Cleaner Air Oregon

Level 3 Risk Assessment

Griffith Rubber Mills
Portland, Oregon

Prepared for:

Griffith Rubber Mills

February 13, 2024

BRIDGEWATER GROUP, INC.

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1.0 Introduction

Griffith Rubber Mills (GRM) operates a rubber products manufacturing facility located at 2625 NW Industrial Street in Portland, Oregon. The site is shown in Figure 1-1 and is located at a latitude of N 45° 32′ 31″ and longitude of W122° 24′ 26″, which corresponds to Universal Transverse Mercator (UTM – NAD 83) Zone 10 coordinates of 522,853 meters Easting by 5,043,190 meters Northing.

GRM leases the southern portion of a shared building. The north section of the building is operated by another company. The driveway on the east side of the lot is used by both GRM and the other company. The parking area along the east side of the lot is used for storage by the other company and is considered ambient air for CAO purposes. The strip along the west side of the property is fenced and under GRM control, thus is considered part of the GRM facility.

The facility has been in operation since 1984. In early 2020, GRM's third party consultant performed an audit of the Portland facility's compliance with environmental regulatory requirements, including with Oregon's air permitting requirements, arising under ORS 468 and 486A. The audit concluded that the PTE of the facility was over the threshold required for an air operating permit and GRM did not have one. GRM disclosed this finding to DEQ in February 2020. In February 2021, DEQ issued GRM a Notice of Civil Penalty and requested a Typically Available Control Technology (TACT) analysis, source testing and criteria pollutant and Cleaner Air Oregon (CAO) emissions inventories. In June 2021, GRM submitted an initial CAO emissions inventory to DEQ. Over the next year, GRM conducted multiple source tests of the Microwave/Hot Air Cure Oven. The results from those source tests were incorporated into the emissions inventory and the emissions inventory was resubmitted to DEQ on October 2022. DEQ reviewed the emission inventory and provided comments. Based on those comments, GRM updated the emissions inventory and submitted a new version in April 2023. As part of a Mutual Agreement and Final Order (MAO) signed on June 22, 2023, DEQ approved the April 2023 CAO emissions inventory, requested a CAO Modeling Protocol be submitted within 30 days and a Level-3 Risk Assessment Work Plan be submitted within 60 days. GRM submitted a combined Modeling Protocol and Level-3 Risk Assessment Work Plan (MPRAWP) on July 21, 2023. On September 5, 2023, GRM submitted Type 1 Notice of Intent to Construct (NOIC) for two new injection splicing machines. This request did not change the production capacities and emissions limits outlined in the previous submittals. DEQ approved the NOIC on September and requested revised addendums to the emissions inventory and MPRAWP within 30 days. GRM submitted the revised emissions inventory and an addendum to the MPRAWP on October 23, 2023. DEQ approved the Emissions Inventory and the MPRAWP (with accompanied addendum) on December 15, 2023 and request the Level-3 Risk Assessment by submitted by February 13, 2024. This document is a Level-3 Risk Assessment Work Plan (L3RA).

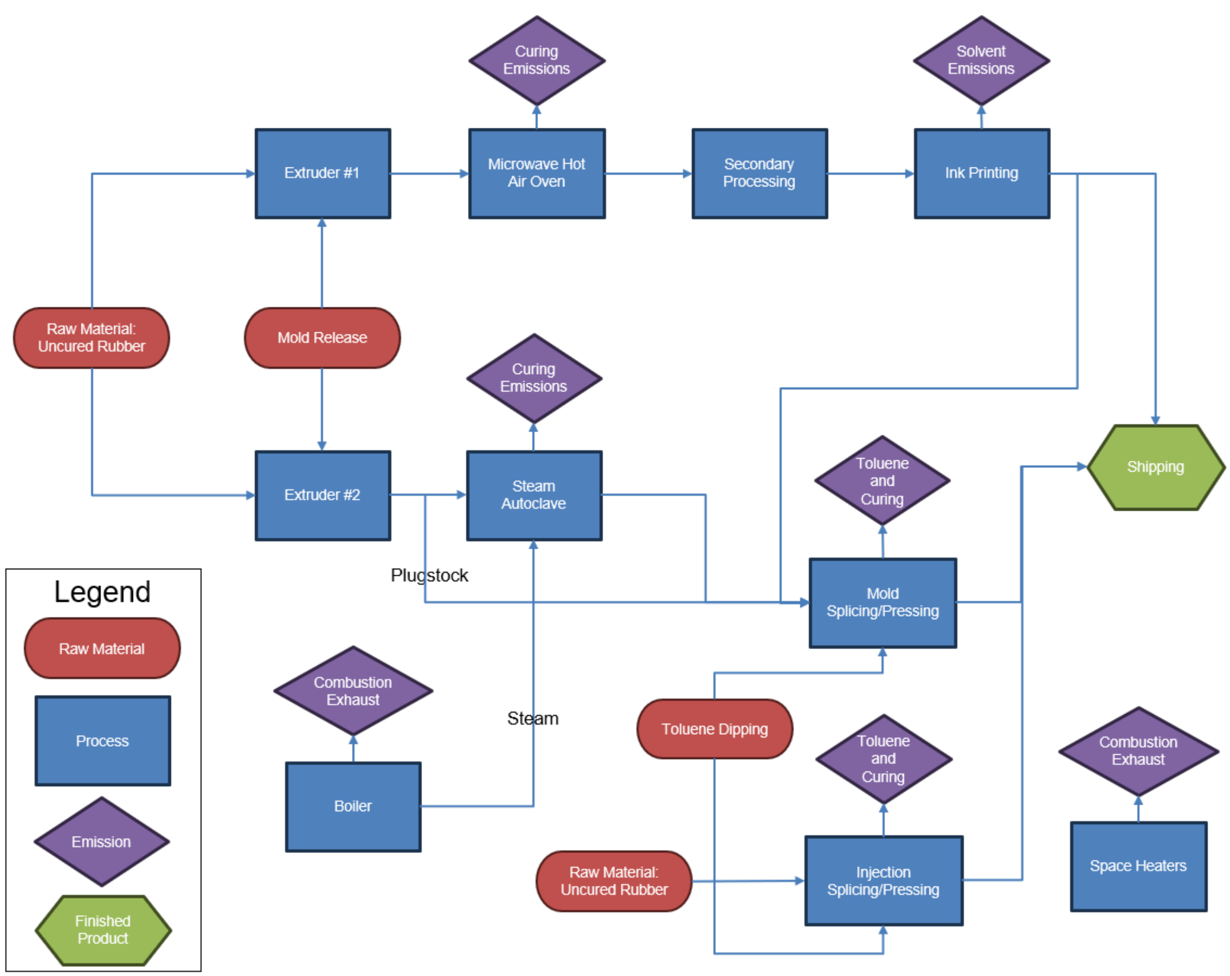
Figure 1-1: Site Location

2.0 Source Description

2.1 Process Description

GRM purchases uncured rubber stock (EPDM, Neoprene, SBR, NBR and natural rubbers) to manufacture rubber seals, gaskets and other similar products used primarily in the automotive industry. The purchased rubber is fed into an extruder that heats, mixes and then forces the material through a die to make a two-dimensional profile on a continuous linear rubber product. The extruded material is then heated in either a microwave and electric oven or in a steam autoclave to cure the rubber. Additional activities which emit pollutants include ink printing, toluene for cleaning, mold release agents, and natural gas combustion equipment including heaters and a boiler producing steam for the autoclave. A Process Flow Diagram is provided in Figure 2-1.

Figure 2-1: Process Flow Diagram



2.2 Toxic Emission Unit Descriptions

Figure 2-2 shows the conceptual site model for the CAO process. As per OAR 340-245-0020(5), emissions from the combustion of natural gas are segregated into a distinct Toxic Emission Units (TEUs) and the risk at each exposure location from those TEUs are determined separately and not included in the total facility risk.

The emissions from these TEU are provided in a revised AQ520 spreadsheet, which is included in this submittal. In developing this MPRAWP, a few minor errors were identified, and a modification was made to the microwave hot air oven TEU. The changes include the following:

- The natural gas usage values were assuming 8760 hours at full capacity, when we intended to only include 50% at capacity as the requested usage. Pre-April CAO emission inventories included the correct usage, but the April version had incorrect values that have now been corrected.
- The extrusion emissions factors for EPDM were accidentally entered into the April version incorrectly, using the Neoprene EFs instead. This has been corrected.
- In previous inventory versions, the microwave-hot air oven emissions were combined into one TEU (e.g., emissions from all stacks combined). However, where a test result was available, the proportion of emission out of these stacks varied by pollutant. To address for this variability, the MWHO TEU was further refined by splitting the emissions out by stack.

Figure 2.1 also shows the TEU labeling between the emissions inventory, modeling, and risk assessment. A description of each TEU group and the sub processes is provided below. The emissions inventory provides greater detail and breaks out the emission points within an EU group. Note that the “xxx” refers to one of the uncured rubber stock (EPDM, Neoprene, SBR, NBR and natural rubbers)

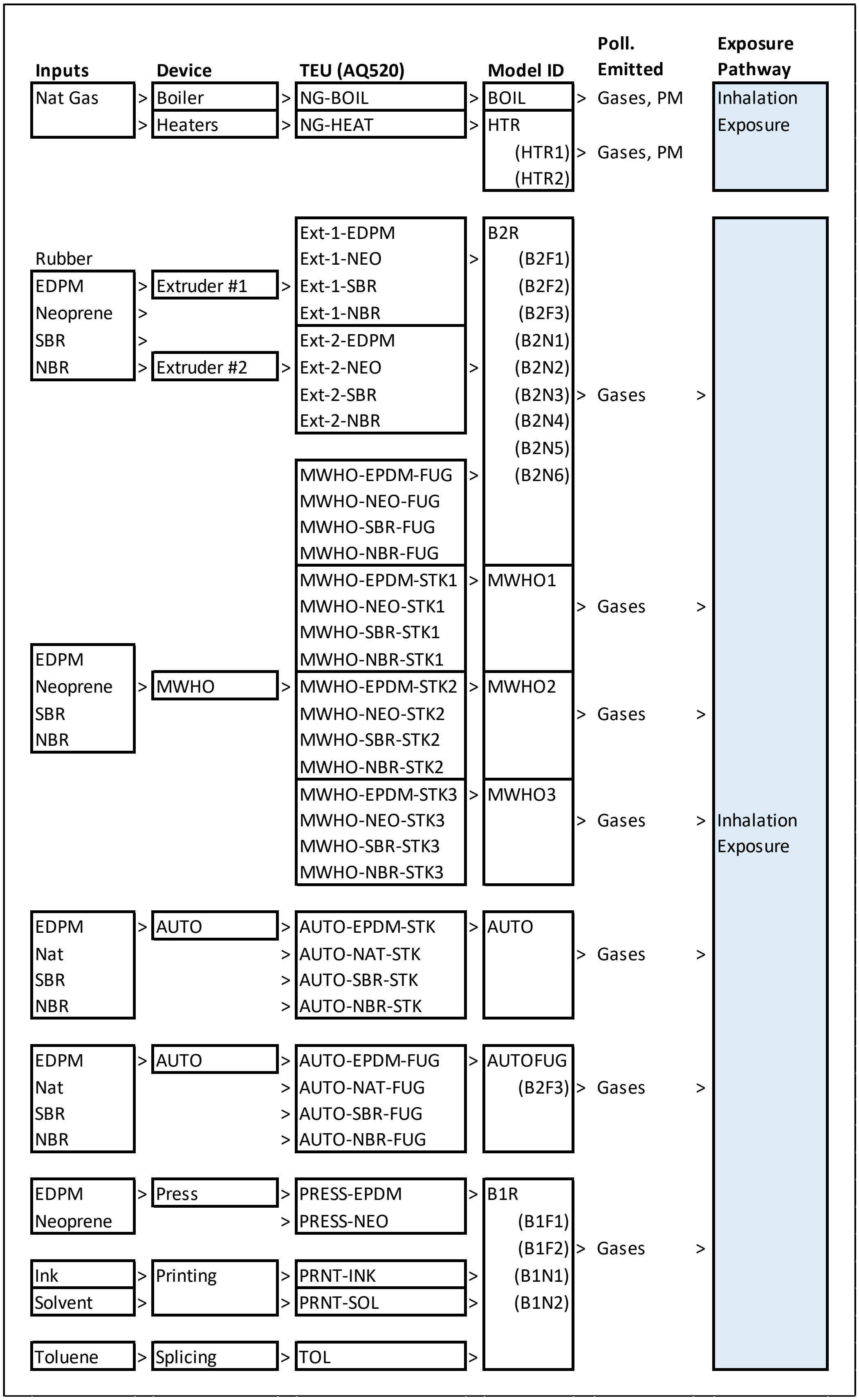
Natural Gas Combustion (NG-BOIL, NG-HTR)

The natural gas combustion sources include a natural gas-fired boiler and some building and space heaters.

