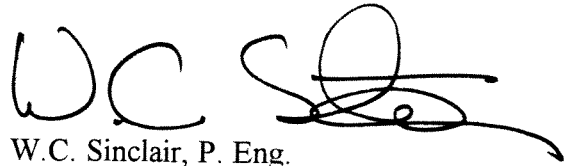
In order to ensure that the residents of North Burnaby are made aware of the findings of the subject study, staff recommend that:

- ▶ The Ministry of Water, Land and Air Protection, as chair of the Chevron Canada Refinery Air Emissions Human Health Risk Assessment Project Advisory Committee, host a public forum to inform the North Burnaby residents on the findings of this Human Health Risk Assessment Study;
- ▶ Staff be authorized to participate in the public forum hosted by the B.C. Ministry of Water, Land and Air Protection; and
- ▶ A copy of the "Air Emissions from Chevron North Burnaby Refinery Human Health Risk Assessment" Report be made available at all public libraries in Burnaby.

## **4.0 CONCLUSION**

The findings of the Human Health Risk Assessment study have been critical in prioritizing the key issues with respect to impacts of air emissions from Chevron Canada Refinery on neighbouring residents. It has now allowed the development of a strategic direction to

address issues relating to air emissions from Chevron Refinery. Follow-up on soil and groundwater remedial works will be the subject of a separate report to Council.

A handwritten signature in black ink, consisting of the letters 'WC' followed by a stylized, cursive 'S' and 'L'.

W.C. Sinclair, P. Eng.  
DIRECTOR ENGINEERING

DD:su  
Attachments

cc: Director Planning and Building

## THE UNIVERSITY OF BRITISH COLUMBIA



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Air Emissions from the Chevron Burnaby Refinery  
Human Health Impact Assessment  
Terms of Reference

January 17, 2001

Investigators: Susan Kennedy, PhD, Professor  
Ray Copes, MD, Adjunct Professor  
UBC School of Occupational and Environmental Hygiene

*Introduction*

UBC researchers will undertake a human health risk assessment focusing on the potential impact of current air emissions from the Chevron Burnaby refinery on the health of north Burnaby residents.

These terms of reference have been developed by the UBC research team and approved by a project advisory committee consisting of representatives from MELP, Environment Canada, GVRD, Simon Fraser Health Region, Chevron Canada, the City of Burnaby, Burnaby School Board, and community members. The project advisory committee's role is to provide input and advice to the UBC research team, to approve the terms of reference for the project, to provide one vehicle for obtaining stakeholder input into the project as it develops, and to receive the final report.

*Project Goal*

The overall goal of the project is to perform an assessment of the potential human health impact of current air emissions (scheduled and unscheduled) from the Chevron Burnaby refinery, tank farm, and associated facilities, based on health and exposure information available in the scientific literature and existing exposure data in and around the Chevron Burnaby facility and the surrounding community.

If the initial assessment indicates that further data need to be collected in order to characterize some of the risks to human health, a proposal outlining the specifics of such work will be prepared for review by the project advisory committee.

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## *General Approach*

Conventional risk assessment methods will be used, as recently elaborated in the Risk Estimation component of the consensus guideline, CSA - Q850 Framework for Risk Management(1). These methods are based on the 1983 US National Research Council report "Risk Assessment in the Federal Government: Managing the Process"(2). This approach is also essentially the same as that recommended by Health Canada in their 1999 draft document, Canadian Handbook on Health Impact Assessment.(3)

Exposure assessment will be based primarily on existing site-specific monitoring data, augmented by information available in the scientific literature on similar operations.

Health information will be obtained through a comprehensive literature review (using MEDLINE, TOXLINE, NIOSHTIC, Environmental Sciences and Pollution Management, and publicly accessible government databases such as the US DOE Risk Assessment Information Systems, and EPA Integrated Risk Information Systems), meetings with stakeholders, public agencies, and others who may have data or site-specific information relevant to the study.

Information sources will be clearly identified in all reports.

It is expected that the final comments on potential human health impact will take one or more of the following forms:

- estimates of the expected extra number of affected persons (for a given disease or symptom), compared to what would be expected for a similar community without a refinery
- the probability that a local resident would develop a specific disease or symptom over and above that expected for a similar community without a refinery
- estimates of the size of the "margin of safety" between current exposures and those known to be linked to disease or symptoms.

