Cleaner Air Oregon Level-3 Modeling Protocol and Risk Assessment Work Plan

EcoLube Recovery LLC
Portland, Oregon

Prepared for:

Oregon Department of Environmental Quality

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BRIDGEWATER GROUP, INC.

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1.0 Introduction

EcoLube Recovery (ELR) is a Northwest owned and operated company engaged in the safe and sustainable practice of collecting and recycling used oil produced here in the region. The benefits of reusing and recycling used oil are well known and include the following:

- Recycling used oil keeps it from polluting soil and water.
- Motor oil does not wear out—it just gets dirty—so recycling it saves a valuable resource.
- Less energy is required to produce a gallon of re-refined base stock than a base stock from crude oil.
- One gallon of used motor oil provides the same 2.5 quarts of lubricating oil as 42 gallons of crude oil.

ELR's facility in Portland utilizes a specialized re-refining process where the used oil is converted into certified products such as marine fuel and Group 2 base oil. The facility is at 11535 N Force Ave. in Portland, Oregon at a latitude of N 45° 36′ 24′′ and a longitude of W122° 41′ 40′′ (UTM NAD 1983 zone 10 coordinates of 523,831 Easting and 5,050,396 Northing). The location of the facility is shown in Figure 1-1.

On September 17, 2020 Ecolube was "called in" to the Cleaner Air Oregon (CAO) program by the Oregon Department of Environmental Quality (DEQ). Under the Cleaner Air Oregon regulations (OAR-340-245), existing sources are required to conduct a health risk assessment of all non-exempt Toxic Emission Units (TEUs) at the facility and demonstrate the facility can operate at or below the applicable existing source Risk Action Levels (RALs). The first step in the CAO process is to submit a CAO Emissions Inventory that provides emission estimates of CAO regulated toxic air contaminants (TACs) from each non-exempt toxic emissions unit (TEU) at the facility. The initial Emissions Inventory (EI) was submitted on December 1, 2020. ELR responded to DEQ questions on this initial EI and conducted source testing. On October 24, 2022, Oregon Department of Environmental Quality (DEQ) approved the revised inventory that was submitted on July 14, 2022. The next step in the CAO process is to submit the Modeling Protocol by no later than November 28, 2022 and Level-3 Risk Assessment Work Plan by December 26, 2022. [OAR 340-245-0030(1)(b)&(c)]. A combined Modeling Protocol and Level-3 Risk Assessment Work Plan (MPRAWP) was submitted on November 28, 2022. DEQ conditionally approved the MPRAWP on May 19, 2023 providing that a number of items be addressed in the final Risk Assessment.

On October 4, 2023, DEQ sent an email request to revise the short-term emissions from tanks based on the maximum fill rates and highest liquid surface temperature and vapor pressure. Ecolube submitted a revised remissions inventory and Level-3 Risk Assessment (L3RA) on October 26, 2023. DEQ requested updates to the tank emission speciation calculations on November 9, 2023, and updates to the tank inventory and exempt TEU calculations on January 16, 2024. EcoLube submitted revised Inventories on December 22, 2023, and January 19, 2024.

On February 6, 2024, DEQ provided EcoLube with a revised version of the Inventory that included the exempt Toxic Emission Units (TEUs) in accordance with Oregon Administrative Rule (OAR) 340-245-0040(4)(a)(A). Bridgewater Group, on behalf of EcoLube, reviewed DEQ's

revised Inventory and indicated that no further corrections were needed. DEQ approved the January 19, 2024 Inventory on February 6, 2024. In that approval, DEQ requested Ecolube submit a revised Modeling Protocol and Risk Assessment Work Plan and a revised Risk Assessment incorporating the information in the approved Inventory by no later than March 15, 2024. The MPRAWP and L4RA were submitted on March 15, 2024. DEQ reviewed and sent a response letter on May 9, 2024. DEQ requested several revisions on the documents, including:

1. Changes to the RTO exhaust parameters.
2a. A correction to Table 4-1 (RBC Concentration Table).
2b. Requesting the use of the most recent version of AERMOD (version 23132).
2c. Revising the urban population value from 1.9 million to 635,067.
3. Reassigning EFU and MUF zoning from acute to residential exposure.

Response: During the protocol phase, Ecolube and DEQ had detailed discussions about the exposure location determination process which is documented above. We believe DEQ's new request to reassigning EFU and MUF zoning from acute to residential exposure is inconsistent with Oregon rule. Under OAR 340-345-0020 (22):

> "Exposure location" means a location where people, including sensitive populations, *actually live* or normally congregate… Exposure locations are associated with exposure scenarios and identified based on allowed land use zoning, except as allowed under OAR 340-245-0210(1)(a)(F) or when DEQ has sufficient information to determine that an area is being used in a manner contrary to its land use zoning." (emphasis added).

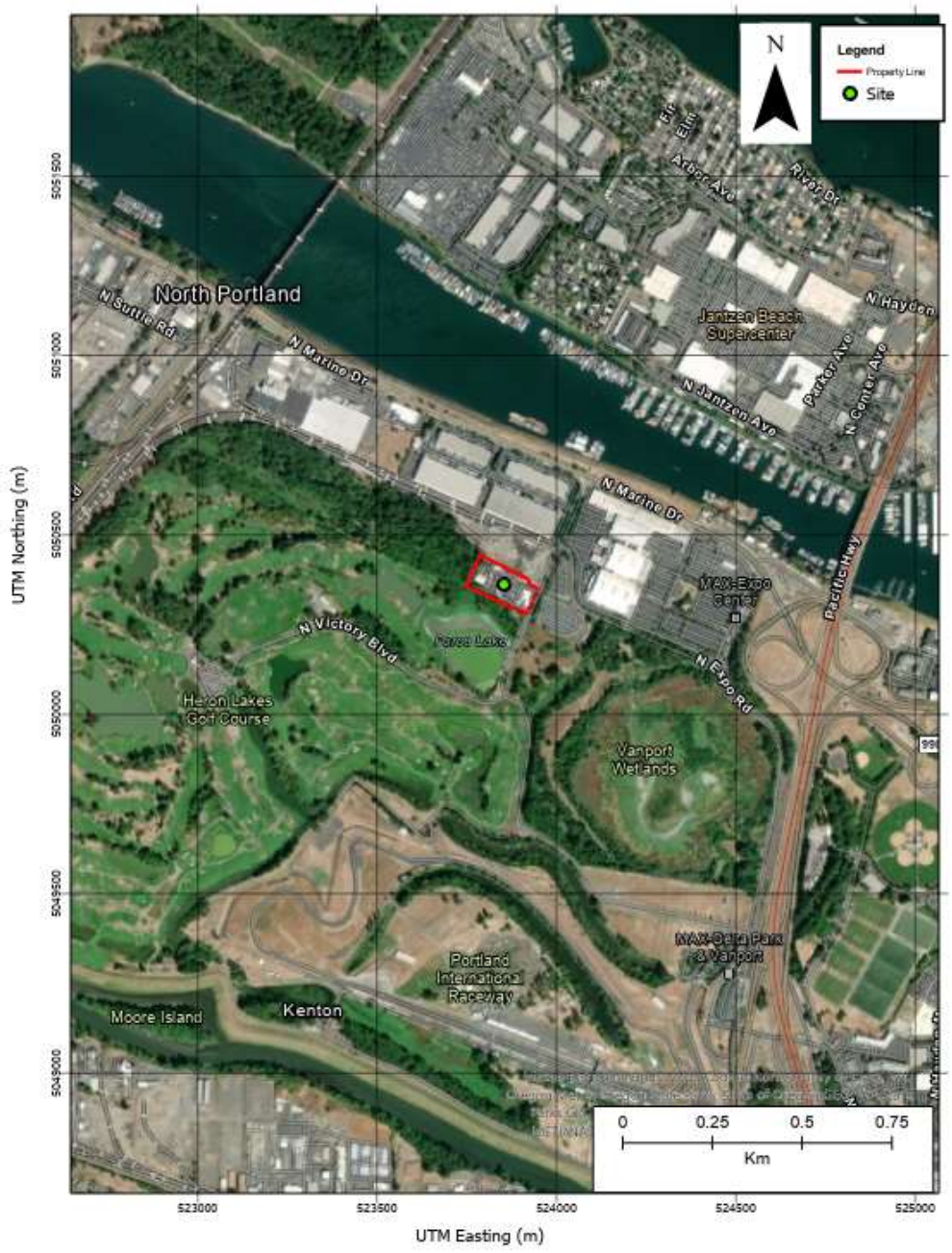
DEQ is applying a blanket determination that these areas are residential regardless of whether people are actually living there. The exposure class should be based on the actual land use at the receptor location and not on a "possibility" that a future residence may be built in the unspecified future. Furthermore, EFU and MUF are not residential land use types, but rather agricultural or forest land uses which allow for residences. Thus, applying an acute exposure to receptors on actual forest land and farmland is appropriate since this is the designated land use in these areas. Oregon rule states the exposure designation is based on the underlying actual land use and not the tax lot designation. This is just a rehash of the proximity/distance argument DEQ agreed was unreasonable in the previous protocol discussions (see point 3e on page 1-2 above). Furthermore, no additional documentation or justification should be required for the acute exposure determinations in the forest/farmlands as those determinations are consistent with the underlying land use designation.

4. Adjusting Table 4-3 rounding.

The revised L3RA and MPRAWP were submitted on 5/29/2024. On July 2, 2024, DEQ responded requesting that tax lots designated as Effective Farm Use (EFU) or Multiple Use Forest (MUF) which do not currently have a dwelling established, should be modeled as residential and acute exposure locations or submit forms to allow for designating those receptors as nonresidential adult (worker) exposure locations rather than residential. Ecolube has decided to set the EFU and MUF areas to be residential so that the future reporting justifications will not be needed.

This document is the revised version of the MPRAWP incorporating most of these changes. Significant revisions to the MPRAWP are identified in red. A updated L3RA incorporating these changes was also submitted.

Figure 1-1: Site Location



2.0 Conceptual Site Model

2.1 Process Overview

ERL is a used oil refinery. Used oil is primarily received from trucks and unloaded into storage tanks. In general, there are three primary process operations at the facility:

- Refinery
- Sulfonation
- Oil Polishing System (OPS)

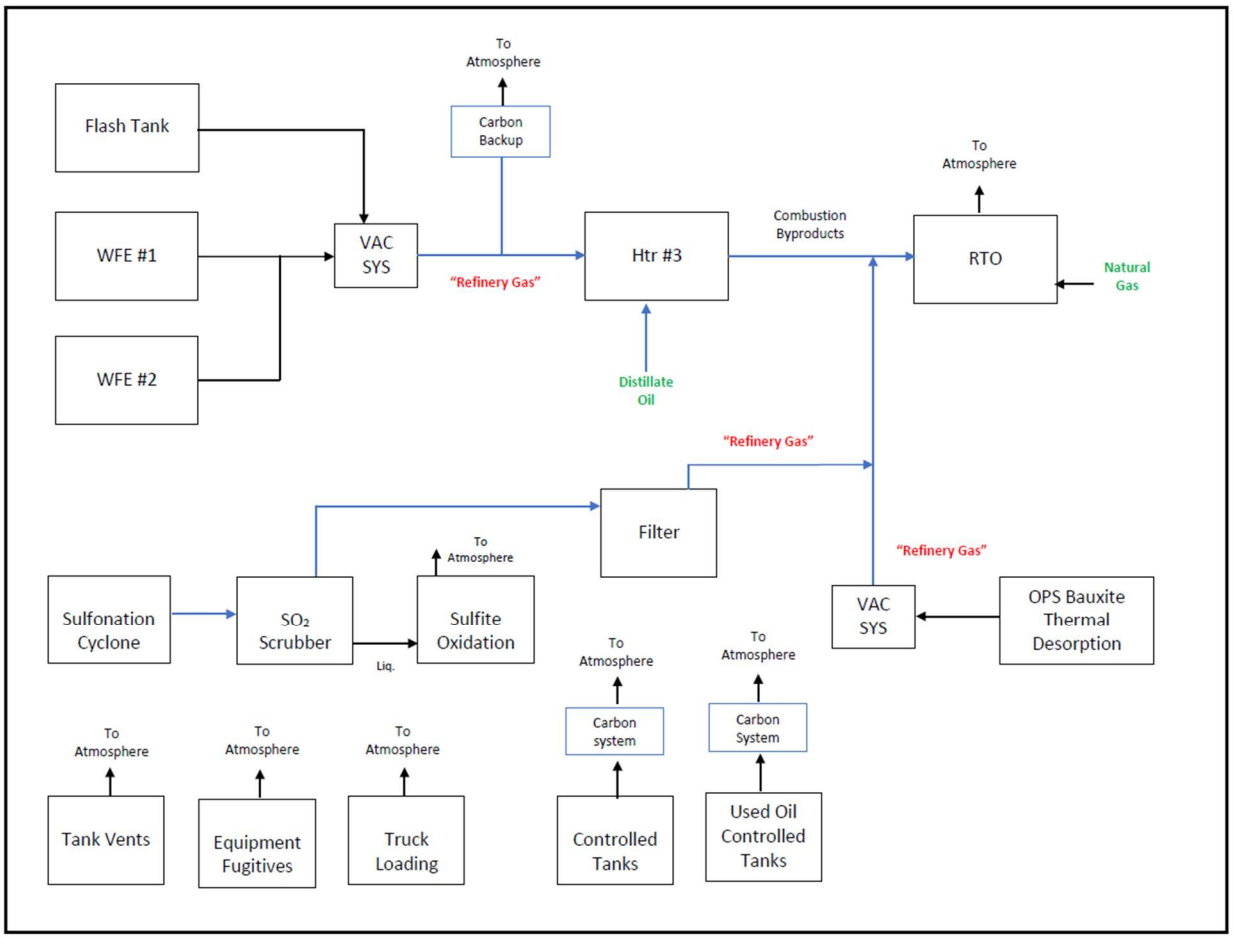
Used oil processed by the Refinery produces vacuum gas oil (VGO), flux, and #2 distillate oil. VGO can be further processed in Sulfonation and the OPS. The Sulfonation process reacts VGO with sulfur trioxide for the ultimate purpose of removing contaminants, color bearing agents and other compounds in the form of sulfonic acid. The sulfonic acid is removed in the OPS to produce base oil. Emissions from all three of these oil processing operations are ultimately controlled by Regenerative Thermal Oxidizer (RTO).

