Air Emissions Management Plan for Construction
Westridge Marine Terminal

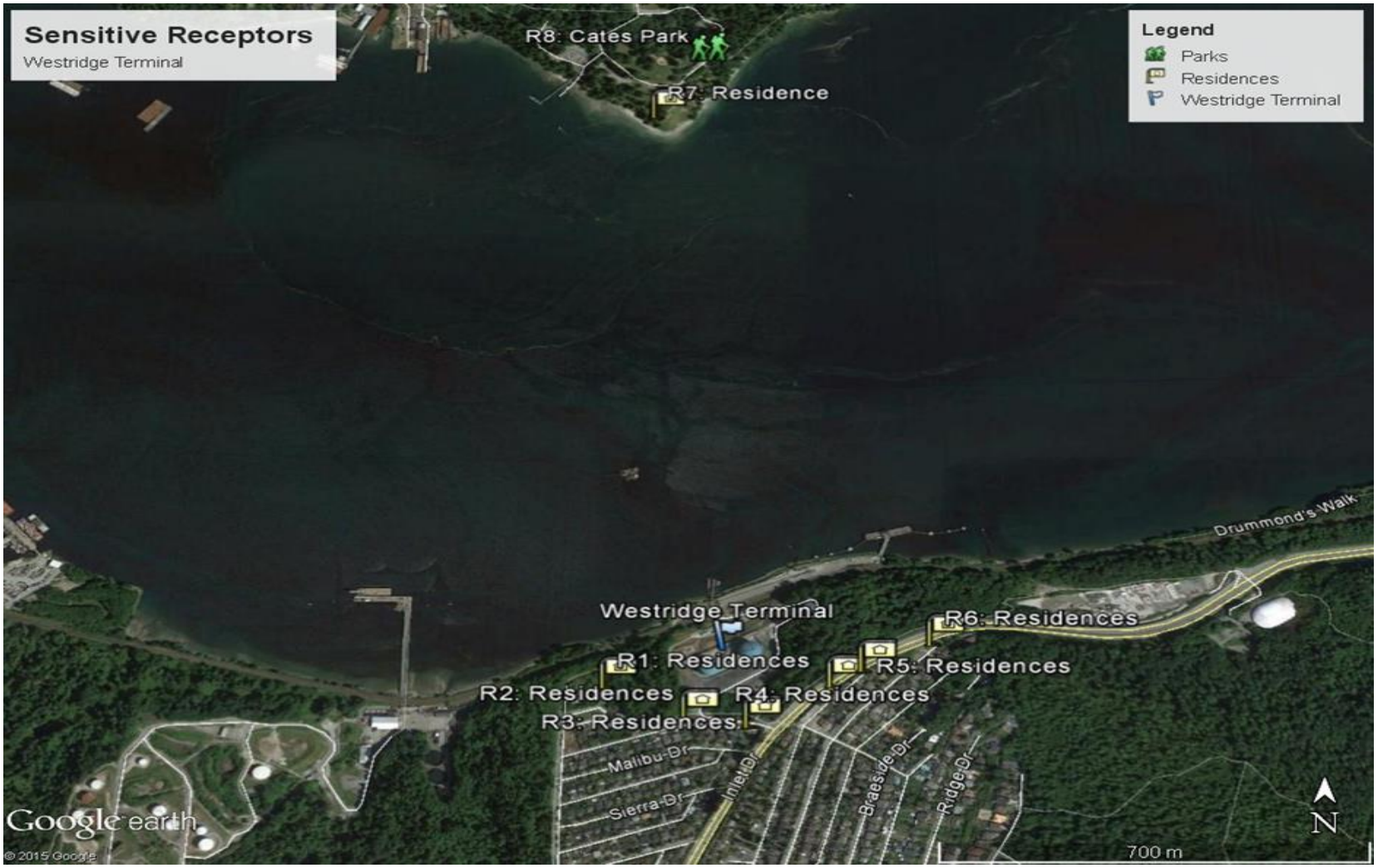
November 24, 2016

Air Emissions Management Plan, Westridge Marine Terminal: Particulate Matter Management Plan