Sources of uncertainty and the possible range of the risk estimates will also be identified. Limited probabilistic modeling of exposures will be carried out to create 'best estimates' of exposure and health risks as well as the range of risk estimates (ie. 'worst case' and 'best case' estimates). Findings will be summarized as much as possible in non-technical language, and general recommendations made where appropriate.

## *Process*

In order to carry out the risk assessment, the UBC research team proposes to undertake the following specific work:

1. Review data from all ambient and personal air monitoring conducted in the community surrounding the Chevron North Burnaby plant and inside the plant gates in the past 5 years.

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*The members of the project advisory committee agree that all available original monitoring data will be made available to UBC for this review (including that from the GVRD, Chevron, MELT, Environment Canada).*

2. Review relevant ambient and personal air monitoring data from the published scientific literature based on studies of refineries or other similar facilities and make an assessment of the relevance of these data for the current project.

*To facilitate the evaluation of data obtained in this step, UBC researchers will review detailed information about specific products (received, processed, shipped), processes, emissions, and site-specific activities of the Chevron Burnaby operation. The project advisory committee members agree to make this information available to the research team.*

3. Review existing toxicology and epidemiology information from the published scientific literature with specific reference to SO<sub>x</sub>, volatile organic compounds, total reduced sulfur, nitrogen oxides, particulate matter, ozone, and other substances (esp. additives and by-products) that may become apparent during the review of products and site-specific activities.
4. Combine and interpret information gathered from the review of health literature review and exposure data to do the following:
  - a) comment on the anticipated added human health impact of exposures to the selected air contaminants at the levels currently present, and / or
  - b) identify what additional information needs to be collected locally in order to determine whether or not there are likely health impacts.

### *Scope*

This project focuses on current air emissions of relevance to residents located in close proximity to the Chevron refinery and storage facility. Priority will be given to those substances and processes associated with the highest levels of community and regional health department concerns. Scheduled and unscheduled emissions refer to planned and fugitive emissions that occur in the course of day to day operations and includes accidental emissions that could reasonably be foreseen based on past occurrences.

The project does not address potential soil or water contamination nor significant accidental air emissions from catastrophic events. Further, it does not cover the social, economic, or general health benefits associated with the Chevron Burnaby refinery operations.

### *Reporting*

At the conclusion of the project, a draft report will be issued by UBC to the advisory committee and input sought. UBC will consider the input from the project advisory committee; however, the contents of the final report will be controlled by the UBC researchers. Peer review will be obtained by UBC on the report prior to its release as a public document. The final report will

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remain the property of the UBC investigators. The final report will be released by UBC to all stakeholder groups represented on the advisory committee.

### *Research Team Members*

Sarah Henderson, Research Engineer  
Sonia Na, Research Scientist  
Anne-Marie Nicol, Risk Communication Scientist  
Colin MacKay, MD, Community Medicine Resident

### *References*

- (1) Canadian Standards Association. CAN/CSA-Q850-97. Risk Management: Guidelines for Decision Makers. Etobicoke: Canadian Standards Association, 1997.
- (2) US National Research Council. Risk Assessment in the Federal Government: Managing the Process.. Washington DC: National Academy Press, 1983.
- (3) Health Canada. Canadian Handbook on Health Impact Assessment (Draft Dec 1999). Health Canada.

### *Advisory Committee Members*

Name	Organization
Judy Marshall	Burnaby Residents Against Chevron Expansion (BRACE)
Guenther Krueger	Community Resident
Peter Borwein	N Capital Hill Neighbourhood Association
Bob Innis	Chevron Canada Ltd, Manager Supply Division
Dipak Dattani	City of Burnaby, Manager, Environmental Engineering
Nancy Harris	City of Burnaby, Councilor
Mondee Redman	Burnaby School Board, Trustee
Adam LaRusic	Environment Canada, Pacific and Yukon Region
Silvano Padovan	Greater Vancouver Regional District, Air Quality Department
Ray Robb (Chair)	MWLAP, Head, Environmental Management Section
Lloyd Phillips	MWLAP, Environmental Protection Compliance Officer
Nadine Loewen	Simon Fraser Health, Medical Health Officer

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**Greater Vancouver Regional District**

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July 11, 2002

W.C. Sinclair, P. Eng., Director Engineering  
Engineering Department  
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4949 Canada Way  
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Dear: Mr. Sinclair