Non-exempt support equipment at the facility that are sources of TACs are the following:

- Storage tank vents, some of which are vented to carbon adsorption systems
- Fugitive equipment leaks
- Truck loading
- Carbon backup systems for the Refinery and OPS.

Figure 2-1 shows the facility process flow diagram.

Figure 2-1: ELR Process Flow Diagram



2.2 TEU Descriptions

Each of the toxic emission units (TEUs) is described below, with its TEU ID in parathesis. A more detail description is provided in the CAO emissions inventory submittal. Table 2-1 shows the cross-walk from the emission inventory TEU to the modeling ID, along with the UTM coordinates of each source. Source parameters are also provided below. The source locations are shown in Figure 2-2, along with buildings and Table 2-2 provides source parameters.

Table 2-1: TEUs, Emission Points, Model IDs and Locations

EI TEU	Description	Emission Point	Model ID	Type	X (m)	Y (m)
TO-01	Regenerative Thermal Oxidizer	RTO1	RTO1	POINT	523826.8	5050381
TANKS_CONTROLLED	Five Controlled tanks to carbon system	TCARBON	TCARBON	POINTHOR	523806.9	5050401
RCARBON	Refinery Carbon Back-Up Systems	RCARBON	RCARBON	POINTHOR	523819.9	5050394
UOTCARBON	UO Tank Controlled to Carbon System	UCARBON	UCARBON	POINTCAP	523824	5050404
TANKS	Uncontrolled Tanks	JAIL1	JAIL1	POINTHOR	523876	5050388
		JAIL2	JAIL2	POINTHOR	523871.3	5050390
		JAIL3	JAIL3	POINTHOR	523866.6	5050393
		JAIL4	JAIL4	POINTHOR	523862.1	5050395
		JAIL7	JAIL7	POINTHOR	523874.6	5050397
		JAIL8	JAIL8	POINTHOR	523869.9	5050399
		JAIL9	JAIL9	POINTHOR	523865.4	5050401
		CT1	CT1	POINTHOR	523904.4	5050375
		CT2	CT2	POINTHOR	523899.7	5050377
		CT3	CT3	POINTHOR	523907	5050380
		CT4	CT4	POINTHOR	523902.3	5050382
		CT5	CT5	POINTHOR	523897.6	5050385
		CT6	CT6	POINTHOR	523893.0	5050387
		TANK12	TANK12	POINTHOR	523855.9	5050403
		IT100-1	IT1001	POINTHOR	523811.4	5050412
		IT220-2	IT2202	POINTHOR	523816.3	5050416
		TK10401	TK10401	POINTHOR	523832.7	5050411
		TK10402	TK10402	POINTHOR	523837.4	5050409
		TK10403	TK10403	POINTHOR	523830.4	5050407
		TK10404	TK10404	POINTHOR	523835.2	5050404
		TK10501	TK10501	POINTHOR	523834.9	5050416
		TK10502	TK10502	POINTHOR	523839.7	5050413
		MDO1	MDO1	POINTHOR	523865.7	5050397
		WWF1	WWF1	POINTHOR	523905.3	5050326
		SO1	SO1	POINTHOR	523815.8	5050373
		SO2	SO2	POINTHOR	523811.4	5050376
FUG-1	Fugitive Equipment Leaks	FRONT	FRONT	AREA	523883.2	5050395
		JAIL	JAIL	AREA	523852.2	5050411
		BO	BO	AREA	523833.3	5050418
		UO	UO	AREA	523821.6	5050419
		IT	IT	AREA	523805.4	5050423
		REF	REF	AREA	523826.7	5050391
	LDAR Derived Fugitive	LDARREF	REF	AREA	523826.7	5050391
		SULF	SULF	AREA	523809.3	5050378
	LDAR Derived Fugitive	LDARLPSSULF	SULF	AREA	523809.3	5050378
		LPS1	LPS1	AREA	523780.1	5050387
		LPS2	LPS2	AREA	523795.5	5050378
TLOAD1	Trunk loading	TLOAD1	TLOAD	VOLUME	523888	5050376

Regenerative Thermal Oxidizer (TO-01)

The Regenerative Thermal Oxidizer (RTO) is a natural gas fired VOC abatement system with an air flowrate capacity of approximately 6,400 acfm. As shown in Figure 2-1, the RTO controls emissions from the Re-refinery, Sulfonation and OPS processes. The RTO uses natural gas as a supplemental fuel to oxidize the three process vapor streams. The RTO was source tested in January 2020 for metals and in January 2022 for toxic gaseous compounds including PCBs, PAHs, furans and dioxins. The RTO will be modeled as a point source, with stack parameters based on the January 2022 source test.

Carbon Back-Up Systems (RCARBON)

The ELR Refinery includes a carbon adsorption back-up system that is used periodically to provide short term control of emissions in lieu of the RTO. In order to determine potential emissions of TACs during use of the Refinery carbon back-up system, vapor stream analytical results from a similar refinery designed by the same manufacturer as the ELR refinery was used and it was conservatively assumed the back-up system was used one time per week for a one-hour duration. The carbon system is assumed to have a 90 percent control efficiency. The RCARBON source will be assumed to exhaust warm (140 F) through a 2-inch diameter vent at an exhaust rate of 57 acfm (13.5 m/s), which is the Refinery Vac System Flow Rate. This source will be modeled as a capped point source.

Uncontrolled Tanks (TANKS)

Tank TAC emissions are based on EPA's AP-42 Compilation of Air Emission Factors Chapter 7.1 Organic Liquid Storage Tanks and speciation factors determined from the compositional analysis. These tanks have a goose neck vent that exhaust above the top of the tank, thus the release height was set to 3 feet above the height of the tank. A tank parameterization from Santa Barbara Air District will be used in which the release temperature is set to ambient (0 K), the exit velocity to 0.001 m/s and the diameters to 0.001 m. This eliminates stack tip downwash while maintain the overall downwash effects. These sources will be modeled as a horizonal release as there is little to no momentum from the exhaust to propel the exhaust downward.

Controlled Tanks (TANKS_CONTROLLED)

Five tanks (AF1, IT100-2, PF2, TK30 and WLE1) have vents that are exhausted to a carbon adsorption abatement system venting at a single point. The carbon system is assumed to have a 90 percent control efficiency. Since this is a low volume source, the release temperature will be set to ambient (0 K), with a nominally small exit velocity of 0.001 m/s and a diameter of 0.001 m. This source will be modeled as a horizonal release at the heigh of the opening as there is little to no momentum from the exhaust.

Used Oil Controlled Tanks (UCARBON)

Six used oil tanks (OU01-U06) have vents that are exhausted to a carbon adsorption abatement system venting at a single point. The carbon system is assumed to have a 90 percent control efficiency. Since this is a low volume source, the release temperature was set to ambient (0 K), with a nominally small exit velocity of 0.001 m/s and a diameter of 0.001 m. This source was modeled as a horizonal release at the heigh of the opening as there is little to no momentum from the exhaust.

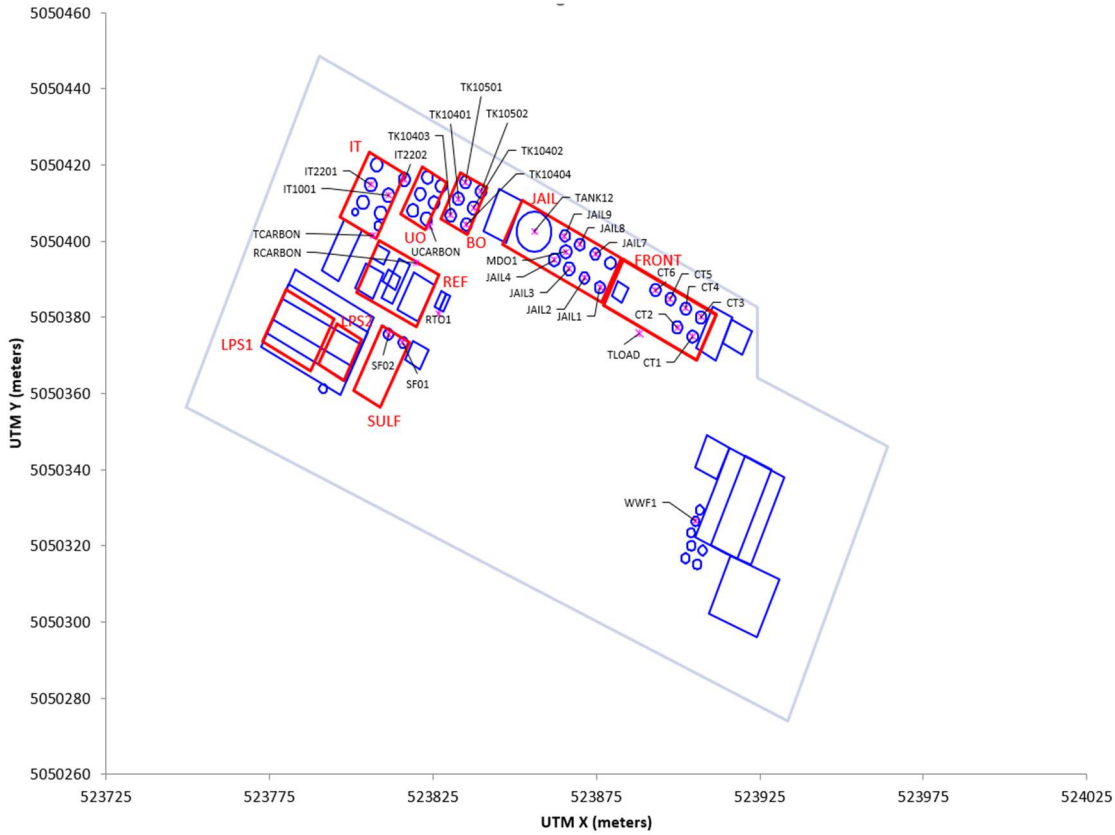
Truck Loading (TLOAD1)

Various products at the ELR facility leave the site via trucks. During truck loading, vapors are displaced from the tank truck compartments resulting in air emissions. VOC emissions were first determined using EPA's AP-42 Compilation of Air Emission Factors Section 5.2, Equation 1 and then the speciation factors determined from the compositional analysis were used to calculate annual and daily emission rates of TACs. This source will be modeled as a volume source based on the dimensions of the truck and loading structure. The release height will be set to ½ of the structure height (14 feet). The lateral dispersion parameter (Sy) will be set to average of the structure length and width (16.4 m) divided by 4.3 and the vertical dispersion parameter (Sz) will be set to the structure height divided by 4.3 as per AERMOD guidance.

