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AIR QUALITY & HEALTH IMPACT ASSESSMENT UPDATE

Chevron CAP September 18, 2013

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SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Presenters

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  Human Health Risk Assessment Specialist

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  Environmental Control Officer
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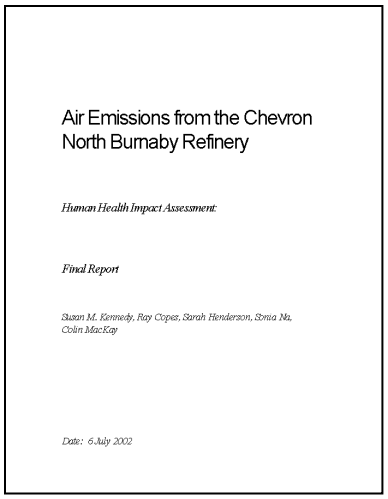
  Air Quality Planner

Presentation Outline

- Background - 2002 Study
- CAP Request
  Monitoring Network
- Sulphur Dioxide:
  - Objectives, monitoring data, trends
  - Potential health impacts/risks
- Benzene:
  - Monitoring data, trends
  - Potential health impacts/risks
- 1,3-Butadiene:
  - Monitoring data, trends
  - Potential health impacts/risks

2002 Human Health Impact Assessment


Air Emissions from the Chevron North Burnaby Refinery

Human Health Impact Assessment:

Final Report

Susan M. Kennedy, Ray Copes, Sarah Henderson, Sonia Na, Colin MacKay

Date: 6 July 2002

- Objective: assess potential human health impacts of air contaminants from select ambient monitoring stations including two located near refinery and tank farm
- Authors: UBC School of Occupational and Environmental Hygiene
- Available air monitoring for multiple pollutants: SO_2, NO_2, CO, O_3, VOCs, etc.
- Study, Summary and Appendices available on-line

CAP Request

- Provide update on air contaminants of concern identified in the 2002 study
    - Sulphur Dioxide (SO_2)
    - Benzene
    - 1,3 Butadiene
- Review ambient air quality objectives, monitoring data and trends (2000 to 2012)
- Review health impacts based on current science

Air Quality Monitoring Network

- Metro Vancouver operates network of 27 stations
- Multiple pollutants: SO_2, NO_2, CO, O_3, $PM_{2.5}$, VOCs, etc.
- Provides measure of performance in achieving air quality goals

Sulphur Dioxide (SO_2)

Sulphur Dioxide (SO_2)

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What is it?

- Colourless gas with pungent odour
- Human health and environmental effects
- Formed by sulphur-containing fuels
- Prevalent near Burrard Inlet - marine vessels (ocean going) and petroleum refinery
- Sulphur Oxide emissions:
  - Marine vessels (43%)
  - Primary metal industry in Whatcom (35%)
  - Petroleum refining (14%)

SO_2 Monitoring Stations

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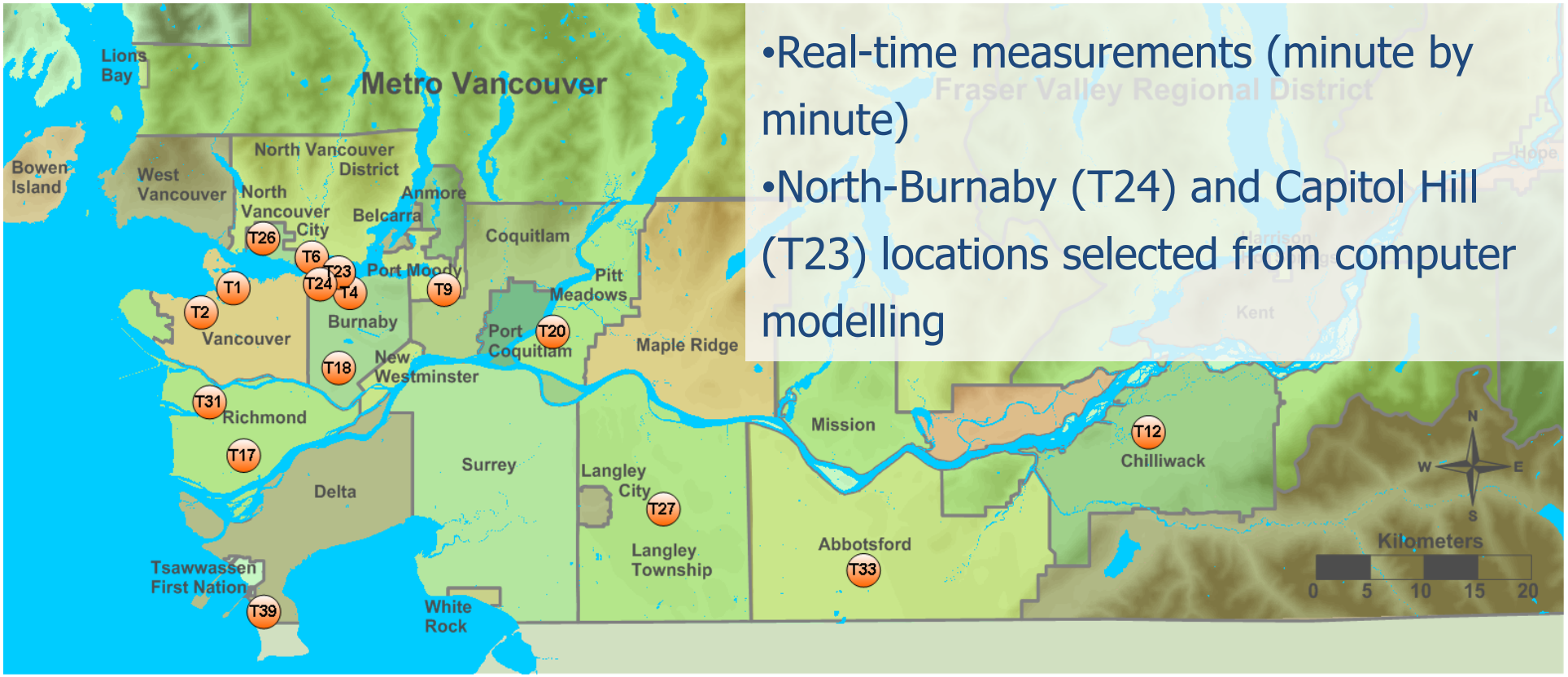
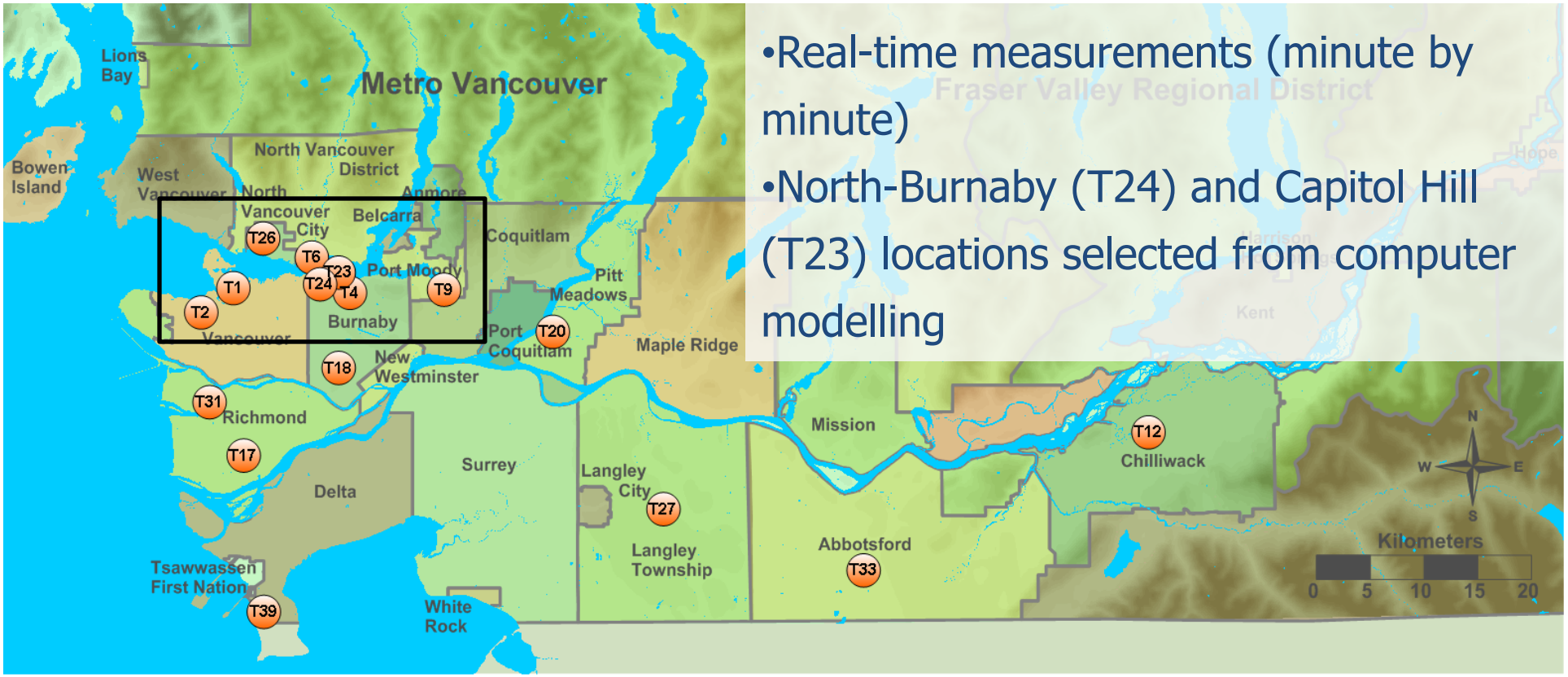
SO_2 Monitoring Stations



