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

Seneca Sustainable Energy
Eugene, Oregon

Prepared for:
Seneca LLC.

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BRIDGEWATER GROUP, INC.

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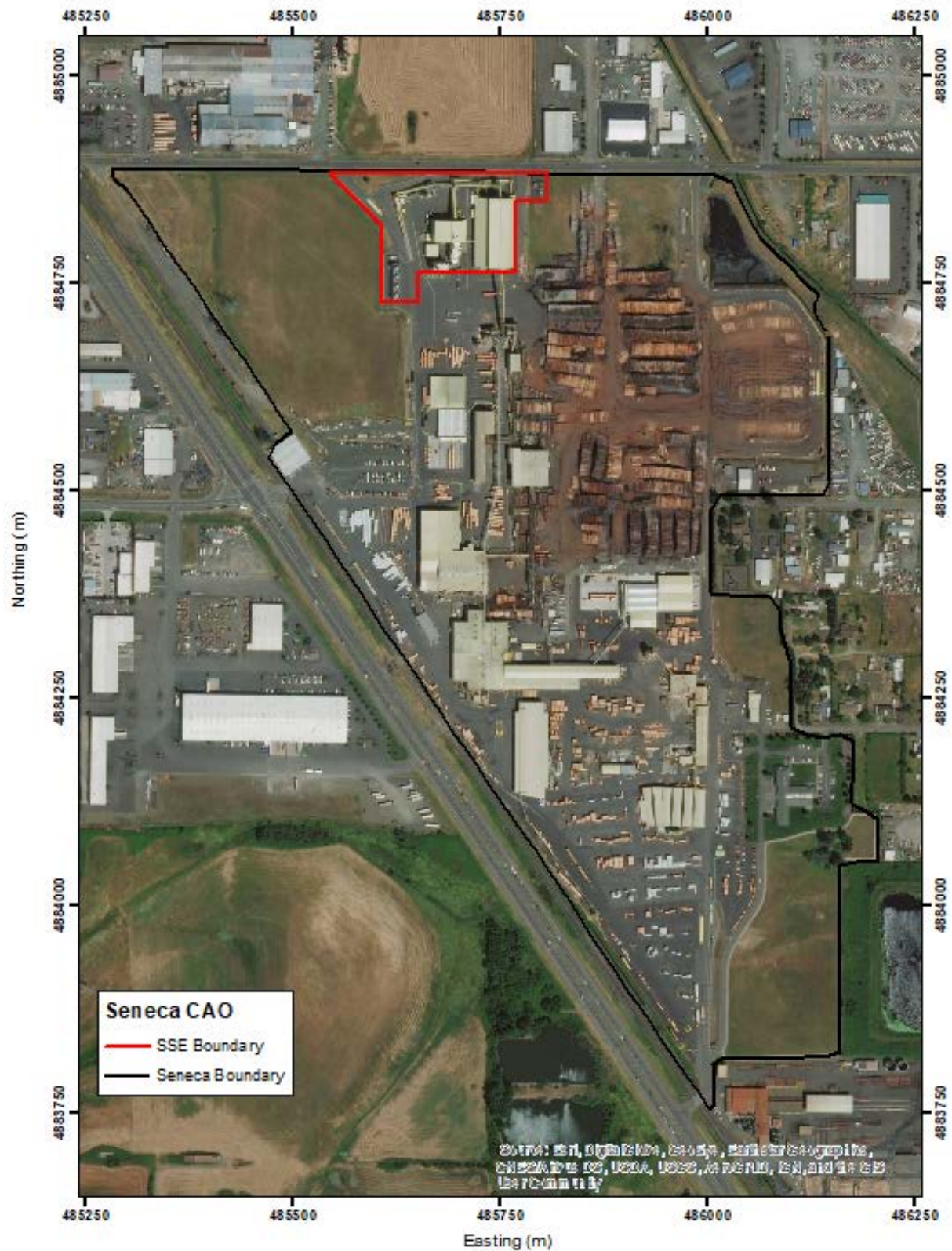
1.0 Introduction

Seneca Sustainable Energy LLC, ("Seneca", "SSE" or "the facility") is a wood-fired electrical cogeneration power plant in Eugene, Oregon with a location of latitude of N 44° 6' 58" and a longitude of W 123° 10' 44" (UTM NAD 1983 zone 10 coordinates of 485668 Easting and 4884771 Northing). The site is located south of East Enid Road and east of Highway 99 as shown in Figure 1. The facility began operations in January 2011.

Seneca is subject to the newly implemented Cleaner Air Oregon (CAO) regulations (OAR 340-245) as an existing source. CAO is a state health risk-based air toxics regulatory program that adds requirements to Lane Regional Air Pollution Agency's (LRAPA) and Oregon Department of Environmental Quality's (ODEQ) existing air permitting framework. For a variety of reasons including scope, detail, public input and technical expertise that went into the creation of the CAO program, LRAPA implemented CAO by reference without any changes.

Seneca was called into the CAO program on December 2, 2019. The facility submitted the emission inventory on February 27, 2020. LRAPA reviewed the emission inventory and requested additional information. The facility submitted revised and/or supplemental information on March 30, 2020, May 4, 2020, and June 11, 2020. LRAPA approved the emission inventory on June 15, 2020. On July 7, SSE is submitted a combined modeling protocol and risk assessment work plan. LRAPA provided comments on the modeling protocol and a risk assessment work plan on July 21, 2020 and in an e-mail on July 29, 2020. This document is the revised modeling protocol and a risk assessment work plan for the SSE facility.

Figure 1-1: Site Location



2.0 Conceptual Site Model

2.1 Process Overview

The only non-exempt TEU at the SSE facility is a wood-fired electrical cogeneration power plant (cogen plant) referred to in SSE Title V Air Operating Permit as EU-1. The facility also has the following exempt TEUs all of which are exempt because they are categorically insignificant activities¹:

- Evaporative and tail pipe emissions from on-site motor vehicle operation
- Distillate oil, kerosene, and gasoline fuel burning equipment rated at less than or equal to 0.4 million Btu/hr
- Natural gas and propane burning equipment rated at less than or equal to 2.0 million Btu/hr
- Office activities
- Janitorial activities
- Personal care activities
- Grounds-keeping activities including, but not limited to building painting and road and parking lot maintenance
- Instrument calibration
- Maintenance and repair shop
- Air cooling or ventilating equipment not designed to remove air contaminants generated by or released from associated equipment
- Refrigeration systems with less than 50 pounds of charge of ozone depleting substances regulated under Title VI, including pressure tanks used in refrigeration systems but excluding any combustion equipment associated with such systems
- Bench scale laboratory equipment and laboratory equipment used exclusively for chemical and physical analysis, including associated vacuum producing devices but excluding research and development facilities
- Temporary construction activities
- Warehouse activities
- Accidental fires
- Air vents from air compressors
- Continuous emissions monitoring line vents
- Demineralized water tanks
- Instrument air dryers and distribution
- Process raw water filtration systems
- Fire Suppression
- Routine maintenance, repair, and replacement such as anticipated activities most often associated with and performed during regularly scheduled equipment outages to maintain a plant and its equipment in good operating condition, including but not limited to steam cleaning, abrasive use, and woodworking
- Electric motors
- Storage tanks, reservoirs, transfer and lubricating equipment used for ASTM grade distillate or residual fuels, lubricants, and hydraulic fluids

¹ LRAPA has adopted DEQ's Division 245-Cleaner Air Oregon rules. OAR 340-245-0060(3)(a)(A) identifies that a TEU is an exempt TEU if the TEU is listed in the definition of Categorically Insignificant Activity with certain exclusions.