Fugitive Equipment Leaks (FUG-1)

Equipment leak fugitive emissions from the ELR facility have the potential to include emissions from piping components such as valves, connectors, flanges or pumps. ELR has prepared an equipment inventory to generate a conservative estimate of the total number of components that have the potential to be fugitive equipment leak sources. The inventory includes liquid service components and vapor service components. The vapor service components are part of ELR's leak detection and repair (LDAR) program. As described in the EI, groupings of equipment components were established to ultimately model the emissions as an area source.

Figure 2-2: Site Layout Drawing



Buildings/tanks are blue, fugitive areas are red, points & volume source with magenta marker.

Table 2-2: Source Parameters

ID	TYPE	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
RTO1	POINT	7.9	478.04	11.67	0.50
TCARBON	POINTHOR	6.7	0	0.001	0.001
RCARBON	POINTCAP	7.6	333.2	13.3	0.1
UCARBON	POINTCAP	3.0	0	0.001	0.001
JAIL1	POINTHOR	11.6	0	0.001	0.001
JAIL2	POINTHOR	11.6	0	0.001	0.001
JAIL3	POINTHOR	11.6	0	0.001	0.001
JAIL4	POINTHOR	11.6	0	0.001	0.001
JAIL7	POINTHOR	11.6	0	0.001	0.001
JAIL8	POINTHOR	11.6	0	0.001	0.001
JAIL9	POINTHOR	11.6	0	0.001	0.001
CT1	POINTHOR	10.1	0	0.001	0.001
CT2	POINTHOR	10.1	0	0.001	0.001
CT3	POINTHOR	9.8	0	0.001	0.001
CT4	POINTHOR	10.7	0	0.001	0.001
CT5	POINTHOR	10.1	0	0.001	0.001
CT6	POINTHOR	10.7	0	0.001	0.001
TANK12	POINTHOR	9.8	0	0.001	0.001
IT1001	POINTHOR	10.7	0	0.001	0.001
IT2202	POINTHOR	10.7	0	0.001	0.001
TK10401	POINTHOR	11.6	0	0.001	0.001
TK10402	POINTHOR	11.6	0	0.001	0.001
TK10403	POINTHOR	11.6	0	0.001	0.001
TK10404	POINTHOR	11.6	0	0.001	0.001
TK10501	POINTHOR	11.6	0	0.001	0.001
TK10502	POINTHOR	11.6	0	0.001	0.001
MDO1	POINTHOR	11.6	0	0.001	0.001
WWF1	POINTHOR	3.0	0	0.001	0.001
SO1	POINTHOR	5.2	0	0.001	0.001
SO2	POINTHOR	5.2	0	0.001	0.001
Volume		**Hgt (m)**	**Sy(m)**	**Sz(m)**	
TLOAD	VOLUME	2.1	3.80	0.992	
AREA		**Hgt(m)**	**Area (sq m)**	**Sz(m)**	
FRONT	AREAPOLY	3.0	427.8	1.42	
JAIL	AREAPOLY	3.0	439.4	1.42	
BO	AREAPOLY	3.0	124.2	1.42	
UO	AREAPOLY	3.0	118.5	1.42	
IT	AREAPOLY	3.0	236.0	1.42	
REF	AREAPOLY	3.0	314.2	1.42	
SULF	AREAPOLY	3.0	178.1	1.42	
LPS1	AREAPOLY	3.0	256.0	1.42	
LPS2	AREAPOLY	3.0	106.3	1.42	

2.3 Compounds Emitted

Table 2-3 shows the toxics air pollutant emitted from the facility, along with the form of the pollutant (particulate or volatile gas), whether the pollutant has an early-life (EL) or multipath way (MP) adjustment made to its RBCs. The table also indicates whether the acute TBACT TAL is 3 or 5.

Table 2-3: Compounds Emitted

CAS	Compound	Type	EL,MP Adj.	TBACT RAL
Compounds with RBCs				
106-99-0	1,3-Butadiene	Volatile	--	HI3
78-93-3	2-Butanone (methyl ethyl ketone)	Volatile	--	HI3
75-07-0	Acetaldehyde	Volatile	--	HI3
67-64-1	Acetone	Volatile	--	HI3
107-02-8	Acrolein	Volatile	--	HI5
7664-41-7	Ammonia	Volatile	--	HI3
7440-36-0	Antimony and compounds	Particulate	--	HI3
7440-38-2	Arsenic and compounds	Particulate	Yes	HI3
56-55-3	Benz[a]anthracene	Volatile	--	--
71-43-2	Benzene	Volatile	--	HI3
50-32-8	Benzo[a]pyrene	Volatile	Yes	HI3
205-99-2	Benzo[b]fluoranthene	Volatile	--	--
191-24-2	Benzo[g,h,i]perylene	Volatile	--	--
207-08-9	Benzo[k]fluoranthene	Volatile	--	--
7440-41-7	Beryllium and compounds	Particulate	--	HI3
7440-43-9	Cadmium and compounds	Particulate	Yes	HI3
75-15-0	Carbon disulfide	Volatile	--	HI3
463-58-1	Carbonyl sulfide	Volatile	--	HI3
75-00-3	Chloroethane (ethyl chloride)	Volatile	--	HI3
67-66-3	Chloroform	Volatile	--	HI3
18540-29-9	Chromium VI, chromate and dichromate particulate	Volatile	Yes	HI3
218-01-9	Chrysene	Volatile	--	--
7440-48-4	Cobalt and compounds	Particulate	--	HI3
7440-50-8	Copper and compounds	Particulate	--	HI3
1319-77-3	Cresols (mixture), including m-cresol, o-cresol, p-cresol	Volatile	--	HI3
100-41-4	Ethyl benzene	Volatile	--	HI3
206-44-0	Fluoranthene	Volatile	--	--
50-00-0	Formaldehyde	Volatile	--	HI3
110-54-3	Hexane	Volatile	--	HI3
7647-01-0	Hydrochloric acid	Volatile	--	HI3
7783-06-4	Hydrogen sulfide	Volatile	--	HI3
98-82-8	Isopropylbenzene (cumene)	Volatile	--	HI3
7439-92-1	Lead and compounds	Particulate	Yes	HI3

CAS	Compound	Type	EL,MP Adj.	TBACT RAL
7439-96-5	Manganese and compounds	Particulate	--	HI3
7439-97-6	Mercury and compounds	Particulate	Yes	HI3
67-56-1	Methanol	Volatile	--	HI3
91-20-3	Naphthalene	Volatile	--	HI3
C365	Nickel compounds, insoluble	Particulate	--	HI3
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	Volatile	--	HI3
3268-87-9	Octachlorodibenzo-p-dioxin (OCDD)	Volatile	--	HI3
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran (TcDF)	Volatile	--	HI3
1336-36-3	Polychlorinated biphenyls (PCBs)	Volatile	Yes	--
32598-14-4	PCB 105 [2,3,3',4,4'-pentachlorobiphenyl]	Volatile	--	HI3
31508-00-6	PCB 118 [2,3',4,4',5-pentachlorobiphenyl]	Volatile	--	HI3
65510-44-3	PCB 123 [2,3',4,4',5'-pentachlorobiphenyl]	Volatile	--	HI3
38380-08-4	PCB 156 [2,3,3',4,4',5-hexachlorobiphenyl]	Volatile	--	HI3
52663-72-6	PCB 167 [2,3',4,4',5,5'-hexachlorobiphenyl]	Volatile	--	HI3
32774-16-6	PCB 169 [3,3',4,4',5,5'-hexachlorobiphenyl]	Volatile	--	HI3
32598-13-3	PCB 77 [3,3',4,4'-tetrachlorobiphenyl]	Volatile	--	HI3
70362-50-4	PCB 81 [3,4,4',5-tetrachlorobiphenyl]	Volatile	--	HI3
108-95-2	Phenol	Volatile	--	HI3
115-07-1	Propylene	Volatile	--	HI5
7782-49-2	Selenium and compounds	Particulate	--	HI3
108-88-3	Toluene	Volatile	--	HI3
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	Volatile	--	HI3
Compounds without RBCs				
91-58-7	2-Chloronaphthalene	Volatile	--	--
91-57-6	2-Methyl naphthalene	Volatile	--	--
83-32-9	Acenaphthene	Volatile	--	--
208-96-8	Acenaphthylene	Volatile	--	--
120-12-7	Anthracene	Volatile	--	--
7440-39-3	Barium and compounds	Particulate	--	--
192-97-2	Benzo[e]pyrene	Volatile	--	--
86-73-7	Fluorene	Volatile	--	--
37680-65-2	PCB 18 [2,2',5-trichlorobiphenyl]	Volatile	--	--
37680-73-2	PCB-101 [2,2',4,5,5'-pentachlorobiphenyl]	Volatile	--	--
38380-07-3	PCB-128 [2,2',3,3',4,4'-hexachlorobiphenyl]	Volatile	--	--
35065-28-2	PCB-138 [2,2',3,4,4',5'-hexachlorobiphenyl]	Volatile	--	--
35065-27-1	PCB-153 [2,2',4,4',5,5'-hexachlorobiphenyl]	Volatile	--	--
35065-30-6	PCB-170 [2,2',3,3',4,4',5-heptachlorobiphenyl]	Volatile	--	--
35065-29-3	PCB-180 [2,2',3,4,4',5,5'-heptachlorobiphenyl]	Volatile	--	--
52663-68-0	PCB-187 [2,2',3,4',5,5',6-heptachlorobiphenyl]	Volatile	--	--
7012-37-5	PCB-28 [2,4,4'-trichlorobiphenyl]	Volatile	--	--
41464-39-5	PCB-44 [2,2',3,5'-tetrachlorobiphenyl]	Volatile	--	--
35693-99-3	PCB-52 [2,2',5,5'-tetrachlorobiphenyl]	Volatile	--	--
32598-10-0	PCB-66 [2,3',4,4'-tetrachlorobiphenyl]	Volatile	--	--

CAS	Compound	Type	EL,MP Adj.	TBACT RAL
34883-43-7	PCB-8 [2,4'-dichlorobiphenyl]	Volatile	--	--
85-01-8	Phenanthrene	Volatile	--	--
7723-14-0	Phosphorus and compounds	Particulate	--	--
129-00-0	Pyrene	Volatile	--	--
7440-22-4	Silver and compounds	Particulate	--	--
7446-11-9	Sulfur trioxide	Volatile/Particulate	--	--
7440-28-0	Thallium and compounds	Particulate	--	--
7440-66-6	Zinc and compounds	Particulate	--	--

2.4 Land Use Characteristics

For initially defining exposure locations, a shapefile of the 2017 Oregon Zoning data from the Oregon Department of Land Conservation and Development was used. This data layer is an element of the Oregon GIS Framework and is available through the Oregon Spatial Data Library[1]. This feature class contains zoning data from 198 local jurisdictions, including the City of Portland and Multnomah County. The data set has 55 zoning classifications, which are binned into three categories: residential, worker (industrial/commercial), and open space. In addition, a City of Portland zoning land use layer from Metro Portland Metro RLIS Discovery will be used to supplement the statewide layer in Oregon. Washington Department of Ecology State Land Use zoning data will be used for Washington State. A crosswalk between the categories and the bins is shown in Table 2-4. The residential bin includes any category designating a residence. For example, mixed use commercial and residential areas and tribal reservation lands are defined as residential. The open space category includes parks, forests, beaches, public lands, and agricultural areas. Open space receptors will be evaluated for acute risk only. Roadway receptors will be excluded. Several areas along the slough have house boats on them. These areas were manually identified as residential.

After discussion with DEQ, the following manual adjustments were made to the land use assignments.

- The City of Portland and Oregon zoning shapefiles extended their zones into the Columbia River. The Columbia River receptors were set to be acute open space receptors.
- Buildings and areas where employees may be spending time during normal business hours at Portland International Raceway, Delta Park – Owens Sports Complex, and Heron Lakes Golf Club were identified as nonresidential adult (worker) exposure locations.
- The I-5 clover leaf and other roadways were excluded as roads themselves are excluded from Risk Assessments;
- A small residential area in the southeast corner of the Smith and Bybee wetland is defined as Residential Farm, with a structure on it. Thus, the receptor closest to the building is defined as residential. The rest of the wetland was designated as open space.
- The zoning of the West Hadyen Island wildlife area is "Single - Dwelling Residential Farm / Forest", it was designated as open space since there are no buildings in this area

[1] https://spatialdata.oregonexplorer.info/geoportal/

and there are no current plans to develop this area. However, the land use designation does allow for single family dwelling. Thus, the entire area was reset to residential so that the facility does not have to conduct the annual documentation requirements under OAR 340—245-0210(a)(f)(iii).