- Real-time measurements (minute by minute)
- North-Burnaby (T24) and Capitol Hill (T23) locations selected from computer modelling

SO_2 Monitoring Stations



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SO_2 Measurements

	Averaging Period
Short-Term (acute)	10-minute
	1-hour
	24-hour
Long-Term (chronic)	annual

SO_2 Measurements

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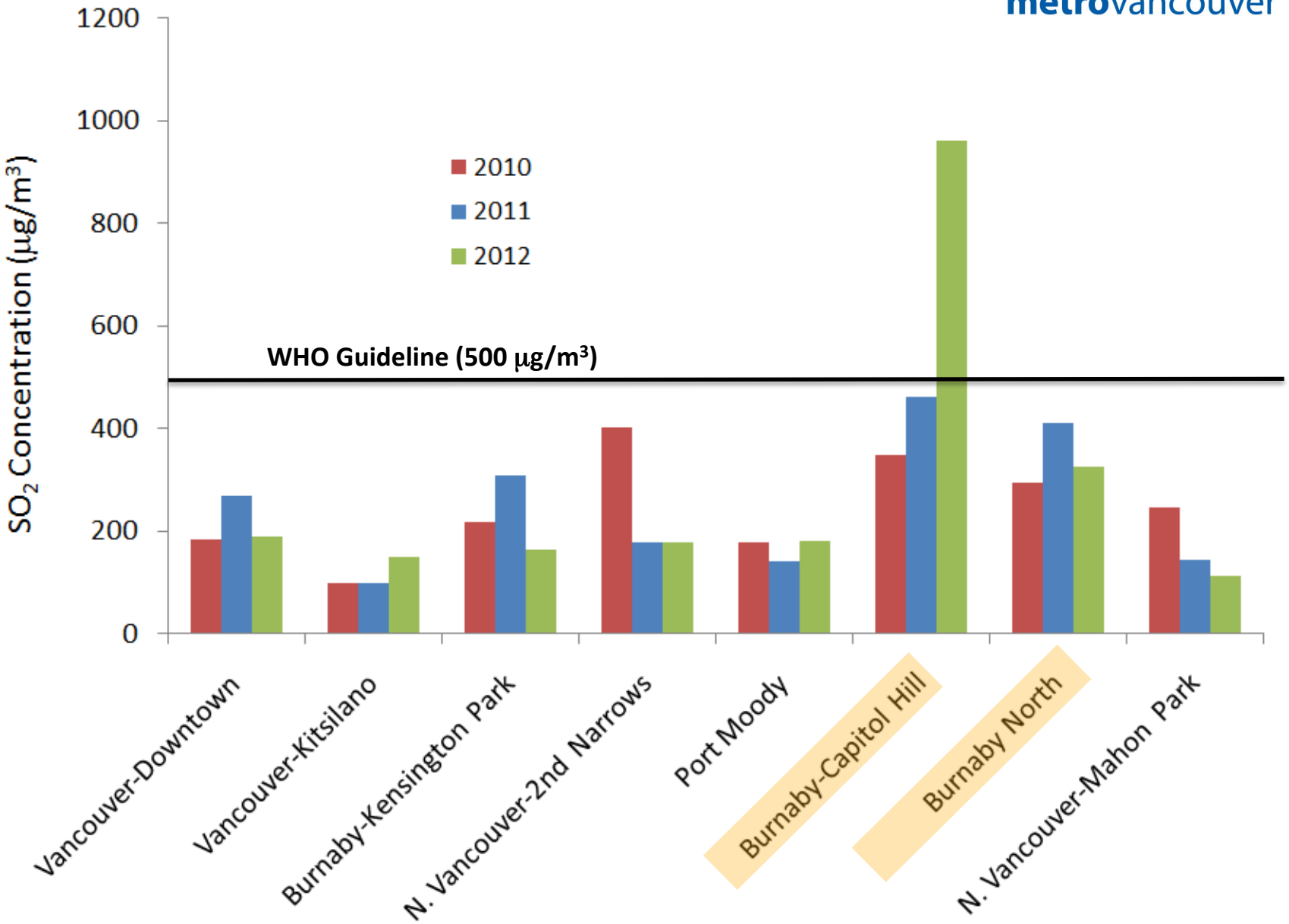
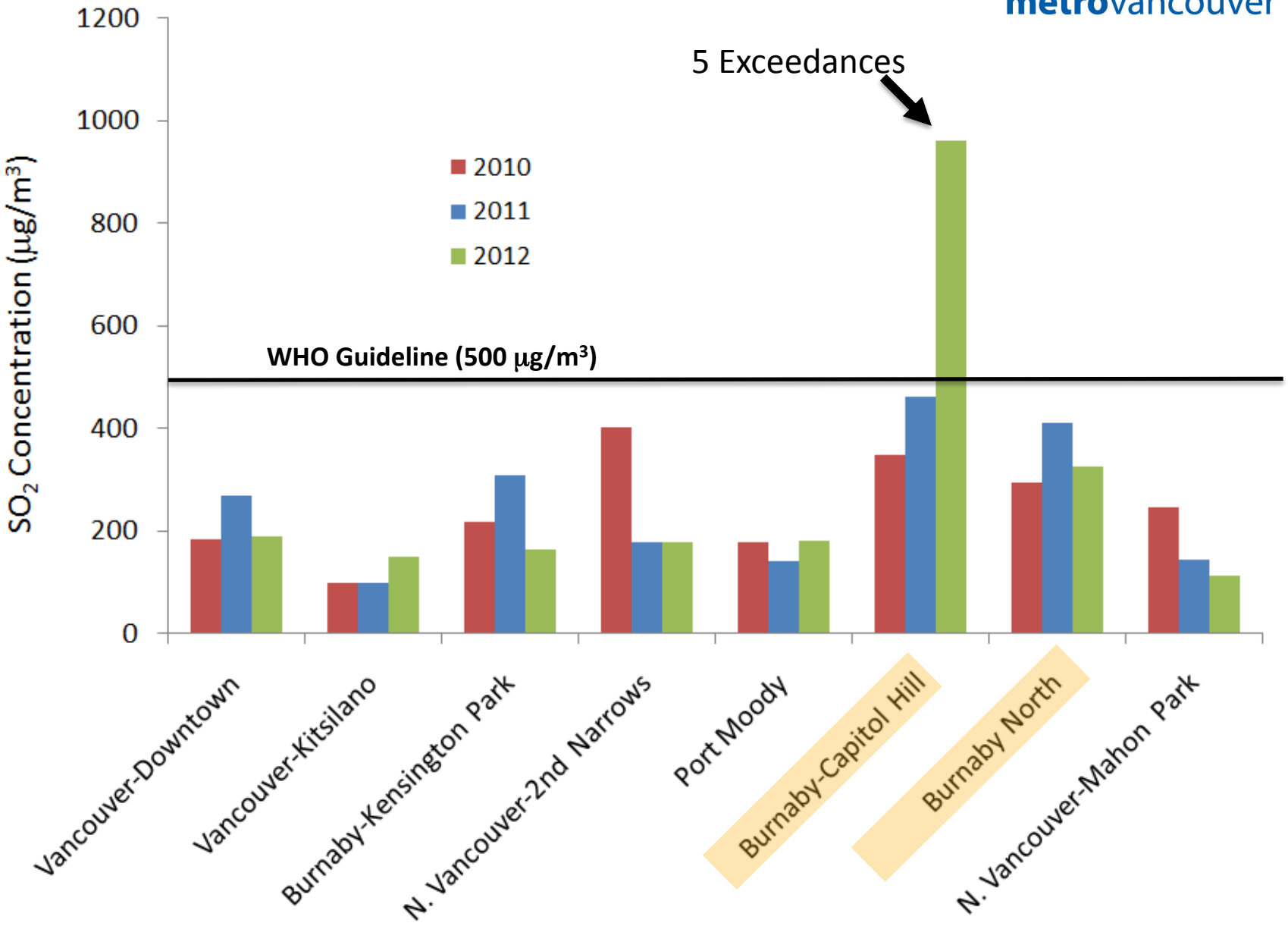
	Averaging Period	Objective or Guideline	Value ($\mu g/m^3$)
Short-Term (acute)	10-minute	WHO Guideline	500
	1-hour	Federal, BC and Metro Vancouver Objective	450
	24-hour	Metro Vancouver Objective	125
Long-Term (chronic)	annual	BC Objective	25