-
- On-site storage tanks not subject to any New Source Performance Standards (NSPS), including underground storage tanks (UST), storing gasoline or diesel used exclusively for fueling of the facility's fleet of vehicles
 - Natural gas, propane, and liquefied petroleum gas (LPG) storage tanks and transfer equipment
 - Storm water settling basins
 - Fire suppression and training
 - Paved roads and paved parking lots within an urban growth boundary, including:

Fugitive Road Dust: This includes emissions from paved road surfaces at the facility. This activity is considered to be a Categorically Insignificant Activity (CIA) per the definition of CIA in LRAPA Title 12, Item RR.

- Hazardous air pollutant emissions of fugitive dust from paved and unpaved roads except for those sources that have processes or activities that contribute to the deposition and entrainment of hazardous air pollutants from surface soils
- Health, safety, and emergency response activities
- Emergency generators and pumps used only during loss of primary equipment or utility service
- Non-contact steam vents and leaks and safety and relief valves for boiler steam distribution systems
- Non-contact steam condensate flash tanks
- Non-contact steam vents on condensate receivers, deaerators and similar equipment
- Boiler blowdown tanks
- Industrial cooling towers that do not use chromium-based water treatment chemicals, including
- Ash piles maintained in a wetted condition and associated handling systems and activities, including
- Oil/water separators in effluent treatment systems

The cogeneration process generates power and thermal energy from a single fuel source: wood biomass. The wood biomass used to fuel the cogeneration facility comes from Seneca Sawmill's bark, sawdust and shavings, as well as forest "logging residuals or slash" from Seneca Jones Timber Company LLC's sustainably managed tree farm, located nearby in Oregon's Coast and Cascade Ranges. The facility is allowed to combust only clean biomass materials in the boiler. The facility is not allowed to combust chemically-treated wood products; including painted or oil stained material, or preservative treated wood, fossil fuel, or sanderdust

2.2 TEU Descriptions

The boiler is a six-cell rotary grate furnace, with a 352.8 MM btu/hr maximum heat rating. The unit is designed to produce 200,000 lb/hr of steam. The boiler is controlled with multiclones, a 4-cell electrostatic precipitator, urea injection selective non-catalytic reduction (SNCR), flue gas recirculation, and low-NOx combustion burners.

Figure 2.1 shows the location of the cogeneration boiler.

(TEU-1 is identified by the yellow arrow)



2.3 Compounds Emitted

Table 2-1 shows the toxics air contaminants (TACs) 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). TACs without RBCs are shown at the bottom of the table. A total of 117 compounds with RBCs were identified in the emissions inventory process.

Table 2-1: Compounds Emitted from the Seneca Cogeneration Boiler

CAS #	Toxic Air Contaminant (TAC)	Type	Adjustment
Compounds with RBC's			
75-07-0	Acetaldehyde	Volatile	
67-64-1	Acetone	Volatile	
107-02-8	Acrolein	Volatile	
7664-41-7	Ammonia	Volatile	
7440-36-0	Antimony	Particulate	
7440-38-2	Arsenic	Particulate	MP
71-43-2	Benzene	Volatile	
7440-41-7	Beryllium	Particulate	
117-81-7	Di(2-ethylhexyl) phthalate	Volatile	MP
74-83-9	Bromomethane	Volatile	
78-93-3	Methyl Ethyl Ketone	Volatile	
7440-43-9	Cadmium Compounds	Particulate	MP
75-15-0	Carbon Disulfide	Volatile	
56-23-5	Carbon Tetrachloride	Volatile	
7782-50-5	Chlorine	Volatile	
108-90-7	Chlorobenzene	Volatile	
67-66-3	Chloroform	Volatile	
74-87-3	Methyl Chloride	Volatile	
18540-29-9	Chromium (VI)	Particulate	EP,MP
7440-48-4	Cobalt Compounds	Particulate	
7440-50-8	Copper Compounds	Particulate	
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	Volatile	
156-60-5	1,2-Dichloroethene	Volatile	
75-09-2	Methylene Chloride	Volatile	EP
78-87-5	1,2-Dichloropropane (Propylene dichloride)	Volatile	
121-14-2	2,4-Dinitrotoluene	Volatile	
100-41-4	Ethyl Benzene	Volatile	
107-06-2	Ethylene dichloride (EDC, 1,2-Dichloroethane)	Volatile	
50-00-0	Formaldehyde	Volatile	
118-74-1	Hexachlorobenzene	Volatile	
110-54-3	n-Hexane	Volatile	
7647-01-0	Hydrochloric Acid	Volatile	
7664-39-3	Hydrogen Fluoride	Volatile	MP
67-63-0	Isopropyl Alcohol	Volatile	
98-82-8	Cumene	Volatile	
7439-92-1	Lead	Particulate	MP
7439-96-5	Manganese Compounds	Particulate	

CAS #	Toxic Air Contaminant (TAC)	Type	Adjustment
7439-97-6	Mercury	Particulate	MP
67-56-1	Methanol	Volatile	
108-10-1	Methyl Isobutyl Ketone	Volatile	
91-20-3	Naphthalene	Volatile	MP
365	Nickel	Particulate	
87-86-5	Pentachlorophenol	Volatile	
108-95-2	Phenol	Volatile	
1336-36-3	Total PCBs	Volatile	MP
1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	Volatile	
40321-76-4	1,2,3,7,8-pentachlorodibenzo-p-dioxin	Volatile	
39227-28-6	1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	Volatile	
57653-85-7	1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	Volatile	
19408-74-3	1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	Volatile	
35822-46-9	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	Volatile	
3268-87-9	1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin	Volatile	
51207-31-9	2,3,7,8-tetrachlorodibenzofuran	Volatile	
57117-41-6	1,2,3,7,8-pentachlorodibenzofuran	Volatile	
57117-31-4	2,3,4,7,8-pentachlorodibenzofuran	Volatile	
70648-26-9	1,2,3,4,7,8-hexachlorodibenzofuran	Volatile	
57117-44-9	1,2,3,6,7,8-hexachlorodibenzofuran	Volatile	
72918-21-9	1,2,3,7,8,9-hexachlorodibenzofuran	Volatile	
60851-34-5	2,3,4,6,7,8-hexachlorodibenzofuran	Volatile	
67562-39-4	1,2,3,4,6,7,8-heptachlorodibenzofuran	Volatile	
55673-89-7	1,2,3,4,7,8,9-heptachlorodibenzofuran	Volatile	
39001-02-0	1,2,3,4,6,7,8,9-octachlorodibenzofuran	Volatile	
56-55-3	Benzo(a) anthracene	Volatile	
50-32-8	Benzo(a) pyrene	Volatile	EP,MP
205-99-2	Benzo(b) fluoranthene	Volatile	
191-24-2	Benzo(g,h,i)perylene	Volatile	
207-08-9	Benzo(k)fluoranthene	Volatile	
218-01-9	Chrysene	Volatile	
53-70-3	Dibenzo(a,h) anthracene	Volatile	
206-44-0	Fluoranthene	Volatile	
193-39-5	Indeno (1,2,3-c,d) pyrene	Volatile	
123-38-6	Propionaldehyde	Volatile	
7782-49-2	Selenium	Particulate	
100-42-5	Styrene	Volatile	
127-18-4	Perchloroethylene	Volatile	
108-88-3	Toluene	Volatile	
71-55-6	Methyl Chloroform	Volatile	
79-01-6	Trichloro ethylene	Volatile	EP
88-06-2	2,4,6-Trichloro phenol	Volatile	
7440-62-2	Vanadium (fume or dust)	Particulate	
75-01-4	Vinyl Chloride	Volatile	EP
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	Volatile	
Compounds without RBC's			
83-32-9	Acenaphthene	Volatile	
208-96-8	Acenaphthylene	Volatile	
98-86-2	Acetophenone	Volatile	