Extrusion (Ext-1-xxx, Ext-2-xxx)

Extrusion is a process used to create a linear rubber strip with a fixed cross-sectional profile. Purchased uncured rubber stock is fed to the extruder and an extruder screw heats, mixes and then pushes the uncured rubber through a die to form the profile. The emissions from this process are directly into the building and ultimately discharged through roof fans.

Figure 2-2: CAO Conceptual Site Model



Microwave Hot Air Oven Cure (MWHO-xxx-STK1, -STK2, -STK3, -FUG)

After exiting the die, the extruded rubber from extruder #1 immediately enters the microwave and hot air oven curing process. The first stage uses microwaves and electric heat, and the second stage uses electric heat to cure the rubber. The microwave and hot air oven have three stacks to exhaust emissions and heat. The first stack exhausts the microwave, the second exhausts the intersection between the two oven sections. The third stack exhausts the end of the second oven section where rubber is water-quenched. The oven was stack tested. Where a test result was available, the values were used for each stack. Where a test result is not available (e.g., AP-42 factors), the split between stacks is based on the overall measured compound split across the stacks, with stack 1 at 15.5%, stack 2 at 69%, and stack 3 at 15.6%.

Steam Autoclave Cure (AUTO-xxx-STK, AUTO-xxx-FUG)

The autoclave uses steam to heat rubber products in a pressurized vessel to cure the rubber into specific shapes. The rubber cured in the autoclave is extruded in extruder #2. Steam is vented through a discharge line on the roof of the building at the end of each batch. The remaining steam is vented through a roof fan above the autoclave when the vessel is opened after each batch.

Pressing/Splicing (PRESS-EPDM, PRESS-NEO)

Transfer pressing is a process which uses small quantities of uncured rubber from extruder #2 (plugstock) to combine two or more rubber pieces. The uncured rubber is manually loaded by the operator into the machine (a "shot"), which uses hydraulic pressure to force the rubber into a mold where it is heated to cure and combine the rubber pieces. The transfer presses are broken into different types: 18 Stanlock presses, 2 air presses, and 6 SMaCo presses. These use rubber that is extruded from the extruder #2 process which is uncured. There are also two film splicers which use a very small amount of EPDM tape to combine strips for a small portion of products. The eight injection splicing machines use a purchased raw material (EPDM) rather than an extruded rubber produced on-site. These machines automatically feed the uncured rubber. The pressing emissions are emitted directly into the building and ultimately discharged through roof fans.

Toluene Usage (TOL)

Toluene is used for pressing and splicing as a lubricant to allow for insertion into the machine. Toluene is also used to do a small amount of cleaning. Toluene emissions are into the building and ultimately discharged through roof fans the same as pressing emissions.

Ink Printing (PRNT-INK, PRNT-SOL)

Certain extruded and cured rubber products are printed with markings using a solvent based ink. The solvent emissions are into the building and ultimately discharged through roof fans in the extrusion area.

2.3 Compounds Emitted

Table 2-1 shows the toxics air pollutants 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 Risk Based Concentrations (RBCs), and what the respective TBACT RAL is (either 3 or 5). The lower part of the table shows compounds which are emitted but do not have RBCs.

Table 2-1: Compounds Emitted from GRM.

CAS	Pollutant	Type	EL,MP	TBACT RAL
Compounds with RBCs				
75-07-0	Acetaldehyde	Volatile	--	HI3
67-64-1	Acetone	Volatile	--	HI3
75-05-8	Acetonitrile	Volatile	--	HI3
107-02-8	Acrolein	Volatile	--	HI5
107-13-1	Acrylonitrile	Volatile	--	HI3
107-05-1	Allyl chloride	Volatile	--	HI3
7664-41-7	Ammonia	Volatile	--	HI3
62-53-3	Aniline	Volatile	--	HI5
7440-38-2	Arsenic and compounds	Particulate	Y	HI3
71-43-2	Benzene	Volatile	--	HI3
7440-41-7	Beryllium and compounds	Particulate	--	HI3
117-81-7	Bis(2-ethylhexyl) phthalate (DEHP)	Volatile	Y	--
106-99-0	1,3-Butadiene	Volatile	--	HI3
78-93-3	2-Butanone (Methyl ethyl ketone)	Volatile	--	HI3
7440-43-9	Cadmium and compounds	Particulate	Y	HI3
75-15-0	Carbon disulfide	Volatile	--	HI3
56-23-5	Carbon tetrachloride	Volatile	--	HI3
463-58-1	Carbonyl sulfide	Volatile	--	HI3
532-27-4	2-Chloroacetophenone	Volatile	--	HI5
108-90-7	Chlorobenzene	Volatile	--	HI3
75-00-3	Chloroethane (Ethyl chloride)	Volatile	--	HI3
67-66-3	Chloroform	Volatile	--	HI3
74-87-3	Chloromethane (Methyl chloride)	Volatile	--	HI3
126-99-8	Chloroprene	Volatile	--	HI3
18540-29-9	Chromium VI, chromate and dichromate particulate	Particulate	Y	HI3
7440-48-4	Cobalt and compounds	Particulate	--	HI3
7440-50-8	Copper and compounds	Particulate	--	HI3
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	Volatile	--	HI3
75-34-3	1,1-Dichloroethane (Ethylidene dichloride)	Volatile	--	--
156-60-5	trans-1,2-dichloroethene	Volatile	--	HI3
75-09-2	Dichloromethane (Methylene chloride)	Volatile	Y	HI3
78-87-5	1,2-Dichloropropane (Propylene dichloride)	Volatile	--	HI3
123-91-1	1,4-Dioxane	Volatile	--	HI3
106-89-8	Epichlorohydrin	Volatile	--	HI3

CAS	Pollutant	Type	EL,MP	TBACT RAL
Compounds with RBCs				
100-41-4	Ethyl benzene	Volatile	--	HI3
107-06-2	Ethylene dichloride (EDC, 1,2-Dichloroethane)	Volatile	--	HI3
50-00-0	Formaldehyde	Volatile	--	HI3
87-68-3	Hexachlorobutadiene	Volatile	--	--
67-72-1	Hexachloroethane	Volatile	--	HI3
110-54-3	Hexane	Volatile	--	HI3
78-59-1	Isophorone	Volatile	--	HI3
67-63-0	Isopropyl alcohol	Volatile	--	HI3
98-82-8	Isopropylbenzene (Cumene)	Volatile	--	HI3
7439-92-1	Lead and compounds	Particulate	Y	HI3
7439-96-5	Manganese and compounds	Particulate	--	HI3
7439-97-6	Mercury and compounds	Particulate	Y	HI3
108-10-1	Methyl isobutyl ketone (MIBK, Hexone)	Volatile	--	HI3
1634-04-4	Methyl tert-butyl ether	Volatile	--	HI3
91-20-3	Naphthalene	Volatile	Y	HI3
C365	Nickel compounds, insoluble	Particulate	--	HI3
62-75-9	N-Nitrosodimethylamine	Volatile	Y	--
87-86-5	Pentachlorophenol	Volatile	--	--
108-95-2	Phenol	Volatile	--	HI3
C401	Polycyclic aromatic hydrocarbons (PAHs)	Volatile	Y	--
50-32-8	Benzo[a]pyrene	Volatile	Y	HI3
115-07-1	Propylene	Volatile	--	HI5
75-56-9	Propylene oxide	Volatile	--	HI3
7782-49-2	Selenium and compounds	Particulate	--	HI3
100-42-5	Styrene	Volatile	--	HI3
127-18-4	Tetrachloroethene (Perchloroethylene)	Volatile	--	HI3
108-88-3	Toluene	Volatile	--	HI3
71-55-6	1,1,1-Trichloroethane (Methyl chloroform)	Volatile	--	HI3
79-01-6	Trichloroethene (TCE, Trichloroethylene)	Volatile	Y	HI3
7440-62-2	Vanadium (fume or dust)	Particulate	--	HI3
75-01-4	Vinyl chloride	Volatile	Y	HI3
75-35-4	Vinylidene chloride	Volatile	--	HI3
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	Volatile	--	HI3
Compounds without RBCs				
7440-39-3	Barium and Compounds	Particulate	--	--
1313-27-5	Molybdenum trioxide	Particulate	--	--
7440-66-6	Zinc and Compounds	Particulate	--	--
95-48-7	2-Methylphenol	Volatile	--	--
98-86-2	Acetophenone	Volatile	--	--
92-52-4	Biphenyl	Volatile	--	--
84-74-2	Dibutyl phthalate	Volatile	--	--
132-64-9	Dibenzofuran	Volatile	--	--
131-11-3	Dimethyl phthalate	Volatile	--	--

CAS	Pollutant	Type	EL,MP	TBACT RAL
Compounds with RBCs				
540-84-1	2,2,4-Trimethylpentane	Volatile	--	--
121-69-7	N,N-Dimethylaniline	Volatile	--	--
95-53-4	o-Toluidine	Volatile	--	--
120-82-1	1,2,4-Trichlorobenzene	Volatile	--	--
75-27-4	Bromodichloromethane	Volatile	--	--
75-69-4	Trichlorofluoromethane (Freon 11)	Volatile	--	--
91-22-5	Quinoline	Volatile	--	--
64-17-5	Ethanol	Volatile	--	--
141-78-6	Ethyl acetate	Volatile	--	--
7791-07-3	Sodium perchlorate monohydrate	Volatile	--	--
9004-70-0	Nitrocellulose	Volatile	--	--
107-98-2	1-Methoxypropan-2-ol	Volatile	--	--