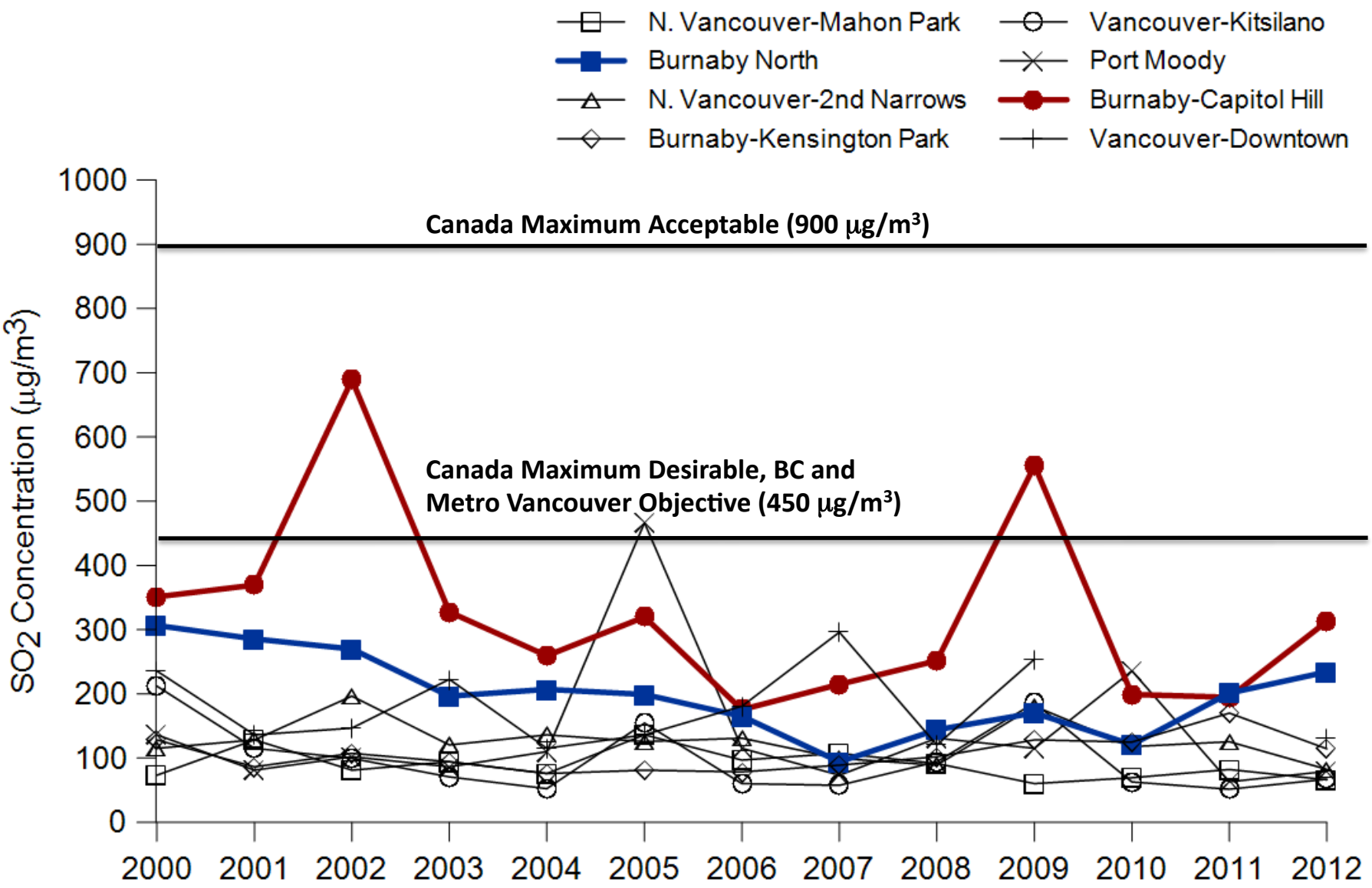
SO_2 Maximum 10-Minute



SO_2 Maximum 10-Minute



SO_2 Maximum 1-Hour



SO_2 Maximum 1-Hour