CAS #	Toxic Air Contaminant (TAC)	Type	Adjustment
120-12-7	Anthracene	Volatile	
192-97-2	Benzo(e) pyrene	Volatile	
7440-39-3	Barium and Compounds	Particulate	
85-68-7	Butyl Benzyl Phthalate	Volatile	
95-57-8	2-Chlorophenol	Volatile	
4170-30-3	Crotonaldehyde	Volatile	
84-74-2	Dibutyl phthalate	Volatile	
84-66-2	Diethylphthalate	Volatile	
534-52-1	4,6-Dinitro-o-cresol (and salts)	Volatile	
51-28-5	2,4-Dinitrophenol	Volatile	
86-73-7	Fluorene	Volatile	
1313-27-5	Molybdenum Trioxide	Volatile	
91-57-6	2-Methyl Naphthalene	Volatile	
100-02-7	4-Nitrophenol	Volatile	
	PCB (decachlorobiphenyl)	Volatile	
	PCB (dichlorobiphenyl)	Volatile	
	PCB (hexachlorobiphenyl)	Volatile	
	PCB (pentachlorobiphenyl)	Volatile	
	PCB (tetrachlorobiphenyl)	Volatile	
	PCB (trichlorobiphenyl)	Volatile	
198-55-0	Perylene	Volatile	
85-01-8	Phenanthrene	Volatile	
129-00-0	Pyrene	Volatile	
57-97-6	7,12-dimethylbenzo(a)anthracene	Volatile	
56-49-5	3-methylchloanthrene	Volatile	
7723-14-0	Phosphorus and compounds	Particulate	
7440-22-4	Silver and compounds	Particulate	
7440-28-0	Thallium and compounds	Particulate	
75-69-4	Trichloro fluoromethane	Volatile	
108-38-3	m-Xylene	Volatile	
95-47-6	o-Xylene	Volatile	
7440-66-6	Zinc	Particulate	

MP = Multipathway Pollutant; EL = Early life adjustment compound

2.4 Exposure Locations

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 Library². 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. A crosswalk between the categories and the bins is shown in Table 2-2. A receptor crosswalk text file is provided on the electronic media submitted with this document. 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, unless it is demonstrated that they represent a location where people do not normally congregate. Roadway receptors will be excluded.

The zoning dataset does not identify schools or daycares. For schools, a statewide GIS layer³ was used to identify the location of schools within 10 kilometers of the facility. For daycares, a manual search (e.g., using a search engine and Google Earth) was done to identify locations. Next, the zoning dataset also does not identify residences located in farmland or forested areas. For these residences, a building footprint layer⁴ from the City of Eugene was used, as it identifies whether a building is a residence or not. Beyond the extent of this layer (e.g. to the north of Seneca), a manual identification was done so that most residences within 5 kilometers of the facility were identified.

Figure 2-2 shows the zoning around the facility. The facility is located in an area zoned for industrial/commercial use. The closest residential receptor is to the east of SSE, near the property line. Irving Elementary School is the closest school at about 2 km east of the facility.

² <https://spatialdata.oregonexplorer.info/geoportal/details?id=49bfb86d4e594a3c8fa8d968aaaa45e9>

³ <https://spatialdata.oregonexplorer.info/geoportal/details?id=1270fe6e833f4d0eabacc71300069738>

⁴ <https://mapping.eugene-or.gov/datasets/eugene-buildings-hub?selectedAttribute=EntryAgenc>

Each land use area is labeled by “CAO code (LU code)”.



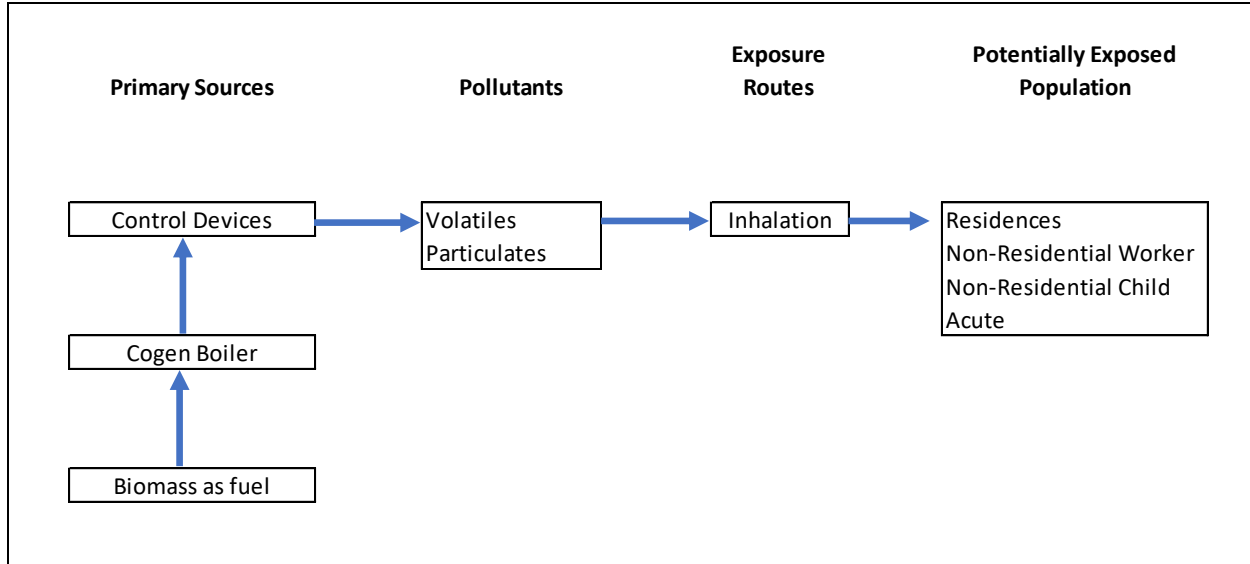
Table 2-2. Land Use Crosswalk

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	Openspace
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	IndustCom	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			

2.5 Conceptual Site Model Diagram

Figure 2-3 shows the conceptual site model for the CAO process. Only the inhalation pathway is considered in this evaluation.

Figure 2-3: CAO Conceptual Site Model



3.0 Level-3 Modeling Protocol

This section is a Level-3 modeling protocol and is intended to outline the assumptions and methodologies that will be used in an air quality analysis for calculating 24-hour and annual risk values for the cogeneration boiler for use in the Risk Assessment Work Plan (Section 4). LRAPA has requested that the start-up condition also be evaluated. This condition only applies to the 24-hour acute risk. Thus, two sets of parameters are provided.

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

3.1 Source Characterization

Table 3-1 shows the steady state and start-up source parameters for the boiler.

Table 3-1: Stack Parameters

Parameter	Boiler (steady state)	Boiler (startup)
X-Coordinate (m)	485668.6	485668.6
Y-Coordinate (m)	4884770.9	4884770.9
Base Elevation (m)	114.5	114.5
Height (ft)	98.0	98.0
Height (m)	29.87	29.87
Temp (°F)	369.7	229.9
Temp (K)	460.8	383.1
Diameter (ft)	9.0	9.0
Diameter (m)	2.74	2.74
Flow Rate (ACFM)	144171	81670
Velocity (m/s)	11.51	6.52

The steady state boiler stack parameters are based on an average of the last three stack tests (2017, 2018, and 2019). Boiler startups at Seneca typically occur 2-3 times per year. During startup, the boiler is heated gradually to avoid thermal stresses that could physically damage the boiler. The entire startup period may last up to 24 hours. During the first part of the startup period, the ESPs are not energized. Fuel is gradually added and once a proper temperature (250°F) is achieved, the ESPs are energized, reducing particulate matter emissions. Then, over the remainder day, the fuel loading is increased until steady state conditions are reached.