Objectives

- To minimize emissions of particulate matter (PM) from construction activities to the air, ensure construction emissions meet applicable standards and control construction activities producing dust and PM from combustion and site disturbance
- The Particulate Matter Management Plan (PMMP) provides guidance to understand relevant weather conditions affecting emissions, best management practices, planning measures, monitoring, record keeping, complaint tracking and remedial actions

Existing Sensitive Receptors in the Westridge Marine Terminal Area



Examples of Proposed Controls for Fugitive Dust Emission Sources during Construction

Activity	Emission Control
Site Preparation	• Grade the construction site in phases. • Stabilize surfaces of completed earthworks with vegetation. • Compact distributed soil.
Storage Piles and Material Handling	• Schedule deliveries to minimize the length of time soil piles are present. • Use tarps or other acceptable means of retaining soils on stock piles especially during the winter months. • Maintain a suitable moisture content/dust suppression on roads and on surface material for handling. • Avoid creating steep faces on soil piles. • When practical, conduct loading/unloading activities on the downwind side of the pile. • Minimize drop heights and transfer points whenever practical.
Conveyor Transfers	• Where conveyors are used to transfer gravel from a barge into the foreshore, the pile will be wetted prior to unloading. • Where feasible, for fully enclosed transfer points and conveyor belts, ventilation through PM control equipment (i.e., cyclone, baghouse or similar control device) must be provided at all times when the conveyors are in operation. • Where feasible, the distance between material transfer points shall be minimized.

Proposed Controls: Combustion Emissions During Construction

- Reduction practices recommended to address combustion emissions from construction equipment:
  - Use ultra-low sulphur diesel (<15 ppm sulphur content)
  - Ensure combustion equipment and exhaust systems are properly maintained
  - Reduce or eliminate engine idling
- Will comply with Metro Vancouver's (MV's) Non-Road Diesel Engine Emission Regulation Bylaw while operating in MV and Fraser Valley Regional District
  - Bylaw applies to all non-road diesel engines having a maximum power of 25 hp (19 kW) or greater. Creates financial incentive to use more modern engine (Tier 2). Adherence to this bylaw will mitigate the combustion-related emissions of NO_X and PM.

Plans and Actions to Reduce Dust Emissions During Construction

In addition to the prescribed mitigation measures, the following actions will also be implemented:

- Site layout
- Administration
- Monitoring
- Record keeping
- Complaint handling
- Complaint tracking
- Complaint response

Tunnel Operations Dust Control: Example Measures

- TBM designed to control dust in tunnel. Tunnel air quality adequate for workers to use without respiratory equipment.
  - Foam Suppression of dust at cutter head
  - Dust collection unit – makes dust paste for disposal.
- Tunnel excavation stockpile wetted as required to control wind blown dust.
- Trucks removing tunnel excavated material will have box covers
- Truck tire wash used if required at Westridge Terminal
- Streets swept on a regular basis

TBM foam suppression system

TBM dust collection system

Images for illustrative purposes only

Proposed Controls for Particulate Matter Emission Sources During Operations

- Use the two VRUs as the primary VOC vapour removal equipment
  - No combustion emissions most of the time
- Keep propane-fired VCU in standby mode to avoid release of combustion products including PM that are created during VOC incineration
  - Anticipated use: less than 5% of the time
- Turn off main engines while at berth and anchorage
  - Current standard practice
  - Typically, one or two auxiliary engines used at berth to power ships systems and provide comfort heating for on board accommodations
- Continue to use low sulphur marine distillate fuel in the Port of Vancouver Emission Control Area to reduce combustion emission products such as SO_2 and PM
  - Required after January 1, 2015

Fugitive Emissions Management Plan for Construction
Westridge Marine Terminal

Fugitive Emissions Management Plan, Construction at Westridge Marine Terminal

- Objectives of the Fugitive Emission Management Plan (FEMP)
  - Minimize emissions of particulate matter (PM) from construction activities to the air
  - Ensure construction emissions meet applicable standards
  - Control construction activities producing dust and PM from combustion and site disturbance
- Fully addressed in the Particulate Matter Management Plan of the Air Emissions Management Plan (NEB Condition 52), will not be discussed here
- Examples of fugitive vapour controls from construction will be addressed in this plan