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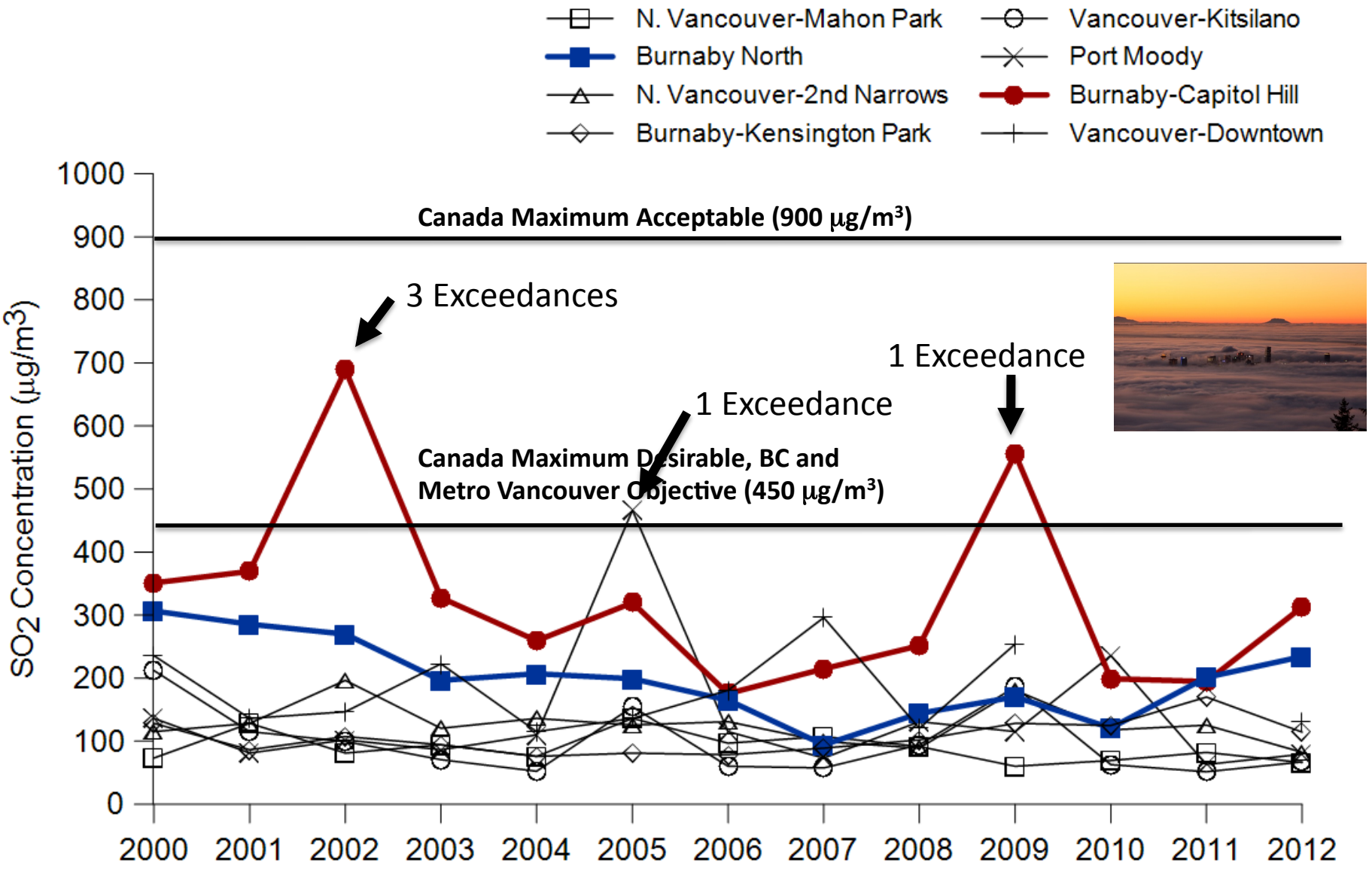
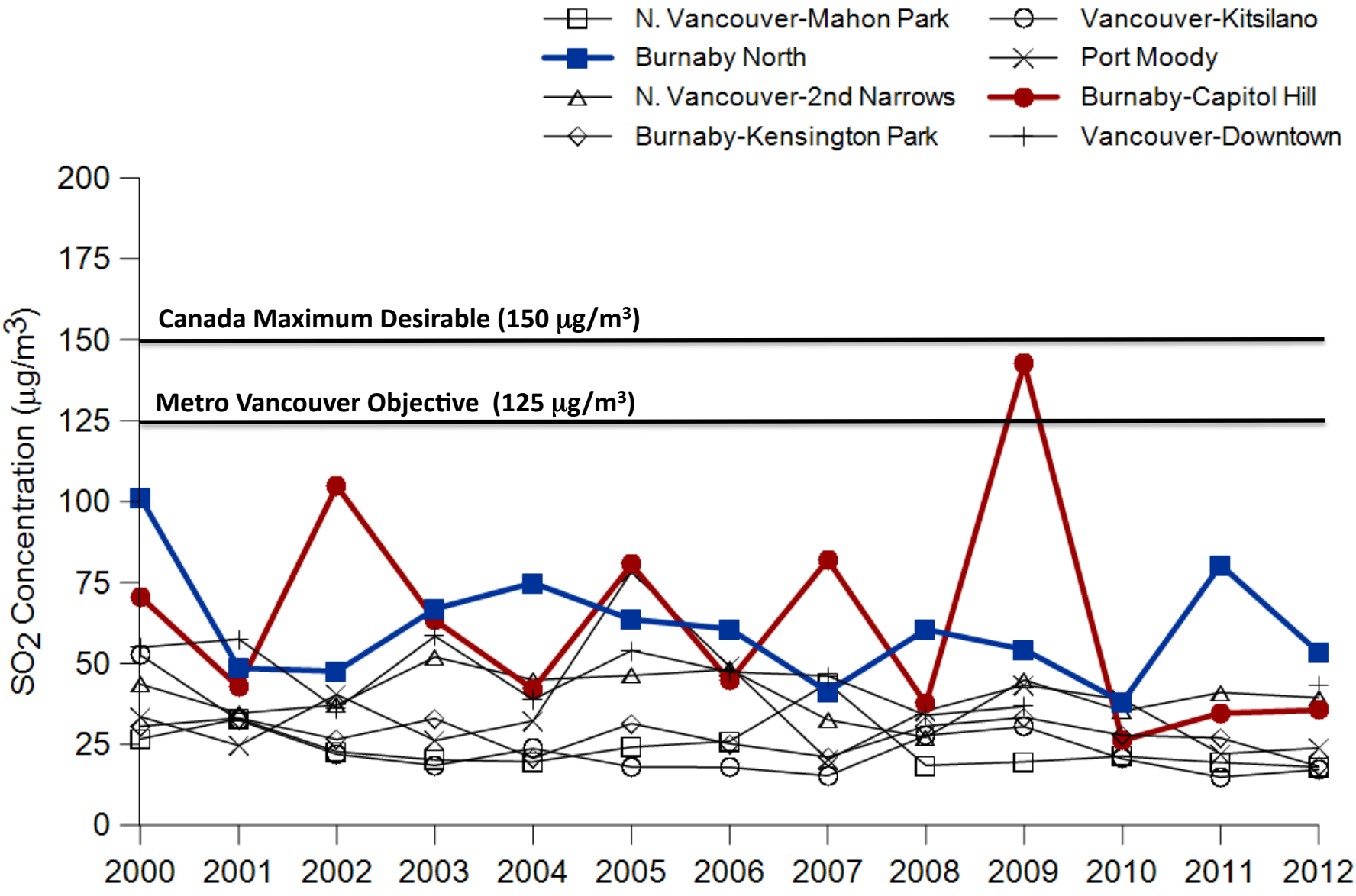