RECEIVED BY  
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JUL 16 2002

File: AQ10 01 117

WCS  
LSC  
DD  
JUL 16 2002  
Jack Bellhouse  
Trish Modella

**Re: Chevron Canada Limited (Chevron) – Application for Amendment to Permit GVA0117**

Thank you for your letters dated April 5 and April 29, 2002, providing comments and questions on the Chevron permit amendment application. The application is currently being considered in relation to a wide range of information and input, including:

- Relevant policy and guidelines (GVRD Air Quality Management Plan, equipment and emission standards currently applied in the GVRD and elsewhere);
- Feedback from community groups and other stakeholders, and recorded citizen complaints;
- Current emissions and proposed changes (estimated actual and permitted levels);
- Previous compliance record;
- Data related to current air quality and projected effects (ambient monitoring data, stack test data, dispersion modelling); and
- Results of the UBC Human Health Impact Assessment, which, as you note, has direct relevance to this amendment application.

I understand that Eric Butler of Chevron has also provided comments on your inquiry. GVRD responses to your questions are attached.

If you have questions, please call me at 604-436-6968.

Yours truly,

Nancy Knight  
District Director

NK/sp

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*Response to City of Burnaby  
Interim Comments and Questions regarding Application for Amendment for Permit  
GVA-117 (Chevron Canada Limited).*

1. *Has Chevron undertaken air emission modeling to delineate localized elevated ground level concentration impact areas for the above contaminants (including estimated and actual emissions)?*

The GVRD uses dispersion modelling as one source of information. We are currently reviewing a draft report, prepared for Chevron by Cirrus Consultants, for conformance with guidelines and procedures for conducting emission dispersion modelling within the GVRD.

2. *It is understood that the Air Quality Management Plan does not address specific Emission Reduction Measures (ERM) for the sulphur recovery unit (SRU). Will the GVRD propose specific ERM's for the SRU at Chevron Refinery given the recent findings by Dillon Consulting Ltd. that Chevron contributes 24% to 28% of total sulphur oxide emissions in Lower Mainland?*

GVRD has requested that Chevron investigate opportunities for improvements to SRU efficiency as part of the application review process.

3. *The current SRU at Chevron utilizes a conventional 3 stage Claus process with a 4<sup>th</sup> Stage selective oxidation reactor to boost operational efficiency. The Permit requires the SRU to meet a minimum efficiency of 98.3%. Is this minimum efficiency being achieved at all times?*

Yes, Chevron meets the permit requirement for sulphur recovery efficiency. The average sulphur recovery efficiency, as reported to the GVRD in quarterly reports required by the permit, from January 2000 to March 2002, has been 98.8%.

4. *It is understood that Chevron's current SRU production is close to 20 tonnes/day. What will be the theoretical SRU production (tonnes/day) once the low sulphur fuel project is completed?*

Results from permit-required quarterly reports, in the previous four quarters, indicate an average elemental sulphur production of 16 tonnes/day. Chevron estimates that SO<sub>x</sub> emission reductions in the airshed from burning low sulphur Chevron gasoline will be 214 tonnes/year. This is equivalent to 107 tonnes/year of sulphur. If approximately 98.8% of this sulphur were captured in the SRU, based on the reported data cited in our response to Question 3, there would be an additional 0.3 tonnes/day sulphur produced.

5. *It is noted that the primary fuel used in the combustion process is de-sulphurized refinery process gas. What is the percentage of sulphur in the de-sulphurized refinery process gas?*

GVRD permit requires that the Hydrogen sulphide (H<sub>2</sub>S) in the desulphurized refinery fuel gas is measured and reported on a weekly basis. The average H<sub>2</sub>S from the previous four quarters has been approximately 5ppm, or 0.0005% H<sub>2</sub>S.

6. *It is noted that Chevron has an active program for replacing old burners and installing low-NOx burners for the past several years. When will Chevron install low-NOx burners in the power plant boilers which have the old burner technology?*

GVRD staff review opportunities to upgrade equipment at permitted operations, in relation to replacement lifecycles and on-going permit administration. This includes issues such as low-NOx burners. The installation of low-NOx burners in the power plant boilers is not being considered as part of the current amendment application.

7. *What is Chevron's emergency response plan to address any excess release of hydrogen sulphide beyond the permitted levels into the air?*

The Provincial government, through its Provincial Emergency Program, addresses excess releases of pollution from industrial operations throughout the province, including the GVRD. Chevron has a Contingency Plan in place for emergencies, which includes an emergency reporting guideline that involves a number of federal, provincial and local agencies. GVRD is a participant on the Chevron Emergency Public Notification committee chaired by the City of Burnaby. GVRD provides air quality monitoring data to emergency response staff on an as needed basis and also reports concerns to appropriate emergency response agencies.