- In the previous version, receptors at Exclusive Farm Use (EFU) zoning were designated as open space, with farm buildings were identified as non-residential (worker) and residences designated as residential. However, to do this, additional justification and annual review of these receptors would be needed. Thus, all EFU receptors were changed to residential, thus avoiding these additional reporting requirements.

Figure 2-3 shows the zoning around the facility. The facility is in an area zoned for industrial/commercial use and has commercial use on three sides of its property. Based on the land use, the closest residences are 360 meters north of the facility.

Figure 2-3: Land Use Around ELR

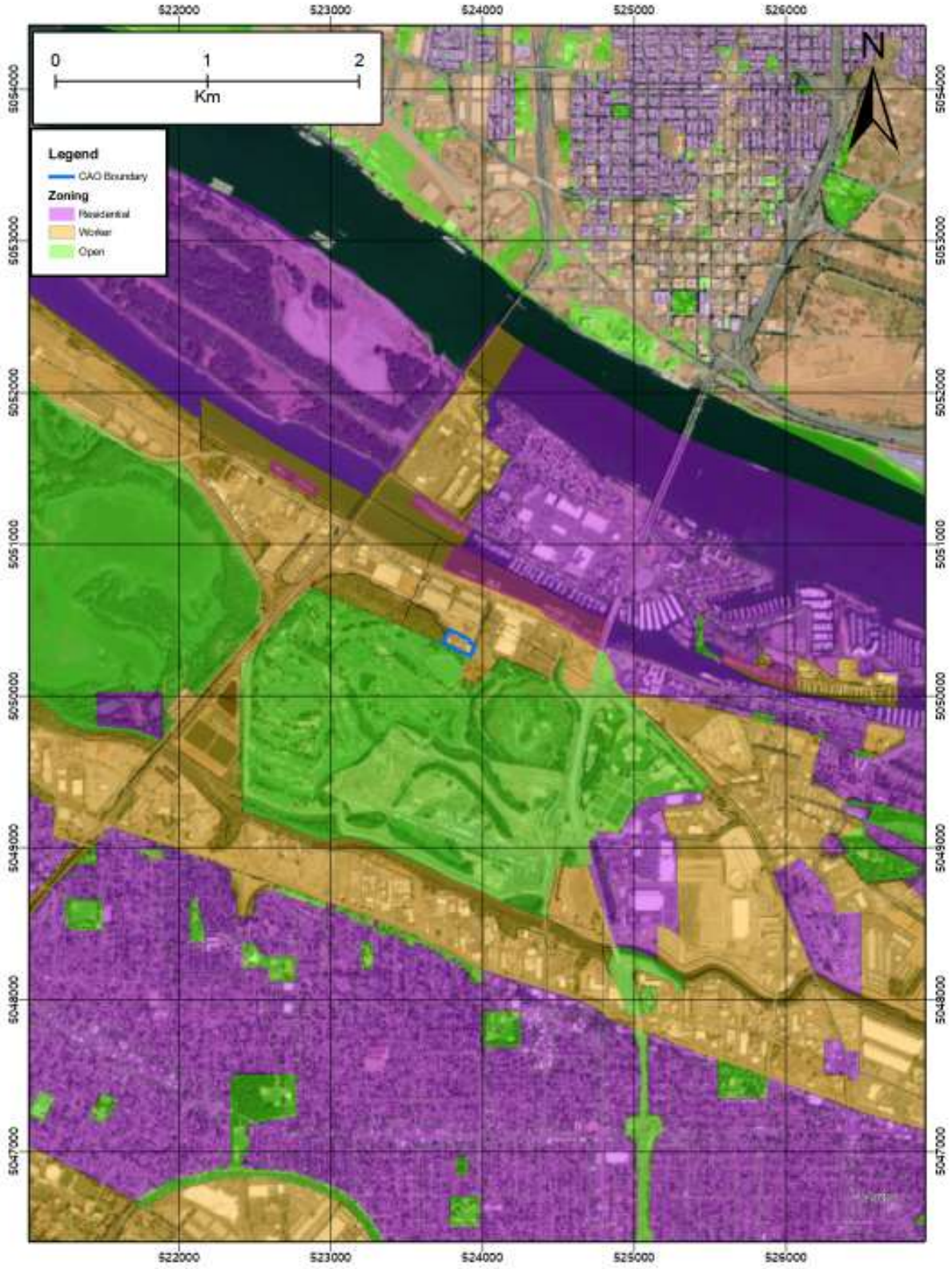


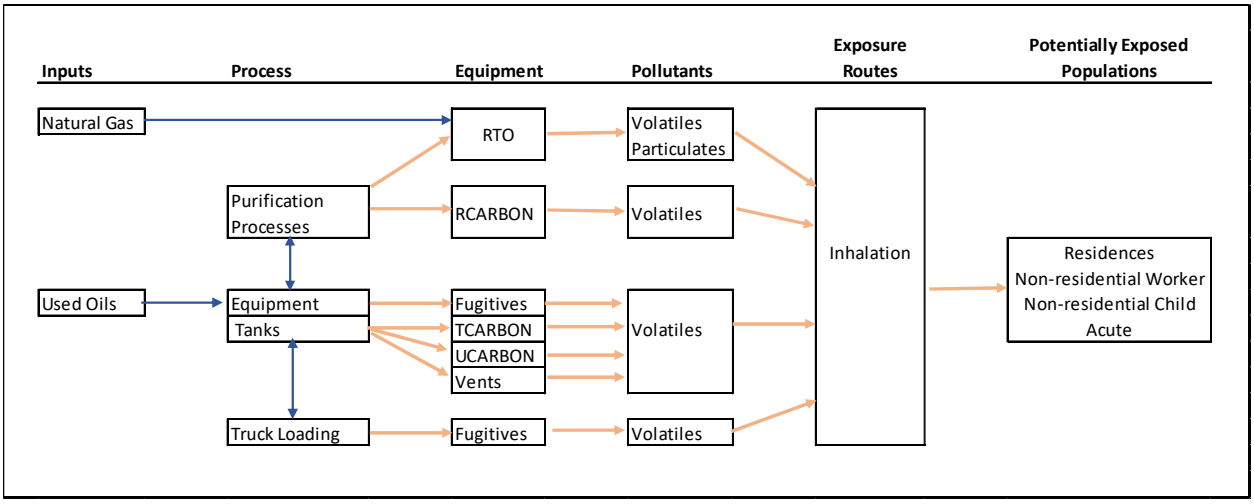
Table 2-4: Land Use Crosswalk

LU Code	Description	CAO code	LU Code	Description	CAO code
BD	Beaches and Dunes	Open	MFL10	Marginal Farm Land 10+	Open
CC	Commercial - Central	Worker	MHDR	Medium High-density Res.	RES
CE	Coastal Estuarine	Open	MLDR	Medium Low-density Res.	RES
CEE	Combo equal emphasis	Worker	MUREH	Mixed-Use Com. & Res. Extremely High	RES
CG	Commercial - General	Worker	MURH	Mixed-Use Com. & Res. High	RES
CN	Commercial - Neighborhood	Worker	MURL	Mixed-Use Com. & Res. Low	RES
CO	Commercial - Office	Worker	MURM	Mixed-Use Com. & Res. Medium	RES
CPE	Combo with priority emphasis	Worker	MURMH	Mixed-Use Com. & Res. Med-high	RES
CS	Coastal Shorelands	Open	MURVH	Mixed-Use Com. & Res. V.High	RES
EFU160	Exclusive Farm Use 160+	RES	ND	No Data	Open
EFU20	Exclusive Farm Use 20+	RES	O	Other	Open
EFU40	Exclusive Farm Use 40+	RES	OSC	Open Space/Conservation	Open
EFU80	Exclusive Farm Use 80	RES	PF	Public & semi-public Uses	Worker
FF160	Mixed Farm-Forest 160+	Open	PF80	Prime Forest 80	Open
FF20	Mixed Farm-Forest 20	Open	POS	Parks & Open Space	Open
FF40	Mixed Farm-Forest 40	Open	RC	Rural Commercial	Worker
FF80	Mixed Farm-Forest 80	Open	RI	Rural Industrial	Worker
FOR	Federal Forest	Open	RNG	Federal Range	Open
FUD	Future Urban Development	Open	RR1	Rural Residential 1 acre	RES
HDR	High-density Res.	RES	RR10	Rural Residential 10 acres	RES
IC	Industrial Campus	Worker	RR2	Rural Residential 2-4 acres	RES
IH	Industrial - Heavy	Worker	RR5	Rural Residential 5 acres	RES
IL	Industrial - Light	Worker	SF80	Secondary Forest 80	Open
IO	Industrial Office	Worker	UCRC	UC Rural Commercial	Worker
IRM	Indian reservation/tribal trust	RES	UCRI	UC Rural Industrial	Worker
LDR	Low-density Res.	RES	VHDR	Very High-density Res.	RES
MA	Mineral and Aggregate	Worker	VLDR	Very Low-density Res.	RES
MDR	Medium-density Res.	RES			

2.5 Conceptual Site Model Diagram

Figure 2-4 shows the conceptual site model for the CAO process. Only the inhalation pathway is considered in this evaluation.

Figure 2-4: CAO Conceptual Site Model



3.0 Level-3 Modeling Protocol

This section presents the Level-3 modeling protocol and is intended to outline the assumptions and methodologies that will be used in the air quality analysis to calculate 24-hour and annual risk values for each emission point for use in the Risk Assessment Work Plan (Section 4).

All coordinates are in Universal Transverse Mercator (UTM) NAD 83 Zone 10.

3.1 Model Selection

For this evaluation, AERMOD (AMS [American Meteorological Society]/EPA [Environmental Protection Agency] Regulatory Model) will be used, which follows the procedure requirements as specified in 40 CFR Part 51, Appendix W, "Guidelines on Air Quality Models (Revised)". AERMOD incorporates air dispersion for both surface and elevated sources, and accounts for differing terrain (i.e., simple and/or complex). AERMOD includes three components: a meteorological data preprocessor, AERMET; a terrain data preprocessor, AERMAP; and the air dispersion model, AERMOD. The dispersion model will be performed using the following versions:

- AERMOD: 23132
- AERMET: 22112
- AERMINUTE: 15272
- AERMAP: 18081
- AERSURFACE: 20060
- BPIP: 04274

AERMOD modeling will be performed using regulatory default options, which include stack tip downwash, buoyancy-induced dispersion, upper-bound downwash concentrations, default wind speed profile exponents and vertical potential temperature gradients, and a routine for processing concentration averages during calm winds and when there are missing meteorological data. The effects from local terrain will also be incorporated.

3.2 Land Use Determination

AERMOD allows for the choice of rural or urban dispersion conditions around the source location, which depends upon the land use characteristics within 3 kilometers of the facility (as per Appendix W to 40 CFR Part 51, section 7.2.1.1). Following Auer (1977), if the land use is industrial, commercial, or developed residential, then these areas are designated as urban. All other types of land use are considered rural. The most objective approach is to use the 2016 NLCD land cover classification data (the same data set as used in AERSURFACE) and designate the "Developed Intensity" areas (IDs 22, 23 & 24) as urban based on Auer's classification. These classes are:

- Developed, Low Intensity (NLDC Code 22) - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20 to 49 percent of total cover. These areas most commonly include single-family housing units.
- Developed, Medium Intensity (NLCD Code 23) – This classification includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50 to 79 percent of the total cover.
- Developed, High Intensity (NLCD Code 24) – This classification includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.