SO_2 Maximum 24-Hour



SO_2 Maximum 24-Hour

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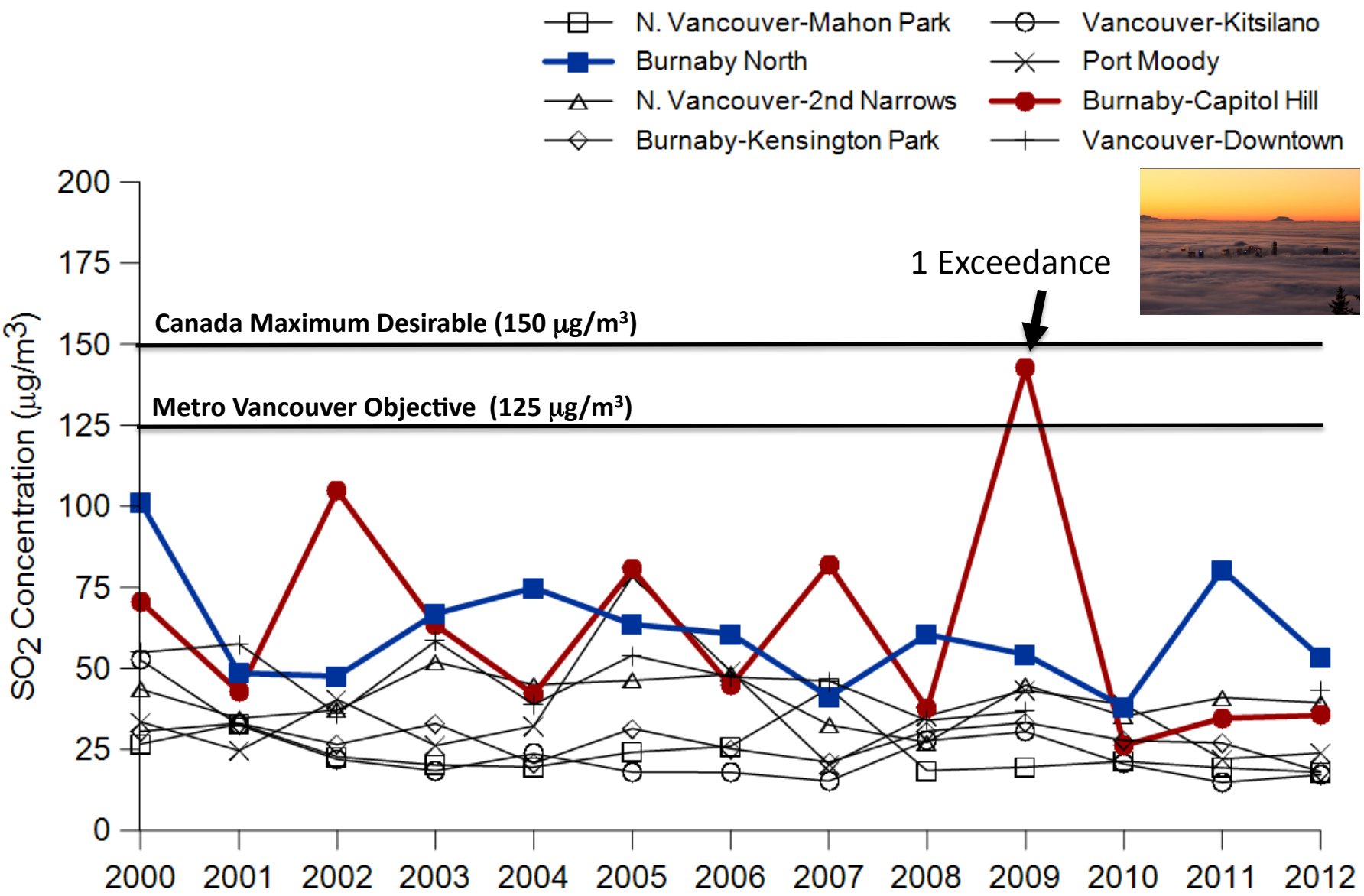
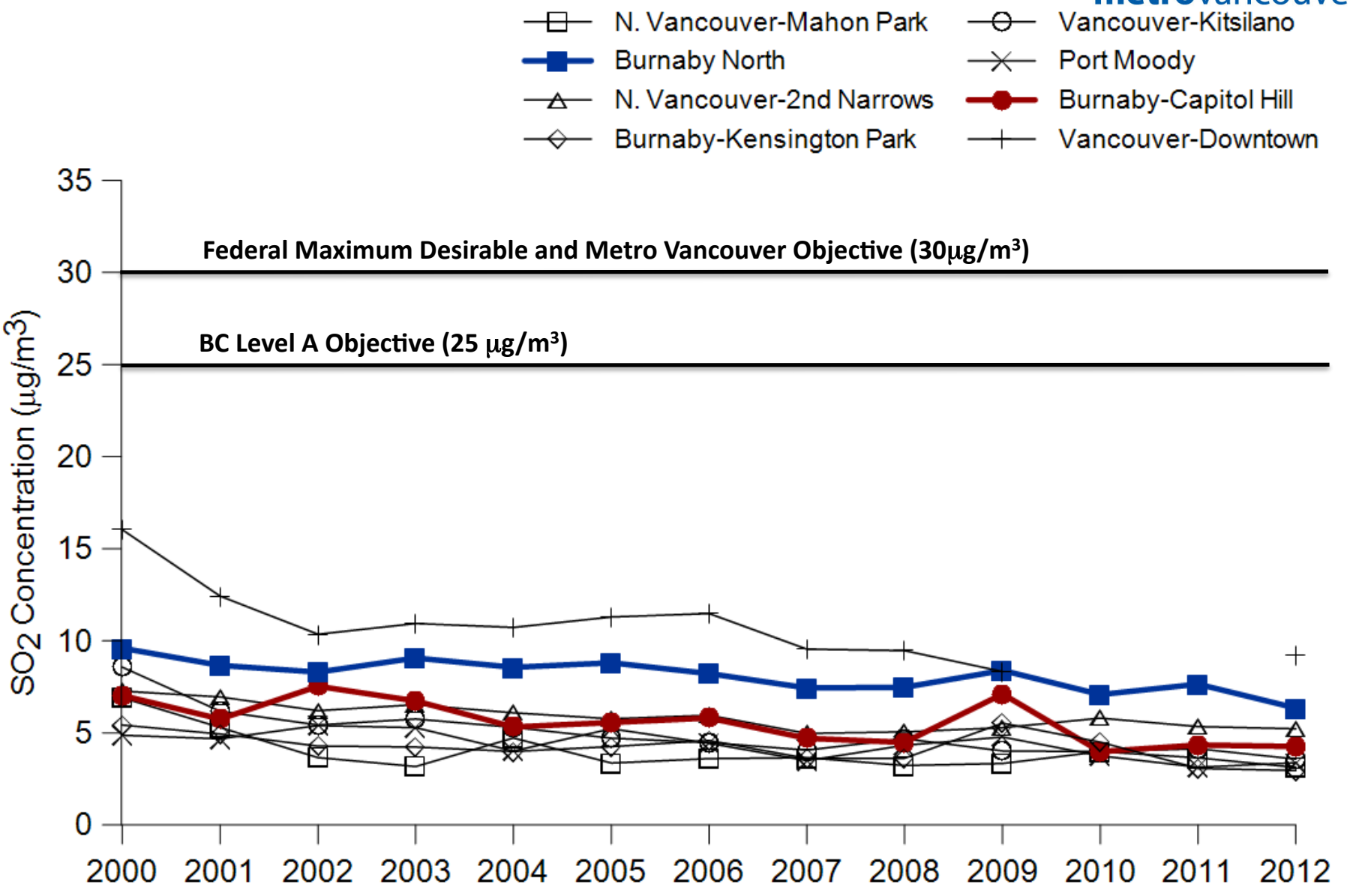


