



U.S. General Services Administration

# Environmental Impact Statement for the Kenneth G. Ward (Lynden) and Sumas Land Ports of Entry Modernization and Expansion Projects Lynden and Sumas, Washington

## Volume II – Appendix C Air Quality Calculations and Emissions – PART 2

**Draft**



August 2024

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## ACRONYMS

<b>Acronym</b>	<b>Definition</b>
AADT	Annual Average Daily Traffic
ACM	asbestos-containing material
ADA	Americans with Disabilities Act
AG	Agriculture
APE	area of potential effect
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
BC	British Columbia
BCC	birds of conservation concern
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practices
BNSF	Burlington Northern Santa Fe Railroad
BTS	Bureau of Transportation Statistics
CAA	Clean Air Act
CBP	Customs and Border Protection
CBSA	Canada Border Services Agency
CCD	census county division
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH <sub>4</sub>	methane
CO <sub>2</sub>	carbon dioxide
COG	Council of Government
COV	commercially owned vehicle
CWA	Clean Water Act
dB	decibels
DFA	Duty Free Americas
dBA	decibels on an A-weighted scale
DOSH	Division of Occupational Safety and Health
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EO	Executive Order
ESA	Environmental Site Assessment
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
GHG	greenhouse gas
GMA	Growth Management Act
GSA	U.S. General Services Administration
GWP	global warming potential
HAP	hazardous air pollutant
HSS	highways of statewide significance
HUC	Hydrologic Unit Code
IDP	Inadvertent Discovery Plan
IECC	International Energy Conservation Code
IPaC	Information for Planning and Consultation

<b>Acronym</b>	<b>Definition</b>
LBP	lead-based paint
LEED®	Leadership in Energy and Environmental Design
LPOE	Land Port of Entry
LRR	Land Resource Region
LUST	leaking underground storage tank
MBTA	Migratory Bird Treaty Act
MLRA	Major Land Resource Area
mph	miles per hour
MPO	Metropolitan Planning Organization
msl	mean sea level
MTCA	Model Toxics Control Act
N <sub>2</sub> O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NII	non-intrusive inspection
NO <sub>x</sub>	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standard
NSR	New Source Review
NWCAA	Northwest Clean Air Agency
O <sub>3</sub>	ozone
OSHA	Occupational Health and Safety Administration
PBS	Public Buildings Service
PCB	non-polychlorinated biphenyl
PDS	Program Development Study
PM <sub>2.5</sub>	very fine particulate matter 2.5 micrometers or smaller
PM <sub>10</sub>	fine particulate matter 10 micrometers or smaller
POV	privately owned vehicle
ppm	parts per million
PPV	peak particle velocity
PSD	Prevention of Significant Deterioration
PSE	Puget Sound Energy
RCRA	Resources Conservation and Recovery Act of 1976
RCW	Revised Code of Washington
ROD	Record of Decision
ROI	region of influence
SC-GHG	social cost of greenhouse gases
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SITES	Sustainable Sites Initiative
SO <sub>2</sub>	sulfur dioxide
SPCC	spill prevention, control, and countermeasures
SR	State Route
STIP	State Transportation Improvement Program
SWPPP	stormwater pollution prevention plan

<b>Acronym</b>	<b>Definition</b>
TC	Tourist Commercial
THPO	Tribal Historic Preservation Officer
TMDL	Total Maximum Daily Load
U.S.C	U.S. Code
USDA	U.S. Department of Agriculture
U.S. DOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
vpd	vehicles per day
vph	vehicles per hour
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WHO	World Health Organization
WNHP	Washington Natural Heritage Program
WOTUS	Waters of the U.S.
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WSS	Web Soil Survey

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**C.3 Sumas LPOE Construction Air Quality Emissions**

Construction	Building (approx. sq ft)	Pavement (sq ft)	Project Area (ac)
Alternatives 2, 3 and 4	105,440	46500	12.64
Demolition	Building (approx. sq ft)	Pavement (sq ft)	
Alternatives 2, 3 and 4	75,000	471754.8	

**C.3.1 Alternatives 2, 3 and 4**

Phase lengths for an approx. 3 ac building (in days) Source: [https://www.caleemod.com/documents/user-guide/05\\_Appendix%20D.pdf](https://www.caleemod.com/documents/user-guide/05_Appendix%20D.pdf)

