Appendix M
Dispersion Modeling Report

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2024 Clean Harbors PFAS Tests
Ambient Air Quality Impact Analysis

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Abbreviations

6:2 FTS	6:2 Fluorotelomer Sulfonic Acid
acfm	actual cubic feet per minute
CHA	Clean Harbors Aragonite
HFPO-DA	Hexafluoropropylene oxide dimer acid
hr	hour
lb	pound
m^3	cubic meter
m	meter
mg	milligram
ng	nanogram
FOSA	Perfluorooctanesulfonamide
PFAS	Per- and Poly-fluorinated alkyl substances
PFBA	Perflurobutanoic acid
PFBS	Perfluorobutanesulfonic acid
PFDA	Perfluorodecanoic acid
PFDoA	Perfluorododecanoic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PFNA	Perfluorodecanoic acid
RfC	reference concentration
RfD	reference dose
U.S. EPA	United States Environmental Protection Agency

1 Summary

The U.S. EPA screening dispersion model AERSCREEN was used to estimate the ambient air impacts of emissions of twelve PFAS compounds emitted from the Clean Harbors Aragonite incinerator stack. The dispersion analysis was based on PFAS emission rates measured during a test program that was conducted November 12-14, 2024. The twelve compounds for which ambient impacts were modeled (PFBA, PFHxA, PFOA, PFNA, PFDA, PFDoA, PFBS, PFHxS, PFOS, FOSA, HPFO-DA and 6:2 FTS) are target analytes for OTM-45 and have ambient concentration guidelines or standards in one or more states. All twelve modeled compounds are considered semi-volatile compounds. Therefore, if they are present in the atmosphere, they would most likely be adsorbed to particulate matter and the effective dose received by human receptors would probably be less than if they were volatile PFAS.

The AERSCREEN model output provides a distribution of impacts downwind from the emission point. The maximum offsite impact occurred at a location 700 meters (2,296 feet) from the stack, which is inside the facility property lines on the east and south sides but outside of the property lines on the north and west sides of the facility. The dispersion modeling results compared to ambient air standards are presented in Table M-1. The analysis shows that the maximum modeled ambient impacts for the twelve PFAS compounds range from 2 to 8 orders of magnitude (no less than 100 times) less than the ambient guidelines/standards. Table M-2 presents a list of sources for the state reference concentrations or guidelines

2 AERSCREEN Modeling Procedures

AERSCREEN is a screening model and is likely to produce more conservative (higher) ambient impacts than U.S. EPA's refined dispersion model AERMOD, which would require multiple years of actual meteorological and topographic data inputs. AERSCREEN produces estimates of 1-hour concentrations for a single point source. AERSCREEN then uses conversion factors to calculate 3-hour, 8-hour, 24-hour, and annual concentrations from the 1-hour concentrations. The AERSCREEN model was run using default meteorological data and excluded terrain effects.

Table M-3 presents the average stack mass emission rates of the twelve PFAS compounds that were measured during the performance test program Runs 1A, 2A, and 3A as shown in Appendix A-1, Table A-1-6. The average mass emission rate of each of the twelve PFAS in each of the three runs was used in the dispersion modeling analysis.

During the testing program, the "stack gas" was actually measured in the scrubber outlet duct (upstream of the ID fan) because of favorable sampling port access conditions. The "actual" stack gas flow conditions at the stack exit were estimated using the measured flow rate, temperature and pressure at the scrubber outlet duct and then adjusting for temperature and pressure at the stack exit. Table M-4 presents the measured gas flow rate parameters measured in the scrubber outlet duct and the calculated parameters at the actual stack exhaust point. This estimated stack gas flow parameters and actual stack diameter were then used to calculate the stack exit gas velocity as shown in Table M-5. Meteorological data during the testing period is presented in Table M-6.

Table M-7 presents the input parameters to the AERSCREEN model. A unitary mass emission rate of 1.0 lb/hr was used to conduct the modeling and then the ambient air quality impacts were scaled by the actual emission rate for each PFAS compound. Table M-8 presents the stack downwash area of influence analysis. Figure M-1 presents a facility map showing the distances from the stack to the facility fence

line. Figure M-2 presents a map showing the distances from the stack to the property boundaries.