For the start-up conditions, a worst-case daily average temperature (T_s) and flow (V_s) will be estimated from the average conditions before and after the ESPs were started, and are given by:

$$T_s(F) = \left[\frac{0.5 (T_e + T_o) t}{24} + \frac{0.5 (T_{ss} + T_e)(24 - t)}{24} \right]$$

$$V_s(ACFM) = \left[\frac{0.5 (V_e + V_o) t}{24} + \frac{0.5 (V_{ss} + V_e)(24 - t)}{24} \right]$$

where t is the number of hours before the ESPs are started, T_o and V_o are the initial temperature (50°F) and flow when start-up commences, T_e and V_e are the temperature (250°F) and flow (67,297 acfm at 20% moisture) when the ESPs are started, and T_{ss} and V_{ss} are the steady state temperature and flow (369.7°F and 144,171 acfm). V_o is assumed to be one third of the steady state flow. From the historical data, the maximum time before the ESPs are started is 9.5 hours. However, to be conservative, t will be assumed to be 12 hours.

3.2 Model Selection

For this analysis, the most recent version (19191) of the AERMOD (AMS [American Meteorological Society]/EPA [Environmental Protection Agency] Regulatory Model) will be used to estimate the unit concentrations resulting from the cogeneration boiler stack. Building downwash will be incorporated into the model runs. The most recent version of the Building Profile Input Program (BPIP) with PRIME (BPIP-PRM, version 04274) will be used to calculate building downwash parameters for input to AERMOD.

Figure 3.1 shows the buildings around the SSE area along with their heights. The building information is used to calculate the building downwash parameters for the stack.

3.3 Meteorological Data

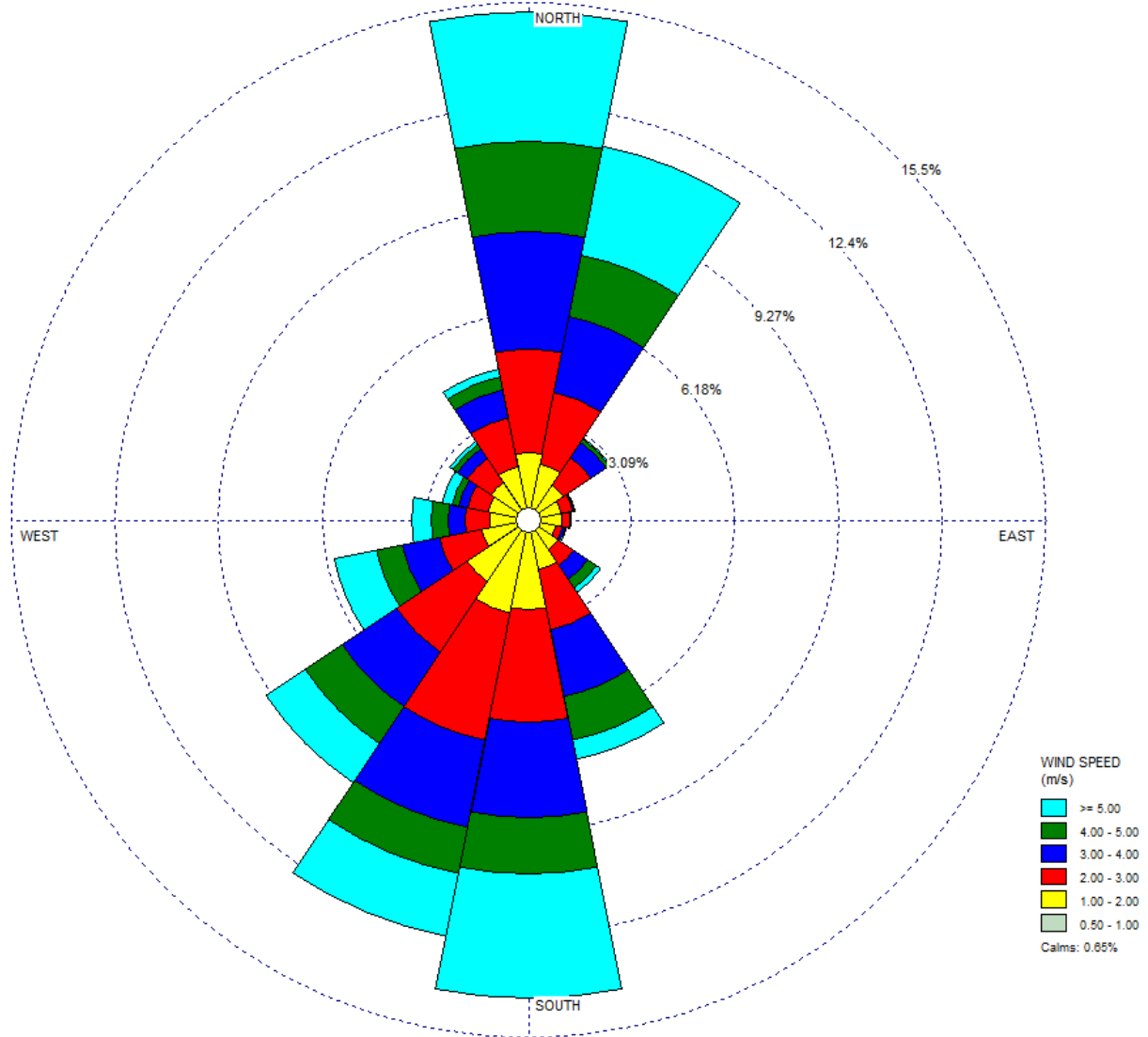
Five years (2015-2019) of AERMOD-ready hourly meteorological data were provided by LRAPA. These data are from the National Weather Service (NWS) station at the Eugene airport (WBAN 24221). The station is located about 3 kilometers west of the project site. Since there is no significant nearby terrain differences between the station and SSE, the Eugene Airport data is representative to model maximum impacts from the proposed SSE facility. Upper air data from Salem Airport (WBAN 24232) were used by LRAPA. A five-year wind rose is shown in Figure 3-2. LRAPA processed the dataset to include the Adjust U^* option.

Figure 3-1: Building IDs and Heights



Figure 3-2: Eugene Airport Wind Rose (2015-2019)

Station #24221 - EUGENE/MAHLON SWEET ARPT, OR Dates: 1/1/2015 - 00:00 ... 12/31/2019 - 23:59



3.4 Receptor Grid

Under the Cleaner Air Oregon Rules, OAR 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 years.” Likewise, OAR 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. When the property line is adjacent to a roadway, railroad track, or an easement under power poles, the CAO boundary is expanded to exclude these areas from the evaluation, as these areas are not where the public would normally congregate. Thus, the receptor boundary for the CAO assessment will be expanded to exclude these areas, as shown below in Figure 3-3.

Receptor elevations for AERMOD will be determined using the AERMAP pre-processor (version 18081). 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 will be run to generate the receptor elevations using the NED data.

The following receptor grid spacing will be 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.