Demolition	20		
Site Prep	3		
Grading	6		
Construction	220		
Coating	10		
Paving	10		

  

	Months	Years
	13	1.1

Equipment List and Vehicle Hours for 15 ac site

Phase	Equipment	No.	Hours/day/ equipment	Days	Hours
Demolition	Excavators	3	8	20	480
Demolition	Rubber tired dozers	2	8	20	320
Demolition	Concrete/industrial saws	1	8	20	160
Demolition	Tractors/loaders/backhoes	0	0	20	0
Site Prep	Graders	0	0	3	0
Site Prep	Tractors/loaders/backhoes	4	8	3	96
Site Prep	Rubber tired dozers	3	8	3	72
Site Prep	Scrapers	0	0	3	0
Grading	Rubber tired dozers	1	8	6	48
Grading	Concrete/industrial saws	0	0	6	0
Grading	Tractors/loaders/backhoes	2	8	6	96
Grading	Graders	1	8	6	48
Grading	Excavators	2	8	6	96
Grading	Scrapers	2	8	6	96
Construction	Cranes	1	7	220	1540
Construction	Forklifts	3	8	220	5280
Construction	Tractors/loaders/backhoes	3	7	220	4620
Construction	Welders	1	8	220	1760
Construction	Generator sets	1	8	220	1760
Coating	Air compressors	1	6	10	60
Paving	Pavers	2	8	10	160
Paving	Cement and Mortar Mixers	0	0	10	0
Paving	Rollers	2	8	10	160
Paving	Tractors/loaders/backhoes	0	0	10	0
Paving	Paving equipment	2	8	10	160

Source: [https://www.caleemod.com/documents/user-guide/05\\_Appendix%20D.pdf](https://www.caleemod.com/documents/user-guide/05_Appendix%20D.pdf)

**C.3.1.1 Construction Equipment**

Equipment hours are multiplied by Emissions Factors (Efs) then converted from grams/hr to tons/hr

Gasoline Equipment Emission Factors					
CO (g/hr)	NO2 (g/hr)	SO2 (g/hr)	PM10 (g/hr)	PM2.5 (g/hr)	VOC (g/hp-hr)
795	7.44	0.0194	6.21	5.72	0.035

Fuel	Equipment	Equipment Hours	Emissions (tons/year)						Equipment HP (for VOC)
			CO	NO2	SO2	PM10	PM2.5	VOC	
Gasoline	Air compressors	60	0.006625	0.000062	1.6167E-07	0.00005175	4.76667E-05	0.000175	75

Diesel Equipment Emission Factors					
CO (g/day)	NO2 (g/day)	SO2 (g/day)	PM10 (g/day)	PM2.5 (g/day)	VOC (g/hp-hr)
160	300	0.507	23.1	22.4	0.035

Fuel	Equipment	Equipment Hours	Emissions (tons/year)						Equipment HP (for VOC)
			CO	NO2	SO2	PM10	PM2.5	VOC	
Diesel	Cement and Mortar Mixers	0	0	0	0	0	0	0	
Diesel	Concrete/industrial saws	160	0.003555556	0.00666667	1.1267E-05	0.00051333	0.000497778	0	
Diesel	Cranes	1540	0.034	0.064	0.000	0.005	0.005	0.014	231
Diesel	Excavators	576	0.013	0.024	0.000	0.002	0.002	0.004	158
Diesel	Forklifts	5280	0.117	0.220	0.000	0.017	0.016	0.018	89
Diesel	Generator sets	1760	0.039	0.073	0.000	0.006	0.005	0.006	84
Diesel	Graders	48	0.001	0.002	0.000	0.000	0.000	0.000	187
Diesel	Pavers	160	0.004	0.007	0.000	0.001	0.000	0.001	130
Diesel	Paving equipment	160	0.004	0.007	0.000	0.001	0.000	0.001	132
Diesel	Rollers	160	0.004	0.007	0.000	0.001	0.000	0.000	80
Diesel	Rubber tired dozers	440	0.010	0.018	0.000	0.001	0.001	0.004	247
Diesel	Scrapers	96	0.002	0.004	0.000	0.000	0.000	0.001	367
Diesel	Tractors/loaders/backhoes	4812	0.107	0.201	0.000	0.015	0.015	0.018	97
Diesel	Welders	1760	0.039	0.073	0.000	0.006	0.005	0.003	46
	<b>Tons of pollutant</b>		<b>0.383336111</b>	<b>0.70639533</b>	<b>0.00119387</b>	<b>0.05443942</b>	<b>0.052787222</b>	<b>0.0709466</b>	