3 AERSCREEN Modeling Results

Attachment A presents the inputs to and output from the AERSCREEN model. Maximum offsite ambient impacts for each of the twelve PFAS compounds for 1-hr, 24-hr, and annual averaging period are presented in Table M-9. Figure M-3 presents a graph of the dispersion modeling results that shows ambient impacts as a function of downwind distance. The maximum offsite impact location is 700 meters (2,296 feet) from the stack. This location is inside of the facility boundary on the east and south side of the plant and outside of the facility boundary on the north and west side of the plant. There are no public receptors within the maximum impact radius. The dispersion factor at the maximum offsite impact location is 1,215 ng/m^3 per 1.0 lb/hr emission rate (1.215 µg/m^3) per 1.0 lb/hour emission rate.

Tables

Table M-1. PFAS Maximum Ambient Air Concentrations vs Reference Concentrations

Regulation Source	Regulation Status	CAS No.	PFAS Compound	Regulatory Standard (ng/m^3)	Modeled Ambient Concentration (ng/m^3)	Averaging Time	Ratio of Regulatory Standard to Modeled Concentration
Michigan	Enforceable	335-67-1	PFOA	0.1	8.10E-05	24-hr	1.2E+03
Michigan	Enforceable	1763-23-1	PFOS	0.4	3.65E-05	24-hr	1.1E+04
Michigan	Enforceable	27619-97-2	6:2 FTS	1000	2.52E-05	Annual	4.0E+07
Minnesota	Risk Assessment Advice (intermediate (>24 hours to1 year)	375-22-4	PFBA	10000	3.62E-04	24-hr	2.8E+07
Minnesota	Risk Assessment Advice (chronic (>1 year to lifetime)	375-22-4	PFBA	10000	6.04E-05	Annual	1.7E+08
Minnesota	Risk Assessment Advice (intermediate (>24 hours to1 year)	335-67-1	PFOA	63	8.10E-05	24-hr	7.8E+05
Minnesota	Risk Assessment Advice (chronic (>1 year to lifetime)	335-67-1	PFOA	63	1.35E-05	Annual	4.7E+06
Minnesota	Risk Assessment Advice (intermediate (>24 hours to1 year)	1763-23-1	PFOS	11	3.65E-05	24-hr	3.0E+05
Minnesota	Risk Assessment Advice (chronic (>1 year to lifetime)	1763-23-1	PFOS	11	6.09E-06	Annual	1.8E+06
Minnesota	Risk Assessment Advice (intermediate (>24 hours to1 year)	355-46-4	PFHxS	34	1.03E-05	24-hr	3.3E+06
Minnesota	Risk Assessment Advice (chronic (>>1 year to lifetime)	355-46-4	PFHxS	34	1.72E-06	Annual	2.0E+07
Minnesota	Risk Assessment Advice (intermediate (>24 hours to1 year)	375-73-5	PFBS	300	1.54E-04	24-hr	2.0E+06
Minnesota	Risk Assessment Advice (chronic (>>1 year to lifetime)	375-73-5	PFBS	300	2.56E-05	Annual	1.2E+07
Minnesota	Risk Assessment Advice (intermediate (>24 hours to1 year)	307-24-4	PFHxA	500	9.08E-05	24-hr	5.5E+06
Minnesota	Risk Assessment Advice (chronic (>>1 year to lifetime)	307-24-4	PFHxA	500	1.51E-05	Annual	3.3E+07
New Jersey	Screening Level	335-67-1	PFOA	7	1.35E-05	Annual	5.2E+05
New Jersey	Screening Level	1763-23-1	PFOS	6	6.09E-06	Annual	9.9E+05
New Jersey	Screening Level	335-67-1 + 1763-23-1	PFOA + PFOS[(a)]	70	1.96E-05	Annual	3.6E+06
New Jersey	Screening Level	13252-13-6	HFPO-DA	10	1.20E-02	Annual	8.3E+02
New York	Enforceable for uncontrolled PFAS Emission Rate Potential (ERP) >100 lb/yr	335-67-1	PFOA	5.3	1.35E-05	Annual	3.9E+05
Texas	Effects Screening Levels (ESLs)	335-67-1	PFOA	50	1.35E-04	1-hr	3.7E+05
Texas	Effects Screening Levels (ESLs)	335-67-1	PFOA	5	1.35E-05	Annual	3.7E+05
Texas	Effects Screening Levels (ESLs)	1763-23-1	PFOS	100	6.09E-05	1-hr	1.6E+06
Texas	Effects Screening Levels (ESLs)	1763-23-1	PFOS	10	6.09E-06	Annual	1.6E+06
Texas	Reference Concentration (Derived from RfD)	375-22-4	PFBA	3500	6.04E-05	Annual	5.8E+07
Texas	Reference Concentration (Derived from RfD)	335-67-1	PFOA	4.1	1.35E-05	Annual	3.0E+05
Texas	Reference Concentration (Derived from RfD)	375-95-1	PFNA	28	3.31E-05	Annual	8.5E+05
Texas	Reference Concentration (Derived from RfD)	335-76-2	PFDA	53	4.36E-06	Annual	1.2E+07
Texas	Reference Concentration (Derived from RfD)	307-55-1	PFDoA	42	3.47E-06	Annual	1.2E+07
Texas	Reference Concentration (Derived from RfD)	375-73-5	PFBS	4900	2.56E-05	Annual	1.9E+08
Texas	Reference Concentration (Derived from RfD)	355-46-4	PFHxS	13	1.72E-06	Annual	7.6E+06
Texas	Reference Concentration (Derived from RfD)	1763-23-1	PFOS	81	6.09E-06	Annual	1.3E+07
Texas	Reference Concentration (Derived from RfD)	754-91-6	FOSA	4.1	2.11E-06	Annual	1.9E+06