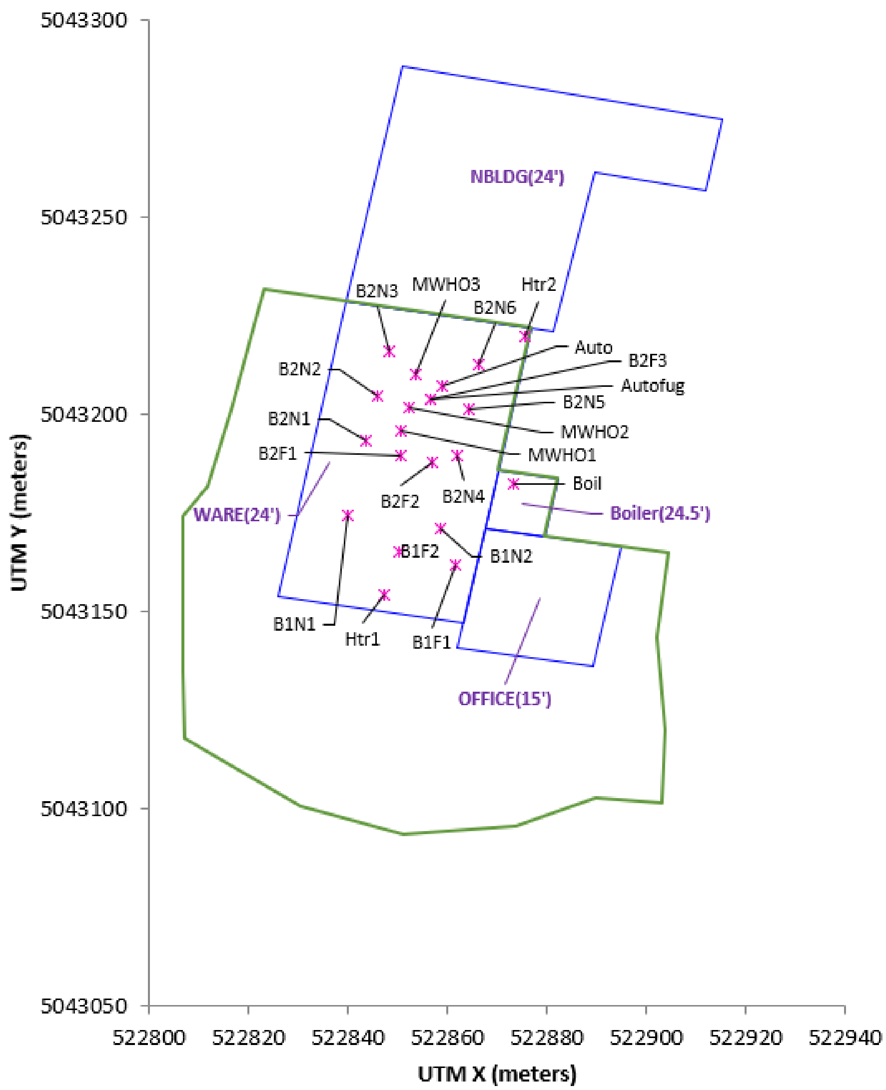
3.0 Modeling Protocol

This section is a modeling protocol and is intended to outline the assumptions and methodologies that were used in an air quality analysis for calculating 24-hour and annual risk values for each TEU for use in the Risk Assessment Work Plan (Section 4).

3.1 Source Characterization

Figure 3-1 shows the buildings and sources. The green line represents the CAO boundary and the blue line is the building footprint. The building blocks are labeled and include the height in feet.

Figure 3-1: GRM Buildings and Sources



GRM leases the southern part of the structure (blocks OFFICE, WARE, and BOILER), while another company leases the north portion of the structure (block NBLDG). The WARE block is partitioned into two areas: the southern splicing area (B1R) and the northern processing area (B2R). There is a wall that separates these two areas. Emissions released into these spaces are primarily exhausted through several natural draft and fan powered vents in the roof. In B1, there are two fan powered vents (B1F1 and B1F2) and two natural draft vents (B1N1 and B1N2). In B2, there are three fan powered vents (B2F1, B2F2, and B2F3) and six natural draft vents (B1N1-6). The fan-powered vents have a flapper that mechanically opens when the unit is powered on, thus the vent exhaust vertically (e.g., POINT source). All of the fans are sized the same, with a flow rate of 4190 cfm, as provided by GRM. The natural draft vents have rain caps. Using a natural draft calculator[1] and a reasonable range of temperature parameters (e.g., a delta T between indoor and outdoor of 5 to 10°F), an exit velocity from the natural draft vent would be expected to be between 1 to 2 m/s. Assuming a mean velocity of 1.5 m/s, a flow rate of 411 cfm was used. The vents were modeled separately but are combined as a source group in AERMOD, with the fraction of emissions based on the respective flow rates. Table 3-1 shows the building vent parameters.

Vent B2F3 is directly above the autoclave and is the primary exhaust for the autoclave fugitive emissions. This fan is sufficiently strong to evacuate the autoclave fugitive emissions in around a minute. GRM believes these roof fans and natural ventilation vent are sufficient to keep the building at negative pressure so pollutants are exhausted out of the roof rather than out a side opening (e.g. door).

For the vents, the exhaust temperature is set to the ambient temperature. In AERMOD, this is set when the source temperature is set to zero.

Table 3-1: Roof Vent Parameters

Group	Vent	Type	Flow (acfm)	Dia (in)	Vel (m/s)	Cover	Hgt (ft)	ER Frac.
B1R	B1F1	Fan	4190	38	2.70	Flap	30’	0.4553
	B1F2	Fan	4190	38	2.70	Flap	33’	0.4553
	B1N1	Natural	411	16	1.50	Raincap	33’	0.0447
	B1N2	Natural	411	16	1.50	Raincap	32’	0.0447
B2R	B2F1	Fan	4190	38	2.70	Flap	32’	0.2787
	B2F2	Fan	4190	38	2.70	Flap	32.5’	0.2787
	B2F3	Fan	4190	30	4.34	Flap	32.6’	0.2787
	B2N1	Natural	411	16	1.50	Raincap	33’	0.0273
	B2N2	Natural	411	16	1.50	Raincap	33’	0.0273
	B2N3	Natural	411	16	1.50	Raincap	33’	0.0273
	B2N4	Natural	411	16	1.50	Raincap	32’	0.0273
	B2N5	Natural	411	16	1.50	Raincap	32’	0.0273
	B2N6	Natural	411	16	1.50	Raincap	32’	0.0273

[1] https://www.engineeringtoolbox.com/natural-draught-ventilation-d_122.html

The autoclave (AUTO) at GRM is a hot, pressurized vessel. The autoclave is 5 feet in diameter and 16 feet long and is operated at approximately 100 psig and 330 °F using saturated steam to cure the rubber products over a period of 30-60 minutes. The autoclave is vented at the end of each batch, which results in a large release of hot steam over that very short period of time (approximately 90 seconds). Most of the steam exhausts through a 3″ pipe into a 12″x12″ metal baffle box intended to dissipate the noise of the venting. Steam escapes horizontally through the gaps in the box construction. The exhaust flow rate is the decompressed steam volume (2019 ft^3) minus the steam left in the vessel (314 ft^3) divided by 1.5 minutes (90 seconds), which results in a flow rate of 1136.6 cfm. Applying the 12″x12″ opening, the autoclave has a resultant exit velocity of 18.94 ft/s (5.77 m/s). The exhaust temperature is assumed to be 212 F, the saturated steam temperature at ambient conditions from Steam Tables.

When the autoclave is opened, the remaining steam cloud is released into the room. It quickly rises to the roof and is exhausted out the B2F3 vent in about a minute. Thus, the AUTOFUG source is the same as B2F3.

The microwave hot air oven (MWHO) has three stacks. All three stacks have been tested two times (Oct 12, 2021 and June 29, 2022) and the results shown in Table 3-2. The first stack test had higher flows but lower temperatures and the second test had higher temperatures and lower flows. For purposes of this analysis, the average of these two stack tests was used for everything except for the stack 3 temperature. Since this stack-3 temperature is close to ambient, ambient temperature was used for this stack (e.g., set to zero in the AERMOD input file).

Table 3-2: MWHO Source Test Stack Parameters

	10/12/2021		6/29/2022		Average	
Stack	Flow ACFM	Temp F	Flow ACFM	Temp F	Flow ACFM	Temp F
MWHO1	1716	63.1	1004.3	134	1360.2	98.6
MWHO2	1128	107.8	990.5	123.8	1059.3	115.8
MWHO3	1126	64	1010.2	76	1068.1	70

The natural gas boiler (BOIL) is located in the boiler room. It is a 2.678 MMBTU/hr unit. The exhaust temperature and flow are not known. Since this is a natural gas source, the flow rate was set to 1 m/s and the temperature to 300°F, which is typical for a boiler combustion source.

There are a number of space heaters on site which use natural gas. The two of the largest heaters are in the main work space and are each 0.332 MMBTU/hr units (HTR1 and HTR2). For this analysis, it is assumed that all of the heater natural gas emissions go out these two units in equal proportions. The units are then combined as a source group in AERMOD. The exhaust temperature and flow are not known for these units. Since these are natural gas sources, the flow rate was set to 1 m/s and the temperature to 300°F, which is typical low value for a combustion source.

The proposed stack parameters for the modeling are shown in Table 3-3. All sources and buildings are assigned the same base elevation of 11.4 m (37.4 ft) above sea level based on the average elevations across the property.

Table 3-3: Proposed Stack Parameters

Grp	EP	X (m)	Y(m)	Hgt (m)	Exh. Vel (m/s)	Dia (m)	Temp (K)	Grp ER Ratio
BOIL	Boil	522873.1	5043182.4	9.14	1	0.30	422.04	1
HTR	Htr1	522847.4	5043154.3	9.75	1	0.30	422.04	0.5
HTR	Htr2	522875.6	5043219.8	10.97	1	0.30	422.04	0.5
B1R	B1F1	522861.5	5043161.8	9.14	2.70	0.97	0	0.455
B1R	B1F2	522850.2	5043165.2	10.06	2.70	0.97	0	0.455
B1R	B1N1	522839.9	5043174.6	10.06	1.50	0.41	0	0.045
B1R	B1N2	522858.5	5043170.9	9.75	1.50	0.41	0	0.045
B2R	B2F1	522850.5	5043189.6	9.75	2.70	0.97	0	0.279
B2R	B2F2	522857.0	5043187.8	9.91	2.70	0.97	0	0.279
B2R	B2F3	522856.5	5043203.6	9.94	4.34	0.76	0	0.279
B2R	B2N1	522843.7	5043193.4	10.06	1.50	0.41	0	0.027
B2R	B2N2	522845.8	5043204.6	10.06	1.50	0.41	0	0.027
B2R	B2N3	522848.1	5043216.0	10.06	1.50	0.41	0	0.027
B2R	B2N4	522862.1	5043189.6	9.75	1.50	0.41	0	0.027
B2R	B2N5	522864.3	5043201.3	9.75	1.50	0.41	0	0.027
B2R	B2N6	522866.4	5043212.8	9.75	1.50	0.41	0	0.027
Auto	Auto	522858.9	5043207.3	9.14	5.29	0.34	373.15	1
Auto	Autofug	522856.5	5043203.6	9.94	4.34	0.76	0	1
MWHO	MWHO1	522850.5	5043196.0	10.36	8.80	0.30	310.15	1
MWHO	MWHO2	522852.1	5043201.5	11.58	6.85	0.30	319.71	1
MWHO	MWHO3	522853.5	5043210.3	10.97	6.91	0.30	0	1

For point sources, the evaluation of building downwash on the adjacent stack is deemed necessary, since the stack height may be below Good Engineering Practice (GEP) heights. The formula for GEP height estimation is:

$$H_s = H_b + 1.50L_b$$

where: H_s = GEP stack height
H_b = building height
L_b = the lesser building dimension of the height, length, or width

The effects of aerodynamic downwash due to buildings and other structures was accounted for by using wind direction-specific building parameters calculated by the USEPA-approved Building Parameter Input Program Prime (BPIP-Prime) and the algorithms included in AERMOD.