Examples of Proposed Controls for Fugitive Vapours When Dispensing Fuel

- All dispensing or transferring of fuel will be attended for the duration of the operation
- The attendant must be aware of proper fuel handling procedures to minimize the risk of a spill and shall continuously scan the area adjacent to the fuelling operation for possible leaks or spills
- Delivery may be into on-site mobile refueling tanks or directly into the equipment
- On-site fueling will be done with on-site single axle or tandem axle fuel trucks (not on highway). In some cases, on-site fueling may be completed by a pick-up truck with a tidy tank in the back
- The transferring and dispensing of fuel will be done with pumping equipment, an approved hose and top-fill nozzle

Examples of Proposed Controls for Fugitive Vapours When Dispensing Fuel

- Ensure that a site-appropriate spill containment kit is readily available
- When unreeling the fuel transfer hose and nozzle, the nozzle must be in the upright position. The nozzle shall be kept clear of the ground when returned to the reel or storage position.
- The transfer of fuel must be stopped prior to overflowing, leaving room for expansion
- Maintain regular inspections of fuel systems and their components

Examples of Proposed Emission Controls for Fugitive Vapours During Operations

Activity	Emission Control
Fugitive VOC vapours from tanker loading	Common header system for the VRUs and VCU to create a homogeneous fugitive vapour composition feeding to the VRUs and VCU if more than one tanker is being loaded
	Closed-system connection between tanker cargo tanks and VRU or VCU
Fugitive odorous sulphur compounds in vapours from tanker loading	H_2S adsorption vessels to capture sulphur before directing the vapour stream to the VRUs or VCU
	Adsorption vessels downstream of VRUs to remove mercaptans. Mercaptans directed to the VCU to be destroyed by combustion
Working losses from jet fuel storage tanks	Detected leaks will be promptly assessed and components found to be leaking materially significant quantities of vapour will be repaired as soon as reasonably practical
Potential equipment leaks (non-storage tank equipment)	Daily, weekly, monthly and annual duties required by the Field Technician, as outlined in the Westridge Terminal Operating Manual. This preventative maintenance is intended to identify and prevent potential leaks before they happen
	Infrared camera technology will scan all components to detect leaks annually
	Detected leaks will be promptly assessed and components found to be leaking materially significant quantities of vapour will be repaired as soon as reasonably practical

Air Emissions Management Plan for Operations
Westridge Marine Terminal

Air Emissions Management Plan
Westridge Marine Terminal: Overview

- Objectives of the Air Emissions Management Plan (AEMP)
  - Provide an ambient air quality monitoring plan
  - Mitigation measures for managing particulate matter (PM) emissions during construction and operations
  - Baseline monitoring would begin in Q4 2018 which is12 months prior to commencing in service operations in Q4 2019.
  - Monitoring of Project-related emissions from operations and regional pollutants would be continuous thereafter.
- Related Information:
  - NEB Condition 53 – Fugitive Emissions Management Plan

Ambient Air Quality Monitoring Commitment and Emissions Tracking, Westridge Marine Terminal

- Commitment made to comply with applicable ambient air quality objectives during operations taken from several regulatory authorities:
  - Metro Vancouver
  - BC Ministry of the Environment
  - Alberta Environment and Parks
  - National
- Annual emissions from point sources will be tracked, monitored and reported to the National Pollutant Release Inventory, if thresholds are triggered.
- Annual greenhouse gas emissions will also be tracked, monitored and reported if they exceed the reporting thresholds for either the National Greenhouse Gas Reporting Program and/or the BC Reporting Regulation

Monitored Contaminants of Interest and Ambient Air Quality Objectives(in µg/m^3)