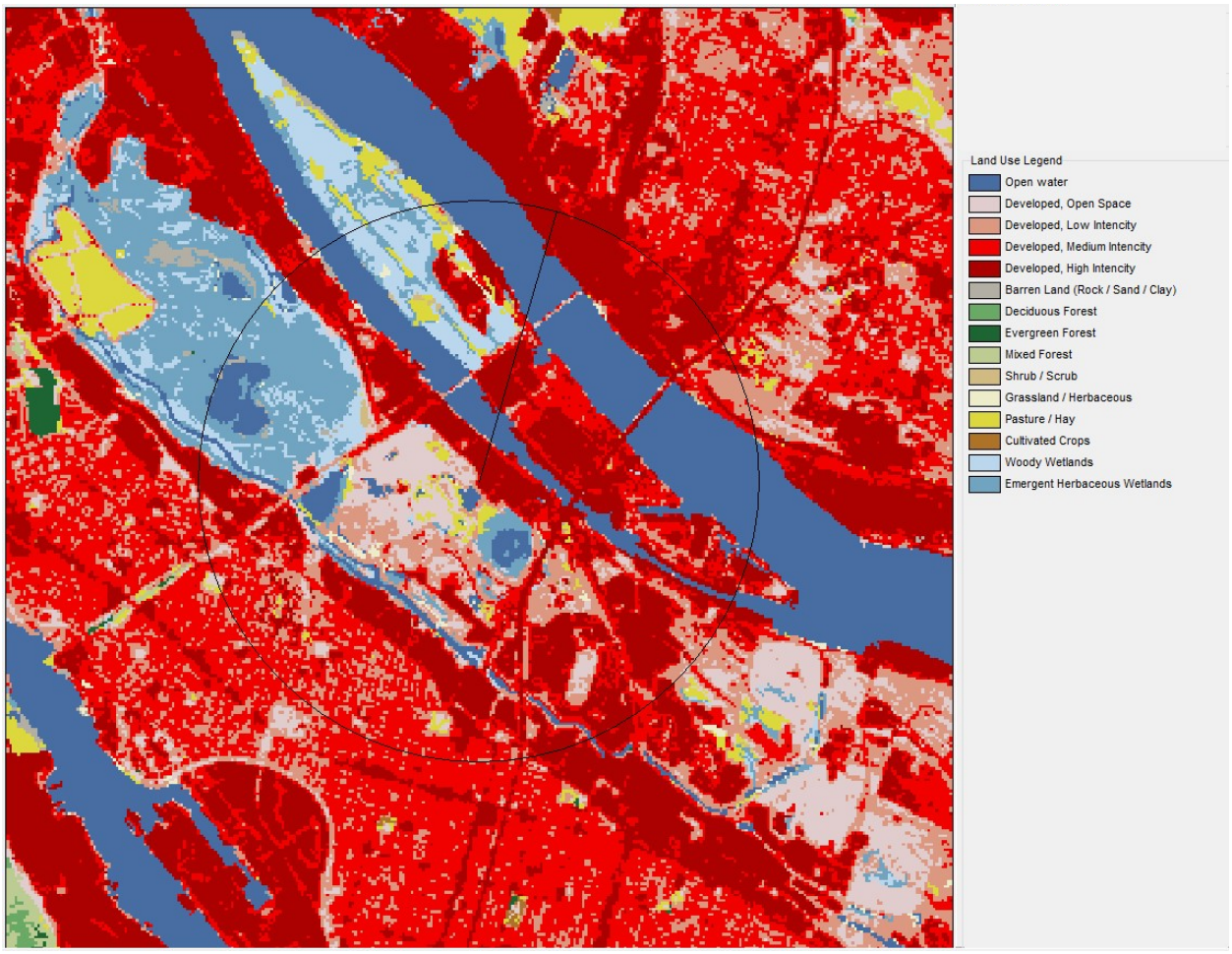
Table 3-1 shows the land use determination around the Ecolube sites. Because the area within 3 km is more than 50 percent classified as urban land use, the URBAN option will be used for AERMOD modeling of the Facility. Typically, the population value should be equal to the population of the counties contained within the modeling domain. For this analysis, the 2022 population for Portland of 635,067 will be used.

Table 3-1: Land User Determination

Cat	Description	Type	Count	Percent
11	Open Water:	Rural	6197	20%
21	Developed, Open Space:	Rural	1764	6%
22	**Developed, Low Intensity:**	**Urban**	**4050**	**13%**
23	**Developed, Medium Intensity:**	**Urban**	**6150**	**20%**
24	**Developed, High Intensity:**	**Urban**	**8498**	**27%**
31	Barren Land (Rock/Sand/Clay):	Rural	91	0%
42	Evergreen Forest:	Rural	2	0%
52	Shrub/Scrub:	Rural	73	0%
71	Grasslands/Herbaceous:	Rural	158	1%
81	Pasture/Hay:	Rural	542	2%
82	Cultivated Crops:	Rural	2	0%
90	Woody Wetlands:	Rural	1519	5%
95	Emergent Herbaceous Wetland:	Rural	2369	8%
	Total:		31415	
	Rural			40%
	Urban			60%

Figure 3-1: Land use around the ELR Facility

The 3-kilometer evaluation circle is shown in black.



3.3 Meteorological Data

For this analysis, five-years (2017-2021) of hourly surface meteorological data from the National Weather Service (NWS) station at the Portland airport will be used. The station is located about 6.5 kilometers east of the project site. The station includes the one-minute data so it can be processed through AERMINUTE as per EPA suggestion. Upper air data from Salem Airport will be used. A five-year wind rose is shown in Figure 3-2.

The surface parameters (surface roughness, Bowen ratio, and noon-time albedo) will be determined using the most recent version of AERSURFACE. AERSURFACE will be run for average, wet, and dry conditions on a monthly basis, using 12 evenly spaced sectors. A 30-year moisture analysis for the Portland area will be conducted to determine the wetness condition for each year. If the yearly precipitation exceeded the 70th percentile, then the year will be defined as wet. If the yearly precipitation was less than the 30th percentile, then the year will be defined as dry. If the precipitation was between the 30th and 70th percentiles, it will be defined as average. The soil moisture conditions for the five years of meteorological data are shown in Table 3-2. Since albedo and Bowen ratio are area averages, all sectors will have the same values. Also, albedo and surface roughness are the same for all wetness conditions. For each modeled year, the appropriate monthly surface parameters will be then entered into the AERMET Stage 2 processing.

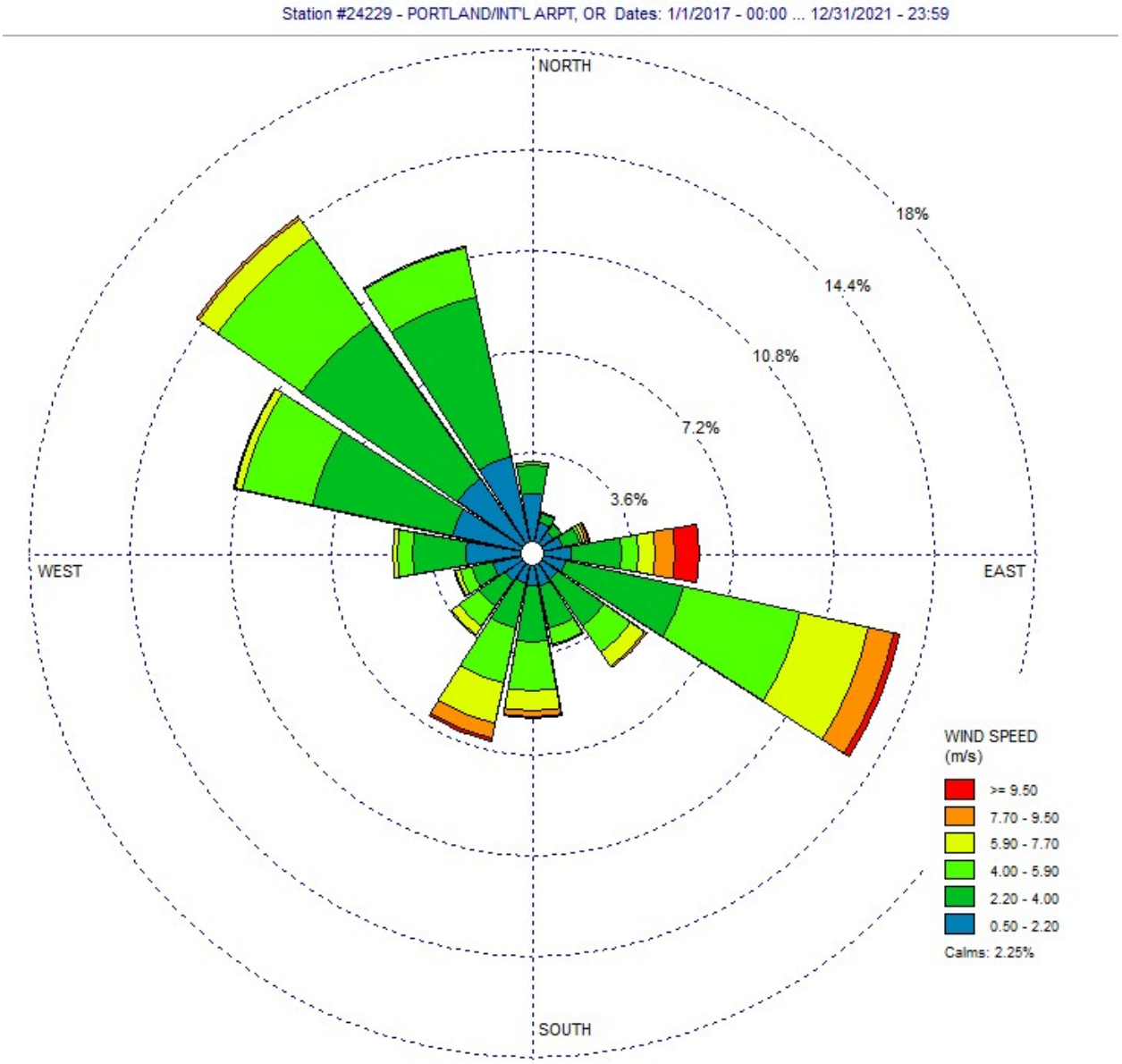
The months of December to February will be assumed as "winter", March to May will be assumed as "spring", June to August will be assumed as "summer", and September to November will be assumed as "autumn". The data will be processed using the AERMET program with the adjust U-star option selected.

Table 3-2: Surface Soil Moisture Condition Assessment

Percentile	Precipitation (in)	
30th	30.48	
70th	41.18	
Year	**Precipitation (in)**	**Soil Moisture Condition**
2017	45.80	wet
2018	27.30	dry
2019	26.67	dry
2020	32.44	average
2021	35.59	average

Historical 30-year record based on period from 1992 to 2021. (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?or6751)

Figure 3-2: Portland Airport Wind Rose



3.4 Receptor Grid and Exposure Locations

Under the Cleaner Air Oregon Rules, section 340-245-0020 (43) indicates that residential exposure locations are to be located "outside the boundary where people may reasonably be present for most hours of the day over a period of many year." Likewise, 340-245-0020 (36) indicates "nonresidential exposure location" means an exposure location outside the boundary of a source where people may reasonably be present for a few hours several days per week, possibly over a period of several years".

Where the property borders other commercial property, receptors on the property boundary will be evaluated. On the east side of the property, there is roadway and in such areas the public will not normally congregate. Thus, the receptor boundary for the CAO assessment will be expanded to exclude such areas.

Receptor elevations for AERMOD were determined using the AERMAP pre-processor. AERMAP uses United States Geological Survey (USGS) 1-degree and 7.5-minute Digital Elevation Model (DEM) files and a newer National Elevation Dataset (NED). AERMAP was run to generate the receptor elevations using the NED data. The dataset was downloaded using the Lakes Environmental AERMOD View program (version 10.0.0).

The following receptor grid spacing was used in the modeling analyses:

- 25-meter spacing along the CAO boundary,
- 25-meter spacing out to 200 m from the CAO boundary,
- 50-meter spacing out to 1.0 kilometers,
- 100-meter spacing out to 2.0 kilometers,
- 200-meter spacing out to 5.0 kilometers,
- 500-meter spacing out to 10.0 kilometers.

The land use classifications are applied to each receptor around the facility to define their exposure class. The receptors, identified by class, are shown in Figure 3-3 (near field), Figure 3-4 (mid-field) and Figure 3-5 (far-field). As described above, receptors exposure classes are defined as residential, non-residential child (schools/daycares), non-residential worker (industrial/comm.), open space, and excluded. The excluded class applies to receptors where the risk is not calculated, for example, along roads or highways or along the facility property line or train tracks where people will likely not congregate. Chronic exposure is only applicable to residential, non-residential child, and non-residential worker classes. The acute exposure is applied to all classes except the excluded class.