SO_2 Annual Average



SO_2 Monitoring Summary

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- Occasional exceedance of short-term objectives
- No exceedances of long-term objectives
- Long-term trend improving and short-term appears unchanged

Sulfur Dioxide (SO_2)

Questions asked:

- What are the health effects of sulphur dioxide, specifically with respect to asthma?
- Any new evidence or studies since 2002?
- What is the specific risk from the refinery?

Sulphur dioxide – health effects

- Asthma
  - Worsens asthma – symptoms being wheezing, difficult breathing, chronic cough, limited physical activity and exercise tolerance
  - On days with high SO_2 peaks – stay indoors, avoid outdoor physical activity, use puffers / inhalers as prescribed, monitor for worsening symptoms
  - The fundamental causes of asthma are poorly understood and still being researched

Sulphur dioxide – health effects (cont.)

- **Long-term inhalation exposures**: at chronic, high occupational exposures; less data for community exposures
- Further: inadequate evidence for the carcinogenicity in humans of sulphur dioxide.
- In their evaluation, the World Health Organization's International Agency for Research on Cancer (**IARC**) has indicated that **sulphur dioxide is not classifiable as to its carcinogenicity to humans**.

Source: WHO IARC Monograph volume 54 (Last updated: 21 November 1997: http://monographs.iarc.fr/ENG/Monographs/vol54/volume54.pdf)

SO_2 - Potential Health Impacts/Risks

- **SO_2 – recommended short-term (acute) exposure levels:**
  - World Health Organization (**WHO**) **10-minute average**: **500** µg/m^3
  - **5 exceedances** observed at T023 (Burnaby Capitol-Hill) in 2012 Maximum observed: **962.1** µg/m^3
- **US** Environmental Protection Agency (**EPA**) Acute Exposure Guideline Level (**AEGL-1**) for **10-minute** to **8-hour** exposure duration: 0.20 ppm (**520** µg/m^3)
  - Developed on the basis of **N**o **O**bservable **E**ffect **L**evel (**NOEL**) for **bronchoconstriction in exercising asthmatics**

SO_2 - Potential Health Impacts/Risks (cont.)

- **US EPA AEGL-2** for **10-minute** to **8-hour** exposure duration:
  - 0.75 ppm (**1950** µg/m^3)
  - Developed on the basis of **moderate bronchoconstriction in exercising asthmatics**
- Canadian **1-hour average** Maximum Acceptable National Ambient Air Quality Objective: **900** µg/m^3
  - **No exceedances** observed at any of the monitoring stations from 2000 to 2012

SO_2 - Potential Health Impacts/Risks (cont.)

- **SO_2 – recommended long-term (chronic) exposure levels:**
  - BC Provincial **Level A** Objective – annual average: **25** µg/m^3
  - Metro Vancouver's and Canadian annual average **Maximum Desirable NAAQ** Objective: **30** µg/m^3
  - **No exceedances** observed at any of the monitoring stations from 2000 to 2012
  - Annual average levels of SO_2 at stations **T023** (Burnaby Capitol-Hill) and **T024** (Burnaby North) are lower than **10** µg/m^3
- **Overall historical trend**: lower SO_2 levels in 2012 when compared to 2000