Contaminant	Averaging Period	BC MOE	Metro Vancouver	National
$PM_{2.5}$ with speciation	24-hour	25[1]	25	27 to 28[4]
	Annual	8	8	8.8 to 10[5]
Diesel PM	24-hour	n/a	n/a	n/a
	Annual	n/a	n/a	n/a
NO_2	1-hour	n/a	200	400
	1-hour 98th	188[2]	n/a	n/a
	24-hour	n/a	n/a	200
	Annual	n/a	40	60
SO_2	1-hour	n/a	196	170 to 183[6]
	1-hour 99th	200[3]	n/a	n/a
	24-hour	n/a	125	n/a
	Annual	25	30	10.5 to 13.1[7]
Benzene	1-hour	30[8]	n/a	n/a
	Annual	3[8]	n/a	n/a
Ethyl benzene	1-hour	2,000[8]	n/a	n/a
Toluene	1-hour	1,880[8]	n/a	n/a
	24-hour	400[8]	n/a	n/a
Xylenes	1-hour	2,300[8]	n/a	n/a
	24-hour	700[8]	n/a	n/a
Total Reduced Sulpurs (H_2S and mercaptans)	1-hour	7	14 acceptable 7 desirable	n/a
	24-hour	3	n/a	n/a

Also ozone and reduced visibility which are regional air shed initiatives

Proposed Air Monitoring Station

Exterior View of Proposed Station

Inside View of Proposed Station

Photos for illustrative purposes only

Example of Web-Based Reporting Platform

RWDI Envision
The Environmental Data Platform

Projects

Current Conditions | Alerts History | Reports | Views | Project Configuration

— MDT (UTC-6)

Station	Most Recent Record	Status
Michel Residence	Oct 13/15 16:00 MDT	
Downtown Air Monitor	Oct 13/15 15:00 MDT	
Whispering Trailer Park	Oct 13/15 16:00 MDT	
Gas Station	Oct 13/15 15:00 MDT	
By-Products Plant	Oct 13/15 16:00 MDT	