8. *Can Chevron provide a mass balance of the SO<sub>x</sub>, NO<sub>x</sub>, VOC's and particulate for this project?*

Projected changes in SO<sub>x</sub>, NO<sub>x</sub>, VOCs and particulate requested by Chevron for this permit amendment application are detailed in the permit amendment application supplementary information forms faxed to Mr. Dipak Dattani on April 19, 2002.

As context, the total emissions from the refinery can be compared to total emissions in the GVRD and Lower Fraser Valley. The GVRD 1999 Emission Inventory report may be viewed at the GVRD web site:

<http://www.gvrd.bc.ca/services/air/emissions/inventory.html>.

9. *Has Chevron monitored for any acid gases in their air emissions other than hydrogen sulphide?*

H<sub>2</sub>S-rich gases from the amine plant are referred to as acid gases, with quantities of H<sub>2</sub>S measured in the percentage range. Emissions of acid gases to the atmosphere are

not allowed in the GVRD permit for the refinery. All acid gases from the amine plant are routed directly to the SRU for conversion and collection of elemental sulphur. During testing, H<sub>2</sub>S stack emissions are measured in the parts per million (ppm) range and are therefore below the threshold that defines acid gases.

10. *The application notes the last amendment date of the Permit GVA0117 to be December 01, 2001. In reviewing the Permit, it is noted that the Permit was last amended in December 1999. However, it is understood that this does not change the intent of the application.*

The amendment date on the Chevron permit currently in force is December 24, 1999 with further minor administrative amendments to the permit enabled in a December 1, 2000 letter. Reference to an incorrect amendment date on the application does not affect the intent of the permit amendment application.

11. *For this project what is the overall impact in a regional and local context when looking at regional air quality targets set for various parameters versus proposed emission levels?*

The before and after (proposed) tonnes/year of contaminants from Chevron, as noted in the Chevron application dated March 11, 2002 are compared to the total GVRD emissions from all sources calculated in the GVRD 1999 Emission Inventory Update report in the following table. GVRD is in the process of assessing potential regional and local impacts.

Contaminant	GVRD	Before		After		Change in % of GVRD
		Chevron	% of GVRD	Chevron	% of GVRD	
Particulates	15,823	416	2.63	421	2.66	+ 0.03
Nitrogen Oxides	42,396	615	1.45	580	1.37	- 0.08
Sulphur Oxides	4,127	1655	40.10	1664	40.31	+ 0.21
VOC	48,211	781	1.62	787	1.63	+ 0.01

12. *Will increase in particulates, sulphur oxides and total volatile organic compounds have a greater impact than the reduction in nitrogen oxides in terms of air quality?*

Each contaminant will have different impacts at different concentrations at a regional or local level. For example, on a regional basis the AQMP has assigned a higher priority on NO<sub>x</sub> and VOC (precursor emissions to ground level ozone formation), whereas SO<sub>x</sub> has been assigned a lower priority. These factors will be considered in

assessing the amendment application on a local basis, where SO<sub>x</sub> has a greater significance.

### Miscellaneous

1. *It is understood that the new equipment needed for the project will be located within an area of the refinery now actively used and will result in the removal of three distillation columns which are no longer required. How and where will the columns be disposed?*

Please refer to Chevron for a response. GVRD actively encourages industry to recycle or dispose of all waste materials in accordance with applicable regulations.

2. *and 3. It is noted that a new 100,000 barrel product storage tank will be constructed in Area 2. Will the tank comply with the CCME Code for Above Ground Storage Tanks? Will all storage tanks used for storing low sulphur fuel comply with the CCME Code for Above Ground Storage Tanks?*

Yes, the GVRD will require Chevron to comply with the "CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks," for which GVRD is responsible for implementation, within its area of jurisdiction.

The Ministry of Water, Land & Air Protection (WLAP) is the authority having jurisdiction for the "CCME Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products". This code offers a model set of technical requirements designed to protect the environment by preventing product releases from aboveground storage tanks and piping. For further information, please contact the Contaminated Sites Section of WLAP in Surrey by calling 604-582-5200.