The zoning dataset does not identify schools or daycares. Three sources were used to identify schools and daycares:

- Manual entries from Google search
- Oregon Child Care Centers ArcGIS Online database
- HIFLD Daycare ArcGIS Online database for OR & WA.

Each school or daycare was explicitly identified with a receptor assigned a daycare/school exposure class. There are 201 schools and daycares within 10 km of the facility with the closest

school/daycare 2.3 km south of the facility. The list of schools and daycares is provided in Appendix B. Both child and worker exposure will be evaluated at schools and daycares.

Figure 3-3: Near Field Receptors

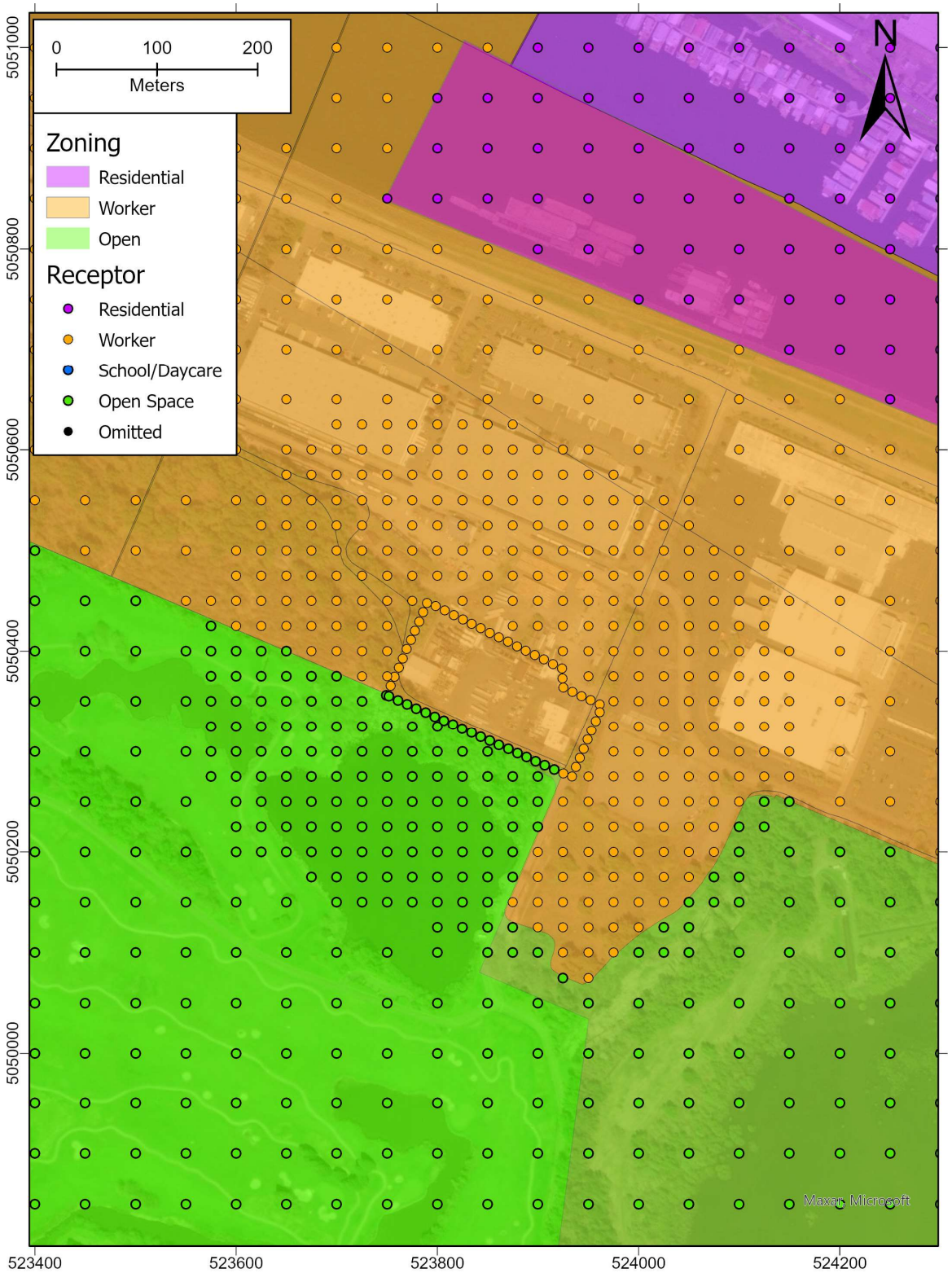


Figure 3-4: Mid-Field Receptors

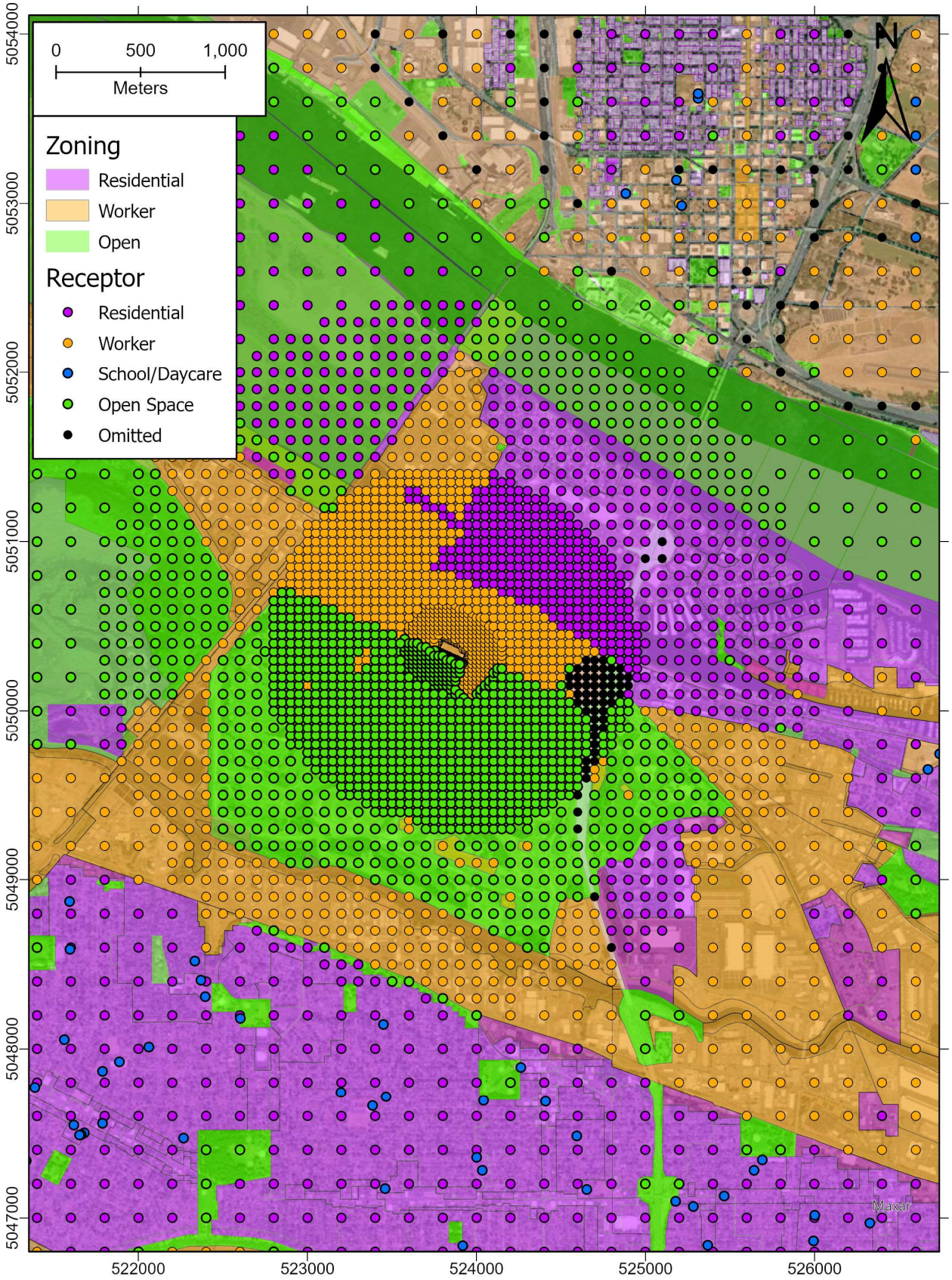
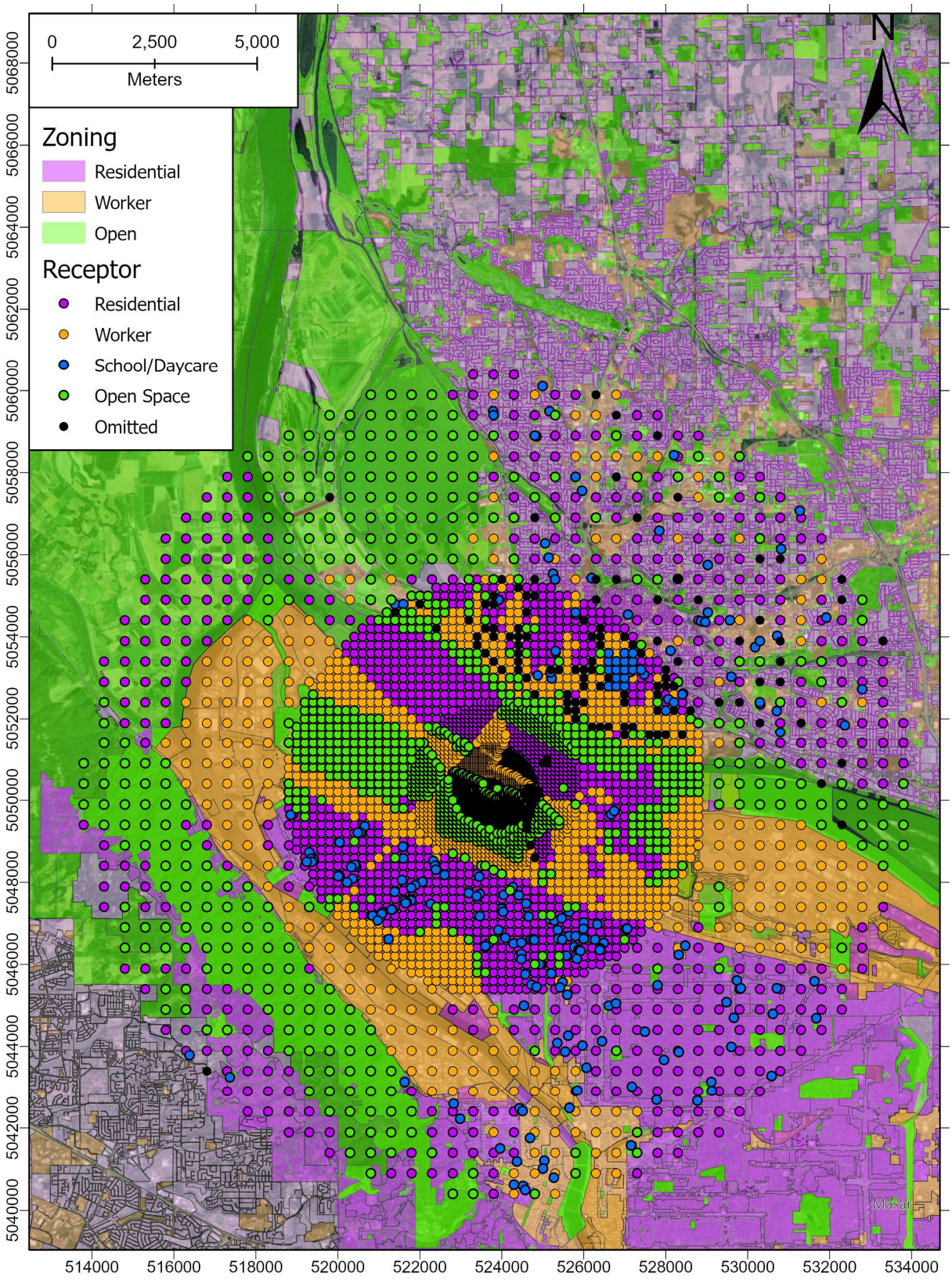


Figure 3-5: Far-Field Receptors



3.5 Model Execution

AERMOD will be run to model each emission point using a 1 g/s unit emission. Area source will be run with the unit emission rate divided by the source area (sq. meters). The outputs will be plot files of the maximum 24-hour concentrations and the 5-year average annual concentrations at each receptor for each emission point. These plot files then be used in the risk assessment as described in Section 4.0.