**C.3.1.2 Demolition Hauling**

158 pounds per sq ft  
5925 tons of C&D debris (estimated) for a 75 ksf building  
1.19 tons per cubic yard  
4979 cubic yard of C&D debris  
40.0 cy per truck  
249 truck trips, 2 trips per load  
50 miles per trip

158 pounds per sq ft  
37268.6292 tons of C&D debris (estimated) for 400 ksf pavement  
0.7 tons per cubic yard for pavement  
53241 cubic yard of C&D debris  
40.0 cy per truck  
2662 truck trips, 2 trips per load  
50 miles per trip  
2911 total truck trips

**C.3.1.3 Construction Hauling**

4.3 pounds per sq ft typical waste generation, per [https://www.epa.gov/sites/production/files/2017-2267\\_tons\\_of\\_c&d\\_debris\\_estimated\\_for\\_a\\_100k\\_sf\\_building](https://www.epa.gov/sites/production/files/2017-2267_tons_of_c&d_debris_estimated_for_a_100k_sf_building)  
226.7 tons of C&D debris (estimated) for a 100k sf building  
1.19 tons per cubic yard <https://www.sandiego.gov/sites/default/files/legacy/environmental-services/recycling/pdf/cdmaterialconversiontable.pdf>  
191 cubic yard (cy) of C&D debris  
40.0 cy per truck  
10 truck trips

Off-peak is considered demolition in this analysis

Phase	Daily Workers Onsite	Daily Vendors	Total Haul Trips	
<b>Off-peak</b>	20	0	2911	
<b>Peak construction</b>	65	45	10	
Phase	Days	Worker Total	Vendor Total	Haul Trucks
Off-peak	183	3660	0	2911
Peak construction	730	47450	32850	10

Miles, roundtrip distance	20	50	50
			Distance is assumed

<b>Off-peak</b>	73200	0	145549.726
<b>Peak construction</b>	949000	1642500	500
<b>Vehicle-miles</b>	1022200	1642500	146050

Pollutant	CO	NOx	SO2	PM10	PM2.5	VOC
Emission Factor (g/mile)						
Vehicle Type	CO	NOx	SO2	PM10	PM2.5	VOC
Passenger cars, gasoline	2.8656	0.1205	0.0055	0.0336	0.019	0.1701
Passenger trucks, gasoline	5.0191	0.3129	0.0073	0.0531	0.0319	0.2833
Heavy trucks, diesel single-unit short haul	1.0359	1.0189	0.0077	0.1069	0.0543	0.0788

		Emissions (tons/year)					
Vehicle Type	Vehicle-miles	CO	NOx	SO2	PM10	PM2.5	VOC
Passenger cars, gasoline	511100	1.6273	0.0684	0.0031	0.0191	0.0108	0.0966
Passenger trucks, gasoline	511100	2.8503	0.1777	0.0041	0.0302	0.0181	0.1609
Heavy trucks, diesel single-unit short haul	1788550	2.0586	2.0248	0.0153	0.2124	0.1079	0.1566
<b>Pollutant Totals, All Vehicles</b>		<b>6.9</b>	<b>3.0</b>	<b>0.0</b>	<b>0.3</b>	<b>0.2</b>	<b>0.5</b>

**C.3.1.4 Construction Dust**

AP-42 EF for Total Suspended Particles	1.2 tons/acre/month	Calculating fugitive dust emissions by estimating multiplying AP-42 Total Suspended Particulates (TSP) EF with anticipated area to be graded. Please note the entire acreage is presented as graded to provide a conservative analysis.
Total area	12.64 acres	
Total TSP	14.6624 tons	
PM10	8.210944 tons	
PM2.5	4.39872 tons	
PM10 Total	8.5	
PM2.5 Total	4.6	