3.2 Model Selection

Air quality dispersion modeling was conducted to simulate the downwind transport of toxic air contaminants emitted by all the existing TEUs at the facility. The analysis estimated maximum off-site concentrations using the AERMOD (AMS [American Meteorological Society]/EPA [Environmental Protection Agency] Regulatory Model), 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 was performed using the following versions for AERMOD and all preprocessors:

- AERMOD: 22112
- AERMET: 22112
- AERMINUTE: 20060
- AERMAP: 18081
- BPIPrime: 04274

AERMOD modeling was 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 were also incorporated.

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 were used. The station is located about 10 kilometers northeast 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 were used. A five-year wind rose is shown in Figure 3-2.

The surface parameters (surface roughness, Bowen ratio, and noon-time albedo) were determined using the most recent version of AERSURFACE. AERSURFACE was 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 was conducted to determine the wetness condition for each year. If the yearly precipitation exceeded the 70th percentile, then the year was defined as wet. If the yearly precipitation is less than the 30th percentile, then the year was defined as dry. If the precipitation was between the 30th and 70th percentiles, it was defined as average. The soil moisture conditions for the five years of meteorological data are shown in Table 3-4. Since albedo and Bowen ratio are area averages, all sectors 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 were entered into the AERMET Stage 2 processing.

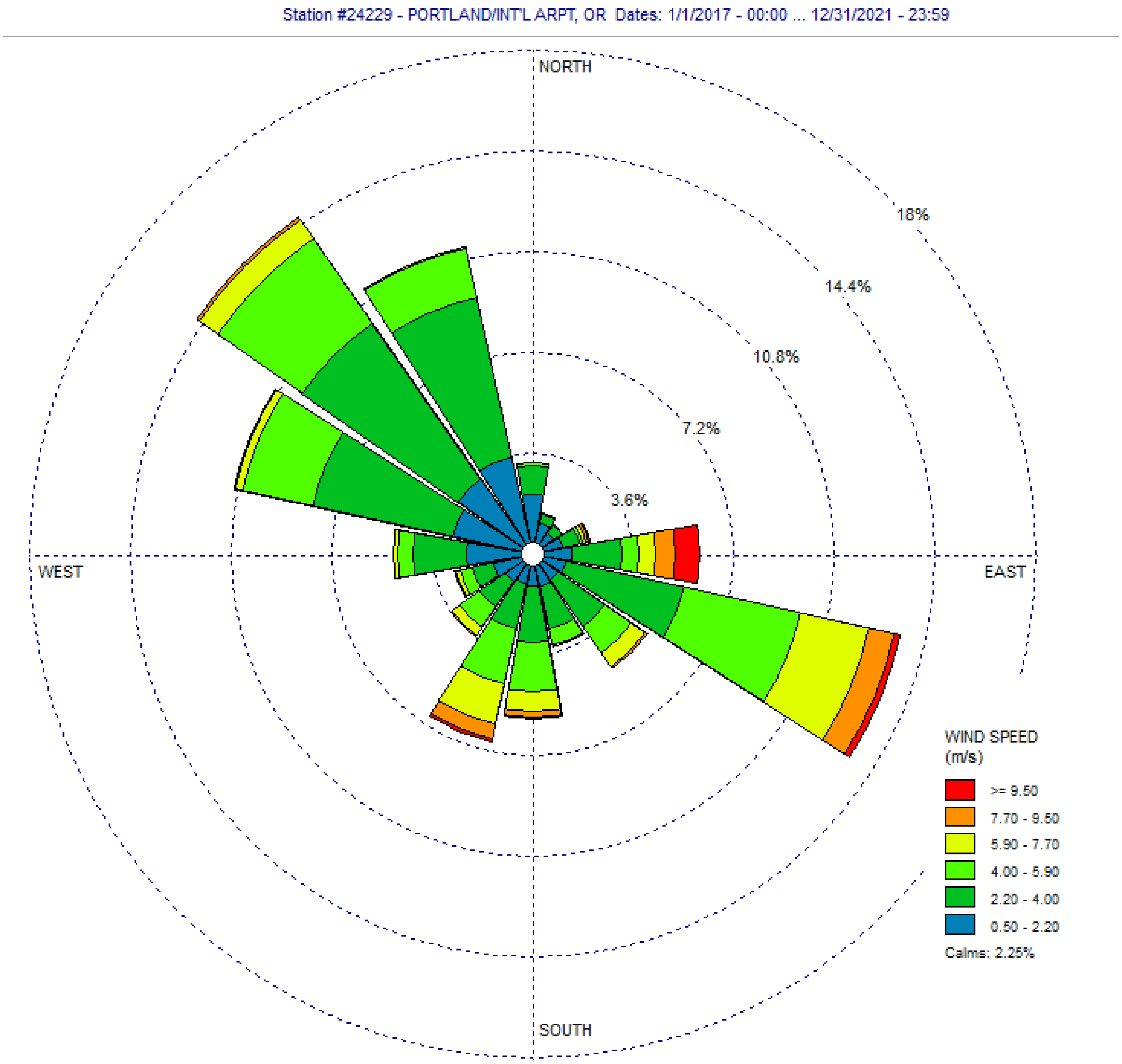
The months of December to February were assumed as "winter", March to May were assumed as "spring", June to August were assumed as "summer", and September to November were assumed as "autumn". The data was processed using the AERMET program with the adjust U-star option selected.

Table 3-4: 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 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 more than 50% of 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:

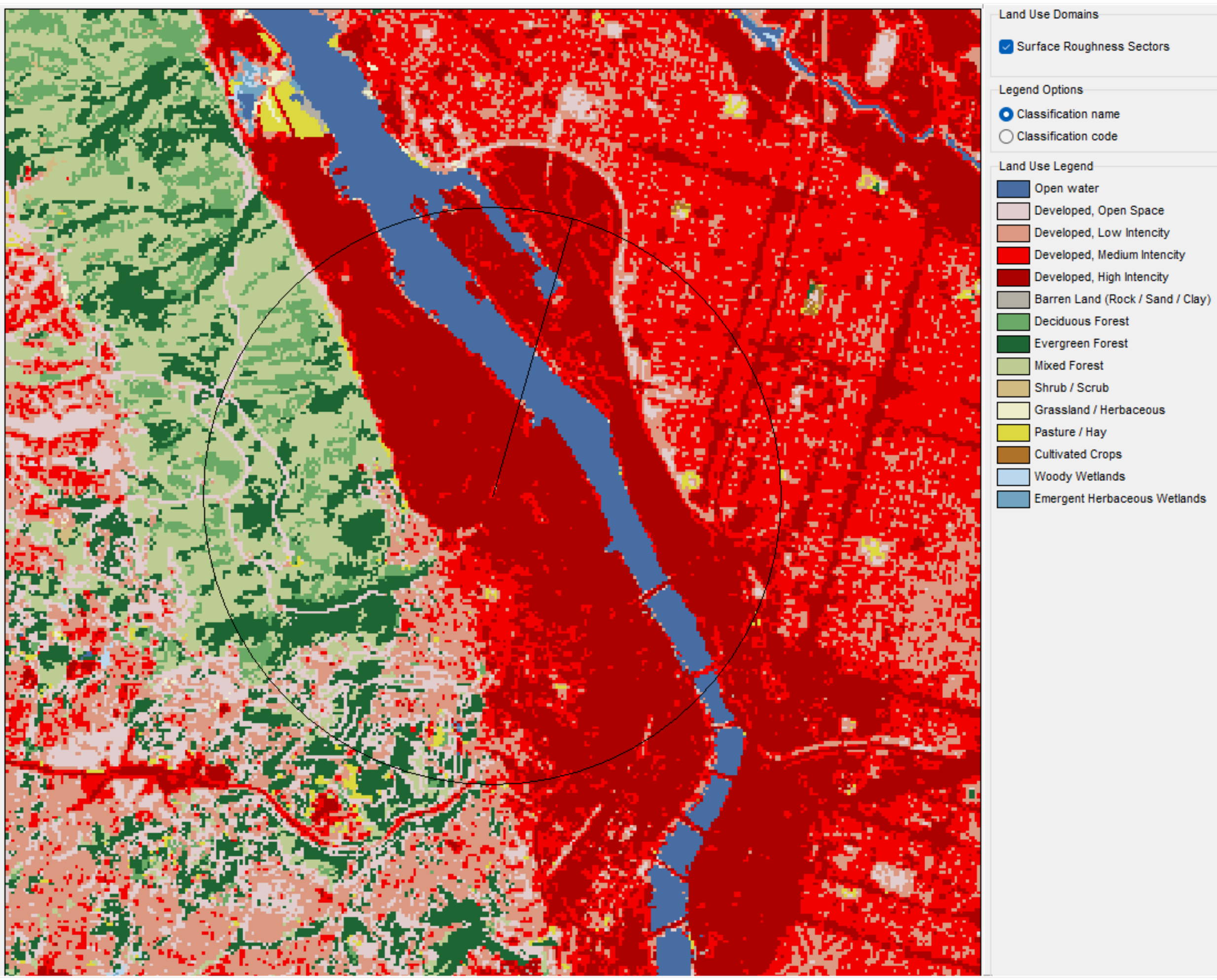
- Developed, Low Intensity (NLDC Code 22) - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20 to 49 percent of total cover. These areas most commonly include single-family housing units.
- Developed, Medium Intensity (NLCD Code 23) – This classification 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.

Figure 3-3 and Table 3-3 show the land use around GRM. About 63% of landuse within 3 km of the facility is classified as urban. Thus, urban dispersion coefficients were used in AERMOD. This option requires a population estimate to account for the urban heat island effect. For this analysis, the City of Portland population of 635,067 (July 2022 estimate) from the U.S. Census Bureau (https://www.census.gov/quickfacts/portlandcityoregon) were used.

Table 3-5: Rural and Urban Land Use Determination

Cat	Starting Direction:	Count	Type	Percent
11	Open Water:	2776	Rural	8.84%
21	Developed, Open Space:	1576	Rural	5.02%
22	Developed, Low Intensity:	2645	Urban	8.42%
23	Developed, Medium Intensity:	4933	Urban	15.70%
24	Developed, High Intensity:	12249	Urban	39.00%
31	Barren Land (Rock/Sand/Clay):	14	Rural	0.04%
42	Evergreen Forest:	2592	Rural	8.25%
43	Mixed Forest:	3365	Rural	10.71%
52	Shrub/Scrub:	10	Rural	0.03%
71	Grasslands/Herbaceous:	1	Rural	0.00%
81	Pasture/Hay:	148	Rural	0.47%
	Total:	31411		
	Percent Urban			63.12%
	Percent Rural			24.53%

Figure 3-3: Land Use around GRM



Black circle has a 3-km radius centered on the facility.