(a) Value applies to the sum of PFOA and PFOS if they are both emitted concurrently.

Table M-2. Regulatory Standards Sources

State or U.S. EPA	State or Federal Agency	Web Site	CAS No.	Analyte	Source
Michigan	Michigan Department of Environment, Great Lakes, and Energy (EGLE) - Air Quality Division. Revised September 1, 2023. List of Screening Levels (ITSL, IRSL & SRSL) in Alphabetical Order.	https://www.michigan.gov/egle/about/organization/air-quality/air-toxics	335-67-1	PFOA	Michigan Department of Environmental Quality, File for Perfluorooctanoic Acid (PFOA) (CAS No. 335-67-1, from Michael Depa, Toxics Unit, Air Quality Division, Updated Derivation of Screening Level, April 25, 2024.
			1763-23-1	PFOS	Michigan Department of Environmental Quality, File for Perfluorooctanoic Sulfonic Acid (PFOS) (CAS No. 1763-23-1, from Michael Depa, Toxics Unit, Air Quality Division, Updated Derivation of Screening Level, April 25, 2024,
			27619-97-2	6:2 FTS	Michigan Department of Environmental Quality, File for 6:2 Fluorotelomer Sulfonic Acid (CAS No. 27619-97-2, from Michael Depa, Toxics Unit, Air Quality Division, Updated Derivation of Screening Level, September 24, 2020.
Minnesota	Minnesota Department of Health (MDH).	https://www.health.state.mn.us/communities/environment/risk/guidance/air/table.html#nshrv	375-22-4	PFBA	Minnesota Department of Health, Air Guidance Values
			335-67-1	PFOA	
			1763-23-1	PFOS	
			355-46-4	PFHxS	
			375-73-5	PFBS	
			307-24-4	PFHxA	
			375-22-4	PFBA	
New Jersey	New Jersey Department of Environmental Protection (NJDEP), Division of Science and Research (DSR).	https://www.nj.gov/dep/dsr/pfas.htm	335-67-1	PFOA	Letter to Francis C. Steitz, Director, from Brian Pachkowski, Evaluation of the Michigan Department of Environmental Quality's Derivation of Initial Threshold Screening Levels for Inhalation Exposure to PFOA and PFOS 12/19/19.
		https://dep.nj.gov/wp-content/uploads/dsr/njdep-pfoa-pfos-rfc-memo.pdf			
		https://www.nj.gov/dep/dsr/pfas.htm	1763-23-1	PFOS	Letter to Francis C. Steitz, Director, from Brian Pachkowski, Evaluation of the Michigan Department of Environmental Quality's Derivation of Initial Threshold Screening Levels for Inhalation Exposure to PFOA and PFOS 12/19/19.
		https://dep.nj.gov/wp-content/uploads/dsr/njdep-pfoa-pfos-rfc-memo.pdf			
		https://www.nj.gov/dep/dsr/pfas.htm	335-67-1 + 1763-23-1	PFOA+ PFOS	Letter to Francis C. Steitz, Director, from Brian Pachkowski, Evaluation of the Michigan Department of Environmental Quality's Derivation of Initial Threshold Screening Levels for Inhalation Exposure to PFOA and PFOS 12/19/19.
		https://dep.nj.gov/wp-content/uploads/dsr/njdep-pfoa-pfos-rfc-memo.pdf			
		https://dep.nj.gov/wp-content/uploads/dsr/njdep-genx-rfc-memo.pdf	13252-13-6	HFPO-DA	Letter to Francis C. Steitz, Director, from Gloria Post, Recommendation for a Reference Concentration for GenX, January 25, 2022.
New York	New York Department of Environmental Conservation (NYDEC)	https://www.dec.ny.gov/docs/air_pdf/dar1.pdf	335-67-1	PFOA	DAR-1 Guidelines for the Evaluation and Control of Ambient Air Contaminants Under 6NYCRR Part 212.
Texas	Texas Commission on Environmental Quality (TCEQ)	https://www17.tceq.texas.gov/tamis/index.cfm?fuseaction=home.welcome	335-67-1	PFOA	Texas Air Monitoring Information (TAMIS) Web Interface
			1763-23-1	PFOS	
Texas	TCEQ. 2023. TCEQ derived oral reference doses (RfDs) for various Perfluoro Compounds (PFCs). February 14.	https://www.tceq.texas.gov/downloads/toxicology/pfc/pfcs.pdf/view	375-22-4	PFBA	TCEQ Derived Oral Reference Doses (RfDs) for Various Perfluoro Compounds (PFCs) (used to derive RfC values), PFCs.pdf, February 14, 2023.
			375-73-5	PFBS	
			355-46-4	PFHxS	
			1763-23-1	PFOS	
			335-67-1	PFOA	
			754-91-6	FOSA	
			375-95-1	PFNA	
			335-76-2	PFDA	
			307-55-1	PFDoA	