**C.3.1.5 Air Quality Emissions Totals**

Alts 2, 3, and 4	CO	No2	PM10	PM2.5	SO2	VOC
Construction Equipment	0.38	0.71	0.05	0.05	0.00	0.07
Worker vehicles	4.48	0.25	0.05	0.03	0.01	0.26
Delivery and waste trucks	2.06	2.02	0.21	0.11	0.02	0.16
Fugitive dust			8.53	4.59		
<b>Total</b>	<b>6.92</b>	<b>2.98</b>	<b>8.84</b>	<b>4.78</b>	<b>0.02</b>	<b>0.49</b>



**C.4 SUMAS LPOE Construction Greenhouse Gas Emissions**

**C.4.1 Alternatives 2, 3, and 4**

**Equipment List and Vehicle Hours for 15 ac site**

Fuel	Equipment	Hours	Horsepower	Load Factor	Gallons of Fuel
Gasoline	Air compressors	60	78	0.48	112.32
Diesel	Cement and Mortar Mixers	0	9	0.56	0
Diesel	Concrete/industrial saws	160	81	0.738	478.224
Diesel	Cranes	1540	231	0.29	5158.23
Diesel	Excavators	576	158	0.38	1729.152
Diesel	Forklifts	5280	89	0.2	4699.2
Diesel	Generator sets	1760	84	0.74	5470.08
Diesel	Graders	48	187	0.41	184.008
Diesel	Pavers	160	130	0.42	436.8
Diesel	Paving equipment	160	132	0.36	380.16
Diesel	Rollers	160	80	0.38	243.2
Diesel	Rubber tired dozers	440	247	0.4	2173.6
Diesel	Scrapers	96	367	0.48	845.568
Diesel	Tractors/loaders/backhoes	4812	97	0.37	8635.134
Diesel	Welders	1760	46	0.45	1821.6

Assumptions:

HP and load factor taken from Capitol Annex DEIR

Assuming 0.05 gallons of fuel consumption per horsepower-hour

**Emissions Factors**

Fuel		CO2	CH4	N2O
		kg/gal	g/gal	g/gal
Gasoline	112.32	8.78	0.5	0.22
Diesel	32254.956	10.21	0.57	0.26

**Emissions (MT)**

Fuel	CO2	CH4	N2O	CO2-eq
Gasoline	1.0	0.0001	0.0000	1.0
Diesel	329.3	0.0184	0.0084	332.3

Note: CO2-eq is calculated by multiplying CO2, CH4, N2O by their respective global warming potential (GWP) and summing. This analysis uses GWP values from 40 CFR 98, Subpart A, Table A-1 (CO2 = 1, CH4 = 25, N2O = 298).

**C.4.1.1 On-road vehicles**

Vehicle	Emissions Factors				Source: AFDC
	CO2 kg/gal fuel	CH4 g/mile	N2O g/mile	Fuel economy mpg	
Passenger cars, gasoline	8.78	0.071	0.0046	24	
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4	
Heavy trucks, diesel single-unit short haul	10.21	0.95	0.0431	7.4	Delivery trucks

Source for fuel economy data: AFDC

Source for emission factors: EPA 2024 emissions factors

Vehicle	VMTs	Gal fuel	Emissions (MT)			
			CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	511100	21296	187	0.0362881	0.002351	188.6
Passenger trucks, gasoline	511100	29374	258	0.00485545	0.001789	258.6
Heavy trucks, diesel single-unit short haul	1788550	241696	2468	1.69912224	0.077086	2533.2

**C.4.1.2 Greenhouse Gas Emissions Totals**

	CO2	CH4	N2O	CO2-eq
Construction equipment	330.31	0.02	0.01	333.28
Worker vehicles	444.88	0.04	0.00	447.14
Delivery and waste trucks	2467.72	1.70	0.08	2533.17
<b>Total (in MT)</b>	<b>3242.90</b>	<b>1.76</b>	<b>0.09</b>	<b>3313.58</b>