3.5 Receptor Grid

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 are evaluated. On the east side of the property, there is the parking lot and roadway which the neighboring business uses, so receptors were included in this area. The GRM's parking lot south of the building and the roadway directly south were not included as people are unlikely to congregate there. Figures 3-4 shows the CAO boundary and the near-field receptors around the GRM facility.

Figure 3-4: Near Field Receptor Grid

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 CAO rules also require that schools and daycares also be identified. For schools and daycares, the following resources was used:

- Manual entries from Google search
- Oregon Educational Locations database from Oregon GEOHub published September 2022[2]
- Homeland Infrastructure Foundation -Level Data (HIFLD) Child Care Centers ArcGIS database published March 2022[3]

Each school or daycare was explicitly identified with a receptor. Duplicate entries were screened by merging sites that are with 100 m of each other. There are 759 schools and daycares within 10 km of the facility with the closest school/daycare being 0.55 km south of the facility. The list of schools and daycares is provided in a spreadsheet.

A map of the full receptor grid is provided in the next section.

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).

3.6 Model Execution

Each source was run separately using the group emission rate ratio (in g/s) unit emission rate. The ratios are set so the source group total equals 1 g/s. The outputs were plot files of the maximum 24-hour unit concentrations and the 5-year average annual unit concentrations at each receptor for each source. These plot files were then used in the risk assessment for the risk calculations as described below.

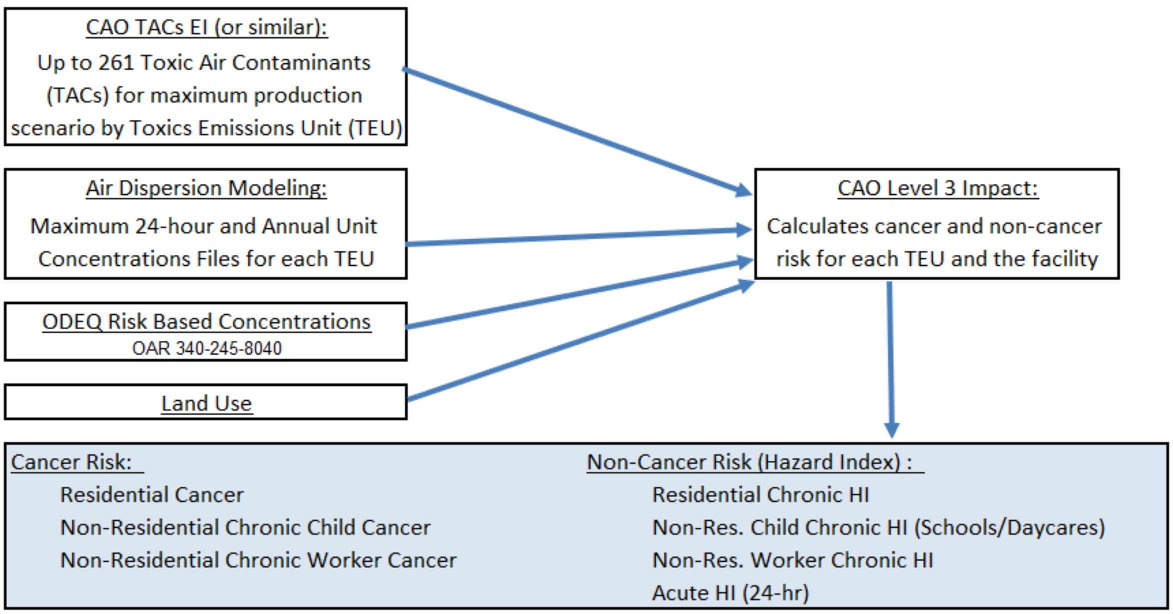
[2] https://geohub-oregon-geo.hub.arcgis.com/datasets/173bee2ad1f14f4ebc144e0a0b3ca6a7_0/explore
[3] https://hifld-geoplatform.opendata.arcgis.com/datasets/child-care-centers/explore

4.0 Risk Assessment Work Plan

4.1 Methodology

Figure 4-1 shows the Level-3 Risk Assessment process. Using the CAO toxic air pollutant EI (e.g., AQ520 CAO spreadsheet), the 24-hr and annual average unit concentration files from 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 were found at every receptor.

Figure 4-1: Level-3 Refined Risk Assessment



The land use classifications are applied to reach receptors around the facility to define their exposure class. The receptors, identified by class, are shown in Figure 4-2. 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.

4.2 Exposure Locations

Each receptor was assigned an exposure type based on its land use designation. Two sources of land use data were used:

- The City of Portland 2020 zoning land use layer from City of Portland Open Data site[4]
- Statewide 2017 Oregon Zoning data from the Oregon Department of Land Conservation and Development. This data layer is an element of the Oregon GIS Framework and is available through the Oregon Spatial Data Library. This feature class contains zoning data from 198 local jurisdictions, including the City of Eugene. The data set has 55 zoning classifications, which are binned into three categories: residential, industrial/commercial, and open space.

The City of Portland land use layer was the primary layer. A crosswalk between the land use categories and the exposure types is shown in Table 4-1. The 2017 statewide layer was used for areas outside the City of Portland layer. A crosswalk between the statewide land use categories and the exposure types is shown in Table 4-2. 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, and agricultural areas. Open space receptors were evaluated for acute risk only. For both layers, the Public Lands category were designated as a Child/Worker exposure type as per Oregon DEQ CAO guidance. School/Daycare receptors were evaluated for worker exposure.

Figures 4-2 and 4-3 shows the near and far field land use around the facility, with receptor exposures. A spreadsheet with receptor and their exposure type is provided with this submittal.

[4] https://gis-pdx.opendata.arcgis.com/search?q=zoning

Table 4-1: City of Portland Land Use Crosswalk

ZONE	CMP	ZONE_CMP	ZONE_DESC	CMP_DESC	CAO Exposure
CE	MU-C	CE_MU-C	Commercial Employment	Mixed Use - Civic Corridor	RES
CE	MU-D	CE_MU-D	Commercial Employment	Mixed Use - Dispersed	RES
CE	MU-N	CE_MU-N	Commercial Employment	Mixed Use - Neighborhood	RES
CE	MU-U	CE_MU-U	Commercial Employment	Mixed Use - Urban Center	RES
CI1	IC	CI1_IC	Campus Institutional 1	Institutional Campus	RES
CI2	IC	CI2_IC	Campus Institutional 2	Institutional Campus	RES
CL	IS	CL_IS	County Zoning - Clackamas	Industrial Sanctuary	Worker
CL	OS	CL_OS	County Zoning - Clackamas	Open Space	Openspace
CL	R10	CL_R10	County Zoning - Clackamas	Single - Dwelling 10,000	RES
CL	R20	CL_R20	County Zoning - Clackamas	Single - Dwelling 20,000	RES
CL	R7	CL_R7	County Zoning - Clackamas	Single - Dwelling 7,000	RES
CM1	MU-C	CM1_MU-C	Commercial Mixed Use 1	Mixed Use - Civic Corridor	RES
CM1	MU-D	CM1_MU-D	Commercial Mixed Use 1	Mixed Use - Dispersed	RES
CM1	MU-N	CM1_MU-N	Commercial Mixed Use 1	Mixed Use - Neighborhood	RES
CM1	MU-U	CM1_MU-U	Commercial Mixed Use 1	Mixed Use - Urban Center	RES
CM2	IC	CM2_IC	Commercial Mixed Use 2	Institutional Campus	RES
CM2	MU-C	CM2_MU-C	Commercial Mixed Use 2	Mixed Use - Civic Corridor	RES
CM2	MU-N	CM2_MU-N	Commercial Mixed Use 2	Mixed Use - Neighborhood	RES
CM2	MU-U	CM2_MU-U	Commercial Mixed Use 2	Mixed Use - Urban Center	RES
CM3	MU-C	CM3_MU-C	Commercial Mixed Use 3	Mixed Use - Civic Corridor	RES
CM3	MU-U	CM3_MU-U	Commercial Mixed Use 2	Mixed Use - Urban Center	RES
CR	MU-D	CR_MU-D	Commercial Residential	Mixed Use - Dispersed	RES
CR	MU-N	CR_MU-N	Commercial Residential	Mixed Use - Neighborhood	RES
CX	CX	CX_CX	Central Commercial	Central Commercial	RES
EG1	ME	EG1_ME	General Employment 1	Mixed Employment	Worker
EG1	MU-U	EG1_MU-U	General Employment 1	Mixed Use - Urban Center	Worker
EG2	IC	EG2_IC	General Employment 2	Institutional Campus	Worker
EG2	ME	EG2_ME	General Employment 2	Mixed Employment	Worker
EG2	MU-U	EG2_MU-U	General Employment 2	Mixed Use - Urban Center	Worker
EX	EX	EX_EX	Central Employment	Central Employment	RES
EX	IC	EX_IC	Central Employment	Institutional Campus	RES
IG1	EX	IG1_EX	General Industrial 1	Central Employment	Worker
IG1	IS	IG1_IS	General Industrial 1	Industrial Sanctuary	Worker
IG1	ME	IG1_ME	General Industrial 1	Mixed Employment	Worker
IG1	MU-U	IG1_MU-U	General Industrial 1	Mixed Use - Urban Center	Worker
IG2	IS	IG2_IS	General Industrial 2	Industrial Sanctuary	Worker
IG2	ME	IG2_ME	General Industrial 2	Mixed Employment	Worker
IH	IS	IH_IS	Heavy Industrial	Industrial Sanctuary	Worker
IH	ME	IH_ME	Heavy Industrial	Mixed Employment	Worker
IR	IC	IR_IC	Institutional Residential	Institutional Campus	RES
MC	RF	MC_RF	County Zoning - Multnomah	Single - Farm / Forest	Openspace