Oct 13/15 10:12 MDT

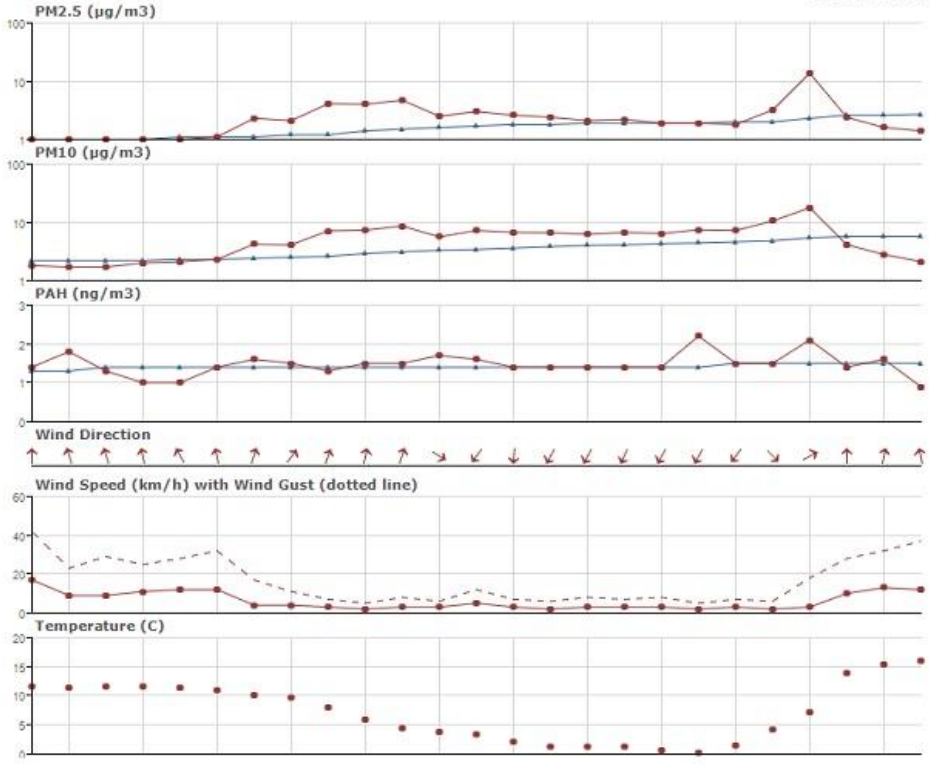
Downtown Air Monitor

Back | Print | Save | Display as Table

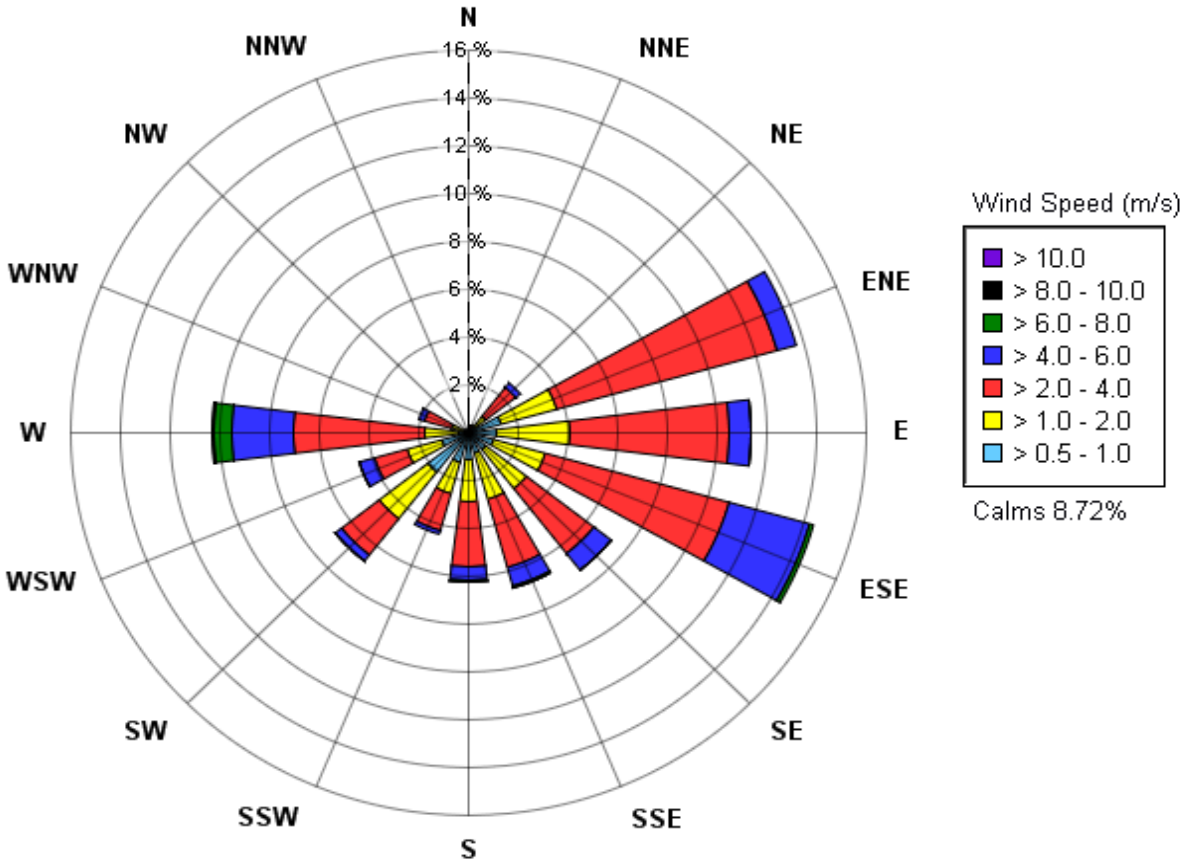