Table M-3. Stack Emission Rate Summary – PFAS Compounds

Parameter	Emission Rate			
	Run 1A (lb/hr)	Run 2A (lb/hr)	Run 3A (lb/hr)	Average (lb/hr)
PFBA	< 5.96E-07	< 4.74E-07	< 4.20E-07	< 4.97E-07
PFHxA	< 2.33E-07	< 6.61E-08	< 7.49E-08	< 1.25E-07
PFOA	< 1.05E-07	< 1.51E-07	< 7.77E-08	< 1.11E-07
PFNA	< 3.93E-08	< 7.53E-07	< 2.38E-08	< 2.72E-07
PFDA	< 3.80E-08	< 3.52E-08	< 3.45E-08	< 3.59E-08
PFDoA	< 1.95E-08	< 4.60E-08	< 2.02E-08	< 2.86E-08
PFBS	< 2.21E-07	< 1.82E-07	< 2.29E-07	< 2.11E-07
PFHxS	< 1.57E-08	< 1.14E-08	< 1.53E-08	< 1.42E-08
PFOS	< 4.58E-08	< 4.77E-08	< 5.69E-08	< 5.01E-08
FOSA	< 1.90E-08	< 1.49E-08	< 1.81E-08	< 1.73E-08
HFPO-DA	< 1.69E-05	2.67E-04	< 1.32E-05	< 9.90E-05
6-2 FTS	< 1.79E-07	< 1.55E-07	< 2.89E-07	< 2.08E-07

Table M-4. Stack Parameters Measured During OTM-45 Testing

				Ambient Conditions			Measured Values at Scrubber Outlet Duct[a]			Estimated Values at Stack Exit		
Run No.	Date	Start Time	End Time	Ambient[b] Temperature (°F)	Barometric[a] Pressure (in. Hg)	Barometric Pressure (in. w.c.)	Gas Flow Rate (acfm)	Gas Temperature (°F)	Gas Static Pressure (in. w.c.)	Stack[c] Temperature (°F)	Gas Static[d] Pressure (in. w.c.)	Stack Gas Flow Rate (acfm)
1A	11/13/24	9:00	12:49	28	25.29	343.8	60,858	142.5	-15.0	147	1.0	58,477
2A	11/13/24	14:30	18:03	26	25.22	342.9	60,057	143.7	-15.0	148	1.0	57,663
3A	11/14/24	8:30	12:27	32	25.18	342.3	60,587	146.2	-15.0	150	1.0	58,081
Average				**29**	**25.23**	**343.0**	**60,501**	**144.1**	**-15.0**	**148**	**1.0**	**58,074**