**C.5 Sumas LPOE Operations Air Quality and Greenhouse Gas Emissions**

**Employees**

73 Current  
99 Total, after expansion  
20 miles, one way commuting distance  
365 working days per year

**C.5.1 Alternatives 2, 3 and 4**

**C.5.1.1 Employee Commuting – Criteria Pollutants**

1445400 vehicle miles per year

Vehicle	Vehicle-miles per year	Emission Factors (g/mile)						Emissions (tons/year)					
		CO	Nox	PM10	PM2.5	SO2	VOC	CO	Nox	PM10	PM2.5	SO2	VOC
Passenger cars, gasoline	722700	2.87	0.12	0.03	0.02	0.01	0.17	2.30	0.10	0.03	0.02	0.00	0.14
Passenger trucks, gasoline	722700	5.02	0.31	0.05	0.03	0.01	0.28	4.03	0.25	0.04	0.03	0.01	0.23
<b>Total</b>								<b>6.33</b>	<b>0.35</b>	<b>0.07</b>	<b>0.04</b>	<b>0.01</b>	<b>0.36</b>

**C.5.1.2 Employee Commuting – GHGs**

Vehicle	Emissions Factors			Fuel economy (mpg)	Vehicle-miles per year	Gal fuel consumed	Emissions (MT/year)			
	(CO2 kg/gal fuel)	CH4 (g/mile)	N2O (g/mile)				CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	8.78	0.071	0.0046	24	722700	30113	264	0.051312	0.003324	<b>266.7</b>
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4	722700	41534	365	0.006866	0.002529	<b>365.6</b>
<b>Total</b>							<b>629.06</b>	<b>0.06</b>	<b>0.01</b>	<b>632.26</b>

Source for fuel economy data: AFDC

Source for emission factors: EPA 2024 Emissions Factors

**C.5.2 No Action Alternative**

**C.5.2.1 Employee Commuting – Criteria Pollutants**

1065800 vehicle miles per year

Vehicle	Vehicle-miles per year	Emission Factors (g/mile)						Emissions (tons/year)					
		CO	Nox	PM10	PM2.5	SO2	VOC	CO	Nox	PM10	PM2.5	SO2	VOC
Passenger cars, gasoline	532900	2.87	0.12	0.03	0.02	0.01	0.17	1.70	0.07	0.02	0.01	0.00	0.10
Passenger trucks, gasoline	532900	5.02	0.31	0.05	0.03	0.01	0.28	2.97	0.19	0.03	0.02	0.00	0.17
<b>Total</b>								<b>4.67</b>	<b>0.26</b>	<b>0.05</b>	<b>0.03</b>	<b>0.01</b>	<b>0.27</b>

**C.5.2.2 Employee Commuting – GHGs**

Vehicle	Emissions Factors			Fuel economy (mpg)	Vehicle-miles per year	Gal fuel consumed	Emissions (MT/year)			
	(CO2 kg/gal fuel)	CH4 (g/mile)	N2O (g/mile)				CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	8.78	0.071	0.0046	24	532900	22204	195	0.037836	0.002451	<b>196.6</b>
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4	532900	30626	269	0.005063	0.001865	<b>269.6</b>
<b>Total</b>							<b>463.85</b>	<b>0.04</b>	<b>0.00</b>	<b>466.21</b>

Source for fuel economy data: AFDC

Source for emission factors: EPA 2024 Emissions Factors

**C.6 Sumas LPOE Construction and Operations Social Cost of Greenhouse Gases**

**C.6.1 Construction Social Cost of Greenhouse Gases**

SC-GHG (\$/metric ton)

Year	CO2		
	2.50%	2%	1.50%
2026	133	215	365

SC-GHG (\$) Commercial

Year	CO2		
	2.50%	2%	1.50%
2026	431,306	697,224	1,183,659

**C.6.2 Operations Social Cost of Greenhouse Gases**

SC-GHG (\$/metric ton)

Year	CO2		
	2.50%	2%	1.50%
2030	144	230	384
2035	158	248	408
2040	173	267	431
2045	189	287	456
2050	205	308	482

Year	CO2		
	2.50%	2%	1.50%
2030	90,584.71	144,683.92	241,559.24
2035	99,391.56	156,007.01	256,656.69
2040	108,827.47	167,959.16	271,125.08
2045	118,892.44	180,540.37	286,851.59
2050	128,957.40	193,750.64	303,207.17