- 4., 5. and 6. *Will the above project affect the throughput of gasoline? Will Chevron process low sulphur fuel on behalf of any other oil companies locally or selling refined (low sulphur) gasoline to other companies? Can Chevron provide information on throughput of all product streams? Will there be an increase in tanker traffic?*

Please refer to Chevron for information on throughput, product flow, and marketing plans, as the GVRD does not regulate these operational or business practices. These practices may be affected indirectly by Chevron's ability to meet emission restrictions and/or emission control practices required by the GVRD through its authority to regulate emissions to the air.



# Chevron

June 18, 2002

JUN 20 2002

WCS *[initials]*  
LSC *[initials]*  
DD *[initials]*

*[initials]* (X/c: Jack Bellamy /  
Trish Aschule)

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Darren Beairsto  
Greater Vancouver Regional District (GVRD)  
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## Request for Answers to Questions from City of Burnaby

Darren,

Further to my memo to you dated June 10, I would like to correct an error to the answer to question # 6 regarding Chevron's plans on burner replacements for NOx reduction. I did not reference the most recent correspondence between Chevron and the GVRD. I have corrected the answer to question # 6 and have attached the revised Q & A document for your use.

If you have any questions, please do not hesitate to call me at 604-257-4917.

Sincerely,

Attachment

Cc: W.C. Sinclair, P. Eng  
Director Engineering  
City of Burnaby

**Answer to Questions posed by the City of Burnaby to the GVRD on April 29, 2002, City of Burnaby File "10-08-11(01)"**

1. Has Chevron undertaken air emission modeling to delineate localized elevated ground level concentration impact areas for the above contaminants (including estimated and actual emissions)?

*Consistent with the dispersion modeling completed in 1997 for the B.C. Reformulated Gasoline project, this model was updated to reflect current(2002) and proposed(2005) for particulates and sulphur oxides(SOx). This effort has been completed by Cirrus Consultants and a report will be available in June, 2002. The GVRD has a draft version of the report.*

2. It is understood that the Air Quality Management Plan does not address specific Emission Reduction Measures (ERM) for the sulphur recovery unit (SRU). Will the GVRD propose specific ERM's for the SRU at Chevron Refinery given the recent findings by Dillon Consulting Ltd. that Chevron contributes 24% to 28% of total sulphur oxide emissions in Lower Mainland?

*GVRD response required. CCL comments; these findings are available in the GVRD 1999 emissions inventory report. The proposed increase in SOx emissions for the new process heater is approximately 0.5 % of total SOx emissions from the refinery. Chevron estimates the impact of low sulphur gasoline on mobile source emissions for the Lower Fraser Valley Airshed to be 214 tonnes per year of SOx which is equivalent to 12.4 % of Burnaby Refinery SOx emissions.*

3. The current SRU at Chevron utilizes a conventional 3 stage Claus process with a 4<sup>th</sup> Stage selective oxidation reactor to boost operational efficiency. The Permit requires the SRU to meet a minimum efficiency of 98.3%. Is this minimum efficiency being achieved at all times?

*All testing to determine SRU recovery efficiency at the Burnaby Refinery has indicated recovery efficiencies in excess of the permitted 98.3%. For example, reported recovery efficiencies have ranged from 98.4% up to 99.2 since first quarter 1999. The permit level versus typical allows for normal process fluctuations that occur and impact efficiency for short durations.*

4. It is understood that Chevron's current SRU production is close to 20 tonnes/day. What will be the theoretical SRU production (tonnes/day) once the low sulphur fuel project is completed?

*Incremental SRU liquid sulphur production is estimated at 0.6 tonnes per day.*

5. It is noted that the primary fuel used in the combustion process is de-sulphurized refinery process gas. What is the percentage of sulphur in the de-sulphurized refinery process gas?

*Based on H2S measurement in our refinery fuel gas and based on SOx measured in refinery furnace stacks, total sulphur in refinery fuel gas is typically in the 10 to 100 ppm(parts per million) sulphur which is 0.001 to 0.01 weight percent. Purchased natural gas contains mercaptan sulphur for leak detection at 3 ppm.*

6. It is noted that Chevron has an active program for replacing old burners and installing low-NOx burners for the past several years. When will Chevron install low-NOx burners in the power plant boilers which have the old burner technology?