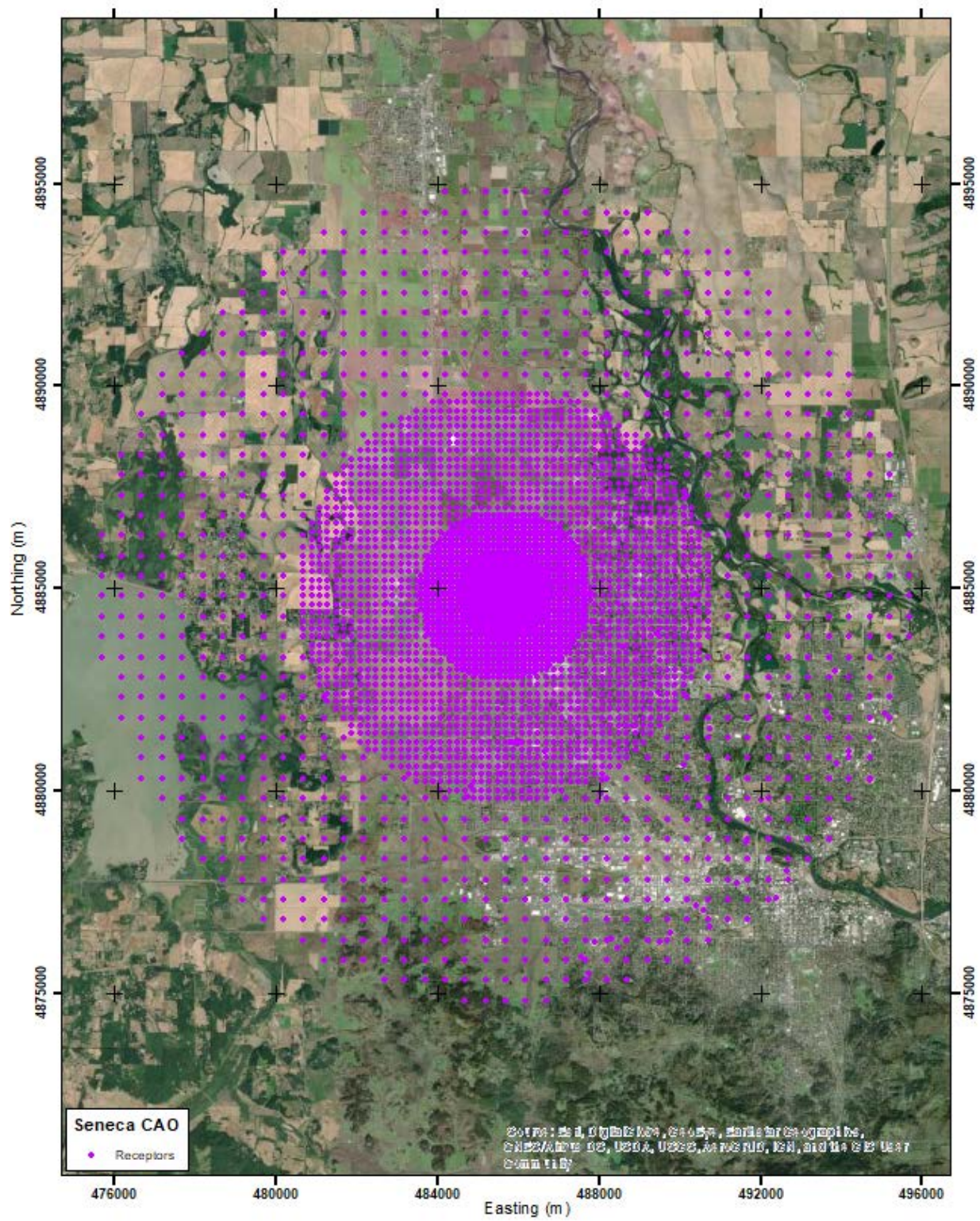
3.5 Model Execution

AERMOD will be run to model each generator separately using a 1 g/s unit emission. Thus, the outputs will be plot files of the maximum 24-hour concentrations and the 5-year average annual concentrations at each receptor for each generator. These plot files then be used in the risk assessment for the risk calculations as described below.