Downtown Air Monitor Data Summary

Envision
The Environmental Data Platform

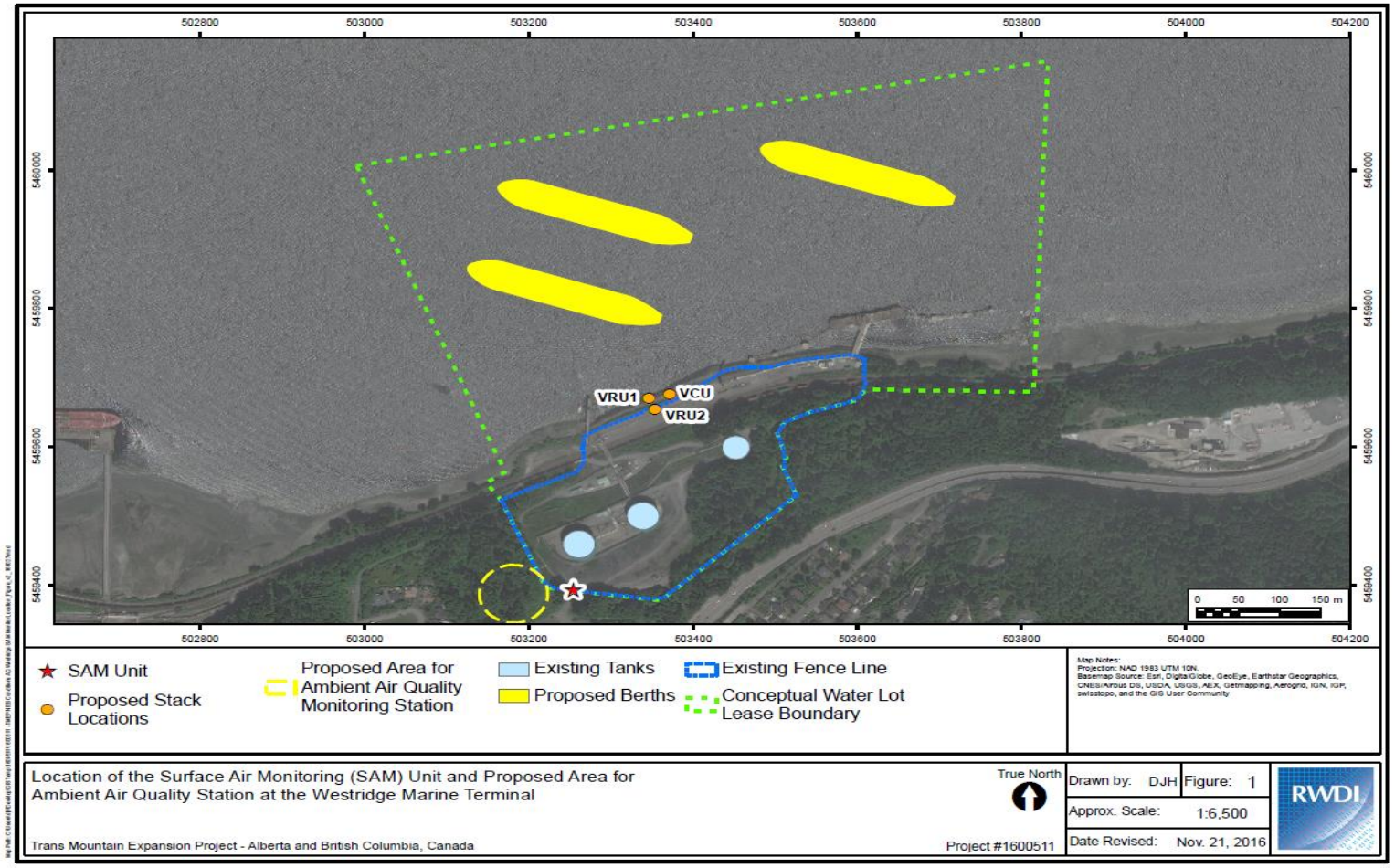
60 minutes — 24 hours updated every hour