ZONE	CMP	ZONE_CMP	ZONE_DESC	CMP_DESC	CAO Exposure
OS	IS	OS_IS	Open Space	Industrial Sanctuary	Worker
OS	OS	OS_OS	Open Space	Open Space	Openspace
OS	R10	OS_R10	Open Space	Single - Dwelling 10,000	RES
R1	IC	R1_IC	Residential 1,000	Institutional Campus	RES
R1	MU-C	R1_MU-C	Residential 1,000	Mixed Use - Civic Corridor	RES
R1	MU-N	R1_MU-N	Residential 1,000	Mixed Use - Neighborhood	RES
R1	MU-U	R1_MU-U	Residential 1,000	Mixed Use - Urban Center	RES
R1	R1	R1_R1	Residential 1,000	Multi - Dwelling 1,000	RES
R10	IS	R10_IS	Residential 10,000	Industrial Sanctuary	RES
R10	MU-D	R10_MU-D	Residential 10,000	Mixed Use - Dispersed	RES
R10	MU-N	R10_MU-N	Residential 10,000	Mixed Use - Neighborhood	RES
R10	R10	R10_R10	Residential 10,000	Single - Dwelling 10,000	RES
R10	R2	R10_R2	Residential 10,000	Multi - Dwelling 2,000	RES
R10	R5	R10_R5	Residential 10,000	Single - Dwelling 5,000	RES
R2.5	IC	R2.5_IC	Residential 2,500	Institutional Campus	RES
R2.5	MU-C	R2.5_MU-C	Residential 2,500	Mixed Use - Civic Corridor	RES
R2.5	MU-N	R2.5_MU-N	Residential 2,500	Mixed Use - Neighborhood	RES
R2.5	R1	R2.5_R1	Residential 2,500	Multi - Dwelling 1,000	RES
R2.5	R2.5	R2.5_R2.5	Residential 2,500	Single - Dwelling 2,500	RES
R2	MU-C	R2_MU-C	Residential 2,000	Mixed Use - Civic Corridor	RES
R2	MU-N	R2_MU-N	Residential 2,000	Mixed Use - Neighborhood	RES
R2	MU-U	R2_MU-U	Residential 2,000	Mixed Use - Urban Center	RES
R2	R1	R2_R1	Residential 2,000	Multi - Dwelling 1,000	RES
R2	R2	R2_R2	Residential 2,000	Multi - Dwelling 2,000	RES
R2	RH	R2_RH	Residential 2,000	High - Density Multi - Dwelling	RES
R20	IS	R20_IS	Residential 20,000	Industrial Sanctuary	RES
R20	R10	R20_R10	Residential 20,000	Single - Dwelling 10,000	RES
R20	R2	R20_R2	Residential 20,000	Multi - Dwelling 2,000	RES
R20	R20	R20_R20	Residential 20,000	Single - Dwelling 20,000	RES
R3	ME	R3_ME	Residential 3,000	Mixed Employment	RES
R3	MU-N	R3_MU-N	Residential 3,000	Mixed Use - Neighborhood	RES
R3	R1	R3_R1	Residential 3,000	Multi - Dwelling 1,000	RES
R3	R2	R3_R2	Residential 3,000	Multi - Dwelling 2,000	RES
R3	R3	R3_R3	Residential 3,000	Multi - Dwelling 3,000	RES
R5	IC	R5_IC	Residential 5,000	Institutional Campus	RES
R5	IS	R5_IS	Residential 5,000	Industrial Sanctuary	RES
R5	ME	R5_ME	Residential 5,000	Mixed Employment	RES
R5	MU-C	R5_MU-C	Residential 5,000	Mixed Use - Civic Corridor	RES
R5	MU-D	R5_MU-D	Residential 5,000	Mixed Use - Dispersed	RES
R5	MU-N	R5_MU-N	Residential 5,000	Mixed Use - Neighborhood	RES
R5	R1	R5_R1	Residential 5,000	Multi - Dwelling 1,000	RES
R5	R2	R5_R2	Residential 5,000	Multi - Dwelling 2,000	RES

ZONE	CMP	ZONE_CMP	ZONE_DESC	CMP_DESC	CAO Exposure
R5	R2.5	R5_R2.5	Residential 5,000	Single - Dwelling 2,500	RES
R5	R5	R5_R5	Residential 5,000	Single - Dwelling 5,000	RES
R5	RH	R5_RH	Residential 5,000	High - Density Multi - Dwelling	RES
R7	IC	R7_IC	Residential 7,000	Institutional Campus	RES
R7	ME	R7_ME	Residential 7,000	Mixed Employment	RES
R7	MU-C	R7_MU-C	Residential 7,000	Mixed Use - Civic Corridor	RES
R7	MU-D	R7_MU-D	Residential 7,000	Mixed Use - Dispersed	RES
R7	MU-U	R7_MU-U	Residential 7,000	Mixed Use - Urban Center	RES
R7	R1	R7_R1	Residential 7,000	Multi - Dwelling 1,000	RES
R7	R2	R7_R2	Residential 7,000	Multi - Dwelling 2,000	RES
R7	R2.5	R7_R2.5	Residential 7,000	Single - Dwelling 2,500	RES
R7	R5	R7_R5	Residential 7,000	Single - Dwelling 5,000	RES
R7	R7	R7_R7	Residential 7,000	Single - Dwelling 7,000	RES
RF	IS	RF_IS	Residential Farm / Forest	Industrial Sanctuary	RES
RF	R10	RF_R10	Residential Farm / Forest	Single - Dwelling 10,000	RES
RF	R20	RF_R20	Residential Farm / Forest	Single - Dwelling 20,000	RES
RF	R7	RF_R7	Residential Farm / Forest	Single - Dwelling 7,000	RES
RF	RF	RF_RF	Residential Farm / Forest	Single - Dwelling Residential Farm / Forest	RES
RH	IC	RH_IC	High Density Residential	Institutional Campus	RES
RH	MU-U	RH_MU-U	High Density Residential	Mixed Use - Urban Center	RES
RH	RH	RH_RH	High Density Residential	High - Density Multi - Dwelling	RES
RMP	MDP	RMP_MDP	Residential Manufactured Dwelling Park	Manufactured Dwelling Park	RES
RX	RX	RX_RX	Central Residential	Central Residential	RES
WC	R10	WC_R10	County Zoning - Washington	Single - Dwelling 10,000	RES
WC	R2	WC_R2	County Zoning - Washington	Multi - Dwelling 2,000	RES
WC	R20	WC_R20	County Zoning - Washington	Single - Dwelling 20,000	RES
WC	R5	WC_R5	County Zoning - Washington	Single - Dwelling 5,000	RES
WC	R7	WC_R7	County Zoning - Washington	Single - Dwelling 7,000	RES

Table 4-2: Statewide Land Use Crosswalk

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

Figure 4-2: Near Field Receptor Exposure Classes

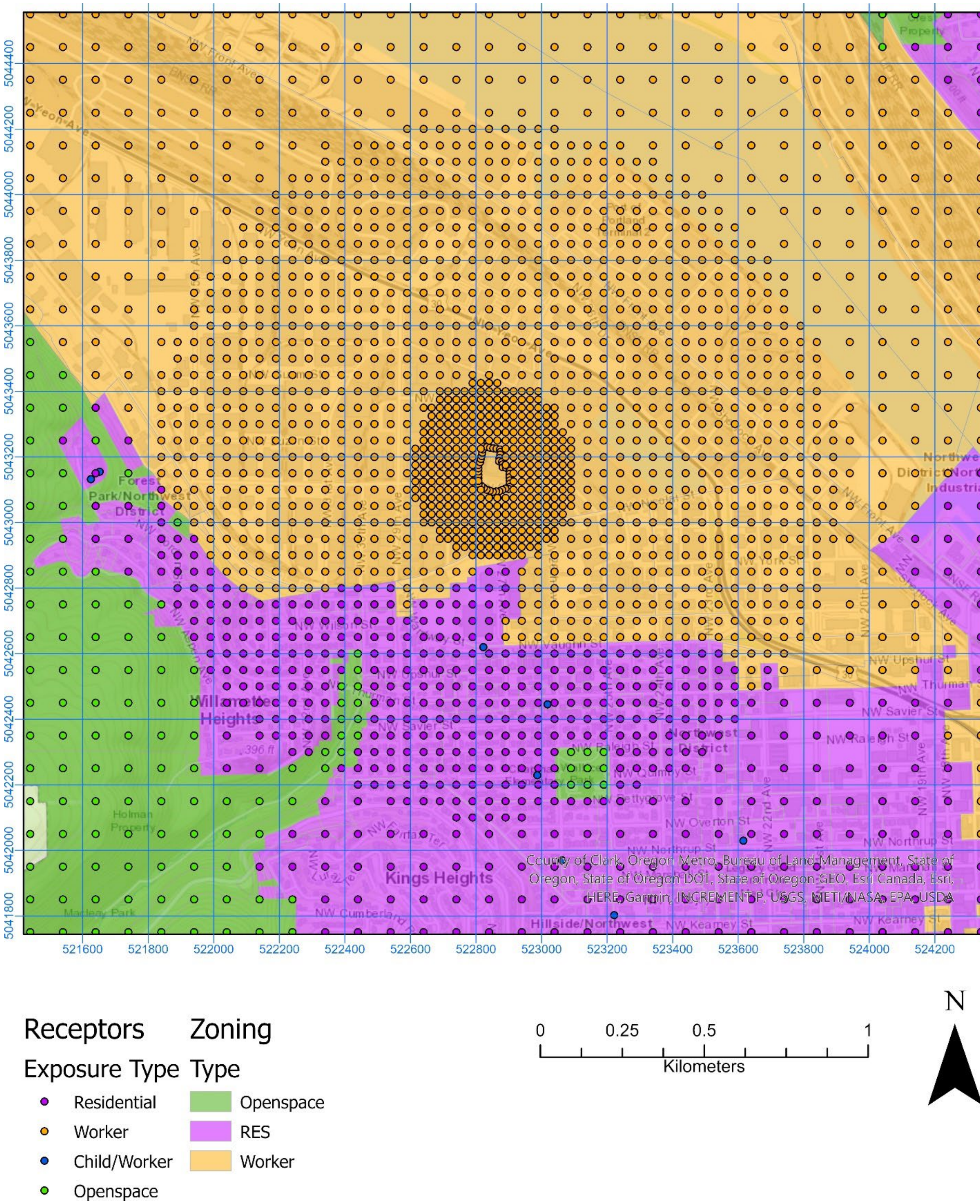
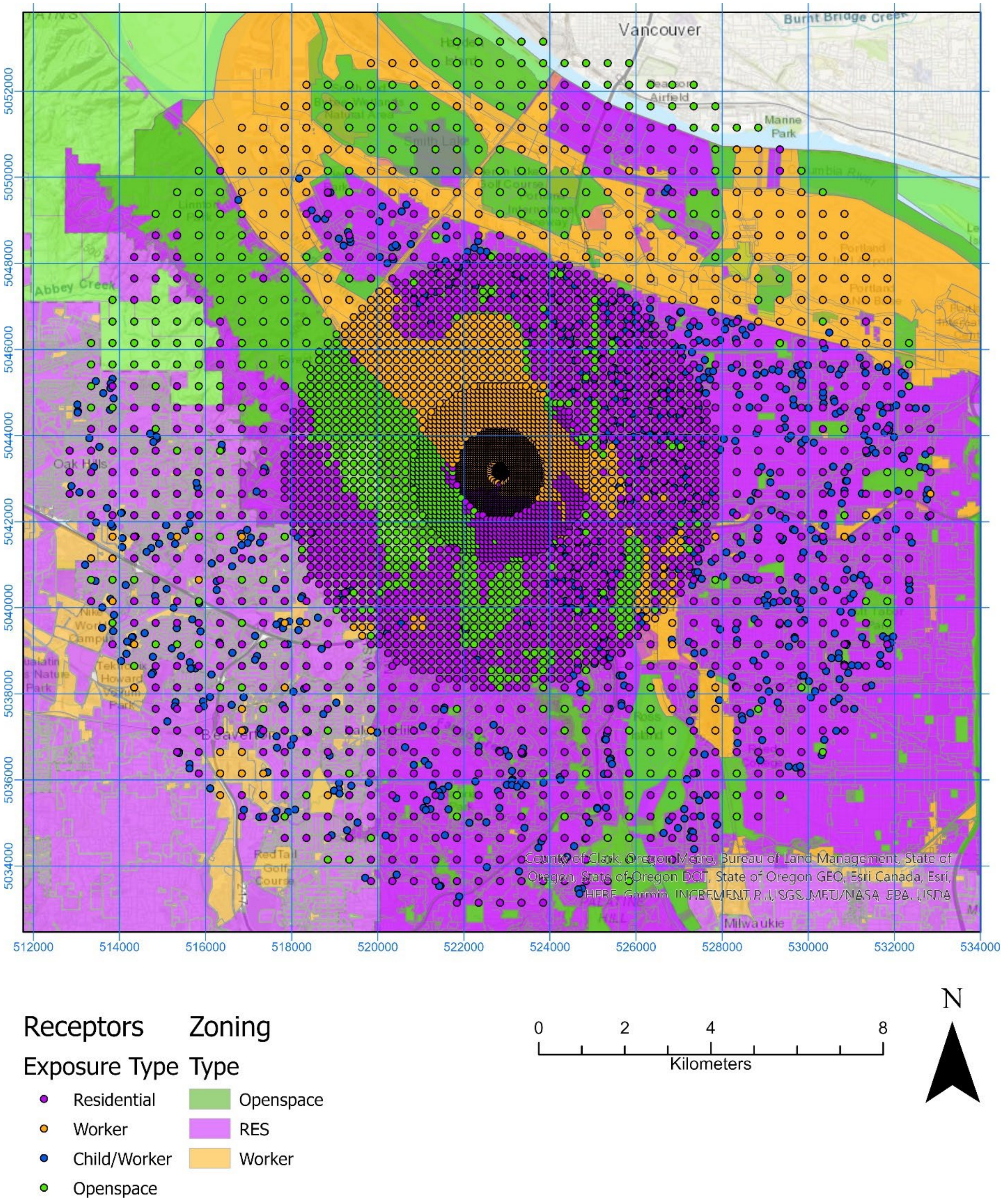