Figure 3-3: CAO Boundary and Near Field Receptors



Figure 3-4: Far Field Receptor Grid

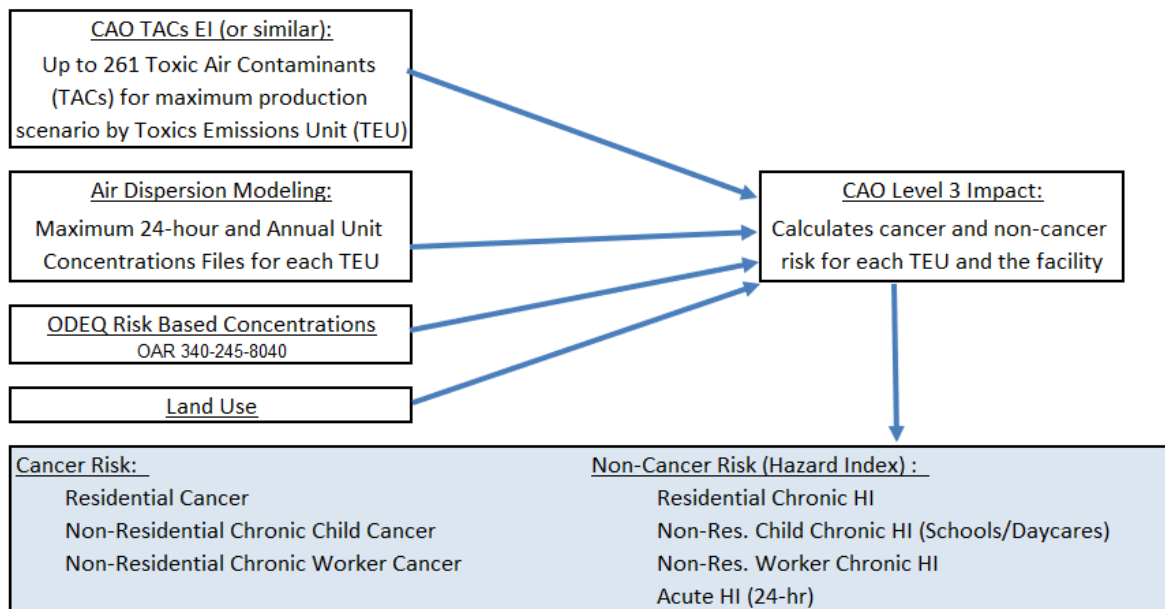


4.0 Risk Assessment Work Plan

4.1 Methodology

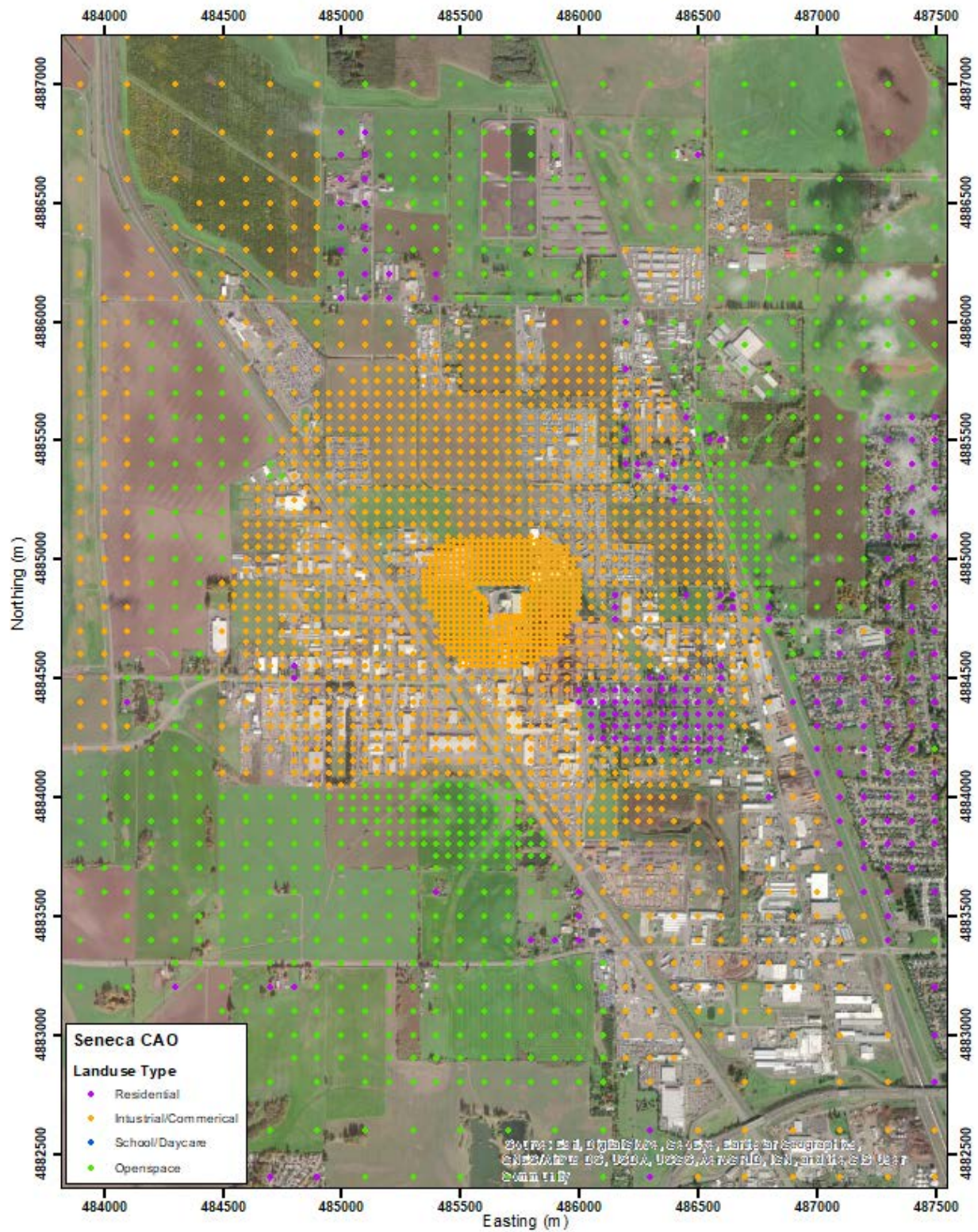
Figure 4-1 shows the Level-3 Risk Assessment process. Using the CAO toxic air pollutant emissions inventory (e.g., AQ405CAO), the 24-hr and annual average concentration files from AERMOD runs, the Risk Based Concentrations, and the land use designations at each receptor, the chronic cancer, chronic non-cancer and acute hazard index risk will be 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.

Figure 4-2: Receptor Exposure Classes



The chronic RBCs to be used at a receptor are a function of the land use at that receptor based on whether it is residential, worker (industrial commercial), or child (schools/daycares). The RBCs are shown in Table 4-1 for each applicable compound. Calculated risk is inversely proportional to the RBC.

The Cleaner Air Oregon rule states that Risk-Based Concentrations (RBCs) listed in OAR 340-245-8040 Table 4 should be used for the risk calculations. LRAPA requested that the acute Antimony RBC of 1 be added to the analysis. However, DEQ still needs to complete the rulemaking to update the table before this RBC can technically be applied. Since this change will likely occur in the next table revision, SSE will add the acute Antimony RBC to the analysis to avoid having to redo the analysis at a later date.

Table 4-1: Compound RBCs (OAR 340-245-8040 Table 4)

CAS#	Compound	Chronic Cancer RBC			Chronic Non-Cancer			Acute
		Res. µg/m ³	Worker µg/m ³	Child µg/m ³	Res. µg/m ³	Worker µg/m ³	Child µg/m ³	
75-07-0	Acetaldehyde	0.45	5.5	12	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	--	--	--	0.3	1.3	1.3	1
7440-38-2	Arsenic	0.000024	0.00062	0.0013	0.00017	0.0024	0.0024	0.2
71-43-2	Benzene	0.13	1.5	3.3	3	13	13	29
7440-41-7	Beryllium	0.00042	0.005	0.011	0.007	0.031	0.031	0.02
117-81-7	Di(2-ethylhexyl) phthalate	0.08	5	11	--	--	--	--
74-83-9	Bromomethane	--	--	--	5	22	22	3900
78-93-3	Methyl Ethyl Ketone	--	--	--	5000	22000	22000	5000
7440-43-9	Cadmium Compounds	0.00056	0.0067	0.014	0.005	0.037	0.037	0.03
75-15-0	Carbon Disulfide	--	--	--	800	3500	3500	6200
56-23-5	Carbon Tetrachloride	0.17	2	4.3	100	440	440	1900
7782-50-5	Chlorine	--	--	--	0.15	0.66	0.66	170
108-90-7	Chlorobenzene	--	--	--	50	220	220	--
67-66-3	Chloroform	--	--	--	300	1300	1300	490
74-87-3	Methyl Chloride	--	--	--	90	400	400	1000
18540-29-9	Chromium (VI)	0.000031	0.001	0.00052	0.083	0.88	0.88	0.3
7440-48-4	Cobalt Compounds	--	--	--	0.1	0.44	0.44	--
7440-50-8	Copper Compounds	--	--	--	--	--	--	100
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	0.091	1.1	2.4	60	260	260	12000
156-60-5	1,2-Dichloroethene	--	--	--	--	--	--	790
75-09-2	Methylene Chloride	59	1200	620	600	2600	2600	2100
78-87-5	1,2-Dichloropropane (Propylene dichloride)	--	--	--	4	18	18	230

CAS#	Compound	Chronic Cancer RBC			Chronic Non-Cancer			Acute
		Res. µg/m ³	Worker µg/m ³	Child µg/m ³	Res. µg/m ³	Worker µg/m ³	Child µg/m ³	
121-14-2	2,4-Dinitrotoluene	0.011	0.13	0.29	--	--	--	--
100-41-4	Ethyl Benzene	0.4	4.8	10	260	1100	1100	22000
107-06-2	Ethylene dichloride (EDC, 1,2-Dichloroethane)	0.038	0.46	1	7	31	31	--
50-00-0	Formaldehyde	0.17	2	4.3	9	40	40	49
118-74-1	Hexachlorobenzene	0.002	0.024	0.051	--	--	--	--
110-54-3	n-Hexane	--	--	--	700	3100	3100	--
7647-01-0	Hydrochloric Acid	--	--	--	20	88	88	2100
7664-39-3	Hydrogen Fluoride	--	--	--	2.1	19	19	16
67-63-0	Isopropyl Alcohol	--	--	--	200	880	880	3200
98-82-8	Cumene	--	--	--	400	1800	1800	--
7439-92-1	Lead	--	--	--	0.15	0.66	0.66	0.15
7439-96-5	Manganese Compounds	--	--	--	0.09	0.4	0.4	0.3
7439-97-6	Mercury	--	--	--	0.077	0.63	0.63	0.6
67-56-1	Methanol	--	--	--	4000	18000	18000	28000
108-10-1	Methyl Isobutyl Ketone	--	--	--	3000	13000	13000	--
91-20-3	Naphthalene	0.029	0.35	0.76	3.7	16	16	200
365	Nickel	0.0038	0.046	0.1	0.014	0.062	0.062	0.2
87-86-5	Pentachlorophenol	0.2	2.4	5.1	--	--	--	--
108-95-2	Phenol	--	--	--	200	880	880	5800
1336-36-3	Total PCBs	0.00053	0.0092	0.02	--	--	--	--
1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	1E-09	4.2E-08	9E-08	1.3E-07	0.000026	0.000026	--
40321-76-4	1,2,3,7,8-pentachlorodibenzo-p-dioxin	1E-09	4.2E-08	9E-08	1.3E-07	0.000026	0.000026	--
39227-28-6	1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
57653-85-7	1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
19408-74-3	1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
35822-46-9	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	1E-07	4.2E-06	0.000009	0.000013	0.0026	0.0026	--
3268-87-9	1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin	3.4E-06	0.00014	0.0003	0.00042	0.085	0.085	--
51207-31-9	2,3,7,8-tetrachlorodibenzofuran	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
57117-41-6	1,2,3,7,8-pentachlorodibenzofuran	3.4E-08	1.4E-06	0.000003	4.2E-06	0.00085	0.00085	--
57117-31-4	2,3,4,7,8-pentachlorodibenzofuran	3.4E-09	1.4E-07	3E-07	4.2E-07	0.000085	0.000085	--
70648-26-9	1,2,3,4,7,8-hexachlorodibenzofuran	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
57117-44-9	1,2,3,6,7,8-hexachlorodibenzofuran	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
72918-21-9	1,2,3,7,8,9-hexachlorodibenzofuran	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--
60851-34-5	2,3,4,6,7,8-hexachlorodibenzofuran	1E-08	4.2E-07	9E-07	1.3E-06	0.00026	0.00026	--