Wind Rose for Westridge Marine Terminal



Locations of Existing and Proposed Ambient Stations



Fugitive Emissions Management Plan
Westridge Marine Terminal, Operations

Image for illustrative purposes only

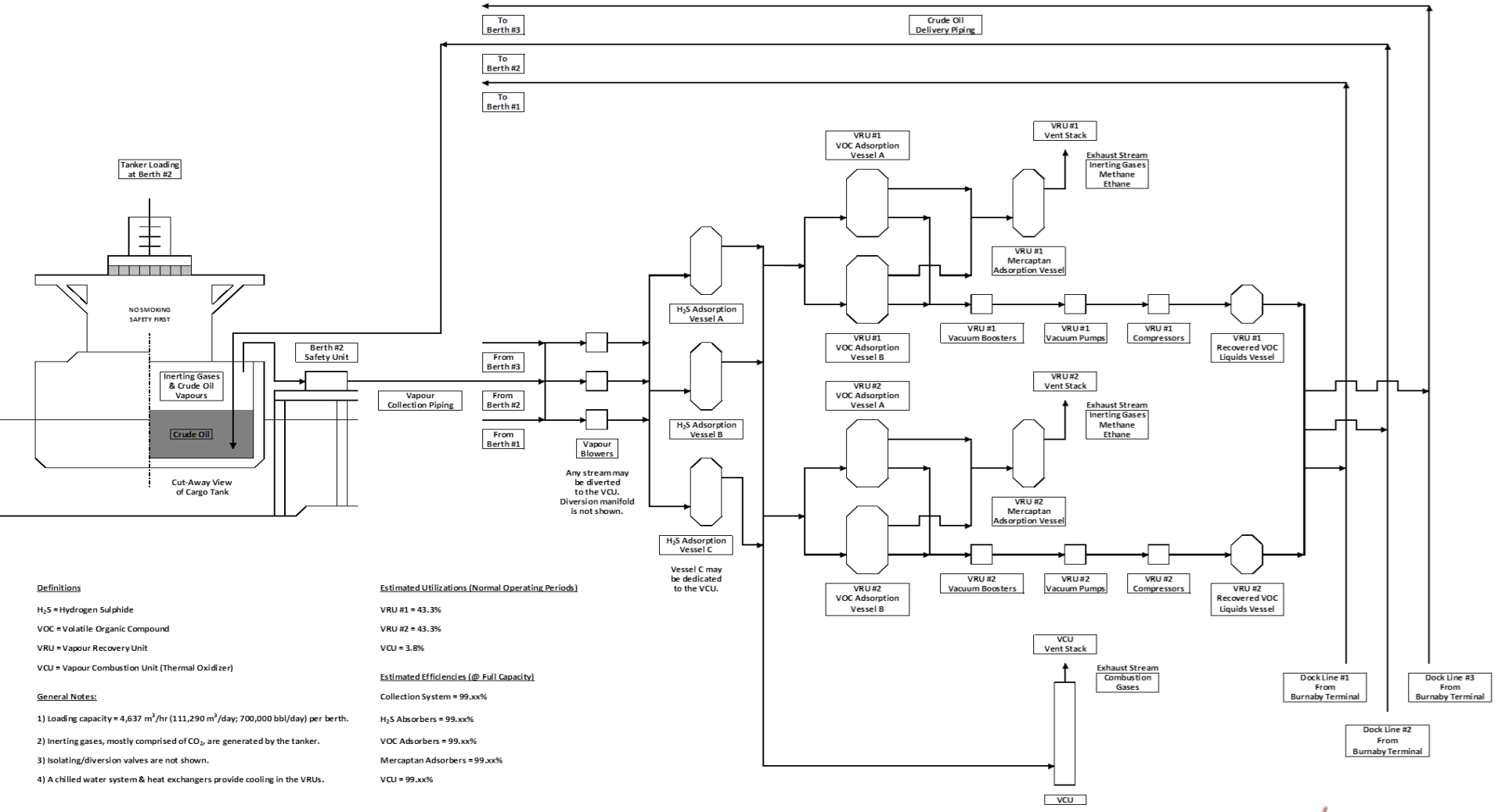
Fugitive Emissions Management Plan
Westridge Marine Terminal: Overview

- What:
  - Purpose of Fugitive Emissions Management Plan (FEMP): Manage and reduce fugitive emissions from the construction and operations at Westridge Marine Terminal
- When:
  - Managing fugitive emissions from construction would take place, September 2017 through Q4 2019
  - Monitoring fugitive emissions from in service operations would be after Project commissioning, Q4 2019
- Related Information:
  - NEB Condition 52 – Air Emissions Management Plan