Figure 4-3: Far Field Receptor Exposure Classes



4.3 Risk Evaluation

Using the 24-hr and annual emission rates from CAO toxic air contaminant emissions inventory (the updated AQ520 spreadsheet is included with this submittal), the 24-hr and annual average concentration files from AERMOD runs, the RBCs (Table 4-3), and the exposure designations at each receptor, the chronic cancer, chronic non-cancer and acute hazard index risk were 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, $TO_{p,o}$ 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 exposure type *L* at the receptor *r*. For cancer risk, the target organ factor is always 1. 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 impact a particular organ and zero otherwise. The target organ analysis was be done if the non-cancer risk exceeds the Source Permit Level.

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

The risk calculations are made in an Excel spreadsheet. The spreadsheet has 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 is provided as part of the risk assessment submittal.

Table 4-3: Compound RBCs

		Chronic Cancer (ug/m3)			Chronic Non-Cancer (ug/m3)			Acute
CAS	Pollutant	Residential	Child	Worker	Residential	Child	Worker	(ug/m3)
75-07-0	Acetaldehyde	0.45	12	5.5	140	620	620	470
67-64-1	Acetone	--	--	--	31000	140000	140000	62000
75-05-8	Acetonitrile	--	--	--	60	260	260	--
107-02-8	Acrolein	--	--	--	0.35	1.5	1.5	6.9
107-13-1	Acrylonitrile	0.015	0.38	0.18	5	22	22	220
107-05-1	Allyl chloride	0.17	4.3	2	1	4.4	4.4	--
7664-41-7	Ammonia	--	--	--	500	2200	2200	1200
62-53-3	Aniline	0.63	16	7.5	1	4.4	4.4	--
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
117-81-7	Bis(2-ethylhexyl) phthalate (DEHP)	0.08	11	5	--	--	--	--

CAS	Pollutant	Chronic Cancer (ug/m3)			Chronic Non-Cancer (ug/m3)			Acute
		Residential	Child	Worker	Residential	Child	Worker	(ug/m3)
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
56-23-5	Carbon tetrachloride	0.17	4.3	2	100	440	440	1900
463-58-1	Carbonyl sulfide	--	--	--	10	44	44	660
532-27-4	2-Chloroacetophenone	--	--	--	0.03	0.13	0.13	--
108-90-7	Chlorobenzene	--	--	--	50	220	220	--
75-00-3	Chloroethane (Ethyl chloride)	--	--	--	30000	130000	130000	40000
67-66-3	Chloroform	--	--	--	300	1300	1300	490
74-87-3	Chloromethane (Methyl chloride)	--	--	--	90	400	400	1000
126-99-8	Chloroprene	0.0033	0.087	0.04	20	88	88	--
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
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	0.091	2.4	1.1	60	260	260	12000
75-34-3	1,1-Dichloroethane (Ethylidene dichloride)	0.63	16	7.5	--	--	--	--
156-60-5	trans-1,2-dichloroethene	--	--	--	--	--	--	790
75-09-2	Dichloromethane (Methylene chloride)	59	620	1200	600	2600	2600	2100
78-87-5	1,2-Dichloropropane (Propylene dichloride)	--	--	--	4	18	18	230
123-91-1	1,4-Dioxane	0.2	5.2	2.4	30	130	130	7200
106-89-8	Epichlorohydrin	0.043	1.1	0.52	3	13	13	1300
100-41-4	Ethyl benzene	0.4	10	4.8	260	1100	1100	22000
107-06-2	Ethylene dichloride (EDC, 1,2-Dichloroethane)	0.038	1	0.46	7	31	31	--
50-00-0	Formaldehyde	0.17	4.3	2	9	40	40	49
87-68-3	Hexachlorobutadiene	0.045	1.2	0.55	--	--	--	--
67-72-1	Hexachloroethane	--	--	--	30	130	130	58000
110-54-3	Hexane	--	--	--	700	3100	3100	--
78-59-1	Isophorone	--	--	--	2000	8800	8800	--
67-63-0	Isopropyl alcohol	--	--	--	200	880	880	3200
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
108-10-1	Methyl isobutyl ketone (MIBK, Hexone)	--	--	--	3000	13000	13000	--
1634-04-4	Methyl tert-butyl ether	3.8	100	46	8000	35000	35000	8000
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
62-75-9	N-Nitrosodimethylamine	0.00013	0.0013	0.0026	--	--	--	--

CAS	Pollutant	Chronic Cancer (ug/m3) Residential	Child	Worker	Chronic Non-Cancer (ug/m3) Residential	Child	Worker	Acute (ug/m3)
87-86-5	Pentachlorophenol	0.2	5.1	2.4	--	--	--	--
108-95-2	Phenol	--	--	--	200	880	880	5800
C401	Polycyclic aromatic hydrocarbons (PAHs)	0.000043	0.0016	0.003	--	--	--	--
50-32-8	Benzo[a]pyrene	0.000043	0.0016	0.003	0.002	0.0088	0.0088	0.002
115-07-1	Propylene	--	--	--	3000	13000	13000	--
75-56-9	Propylene oxide	0.27	7	3.2	30	130	130	3100
7782-49-2	Selenium and compounds	--	--	--	--	--	--	2
100-42-5	Styrene	--	--	--	1000	4400	4400	21000
127-18-4	Tetrachloroethene (Perchloroethylene)	3.8	100	46	41	180	180	41
108-88-3	Toluene	--	--	--	5000	22000	22000	7500
71-55-6	1,1,1-Trichloroethane (Methyl chloroform)	--	--	--	5000	22000	22000	11000
79-01-6	Trichloroethene (TCE, Trichloroethylene)	0.2	3.5	2.9	2.1	9.2	9.2	2.1
7440-62-2	Vanadium (fume or dust)	--	--	--	0.1	0.44	0.44	0.8
75-01-4	Vinyl chloride	0.11	0.22	2.7	100	440	440	1300
75-35-4	Vinylidene chloride	--	--	--	200	880	880	200
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	--	--	--	220	970	970	8700

Table 4-4: New Facility Risk Action Levels

	Cancer	Non-Cancer
Source Permit Level	0.5	0.5
Community Engagement Level	5	1
TLAER Level	10	1
Permit Denial Level	25	1

As per OAR 340-245-0020(5), emissions from the combustion of natural gas are segregated into a distinct TEUs and the risk at each exposure location from those TEUs are determined separately and not included in the total facility risk. Table 4-5 shows the maximum seven risk values for each natural gas TEU.

Table 4-5: GRM Natural Gas Risk Values

Source	Description	Chronic Cancer Risk			Chronic Non-Cancer Risk			Acute Risk
		Residential	Non-Residential		Residential	Non-Residential		
			Child	Worker		Child	Worker	
NG-BOIL	Natural Gas Combustion - Boiler	0.0474	0.0008	0.2995	0.0013	0.0000	0.0253	0.0644
NG-HEAT	Natural Gas Combustion - Heater	0.0170	0.0003	0.0116	0.0005	0.0000	0.0010	0.0057
Recp by Recp Max >		**0.064**	**0.001**	**0.31**0	**0.002**	**0.000**	**0.026**	**0.069**

Table 4-6 shows the maximum seven risk values for the facility. The GRM risk is below the Community Engagement Level for all risk values. The worker chronic non-cancer risk is over the source permit level so the target organ analysis was applied for this risk. The results are shown in Table 4-7. The majority of the risk (0.56 out of 0.58) is from one compound (Aniline) which targets the immune system. The next highest risk (0.03 out of 0.58) impacts the respiratory system.

Figure 4-4 shows the receptors which have a cancer risk at or above 0.5-in-a-million risk or a hazard index of 0.5 or above.