CAS#	Compound	Chronic Cancer RBC			Chronic Non-Cancer			Acute µg/m ³
		Res. µg/m ³	Worker µg/m ³	Child µg/m ³	Res. µg/m ³	Worker µg/m ³	Child µg/m ³	
67562-39-4	1,2,3,4,6,7,8-heptachlorodibenzofuran	1E-07	4.2E-06	0.000009	0.000013	0.0026	0.0026	--
55673-89-7	1,2,3,4,7,8,9-heptachlorodibenzofuran	1E-07	4.2E-06	0.000009	0.000013	0.0026	0.0026	--
39001-02-0	1,2,3,4,6,7,8,9-octachlorodibenzofuran	3.4E-06	0.00014	0.0003	0.00042	0.085	0.085	--
56-55-3	Benzo(a) anthracene	0.00021	0.015	0.0078	--	--	--	--
50-32-8	Benzo(a) pyrene	0.000043	0.003	0.0016	0.002	0.0088	0.0088	0.002
205-99-2	Benzo(b) fluoranthene	0.000053	0.0038	0.002	--	--	--	--
191-24-2	Benzo(g,h,i)perylene	0.0047	0.34	0.17	--	--	--	--
207-08-9	Benzo(k)fluoranthene	0.0014	0.1	0.052	--	--	--	--
218-01-9	Chrysene	0.00043	0.03	0.016	--	--	--	--
53-70-3	Dibenzo(a,h) anthracene	4.3E-06	0.0003	0.00016	--	--	--	--
206-44-0	Fluoranthene	0.00053	0.038	0.02	--	--	--	--
193-39-5	Indeno (1,2,3-c,d) pyrene	0.00061	0.043	0.022	--	--	--	--
123-38-6	Propionaldehyde	--	--	--	8	35	35	--
7782-49-2	Selenium	--	--	--	--	--	--	2
100-42-5	Styrene	--	--	--	1000	4400	4400	21000
127-18-4	Perchloroethylene	3.8	46	100	41	180	180	41
108-88-3	Toluene	--	--	--	5000	22000	22000	7500
71-55-6	Methyl Chloroform	--	--	--	5000	22000	22000	11000
79-01-6	Trichloro ethylene	0.2	2.9	3.5	2.1	9.2	9.2	2.1
88-06-2	2,4,6-Trichloro phenol	0.05	0.6	1.3	--	--	--	--
7440-62-2	Vanadium (fume or dust)	--	--	--	0.1	0.44	0.44	0.8
75-01-4	Vinyl Chloride	0.11	2.7	0.22	100	440	440	1300
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	--	--	--	220	970	970	8700

The steady state and start-up emission factors are shown in Table 4-2.

Table 4-2: Cogeneration Boiler Emissions

CAS	Pollutant	Metal	Steady State Emissions (lb/yr)	Steady State Emissions (lb/day)	Start-up Emissions (lb/day)
75-07-0	Acetaldehyde	-	1.01E+03	2.77E+00	1.03E+00
67-64-1	Acetone	-	3.68E+03	1.01E+01	3.73E+00
107-02-8	Acrolein	-	3.23E+02	8.86E-01	3.28E-01
7664-41-7	Ammonia	-	2.14E+04	5.85E+01	2.17E+01
7440-36-0	Antimony and compounds	Yes	9.33E-01	2.56E-03	2.38E-03
7440-38-2	Arsenic and compounds	Yes	5.81E+00	1.59E-02	8.60E-03
71-43-2	Benzene	-	3.03E+03	8.30E+00	3.07E+00
7440-41-7	Beryllium and compounds	Yes	9.30E-02	2.55E-04	1.47E-04
117-81-7	Bis(2-ethylhexyl) phthalate (DEHP)	-	1.44E-01	3.94E-04	1.46E-04
74-83-9	Bromomethane (Methyl bromide)	-	3.51E+01	9.61E-02	3.56E-02
78-93-3	2-Butanone (Methyl ethyl ketone)	-	4.82E+01	1.32E-01	4.89E-02
7440-43-9	Cadmium and compounds	Yes	1.13E+00	3.10E-03	3.50E-03
75-15-0	Carbon disulfide	-	3.87E+02	1.06E+00	3.92E-01
56-23-5	Carbon tetrachloride	-	6.21E+01	1.70E-01	6.30E-02
7782-50-5	Chlorine	-	2.26E+03	6.20E+00	2.29E+00
108-90-7	Chlorobenzene	-	5.13E+01	1.41E-01	5.20E-02
67-66-3	Chloroform	-	6.21E+01	1.70E-01	6.30E-02
74-87-3	Chloromethane (Methyl chloride)	-	1.17E+02	3.20E-01	1.18E-01
18540-29-9	Chromium VI, chromate and dichromate particulate	Yes	8.41E-01	2.31E-03	4.26E-03
7440-48-4	Cobalt and compounds	Yes	7.27E+00	1.99E-02	7.02E-03
7440-50-8	Copper and compounds	Yes	1.54E+01	4.23E-02	6.96E-02
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	-	8.62E+02	2.36E+00	8.75E-01
156-60-5	trans-1,2-dichloroethene	-	4.23E+03	1.16E+01	4.29E+00
75-09-2	Dichloromethane (Methylene chloride)	-	1.69E+03	4.63E+00	1.71E+00
78-87-5	1,2-Dichloropropane (Propylene dichloride)	-	5.20E+01	1.43E-01	5.28E-02
121-14-2	2,4-Dinitrotoluene	-	2.91E+00	7.98E-03	2.95E-03
100-41-4	Ethyl benzene	-	1.22E+03	3.35E+00	1.24E+00
107-06-2	Ethylene dichloride (EDC, 1,2-Dichloroethane)	-	9.02E+01	2.47E-01	9.15E-02
50-00-0	Formaldehyde	-	3.25E+02	8.90E-01	3.30E-01
118-74-1	Hexachlorobenzene	-	3.18E+00	8.72E-03	3.23E-03
110-54-3	Hexane	-	8.90E+02	2.44E+00	9.03E-01
7647-01-0	Hydrochloric acid	-	2.92E+03	7.99E+00	2.96E+00
7664-39-3	Hydrogen fluoride	-	7.26E+02	1.99E+00	7.37E-01
67-63-0	Isopropyl alcohol	-	1.12E+04	3.08E+01	1.14E+01
98-82-8	Isopropylbenzene (Cumene)	-	5.47E+01	1.50E-01	5.55E-02
7439-92-1	Lead and compounds	Yes	1.61E+01	4.41E-02	2.95E-02
7439-96-5	Manganese and compounds	Yes	2.82E+02	7.73E-01	1.64E+00
7439-97-6	Mercury and compounds	Yes	3.29E+00	9.02E-03	3.68E-03
67-56-1	Methanol	-	2.26E+03	6.20E+00	2.29E+00
108-10-1	Methyl isobutyl ketone (MIBK, Hexone)	-	1.38E+03	3.77E+00	1.40E+00
91-20-3	Naphthalene	-	3.08E+02	8.43E-01	3.12E-01
365	Nickel compounds, insoluble	Yes	8.66E+00	2.37E-02	1.41E-02
87-86-5	Pentachlorophenol	-	7.08E-01	1.94E-03	7.18E-04