(a) Data from Alliance Technical Group, "PFAS Test Program Report, Clean Harbors' Aragonite - Utah, Test Dates November 12-14, 2024. Table 2-1 and Appendix A, Field Data Condition A, OTM-45 train field data sheets.
(b) Weather Underground https://www.wunderground.com/history/daily/US/UT/84074/date/2014-9-24 Salt Lake City Airport
(c) From Appendix B, Process Parameters, Table B-2, thermocouple TT-2194.
(d) Assume 1 inch w.c. positive pressure.

Constants

Conversion Factor, °F +	459.67	=°R
Atmospheric Pressure	29.9213	in. Hg
Atmospheric Pressure	406.78	in. w.c.

Table M-5. Stack Parameters

Parameter	U.S. Units		Metric Units	
	Value	Units	Value	Units
Stack height	149	ft	45.43	m
Stack diameter	5	ft	1.52	m
Stack cross-sectional area	19.63	ft^2	1.82	m^2
Stack gas flow	58,074	acfm	1,645.7	m^3/min
Stack gas temperature	148	°F	338	°K
Stack gas temperature	65	°C	338	°K
Stack gas velocity	49.3	ft/sec	15.04	m/sec
Ambient temperature	29	°F	-1.8	°C
Ambient temperature	488	°R	271.3	°K
Barometric Pressure	343.0	in. w.c.	25.23	in. Hg

Conversion factors

	3.28	ft/meter
	35.29	ft^3/m^3
	273.15	°K
°F +	**459.67**	=°R

Table M-6. Meteorological Data

Run No.	Date	Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
Run 1A	11/13/24	8:54 AM	35 °F	28 °F	76 %	S	13 mph	0 mph	25.89 in	0.0 in	Mostly Cloudy
Run 1A	11/13/24	9:54 AM	37 °F	28 °F	70 %	SSE	13 mph	0 mph	25.89 in	0.0 in	Mostly Cloudy
Run 1A	11/13/24	10:54 AM	40 °F	28 °F	63 %	S	9 mph	0 mph	25.89 in	0.0 in	Mostly Cloudy
Run 1A	11/13/24	11:54 AM	42 °F	28 °F	58 %	SE	8 mph	0 mph	25.89 in	0.0 in	Mostly Cloudy
Run 1A	11/13/24	12:54 PM	44 °F	27 °F	51 %	SE	8 mph	0 mph	25.86 in	0.0 in	Mostly Cloudy
Run 2A	11/13/24	1:54 PM	46 °F	25 °F	44 %	SE	12 mph	0 mph	25.83 in	0.0 in	Mostly Cloudy
Run 2A	11/13/24	2:54 PM	49 °F	25 °F	39 %	SE	10 mph	0 mph	25.78 in	0.0 in	Mostly Cloudy
Run 2A	11/13/24	3:54 PM	51 °F	24 °F	35 %	SE	12 mph	0 mph	25.76 in	0.0 in	Mostly Cloudy
Run 2A	11/13/24	4:54 PM	51 °F	24 °F	35 %	VAR	7 mph	0 mph	25.75 in	0.0 in	Mostly Cloudy
Run 2A	11/13/24	5:54 PM	47 °F	29 °F	50 %	NNW	7 mph	0 mph	25.76 in	0.0 in	Mostly Cloudy
Run 2A	11/13/24	6:54 PM	42 °F	30 °F	62 %	N	6 mph	0 mph	25.75 in	0.0 in	Mostly Cloudy