Potential Fugitive Emissions
Westridge Marine Terminal Operations

- Fugitive emission sources may include:
  - Minute vapour losses of volatile organic compounds (VOCs) during product loading from the tankers, piping, the Vapour Recovery Units (VRUs) and the Vapour Combustion Unit (VCU), standing and working losses from the jet fuel storage tanks and other potential equipment leaks
- During tanker loading operations, two VRUs will capture, liquefy, and re-inject fugitive VOC vapours (one VRU will operate per tanker)
- Although used infrequently, the VCU will collect and destroy fugitive vapours when three tankers are being loaded simultaneously or when one VRU is out of service for maintenance and two tankers are being loaded simultaneously
- Adsorption vessels
  - Will be used to remove reduced sulphurs, like H_2S, upstream of the VRUs and the VCU
  - Will be used downstream of the VRUs to remove mercaptans

Westridge Marine Terminal, Proposed Vapour Control System



Definitions

H_2S = Hydrogen Sulphide

VOC = Volatile Organic Compound

VRU = Vapour Recovery Unit

VCU = Vapour Combustion Unit (Thermal Oxidizer)

General Notes:

1) Loading capacity = 4,637 m^3/hr (111,290 m^3/day; 700,000 bbl/day) per berth.

2) Inerting gases, mostly comprised of CO_2, are generated by the tanker.

3) Isolating/diversion valves are not shown.

4) A chilled water system & heat exchangers provide cooling in the VRUs.

Estimated Utilizations (Normal Operating Periods)

VRU #1 = 43.3%

VRU #2 = 43.3%

VCU = 3.8%

Estimated Efficiencies (@ Full Capacity)

Collection System = 99.xx%

H_2S Absorbers = 99.xx%

VOC Adsorbers = 99.xx%

Mercaptan Adsorbers = 99.xx%

VCU = 99.xx%

Verifying and Quantifying Fugitive Emissions, Westridge Marine Terminals, Tankers

Sampling surveys will be conducted onboard randomly selected tankers during which time cargo tank covers and associated seals will be checked for leaks of total hydrocarbon or total VOCs – four times (one per season) in one year.

Manifold vapour connections

Intrinsically safe flame or photo-ionisation detector

Tanker cargo access plate

Photos for illustrative purposes only: Photo c redits URS, Kinder Morgan, Disorbo (ILTA, 2 014)

Verifying and Quantifying Fugitive Emissions: Westridge Marine Terminal

- Tankers
  - Sampling surveys will be conducted onboard randomly selected tankers during which time cargo tank covers and associated seals will be checked for leaks of total hydrocarbon or total VOCs – four times per year (one per season)
- Piping
  - Any piping fugitive emissions will be determined as part of leak detection procedures
- VRUs
  - Emissions testing of inlet vapours upstream of H_2S adsorption vessels and downstream of VRUs to verify reduction efficiencies for H_2S, mercaptans and VOCs
  - Continuous H_2S vent monitor downstream of each H_2S adsorption vessel (upstream of the VRUs) to detect breakthrough and inform need for replacement of absorptive medium
  - Continuous monitoring of any VOCs in the VRU vent stacks
- VCU
  - Annual combustion efficiency testing to ensure system is optimized

Verifying and Quantifying Fugitive Emissions, Westridge Marine Terminal

The final verification procedures for the VRUs are expected to be complex and may be subject to change:

- Flow rate (based on US EPA Method 2)
- Dilution probe for continuous measurements on the inlet flow port to the H_2S adsorption vessels
- Continuous measurement of total hydrocarbons or VOCs (based on US EPA Method 25B) or equivalent
- Semi-continuous measurement (15-minute cycle) of H_2S concentrations (based on US EPA Method 15)
- Continuous measurement of mercaptans, in terms of Total Reduced Sulphur (TRS) (based on modified US EPA Method 16C
- Canisters of gas samples will be taken for analysis of the individual mercaptan species by an outside laboratory

Similar complex source testing proposed for the VCU.

Additional Mitigation Measures: Westridge Marine Terminal

Additional mitigation measures that could be implemented:

- Allocating highly odorous vapour streams to VCU
- Adjusting sequence of tanker loadings to reduce peak VOC generation rates
- Temporarily limiting or suspending the loading of highly odorous crude oils
- Loading crude oil at lower flow rates
- Installing a VCU downstream of the VRUs