*Chevron's NOx reduction commitments are detailed in a letter dated July 21, 2001 to the Director of Air Quality at the GVRD. This memo was the latest response to the GVRD's request for Chevron to undertake a NOx reduction study for the refinery.*

7. What is Chevron's emergency response plan to address any excess release of hydrogen sulphide beyond the permitted levels into the air?

*H2S emissions from the refinery are not changing as a result of the Low Sulphur Gasoline project. In the unlikely event of a release of hydrogen sulphide gas, Chevron has a contingency plan for dealing with toxic emissions.*



*Our personnel will conduct immediate assessment of the situation and should there be any risk of the toxic emissions leaving the plant site they will contact regulatory agencies including Burnaby Fire Department, the City of Burnaby, the RCMP and the GVRD.*

8. Can Chevron provide a mass balance of the SO<sub>x</sub>, NO<sub>x</sub>, VOC's and particulate for this project?

*See the GVRD permit amendment letter dated March 11, 2002 for a discussion of actual and permitted emissions.*

9. Has Chevron monitored for any acid gases in their air emissions other than hydrogen sulphide?

*The normal operation of the refinery does not have releases of acid gas. Our acid gas produced from concentrating H<sub>2</sub>S from our sour refinery fuel gas is fed to our SRU. Normal operation results in H<sub>2</sub>S concentrations in the FCC stack and the SRU incinerator stack below the 5 mg/m<sup>3</sup> permit level.*

10. The application notes the last amendment date of the Permit GVA0117 to be December 01, 2001. In reviewing the Permit, it is noted that the Permit was last amended in December, 1999. However, it is understood that this does not change the intent of the application.

*Chevron recognizes the error of the last amendment data on our current permit amendment. The GVRD is aware of this error and does not want a new issue of the permit amendment to correct.*

11. For this project what is the overall impact in a regional and local context when looking at regional air quality targets set for various parameters versus proposed emission levels?

*GVRD answer required.*

12. Will increase in particulates, sulphur oxides and total volatile organic compounds have a greater impact than the reduction in nitrogen oxides in terms of air quality?

*GVRD and Environment Canada answer required.*

13. It is understood that the new equipment needed for the project will be located within an area of the refinery now actively used and will result in the removal of three distillation columns which are no longer required. How and where will the columns be disposed?

*Reuse of the columns and associated equipment will be evaluated. If equipment can not be reused, it will be cleaned as required for disposal as scrap metal.*

14. It is noted that a new 100,000 barrel product storage tank will be constructed in Area 2. Will the tank comply with the CCME Code for Above Ground Storage Tanks?

*As indicated in our Air Permit Amendment, any new product storage tanks will be constructed to meet the CCME guidelines for controlling emissions from above ground storage tanks (CCME-EPC-87E or PN1180). The new tank would feature the most current leak prevention and emission reduction technology including an internal floating roof, remotely monitored high level alarms and level indication, leak detection floor design along with primary and secondary vapour control seals.*

15. Will all storage tanks used for storing low sulphur fuel comply with the CCME Code for Above Ground Storage Tanks?

*We commit to meet our current obligations with respect to tank maintenance and tank upgrades per existing documentation provided as part of the Isooctane Preliminary Plan Approval.*

16. Will the above project affect the throughput of gasoline? Will Chevron process low sulphur fuel on behalf of any other oil companies locally or selling refined (low sulphur) gasoline to other companies?

*This project does not increase the production of gasoline. Chevron may process other companies' gasoline blend stocks to manage off specification product or unprocessed blend stocks from other companies. The proposed facilities may be used to cleanup third party high sulphur blendstocks but our ability to do this is limited. If we change our plans to bring in significant volumes of third party gasolines, we will notify the City.*

17. Can Chevron provide information on throughput of all product streams?

*Typical crude throughput is 52,000 BPD with typical products yields of 50% gasolines, 45% distillates (diesel and jet fuels), 3% LPG's and the remainder as fuel oils and asphalt.*

18. Will there be an increase in tanker traffic?

*No. We do not anticipate any increase in tanker traffic as a result of the LSG Project.*

Other questions that Chevron may want to provide (review our Q & A document)

19. Will there be an increase in odours from the refinery as a result of the LSG Project?

*There will not be an increase in odours from the refinery as a result of the LSG Project. In fact, odours may decrease from our tank farm in Area 1. Existing facilities used to treat gasoline blendstocks will be retired. This existing facility injects air and some air becomes dissolved in the gasoline blendstock. This dissolved air tends to come out of solution when the blendstock is stored in tankage at ambient conditions.*