Run No.	Date	Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
Run 3A	11/14/24	7:54 AM	36 °F	31 °F	82 %	CALM	0 mph	0 mph	25.75 in	0.0 in	Mostly Cloudy
Run 3A	11/14/24	8:54 AM	38 °F	33 °F	83 %	CALM	0 mph	0 mph	25.76 in	0.0 in	Mostly Cloudy
Run 3A	11/14/24	9:54 AM	42 °F	32 °F	67 %	N	5 mph	0 mph	25.77 in	0.0 in	Mostly Cloudy
Run 3A	11/14/24	10:54 AM	46 °F	34 °F	63 %	CALM	0 mph	0 mph	25.76 in	0.0 in	Mostly Cloudy
Run 3A	11/14/24	11:54 AM	49 °F	33 °F	54 %	CALM	0 mph	0 mph	25.76 in	0.0 in	Mostly Cloudy
Run 3A	11/14/24	12:54 PM	51 °F	30 °F	44 %	SSW	3 mph	0 mph	25.73 in	0.0 in	Mostly Cloudy
Average Temperature During Test Runs											
Run 1A				28°F							
Run 2A				26°F							
Run 3A				32°F							
Average				29°F							

Data Source
https://www.wunderground.com/history/daily/US/UT/84074/date/2014-9-24
Salt Lake City Airport
40.78°N, 111.92°W

Table M-7. Dispersion Modeling Inputs

Parameters	Inputs	Values	Units	Source
Facility Name Facility Address Latitude Longitude	Clean Harbors Aragonite Incineration Facility 11600 North Aptus Road, Grantsville, UT 84029 40.601520 deg (°) -112.506540 deg (°)			
Source Information	Source type (point, volume, area, circle, flare, pointcap, horizontal)	Point		
	Stack height	149	ft	(a)
	Parameter emission rate - PFAS Compound	1.00	lb/hr	(b)
	Stack diameter	60.0	inches	(b)
	Stack exit temperature	148	°F	(c)
	Stack gas velocity	57	ft/sec	(d)
	Stack exit flow rate	58,074	acfm	(b)
	Rural/urban	Rural		
	Minimum distance to ambient air, default (feet)	3.3		
NOx Chemistry	Option for Modeling NO_2 Chemistry			
	1) No chemistry or pollutant is not NOx	1	NA	
	2) Use ozone limiting method (OLM)			
	3) Use plume volume molar ratio method (PVMRM)			
Building Downwash Information	Include building downwash	Yes	NA	
	Use pre-existing BPIPPRM input file (y/n)	No		
	Building height	55	ft	
	Maximum horizontal dimension	45	ft	
	Minimum horizontal dimension	30	ft	
	Orientation of maximum building dimension to True North (0-179 degrees)	90	deg (°)	
	Direction of stack from building center (0-360 degrees)	275	deg (°)	
	Distance from stack to building center	200	ft	
Terrain Height	Include terrain heights	No	yes/no	
Receptors	Maximum distance to probe (5000 m default)	5,000	m	
	Enter up to 10 discrete receptors?	No	NA	
	Use flagpole receptors	No	NA	
	Use source elevation (0.0 ft default)	0	ft	
Surface Friction	Surface friction velocity - u* Y) Adjust u* N) Do not adjust u*	No		
Makemet Meteorology	Minimum ambient temperature (default value)	-10	°F	
	Maximum ambient temperature (default value)	100	°F	
	Minimum wind speed (enter or use 0.5 m/s default)	0.5	m/s	
	Anemometer height (enter or use 10.0 m default)	10	m	
	Surface characteristics 1) user-entered 2) AERMET tables 3) external file)	AERMET tables	NA	
Dominant Surface Profile	Dominant Surface Profile 1) Water 2) Deciduous forest 3) Coniferous forest 4) Swamp 5) Cultivated land 6) Grassland 7) Urban 8) Desert shrubland	Desert shrubland	NA	
Dominant Climate Profile	1) Average moisture 2) Wet conditions 3) Dry conditions	Dry conditions		
Fumigation	Apply inversion break-up fumigation (Y/N)	No		
	Apply shoreline fumigation (Y/N)	No		
Debug Option	Turn on debug option (Y or enter to not use)	Enter		
Discrete receptors	Distance to Closest Facility Fenceline	440	feet	
		134	meters	
Discrete receptors	Distance to Closest Property Fenceline	900	feet	
		274	meters	
Other inputs	Input units (English or Metric)	English		
	Use flagpole receptors	No	yes/no	
Output file	Use non-default name (ending with ".out")			

(a) 12/04/20 E-mail,Kenneth Banks (Clean Harbors) to Bill Troxler (Focus)
(b) Data from Alliance Technical Group, "PFAS Test Program Report, Clean Harbors' Aragonite - Utah, Test Dates November 12-14, 2024, Table 2-1 and Appendix A, Field Data Condition A, OTM-45 train field data sheets.
(c) From Appendix B, Process Parameters, Table B-2, thermocouple TT-2194.
(d) Calculated by Focus Environmental, Inc.