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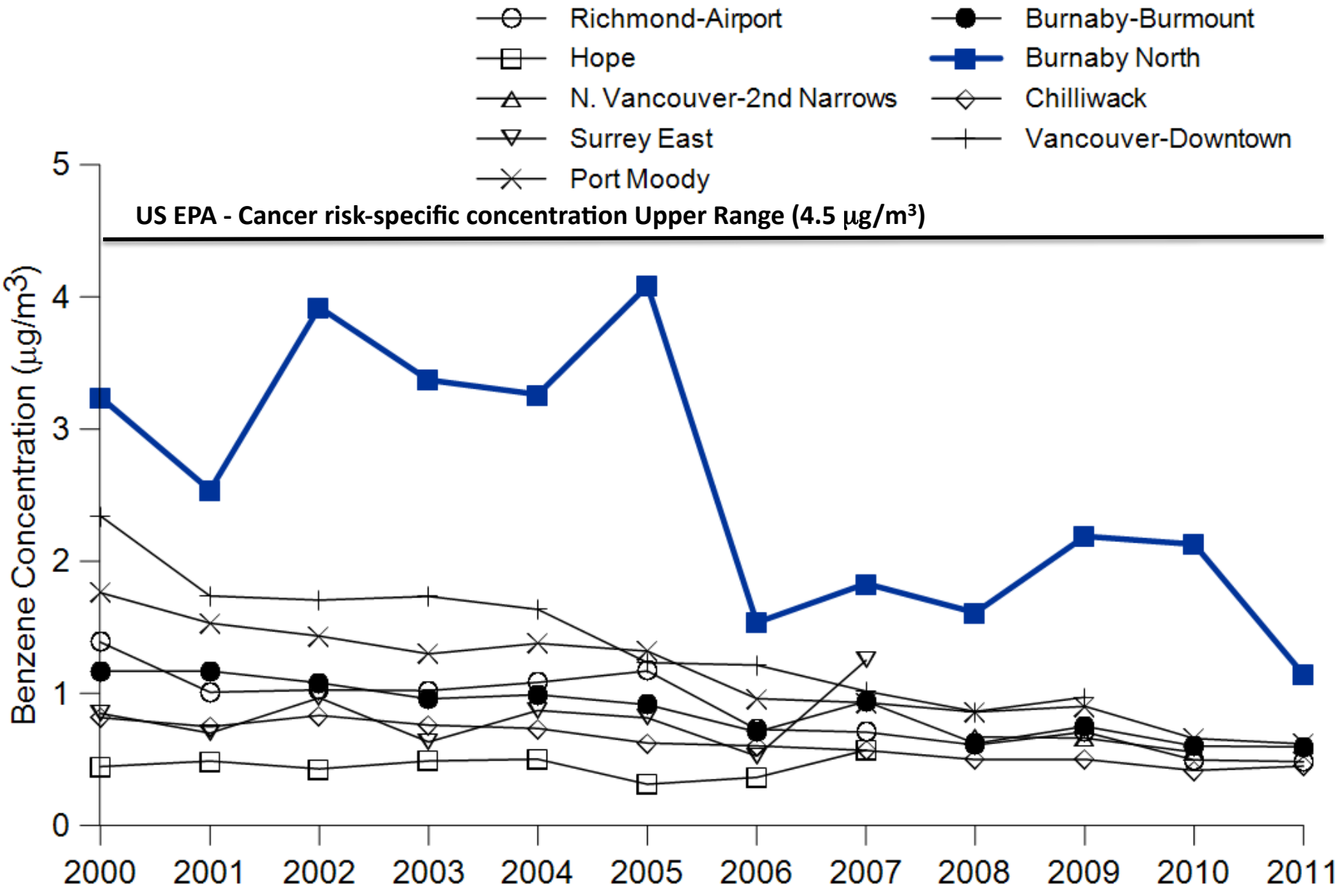
Questions/Comments

Benzene

Benzene

- VOC present in gasoline and diesel fuels
- Sources: wood burning, transportation, petroleum refining
- Regional: on-road (56%), non-road (27%), area (15%), industrial (2%)
- Samples every 6 days
- No objectives, compare to US EPA - risk concentration

Annual Average Benzene



Benzene

Questions asked:

- What types of cancers are associated with exposure to benzene?
- Other known health concerns associated with exposure?
- New links between health and benzene documented since 2002?

Benzene – health effects

- Changes since last report: updated summary, US EPA, Jan 2012
- Short-term high level inhalation exposure risks: drowsiness, dizziness, headaches, irritation
- Long-term non-cancer inhalation exposures: immune system effects and low blood count
- Long-term cancer inhalation exposures: acute myeloid leukaemia

Sources: WHO IARC Monograph volume 71 (1999)
http://monographs.iarc.fr/ENG/Monographs/vol71/volume71.pdf
US Environmental Protection Agency. Technology Transfer Network.
Statement on benzene: http://www.epa.gov/ttnatw01/hlthef/benzene.html

Benzene - Potential Health Impacts/Risks

- **Benzene – recommended long-term (chronic) exposure levels:**
  - **US EPA Reference Concentration (RFC)** for **non-cancer effects** of benzene:

    30 µg/m^3
  - An uncertainty factor (**UF**) of **300** is applied on a benchmark concentration (BMC) of **~8,200** µg/m^3 from a human **occupational inhalation study**

Benzene - Potential Health Impacts/Risks (Cont.)

- **US EPA Risk-specific Concentration range** for a cancer risk level of E-5 (1 in 100,000):

  1.3 to **4.5** µg/m^3 (cancer type: **leukemia** - mainly acute myelogenous leukemia (**AML**))

  - Concentration range developed on the basis of **different epidemiological studies** and **exposure estimates** in occupational settings

Benzene - Potential Health Impacts/Risks (Cont.)

- **No exceedances** observed at any of the monitoring stations from 2000 to 2012

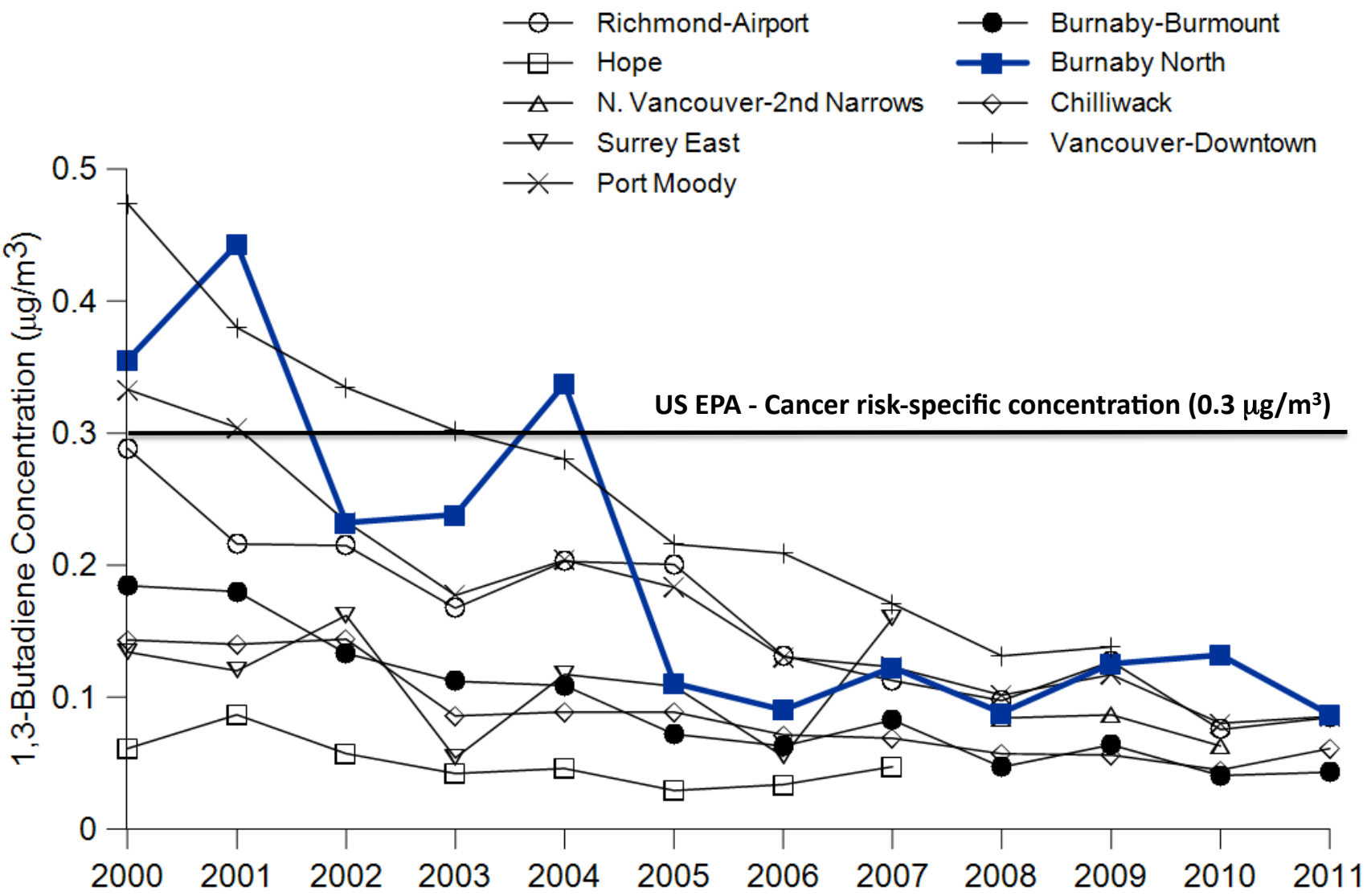
- **Overall historical trend**: lower benzene levels in 2012 when compared to 2000