The air quality analysis submittal will consist of a report and electronic modeling files, which will include:

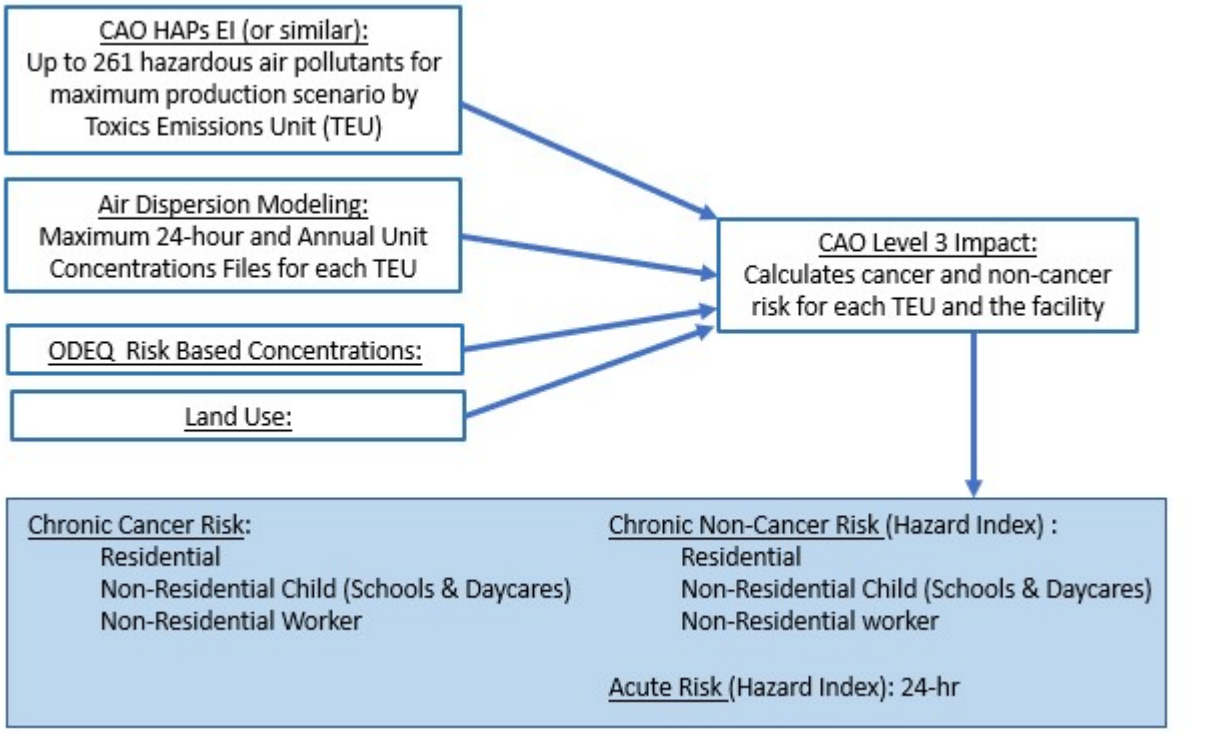
- AERMAP, BPIP, and AERMOD input and output files;
- AERSURFACE files;
- Downwash files including building heights and locations; and
- Meteorological data.

4.0 Risk Assessment Work Plan

4.1 Methodology

Figure 4-1 shows the Level-3 Risk Assessment process. Using the CAO air toxics emissions inventory, the 24-hr and annual average concentration files from the AERMOD runs, the Risk Based Concentrations, and the land use designations at each receptor, the chronic cancer, chronic non-cancer and acute hazard index risk will be found at every receptor.

Figure 4-1: Level-3 Refined Risk Assessment



Using the 24-hr and annual emission rates from CAO toxic air contaminant emissions inventory (Provided in Appendix A), the 24-hr and annual average concentration files from AERMOD runs, the RBCs, and the land use designations at each receptor, the chronic cancer, chronic non-cancer and acute hazard index risk will be found at every receptor. The risk at each receptor from source ($R_{r,s}$) is given by:

$$R_{r,s} = \chi_{r,s}\, C \sum_{p} \frac{Q_p TO_{p,o}}{RBC_{p,L(r)}}$$

where $\chi_{r,g}$ is the unit concentration for source s at receptor r, C is a constant to convert g/s to either lbs/day or lbs/year, Q_p is the pollutant emission rate from the CAO emission inventory

(Appendix A), $TO_{p,o}$ is the target organ factor (0 or 1) for pollutant p and organ o, and $RBC_{p,L(r)}$ is the RBC for pollutant *p* and land use *L* at the receptor *r*. For non-cancer risk, different pollutants impact different parts of the body so the non-cancer risk is not additive. When applied, the target organ factor is set to 1 for pollutants that impacts a particular organ and zero otherwise. For cancer risk, TO is always 1. The target organ analysis will only be done if the non-cancer risk exceeds the Source Permit Level.

Each receptor will have three risk numbers for each source: chronic cancer risk, chronic non-cancer risk, and acute risk. For informational purposes, the chronic risk values will be grouped by exposure type (residential, non-residential child, and worker) from which the maximum risk will be determined. This results in seven risk levels being determined. The risk levels will be compared to the Risk Action Levels for existing sources (Table 4-2).

If the facility non-cancer risk exceeds the non-cancer Source Permit Level, then the Risk Determination Ratio (RDR) will be explicitly calculated. The RDR is the combined risk for HI3 chemicals/3 plus the combined risk for HI5 chemicals/5.

The risk calculations will be made in an Excel spreadsheet. The spreadsheet will have tabs for the RBCs, the target organ assignments, annual and 24-hr emissions, annual and 24-hr unit concentrations, receptors, seven risk evaluations, and a final summary. The spreadsheet will be provided as part of the submittal.

Table 4-1: Compound RBCs

		Chronic Cancer			Chronic Non-Cancer			Acute
		Res.	Child	Worker	Res.	Child	Worker	
CAS	Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
75-07-0	Acetaldehyde	0.45	12	5.5	140	620	620	470
67-64-1	Acetone	--	--	--	31000	140000	140000	62000
107-02-8	Acrolein	--	--	--	0.35	1.5	1.5	6.9
7664-41-7	Ammonia	--	--	--	500	2200	2200	1200
7440-36-0	Antimony and compounds	--	--	--	0.3	1.3	1.3	1
7440-38-2	Arsenic and compounds	0.000024	0.0013	0.00062	0.00017	0.0024	0.0024	0.2
71-43-2	Benzene	0.13	3.3	1.5	3	13	13	29
7440-41-7	Beryllium and compounds	0.00042	0.011	0.005	0.007	0.031	0.031	0.02
106-99-0	1,3-Butadiene	0.033	0.86	0.4	2	8.8	8.8	660
78-93-3	2-Butanone (Methyl ethyl ketone)	--	--	--	5000	22000	22000	5000
7440-43-9	Cadmium and compounds	0.00056	0.014	0.0067	0.005	0.037	0.037	0.03
75-15-0	Carbon Disulfide	--	--	--	800	3500	3500	6200
463-58-1	Carbonyl Sulfide	--	--	--	10	44	44	660
75-00-3	Chloroethane (Ethyl chloride)	--	--	--	30000	130000	130000	40000
67-66-3	Chloroform	--	--	--	300	1300	1300	490
18540-29-9	Chromium VI, chromate, and dichromate particulate	0.000031	0.00052	0.001	0.083	0.88	0.88	0.3
7440-48-4	Cobalt and compounds	--	--	--	0.1	0.44	0.44	--
7440-50-8	Copper and compounds	--	--	--	--	--	--	100
1319-77-3	Cresols (mixture), including m-cresol, o-cresol, p-cresol	--	--	--	600	2600	2600	--
100-41-4	Ethylbenzene	0.4	10	4.8	260	1100	1100	22000
100-41-4	Ethyl benzene	0.4	10	4.8	260	1100	1100	22000
50-00-0	Formaldehyde	0.17	4.3	2	9	40	40	49
110-54-3	Hexane	--	--	--	700	3100	3100	--
7647-01-0	Hydrochloric acid	--	--	--	20	88	88	2100

CAS	Compound	Chronic Cancer			Chronic Non-Cancer			Acute
		Res.	Child	Worker	Res.	Child	Worker	
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
7783-06-4	Hydrogen Sulfide	--	--	--	2	8.8	8.8	98
98-82-8	Isopropylbenzene (Cumene)	--	--	--	400	1800	1800	--
7439-92-1	Lead and compounds	--	--	--	0.15	0.66	0.66	0.15
7439-96-5	Manganese and compounds	--	--	--	0.09	0.4	0.4	0.3
7439-97-6	Mercury and compounds	--	--	--	0.077	0.63	0.63	0.6
67-56-1	Methanol	--	--	--	4000	18000	18000	28000
91-20-3	Naphthalene	0.029	0.76	0.35	3.7	16	16	200
C365	Nickel compounds, insoluble	0.0038	0.1	0.046	0.014	0.062	0.062	0.2
108-95-2	Phenol	--	--	--	200	880	880	5800
1336-36-3	Polychlorinated biphenyls (PCBs)	5.3E-04	2.0E-02	9.2E-03	--	--	--	--
32598-13-3	PCB 77 [3,3',4,4'-tetrachlorobiphenyl]	1.0E-05	9.0E-04	4.2E-04	0.0013	0.26	0.26	--
70362-50-4	PCB 81 [3,4,4',5-tetrachlorobiphenyl]	3.4E-06	3.0E-04	1.4E-04	0.00042	0.085	0.085	--
32598-14-4	PCB 105 [2,3,3',4,4'-pentachlorobiphenyl]	3.4E-05	3.0E-03	1.4E-03	0.0042	0.85	0.85	--
31508-00-6	PCB 118 [2,3',4,4',5-pentachlorobiphenyl]	3.4E-05	3.0E-03	1.4E-03	0.0042	0.85	0.85	--
65510-44-3	PCB 123 [2,3',4,4',5'-pentachlorobiphenyl]	3.4E-05	3.0E-03	1.4E-03	0.0042	0.85	0.85	--
38380-08-4	PCB 156 [2,3,3',4,4',5-hexachlorobiphenyl]	3.4E-05	3.0E-03	1.4E-03	0.0042	0.85	0.85	--
52663-72-6	PCB 167 [2,3',4,4',5,5'-hexachlorobiphenyl]	3.4E-05	3.0E-03	1.4E-03	0.0042	0.85	0.85	--
32774-16-6	PCB 169 [3,3',4,4',5,5'-hexachlorobiphenyl]	3.4E-08	3.0E-06	1.4E-06	4.2E-06	8.5E-04	8.5E-04	--
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	1.0E-07	9.0E-06	4.2E-06	1.3E-05	2.6E-03	2.6E-03	--
3268-87-9	Octachlorodibenzo-p-dioxin (OCDD)	3.4E-06	3.0E-04	1.4E-04	0.00042	0.085	0.085	--
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran (TcDF)	1.0E-08	9.0E-07	4.2E-07	1.3E-06	0.00026	0.00026	--
56-55-3	Benz[a]anthracene	2.1E-04	7.8E-03	1.5E-02	--	--	--	--
50-32-8	Benzo[a]pyrene	4.3E-05	1.6E-03	3.0E-03	0.002	0.0088	0.0088	0.002
205-99-2	Benzo[b]fluoranthene	5.3E-05	2.0E-03	3.8E-03	--	--	--	--
191-24-2	Benzo[g,h,i]perylene	0.0047	0.17	0.34	--	--	--	--
207-08-9	Benzo[k]fluoranthene	0.0014	0.052	0.1	--	--	--	--
218-01-9	Chrysene	0.00043	0.016	0.03	--	--	--	--
206-44-0	Fluoranthene	0.00053	0.02	0.038	--	--	--	--
115-07-1	Propylene	--	--	--	3000	13000	13000	--
7782-49-2	Selenium and compounds	--	--	--	--	--	--	2
108-88-3	Toluene	--	--	--	5000	22000	22000	7500
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	--	--	--	220	970	970	8700

Table 4-2: Existing Facility Risk Action Levels

	Existing Source	
	Cancer	Non-Cancer
Source Permit Level	5	0.5
Community Engagement Level	25	1
TBACT Level	50	3*/5** or RDR of 1
Risk Reduction Level	200	6*/10** or RDR of 2
Immediate Curtailment Level	500	12*/20** or RDR of 4

* For pollutant identified as HI3 in OAR 340-245-8010, Table 2.