CAS	Pollutant	Metal	Steady State Emissions (lb/yr)	Steady State Emissions (lb/day)	Start-up Emissions (lb/day)
108-95-2	Phenol	-	4.94E+02	1.35E+00	5.02E-01
1336-36-3	Polychlorinated biphenyls (PCBs)	-	2.43E-02	6.65E-05	2.46E-05
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	-	2.03E-06	5.55E-09	2.06E-09
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	-	4.45E-06	1.22E-08	4.51E-09
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	-	2.84E-06	7.78E-09	2.88E-09
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	-	6.89E-06	1.89E-08	6.99E-09
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	-	6.89E-06	1.89E-08	6.99E-09
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	-	3.04E-05	8.33E-08	3.08E-08
3268-87-9	Octachlorodibenzo-p-dioxin (OCDD)	-	7.70E-05	2.11E-07	7.81E-08
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran (TcDF)	-	2.56E-05	7.00E-08	2.59E-08
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	-	1.26E-05	3.45E-08	1.28E-08
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	-	1.74E-05	4.78E-08	1.77E-08
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	-	1.13E-05	3.11E-08	1.15E-08
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	-	9.74E-06	2.67E-08	9.88E-09
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	-	2.03E-06	5.55E-09	2.06E-09
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	-	8.10E-06	2.22E-08	8.21E-09
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	-	1.78E-05	4.89E-08	1.81E-08
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	-	2.84E-06	7.78E-09	2.88E-09
39001-02-0	Octachlorodibenzofuran (OCDF)	-	1.58E-05	4.34E-08	1.61E-08
56-55-3	Benz[a]anthracene	-	1.04E-01	2.86E-04	1.06E-04
50-32-8	Benzo[a]pyrene	-	5.77E-02	1.58E-04	5.85E-05
205-99-2	Benzo[b]fluoranthene	-	1.29E-01	3.53E-04	1.31E-04
191-24-2	Benzo[g,h,i]perylene	-	1.57E-01	4.29E-04	1.59E-04
207-08-9	Benzo[k]fluoranthene	-	2.50E-01	6.85E-04	2.54E-04
218-01-9	Chrysene	-	1.79E-01	4.91E-04	1.82E-04
53-70-3	Dibenz[a,h]anthracene	-	3.18E-02	8.71E-05	3.22E-05
206-44-0	Fluoranthene	-	3.85E+00	1.06E-02	3.91E-03
193-39-5	Indeno[1,2,3-cd]pyrene	-	4.54E-02	1.24E-04	4.60E-05
123-38-6	Propionaldehyde	-	7.79E+02	2.13E+00	7.90E-01
7782-49-2	Selenium and compounds	Yes	5.01E+00	1.37E-02	5.91E-03
100-42-5	Styrene	-	1.23E+01	3.36E-02	1.24E-02
127-18-4	Tetrachloroethene (Perchloroethylene)	-	7.61E+01	2.09E-01	7.72E-02
108-88-3	Toluene	-	2.17E+01	5.94E-02	2.20E-02
71-55-6	1,1,1-Trichloroethane (Methyl chloroform)	-	1.79E+02	4.90E-01	1.81E-01
79-01-6	Trichloroethene (TCE, Trichloroethylene)	-	6.14E+01	1.68E-01	6.23E-02
88-06-2	2,4,6-Trichlorophenol	-	8.53E-01	2.34E-03	8.66E-04
7440-62-2	Vanadium (fume or dust)	Yes	1.84E+00	5.03E-03	4.58E-03
75-01-4	Vinyl chloride	-	5.69E+01	1.56E-01	5.77E-02
1330-20-7	Xylene (mixture), including m-xylene, o-xylene, p-xylene	-	1.61E+01	4.42E-02	1.64E-02

The risk ($R_{r,L,m}$) at each receptor r with an exposure class L , and operation mode m (steady state or start-up) is given by:

$$R_{r,L,m} = \chi_r * C * TO_m * \sum_p \frac{E_{p,m}}{RBC_{p,L}}$$

where χ_r is the unit concentration at receptor r , C is a constant to convert g/s to either lbs/day or lbs/year, $E_{p,m}$ is the emissions of pollutant p and mode m (steady state or start-up), $RBC_{p,L}$ is the risk based concentration for pollutant p (Table 4-1) and exposure class type L , and TO_m is the target organ factor (Table 4-3) for mode m (non-cancer only).

For the non-cancer risk, the different pollutants impact different parts of the body so that the non-cancer risk is not additive. To account for this, a target organ fraction is applied. Table 4-3 shows the target organ fractions for each exposure class. Regular operation and start-up emissions have different target organ values as the pollutant mixtures are different for these two cases. The non-cancer risk will be evaluated using the worst-case target organ contribution, however, for informational purposes, the non-cancer risk for organs which have a fraction of 0.3 or more will be reported. An electronic spreadsheet with the target organ calculation is provided with this document.

In the end, each receptor will have three risk numbers: chronic cancer risk, chronic non-cancer risk, and acute risk based on the exposure class. 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 reported. For the risk assessment, the July 22, 2020 target organ tables from DEQ's "Step-by-Step Guide for Facilities" guidance webpage⁵ will be used.

The risks are then compared to the applicable risk action level (Table 4-4) for an existing source. The RAL for the non-cancer risk depends on the pollutant, with either a RAL value of 3 or 5. Only two of the acute risk compounds (Acrolein and Propionaldehyde) have a RAL of 5, while the remaining acute TACs have a RAL of 3. To account for the different RALs, ODEQ has a "Risk Determination Ratio (RDR)" which weights the noncancer risk from a source's emissions relative to both HI benchmarks of 3 and 5. The RDR is given by:

$$RDR = \frac{\sum Risk_{HI=3}}{3} + \frac{\sum Risk_{HI=5}}{5}$$

If the RDR rounds to 1 or less, then a TBACT analysis is not required.

⁵ <https://www.oregon.gov/deq/aq/cao/Pages/CAO-Risk-Assessment-Resources.aspx>

Table 4-3: Target Organ Fractions

Target Organ	Exposure Scenario		Acute	Acute startup
	Chronic Residential	Chronic Child Chronic Worker		
Kidney	0.00	0.00	0.00	0.00
Liver	0.00	0.00	0.00	0.00
Blood	0.02	0.03	0.00	0.00
Endo	0.00	0.00	0.00	0.00
Muscular	0.01	0.01	0.00	0.00
Eyes	0.00	0.00	0.02	0.00
Skin	0.00	0.00	0.00	0.00
Nervous System	0.66	0.43	0.64	0.88
Cardio	0.00	0.00	0.00	0.00
Immune	0.00	0.00	0.09	0.02
Respiratory	0.30	0.51	0.13	0.05
Gastro	0.00	0.00	0.00	0.00
Developmental	0.00	0.01	0.13	0.05
Reproductive	0.00	0.00	0.02	0.00

Table 4-4: Risk Action Levels

Level Description	Cancer	Non-Cancer
Source Permit (De Minimis) Level	5	0.5
Community Engagement Level	25	1
TBACT Level	50	5, 3 or RDR = 1
Risk Reduction Level	200	10, 6 or RDR = 2
Immediate Curtailment Level	500	20, 12 or RDR = 4

4.2 Uncertainty Analysis

CAO rules require that a quantitative or qualitative uncertainty evaluation be included in a Level 3 and Level 4 risk assessment. The uncertainty in the various elements of the analysis will be described.