1,3-Butadiene

1,3-Butadiene

- VOC with mild gasoline odour
- Sources: motor vehicle, manufacturing, wood combustion, cigarette smoke
- Regional: on-road (62%), non-road (31%), area (2%), industrial (5%)
- Samples every 6 days
- No objectives, compare to US EPA - risk concentration

Annual Average 1,3-Butadiene



1,3-Butadiene

Questions asked:

- What types of cancers are associated with exposure to 1,3-butadiene?
- Other known health concerns associated with exposure?
- New links between health and 1,3-butadiene documented since 2002?

1,3-Butadiene – health effects

- Changes since last report: 1,3-butadiene – new **IARC** classification **2A → 1 (carcinogenic to humans)**
- Short-term high level inhalation exposure risks: irritation typically, with blurred vision/headaches at +++levels
- Long-term non-cancer inhalation exposures: cardiovascular and respiratory effects
- Long-term cancer inhalation exposures: 1,3-butadiene: leukaemia

Sources: WHO Monograph 97 (2008) http://monographs.iarc.fr/ENG/Monographs/vol97/mono97.pdf

US Environmental Protection Agency. Technology Transfer Network. Statement on 1,3-butadiene: http://www.epa.gov/ttnatw01/hlthef/butadien.html

1,3-Butadiene - Potential Health Impacts/Risks

- **1,3-Butadiene – recommended long-term (chronic) exposure levels:**
  - **US EPA Reference Concentration (RFC)** for **non-cancer effects** of 1,3-butadiene:

    2 µg/m^3
  - An uncertainty factor (**UF**) of **1000** is applied on a benchmark concentration (BMC) of 0.88 ppm (~**1,950** µg/m^3) from a **toxicological study in laboratory animals**

1,3-Butadiene - Potential Health Impacts/Risks (Cont.)

- **US EPA Risk-specific Concentration** for a cancer risk level of E-5 (1 in 100,000):

  0.3 µg/m^3 (cancer type: **leukemia**)

  - Includes adjustments for uncertainties

- Some small **exceedances** observed in the period from 2000 to 2004

1,3-Butadiene - Potential Health Impacts/Risks (Cont.)

- Air concentrations in the period from 2005 to 2011 consistently below **0.2** µg/m^3 (i.e., less than 1 in 100,000 risk level)

- **Overall historical trend**: lower 1,3-butadiene levels in 2011 when compared to 2000

Lifetime Cancer Risk

- **Health Canada** (2010) – Guidance on Risk Assessment:
  - "*Cancer risks will be deemed to be "**essentially negligible**" (**de minimus**) where the estimated **I**ncremental **L**ifetime **C**ancer **R**isk (**ILCR**) is ≤ 1 in 100,000 (≤ 1 x 10^{-5})*".

Lifetime Cancer Risk (Cont.)

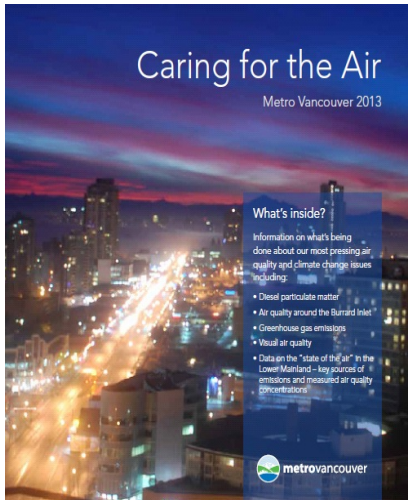
- **Health Canada**'s rationale for "*essentially negligible*" cancer risk level:
  - "*The background incidence of cancer in Canada and the US is high, relative to a 10^{-5} or 10^{-6} risk level. The lifetime probability of developing cancer in the US and Canada is approximately 0.4, or 40%".*
  - *"Thus, an excess or incremental cancer risk of 1×10^{-5} increases a person's lifetime cancer risk from **0.40000** to **0.40001**"* (i.e., only a **0.0025%** increase over background cancer incidence).
- **Health Canada** indicates that this increase "*would be undetectable using available epidemiological data and statistics, particularly in smaller populations*".

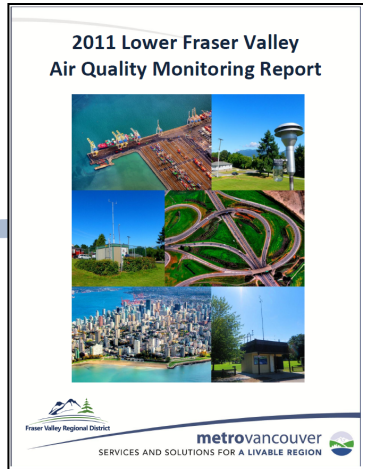
Caveat emptor

- Occupational and animal data
- Levels of exposure in studies different
- Many other sources (e.g. cigarette smoking)
- Trends over the last decade are extremely promising, right direction, minimal exceedances

Data Reporting

- Real-time data:
  - Metro Vancouver web app **airmap.ca**
  - Provincial website **bcairquality.ca**
- Routine reports:
  - Metro Vancouver
    - Caring for the Air bit.ly/CaringfortheAir
    - Detailed LFV AQ Monitoring Report bit.ly/2011AirReport
  - BC Lung Association
    - State of the Air bit.ly/StateoftheAir





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Questions/Comments