Table 4-6: GRM Facility Risk Values

TEU	Description	Chronic Cancer Risk			Chronic Non-Cancer Risk			Acute
		Residential	Non-Residential		Residential	Non-Residential		Risk
			Child	Worker		Child	Worker	
EXT-1-EPDM	Rubber Extruder #1 - EPDM	0.0276	0.0004	0.1387	0.0007	0.0001	0.0106	0.0441
EXT-1-NEO	Rubber Extruder #1 - NEO	0.0008	0.0000	0.0040	0.0001	0.0000	0.0007	0.0034
EXT-1-SBR	Rubber Extruder #1 - SBR	0.0001	0.0000	0.0005	0.0000	0.0000	0.0001	0.0064
EXT-1-NBR	Rubber Extruder #1 - NBR	0.0001	0.0000	0.0004	0.0000	0.0000	0.0001	0.0031
EXT-2-EPDM	Rubber Extruder #2 - EPDM	0.0083	0.0001	0.0416	0.0002	0.0000	0.0032	0.0087
EXT-2-NEO	Rubber Extruder #2 - NEO	0.0004	0.0000	0.0021	0.0000	0.0000	0.0004	0.0010
EXT-2-NAT	Rubber Extruder #2 - NAT	0.0003	0.0000	0.0011	0.0000	0.0000	0.0004	0.0049
EXT-2-SBR	Rubber Extruder #2 - SBR	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0050
EXT-2-NBR	Rubber Extruder #2 - NBR	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0014
MWHO-EPDM-STK1	Microwave Hot Air Oven Curing EPDM-STK1	0.0002	0.0000	0.0010	0.0000	0.0000	0.0005	0.0001
MWHO-EPDM-STK2	Microwave Hot Air Oven Curing EPDM-STK2	0.0008	0.0000	0.0029	0.0002	0.0000	0.0047	0.0005
MWHO-EPDM-STK3	Microwave Hot Air Oven Curing EPDM-STK3	0.0002	0.0000	0.0009	0.0000	0.0000	0.0005	0.0002
MWHO-EPDM-FUG	Microwave Hot Air Oven Curing EPDM-FUG	0.0002	0.0000	0.0005	0.0000	0.0000	0.0006	0.0001
MWHO-NEO-STK1	Microwave Hot Air Oven Curing NEO-STK1	0.0021	0.0000	0.0158	0.0001	0.0000	0.0018	0.0245
MWHO-NEO-STK2	Microwave Hot Air Oven Curing NEO-STK2	0.0025	0.0000	0.0171	0.0006	0.0000	0.0110	0.0813
MWHO-NEO-STK3	Microwave Hot Air Oven Curing NEO-STK3	0.0017	0.0000	0.0135	0.0001	0.0000	0.0015	0.0299
MWHO-NEO-FUG	Microwave Hot Air Oven Curing -NEO-FUG	0.0008	0.0000	0.0042	0.0001	0.0000	0.0014	0.0123
MWHO-SBR-STK1	Microwave Hot Air Oven Curing SBR-STK1	0.0002	0.0000	0.0016	0.0000	0.0000	0.0002	0.0035
MWHO-SBR-STK2	Microwave Hot Air Oven Curing SBR-STK2	0.0005	0.0000	0.0034	0.0002	0.0000	0.0042	0.0536
MWHO-SBR-STK3	Microwave Hot Air Oven Curing SBR-STK3	0.0002	0.0000	0.0015	0.0000	0.0000	0.0002	0.0052
MWHO-SBR-FUG	Microwave Hot Air Oven Curing SBR-FUG	0.0001	0.0000	0.0006	0.0000	0.0000	0.0005	0.0062
MWHO-NBR-STK1	Microwave Hot Air Oven Curing NBR-STK1	0.0002	0.0000	0.0014	0.0000	0.0000	0.0002	0.0220
MWHO-NBR-STK2	Microwave Hot Air Oven Curing NBR-STK2	0.0002	0.0000	0.0016	0.0001	0.0000	0.0010	0.0733
MWHO-NBR-STK3	Microwave Hot Air Oven Curing NBR-STK3	0.0002	0.0000	0.0012	0.0000	0.0000	0.0001	0.0269
MWHO-NBR-FUG	Microwave Hot Air Oven Curing NBR-FUG	0.0001	0.0000	0.0004	0.0000	0.0000	0.0001	0.0111
AUTO-EPDM-STK	Steam Autoclave EPDM-STK	0.0056	0.0001	0.0359	0.0005	0.0000	0.0086	0.0428
AUTO-NAT-STK	Steam Autoclave NAT-STK	0.0014	0.0000	0.0087	0.0001	0.0000	0.0015	0.0067
AUTO-SBR-STK	Steam Autoclave SBR-STK	0.0001	0.0000	0.0006	0.0000	0.0000	0.0001	0.0070
AUTO-NBR-STK	Steam Autoclave NBR-STK	0.0006	0.0000	0.0024	0.0000	0.0000	0.0002	0.0085
AUTO-EPDM-FUG	Steam Autoclave EPDM-FUG	0.0013	0.0000	0.0087	0.0001	0.0000	0.0021	0.0095
AUTO-NAT-FUG	Steam Autoclave NAT-FUG	0.0003	0.0000	0.0021	0.0000	0.0000	0.0004	0.0015
AUTO-SBR-FUG	Steam Autoclave SBR-FUG	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0016
AUTO-NBR-FUG	Steam Autoclave NBR-FUG	0.0001	0.0000	0.0006	0.0000	0.0000	0.0000	0.0019
PRESS-EPDM	Pressing and Splicing - EPDM	0.5348	0.0067	1.5446	0.0706	0.0053	0.5702	0.0104
PRESS-NEO	Pressing and Splicing - NEO	0.0012	0.0000	0.0013	0.0001	0.0000	0.0008	0.0003
PRNT-INK	Ink Printing	0	0	0	0.0000	0.0000	0.0000	0.0006
PRNT-SOL	Printing Solvent Use	0	0	0	0.0000	0.0000	0.0000	0.0062
TOL	Toluene Splicing	0	0	0	0.0001	0.0000	0.0010	0.0655
Recp by Recp Max >		**0.593**	**0.008**	**1.594**	**0.074**	**0.006**	**0.580**	**0.498**
Rounded Risk			**1.6**			**0.6**		**0.5**
	Source Permit Level		**0.5**			**0,5**		**0.5**
	Community Engagement Level		**5**			**1**		**1**

Table 4-7: GRM Worker Target Organ Risk Values

TEU	Description	Worker Chronic Risk		
		No TO applied	Immune System	Respiratory
EXT-1-EPDM	Rubber Extruder #1 - EPDM	0.0106	0.0025	0.0066
EXT-1-NEO	Rubber Extruder #1 - NEO	0.0007	0.0001	0.0005
EXT-1-SBR	Rubber Extruder #1 - SBR	0.0001	0.0001	0.0001
EXT-1-NBR	Rubber Extruder #1 - NBR	0.0001	0.0000	0.0000
EXT-2-EPDM	Rubber Extruder #2 - EPDM	0.0032	0.0008	0.0020
EXT-2-NEO	Rubber Extruder #2 - NEO	0.0004	0.0001	0.0003
EXT-2-NAT	Rubber Extruder #2 - NAT	0.0004	0.0001	0.0002
EXT-2-SBR	Rubber Extruder #2 - SBR	0.0000	0.0000	0.0000
EXT-2-NBR	Rubber Extruder #2 - NBR	0.0000	0.0000	0.0000
MWHO-EPDM-STK1	Microwave Hot Air Oven Curing EPDM-STK1	0.0005	0.0001	0.0000
MWHO-EPDM-STK2	Microwave Hot Air Oven Curing EPDM-STK2	0.0047	0.0004	0.0021
MWHO-EPDM-STK3	Microwave Hot Air Oven Curing EPDM-STK3	0.0005	0.0001	0.0000
MWHO-EPDM-FUG	Microwave Hot Air Oven Curing EPDM-FUG	0.0006	0.0001	0.0002
MWHO-NEO-STK1	Microwave Hot Air Oven Curing NEO-STK1	0.0018	0.0000	0.0001
MWHO-NEO-STK2	Microwave Hot Air Oven Curing NEO-STK2	0.0110	0.0001	0.0096
MWHO-NEO-STK3	Microwave Hot Air Oven Curing NEO-STK3	0.0015	0.0000	0.0001
MWHO-NEO-FUG	Microwave Hot Air Oven Curing -NEO-FUG	0.0014	0.0000	0.0010
MWHO-SBR-STK1	Microwave Hot Air Oven Curing SBR-STK1	0.0002	0.0000	0.0000
MWHO-SBR-STK2	Microwave Hot Air Oven Curing SBR-STK2	0.0042	0.0001	0.0039
MWHO-SBR-STK3	Microwave Hot Air Oven Curing SBR-STK3	0.0002	0.0000	0.0000
MWHO-SBR-FUG	Microwave Hot Air Oven Curing SBR-FUG	0.0005	0.0000	0.0004
MWHO-NBR-STK1	Microwave Hot Air Oven Curing NBR-STK1	0.0002	0.0000	0.0000
MWHO-NBR-STK2	Microwave Hot Air Oven Curing NBR-STK2	0.0010	0.0000	0.0009
MWHO-NBR-STK3	Microwave Hot Air Oven Curing NBR-STK3	0.0001	0.0000	0.0000
MWHO-NBR-FUG	Microwave Hot Air Oven Curing NBR-FUG	0.0001	0.0000	0.0001
AUTO-EPDM-STK	Steam Autoclave EPDM-STK	0.0086	0	0.0003
AUTO-NAT-STK	Steam Autoclave NAT-STK	0.0015	0.0007	0.0000
AUTO-SBR-STK	Steam Autoclave SBR-STK	0.0001	0.0001	0.0000
AUTO-NBR-STK	Steam Autoclave NBR-STK	0.0002	0.0001	0.0001
AUTO-EPDM-FUG	Steam Autoclave EPDM-FUG	0.0021	0	0.0001
AUTO-NAT-FUG	Steam Autoclave NAT-FUG	0.0004	0.0002	0.0000
AUTO-SBR-FUG	Steam Autoclave SBR-FUG	0.0000	0.0000	0.0000
AUTO-NBR-FUG	Steam Autoclave NBR-FUG	0.0000	0.0000	0.0000
PRESS-EPDM	Pressing and Splicing - EPDM	0.5702	0.5504	0.0061
PRESS-NEO	Pressing and Splicing - NEO	0.0008	0	0.0000
PRNT-INK	Ink Printing	0.0000	0	0
PRNT-SOL	Printing Solvent Use	0.0000	0	0
TOL	Toluene Splicing	0.0010	0	0
Recp by Recp Max >		**0.580**	**0.551**	**0.031**

Figure 4-4: Receptors with Risk Values Over 0.5

4.4 Uncertainty Analysis

CAO rules require that a quantitative or qualitative uncertainty evaluation be included in a Level 3 risk assessment.

Only a portion of the total reportable pollutants have RBCs. However, ODEQ has determined that they have captured the most toxic compounds in the current RBC list. Thus, incorporating a new compound into the RBC list would have a small potential to increase risk.

Threshold risk values (TRV's) form the basis for the RBCs. Both the TRV and RBC values consider scientific uncertainty for safety, particularly in sensitive populations. Often the exact level of exposure that causes health effects in people is unknown because: 1) experiments are rarely conducted on people; 2) science experiments can only reflect the doses tested; and 3) different people have different sensitivities to the same dose. The greater the scientific uncertainty in determining potential harm, the more scientists add safety buffers to the TRV and RBC values.

Another source of uncertainty is in the emission calculations. Sources can rely on existing literature (e.g., AP-42), mass balances approaches, or another source's testing for characterizing emissions from a process. In some cases, the existing data is dated, often based on older and less efficient equipment or controls. Often, conservative assumptions are used.

AERMOD is designed to predict the overall maximum impact within a domain. However, it is well documented that the model often cannot accurately predict the actual concentration at a specific location. Localized variations in winds, the influences of trees and terrain can influence when and where the worst-case impact may occur around a facility. For example, the downwash algorithm in AERMOD is a simplification of reality, treating all buildings as rectangular boxes. Wind tunnel studies have documented that for long buildings, modeled downwash is greatly overestimated downwind of the site. Downwash is also not well characterized when the winds are approaching a building from a diagonal direction (e.g. toward a corner). Thus, AERMOD has to potential to underpredict or overpredict at a particular location.

A chronic exposure location is defined in the CAO rules in terms of residential locations and non-residential locations. For residential locations, the rule indicates that the location is considered residential based on whether "… a person or persons may reasonably be present for most hours of each day over a period of many years" (340-245-0020 (21)(i)). For the chronic non-residential location, the rules state such a location is where "a person or persons may reasonably be present for a few hours several days per week, possibly over a period of several years" (340-245-0020 (21)(ii)). In practice both of these chronic cancer exposure locations assume a continuous exposure duration of 70 consecutive years, which is expected to overestimate chronic cancer exposures and, therefore, risk.

For acute exposures, the CAO regulation requires the use of the maximum 24-hour concentration that the computer model predicts using five years of meteorological data (1,825 days). Thus, the acute risk can be driven by the one "bad" meteorological day, regardless of whether such an impact would actually occur when the public is present or at the same time that the facility is emitting from all of its all TEU's at maximum capacity. Thus, using the 24-hr maximum provides a very conservative risk estimate as it assumes that someone will be present at a time when there is perfect alignment between worst-case meteorological conditions and maximum facility emissions.

4.5 Submittal Information

The L3RA submittal consists of this report and electronic modeling files, which include:

- AERMAP, BPIP, and AERMOD input and output files;
- Downwash files including building heights and locations; and
- AERMET, AERSURFACE input and output files, and associated meteorological data.
- The CAO risk assessment calculation spreadsheet