** For pollutant identified as HI5 in OAR 340-245-8010, Table 2.

RDR: Risk Determination Ratio = (Combined Risk for HI3 chemicals / 3) + (Combined Risk for HI5 chemicals / 5)

4.2 Uncertainty Analysis

CAO rules require that a quantitative or qualitative uncertainty evaluation be included in a Level 3 risk assessment. The uncertainty in the various elements of the analysis will be described in the Risk Assessment report.

Appendix A: CAO EI Data

<Provided in Risk Assessment>

Appendix B: Schools and Daycares

Institution	X (m)	Y (m)	Dist (km)	Institution	X (m)	Y (m)	Dist (km)
Nanny Mo's Child Care	523449	5048144	2.28	Washington State School for the Deaf	528062	5052483	4.72
PRIV Portsmouth Portland	522333	5048521	2.40	GROWING SEEDS	526399	5046393	4.76
Cece Babysitting	522369	5048407	2.47	YMCA WOODLAWN	527050	5046882	4.77
Rosa Parks Elementary School	522397	5048310	2.53	SUN Community School - Woodlawn	527025	5046858	4.77
Albina Early Head Start - Charles Jordan	522602	5048180	2.53	Woodlawn Elementary School	527060	5046874	4.78
Discovery Gardens - Kenton	524263	5047890	2.54	GROWING SEEDS NORTH	526391	5046351	4.79
B's Preschool LLC	523464	5047717	2.70	The Montessori House	519404	5048571	4.79
Clarendon Early Learner's Academy Head Start	521593	5048870	2.71	Today's Little Scholars Childcare	525207	5045779	4.82
Air/Plane Cottage School	524041	5047693	2.71	Portland Parks & Rec - St. Johns Community Center	519307	5048728	4.82
Helping Hands Family Daycare & Preschool Inc	523198	5047743	2.73	James John Elementary School	519349	5048573	4.84
Little Angels Academy	524409	5047689	2.77	SUN Community School - James John Elementary	519364	5048495	4.85
Peninsula Elementary School	523384	5047663	2.77	CLARK COLLEGE CHILD & FAMILY STUDIES	527348	5053758	4.87
LITTLE WORLD CHILD CARE CTR	524884	5053057	2.86	Lifeworks Northwest/Children's Relief Nursery	519234	5048501	4.97
Albina Early Head Start - Clarendon	521595	5048588	2.88	Sunshine Center Montessori Preschool	524721	5045503	4.97
Clark County Juvenile Detention School	525215	5052987	2.94	SUN Community School - Sitton Elementary	518900	5049649	4.99
Siletz Tribal Head Start - Portland Center	526672	5049651	2.94	Sitton Elementary School	518847	5049638	5.04
Cynthia's Busy Bee's Childcare	522062	5048013	2.97	Trillium	524848	5045451	5.05
Bridges Middle School	526740	5049742	2.98	Harney Elementary School	528425	5052614	5.10
Mrs Teapot's Tiny Tots	524593	5047484	3.01	Portland Community College	525486	5045572	5.10
Vermont Hills - Portland Village	524001	5047357	3.04	Rosemary Anderson High School	525424	5045438	5.21
ST PAUL CHRISTIAN DCC	525185	5053138	3.06	Washington Elementary	527079	5054540	5.26
Portland Village School	524034	5047281	3.12	Lincoln Elementary School	525251	5055538	5.33
Cesar Chavez K-8 School	521888	5047924	3.15	Gate Program	528123	5053666	5.39
Open Meadow School North	523459	5047174	3.24	Jefferson High School	525597	5045263	5.43
Rock, Paper, Scissors Childcare	521787	5047869	3.25	Beach Elementary School	524544	5044993	5.45
Honor's Day Care	521563	5048056	3.26	Discovery Middle School	526193	5055434	5.56
Child's Reach	522268	5047470	3.32	Our Lady of Lourdes School	525143	5055928	5.69
De La Salle North Catholic High School	524654	5047168	3.33	Benjamin Franklin Elementary	525057	5056283	6.01
Veronica's Daycare	520661	5049363	3.33	King Elementary School	526613	5045000	6.07
George Middle School	520551	5049209	3.49	Faubion Elementary School	528473	5046459	6.09
Bronwyn's Place, Inc.	521787	5047557	3.50	St. Andrew Nativity School	526783	5045051	6.11
SWCCC HOUGH DCC	525312	5053619	3.55	Concordia University	528319	5046234	6.12
SUN Community School - George Middle	520484	5049204	3.55	Vernon Elementary School	527801	5045494	6.31
Olive Branch School	523919	5046838	3.56	Martin Luther King Elementary	529599	5053034	6.34
Discovery Gardens Childcare	525179	5047099	3.56	Self Enhancement Inc/SEI Academy	525623	5044270	6.38
Hough Elementary School	525310	5053649	3.57	Fir Grove Childrens Center	528863	5054385	6.42
Applegate Head Start	525692	5047342	3.58	Open Doors Vancouver	528963	5054364	6.49
Uno Dos Tres Academy St Johns	521388	5047773	3.58	Albina Youth Opportunity School	525352	5044088	6.49
In Kim's Care	525643	5047281	3.60	Roosevelt Elementary School	529033	5054592	6.68
Vermont Hills - Holy Cross Elementary	521681	5047502	3.60	Hosanna Christian School	528298	5055409	6.71
Holy Cross Catholic School Pre Kindergarten	521618	5047548	3.61	Kairos PDX	525971	5044024	6.72
VERMONT HILLS-HOLY CROSS ELEMENTARY	521662	5047490	3.63	Boise-Eliot Elementary School	525548	5043871	6.75
Trinity Academy	525284	5047067	3.63	Mcloughlin Middle School	530307	5052355	6.76
Holy Cross Catholic School	521653	5047489	3.63	The Gladys McCoy Academy	526444	5044129	6.79
Rubies Child Care	525466	5047129	3.65	Lewis and Clark High School	529565	5054407	7.00
Chief Joseph Elementary School	524082	5046644	3.76	Sabin Elementary School	527496	5044356	7.07
North Portland Montessori School	525369	5046839	3.87	St. Joseph School	530798	5051660	7.08
Little Imprints LLC	524714	5046619	3.88	George C Marshall Elementary	530712	5052195	7.11
Albina Early Head Start - Carl Talton Center	523652	5046502	3.90	Fort Vancouver High School	530182	5053749	7.18
HEAD START PRIESTLEY CENTER (ALBINA)	524772	5046611	3.90	The Ivy School	526067	5043485	7.26
Blooming Rose Preschool, LLC	523675	5046495	3.90	Minnehaha Elementary School	527838	5056583	7.37
Sheila Ward	524287	5046507	3.92	Harry S Truman Elementary School	529029	5055753	7.46
Albina Head Start - Benjamin M Priestley Center	524793	5046598	3.92	Hazel Dell Elementary School	525954	5057555	7.47
Petit a Petit	524481	5046527	3.92	White Shield Center	521626	5043132	7.59

Institution	X (m)	Y (m)	Dist (km)	Institution	X (m)	Y (m)	Dist (km)
HEAD START ROOSEVELT (ALBINA)	520449	5048385	3.94	Portland Community College	529742	5045611	7.60
Roosevelt High School	520414	5048425	3.95	Pioneer High School	525843	5042918	7.74
Cathedral Park Preschool	521336	5047338	3.95	Alliance High School	529485	5045084	7.76
Flouriche LLC	523603	5046448	3.95	ESA 112 Special Ed Co-Op	530723	5054023	7.79
IMAGINATION STATION DAYCARE CENTER	521309	5047331	3.97	Depaul Youth Center	529834	5045425	7.79
Crayola Kids Child Care	526001	5047017	4.02	CLASS Academy	522823	5042598	7.86
SUN Community School - Roosevelt High	520334	5048375	4.04	The Madeleine School	527956	5043677	7.88
Little Oats Daycare	520038	5048977	4.05	Alameda Elementary School	528315	5043860	7.93
Nature's Way Child Care	525375	5046624	4.08	Childpeace Montessori School	524433	5042475	7.94
HEAD START MCCORMACK/MATHEWS (ALBINA)	525545	5046682	4.09	Childpeace Montessori	524510	5042416	8.01
PRIV Piedmont Portland	525638	5046694	4.12	Irvington Elementary School	527174	5043022	8.10
PRIV Piedmont Portland	525477	5046610	4.13	Portland SD 1J	525657	5042490	8.11
VERMONT HILLS - ASTOR ELEMENTARY	521106	5047285	4.14	The Ivy School	529664	5044699	8.15
Adams Child Care	525995	5046865	4.14	Chapman Elementary School	522989	5042229	8.21
Astor Elementary School	521089	5047273	4.16	Trinity Lutheran School	530707	5045418	8.49
St John's Day Care	520360	5048087	4.17	Jason Lee Middle School	524844	5058878	8.54
Wild Portland Nature Care	524476	5046258	4.19	Beaumont Middle School	529596	5043994	8.62
Georgy's Playcare	525798	5046694	4.19	Shining Star Waldorf School	527777	5042685	8.66
Hudson's Bay High School	527043	5053105	4.20	Early Childhood Education Center	532375	5051849	8.67
Vermont Hills - Astor	521068	5047232	4.20	Pacific Northwest College of Art	524689	5041759	8.68
Fresh Start Preschool Enrichment Program	526328	5046971	4.24	Rigler Elementary School	530617	5044790	8.80
SWCCC HUDSON'S BAY	527146	5053151	4.31	Metropolitan Learning Center	523954	5041503	8.89
New Farm Montessori	524473	5046130	4.31	Beverly Cleary School	529116	5043137	8.98
Luhndyn Daycare	520227	5048000	4.33	Skinner Elementary Montessori School	530812	5056137	9.04
Ladybugs Childcare	525998	5046622	4.35	Peter S Ogden Elementary	531918	5054465	9.05
Casita Montessori School	520843	5047192	4.38	Lake Shore Elementary	523790	5059494	9.10
Vermont Hills Family Life Center at University of Portland	520977	5047071	4.38	King's Way Christian School	528203	5058423	9.14
PRIV St. Johns Portland	520044	5048147	4.40	Community Transitional School	531634	5045585	9.17
Wow & Flutterville Playopolis	525766	5046428	4.41	Grant High School	529123	5042911	9.17
The Montessori House of St Johns	520011	5048151	4.43	Beverly Cleary School	528774	5042668	9.17
EOCF FRUIT VALLEY EARLY LEARNING CENTER	523921	5054891	4.50	Dwight D Eisenhower Elementary	525160	5059494	9.19
Rowanberry School	526271	5046608	4.51	Cathedral School	524369	5041188	9.22
SWCCC FRUIT VALLEY DCC	523922	5054904	4.51	Henrietta Lacks Health and Bioscience High School	532795	5052724	9.26
Fruit Valley Elementary School	523911	5054906	4.51	Emerson School	525036	5041205	9.27
SWCCC CENTRAL PARK	527367	5053215	4.52	Benson Polytechnic High School	527157	5041578	9.42
Washington State School for the Blind	527474	5053078	4.52	New Avenues School	525006	5041013	9.46
Holy Redeemer Catholic School	525874	5046360	4.52	Forest Park Elementary School	517361	5043246	9.64
SUN Community School - Ockley Green	524957	5046011	4.53	Scott Elementary School	531673	5044692	9.70
Chief Joseph/Ockley Green School	524919	5046000	4.53	Everest College	525266	5040792	9.71
Rivendell Preschool	525574	5046214	4.53	Columbia River High	524991	5060110	9.78
HOLY REDEEMER BEYOND THE CLASSROOM	525900	5046353	4.54	Lincoln High School	524293	5040624	9.78
Holy Redeemer Pre Kindergarten and Beyond the Classroom	525917	5046325	4.57	Archbishop Howard School	530584	5043280	9.81
University of Portland	521238	5046615	4.59	Le Monde French Immersion Public Charter School	524514	5040592	9.83
Vancouver School of Arts and Academics	525810	5054544	4.59	Northwest Academy	524575	5040500	9.92
OVERLOOK COLLABORATIVE PRESCHOOL	524577	5045763	4.69	Montessori School of Beaverton	516376	5043786	9.96
Peace Tree School	526485	5046524	4.69	Walnut Grove Elementary	531269	5057076	10.00
Toni's Daycare	525836	5046137	4.71				