Conversion Factor

5280	feet/mile
3.28	ft/meter

Table M-8. Building Downwash Area of Influence Analysis

Building No.	Description[a]	Length (ft)	Width (ft)	Height (ft)	Projected Building Width (ft)	Lesser of Height or Projected Width (ft)	Five (5) x Lesser of Height or Projected Width (ft)	Distance from Closest Part of Building to Stack (ft)	Wake[b] Effects Caused by Building?
A	Cooling Tower Utility Building (W-15)	25	17	15	30	15	75	83	No
B	Building W-12	40	16	20	43	20	100	10	Yes
C	Neutralization Pumphouse Building (W-11)	120	21	35	122	35	175	323	No
D	Baghouse Building	45	30	55	54	54	270	167	Yes
E	Baghouse Residue Building	50	34	27	60	27	135	183	No
F	Utility Building (W-10)	60	50	25	78	25	125	207	No
G	MCC Building	74	39	35	84	35	175	320	No

(a) Building No. as identified on Aptus Drawing D-034-M-002, "Utah Environmental Service Center Incineration Plant for Industrial Wastes Plot Plan".

(b) Building downwash area of influence definition:

A building is considered sufficiently close to a stack to cause wake effects when the distance between the stack and the nearest part of the building is less than or equal to five (5) times the lesser of the building height or the projected width of the building.

Table M-9. Ambient Impact Analysis Results

Impact Location	Parameter	Modeled Emission Rate (lb/hr)	Measured Average Emission Rate (lb/hr)	Maximum 1-Hour Ground Level Concentration @ Modeled Emission Rate (ng/m^3)	Scaled 1-Hour Ground Level Concentration (ng/m^3)	Scaled 24-Hour Ground Level Concentration (ng/m^3)	Scaled Annual Ground Level Concentration (ng/m^3)
Maximum Impact (800 m from stack)	PFBA	1.00	4.97E-07	1215	6.04E-04	3.62E-04	6.04E-05
	PFHxA	1.00	1.25E-07	1215	1.51E-04	9.08E-05	1.51E-05
	PFOA	1.00	1.11E-07	1215	1.35E-04	8.10E-05	1.35E-05
	PFNA	1.00	2.72E-07	1215	3.31E-04	1.98E-04	3.31E-05
	PFDA	1.00	3.59E-08	1215	4.36E-05	2.62E-05	4.36E-06
	PFDoA	1.00	2.86E-08	1215	3.47E-05	2.08E-05	3.47E-06
	PFBS	1.00	2.11E-07	1215	2.56E-04	1.54E-04	2.56E-05
	PFHxS	1.00	1.42E-08	1215	1.72E-05	1.03E-05	1.72E-06
	PFOS	1.00	5.01E-08	1215	6.09E-05	3.65E-05	6.09E-06
	FOSA	1.00	1.73E-08	1215	2.11E-05	1.26E-05	2.11E-06
	HFPO-DA	1.00	9.90E-05	1215	1.20E-01	7.22E-02	1.20E-02
	6:2 FTS	1.00	2.08E-07	1215	2.52E-04	1.51E-04	2.52E-05

1-Hour Ground Level Concentration @ 1.0 lb/hr Modeled Emission Rate			**Distance from Stack**
Location	**Impact**		**(m)**
At closest facility fenceline	823	$\mu g/m^3$ per lb/hr emissions	134
At closest property line	844	$\mu g/m^3$ per lb/hr emissions	274
Maximum impact point	1215	ng/m^3 per lb/hr emissions	800

Averaging Time Conversion Factors	
1 hr to 3 hr	1.0
1 hr to 8 hr	0.9
1 hr to 24 hr	0.6
1 hr to annual	0.1

Figures

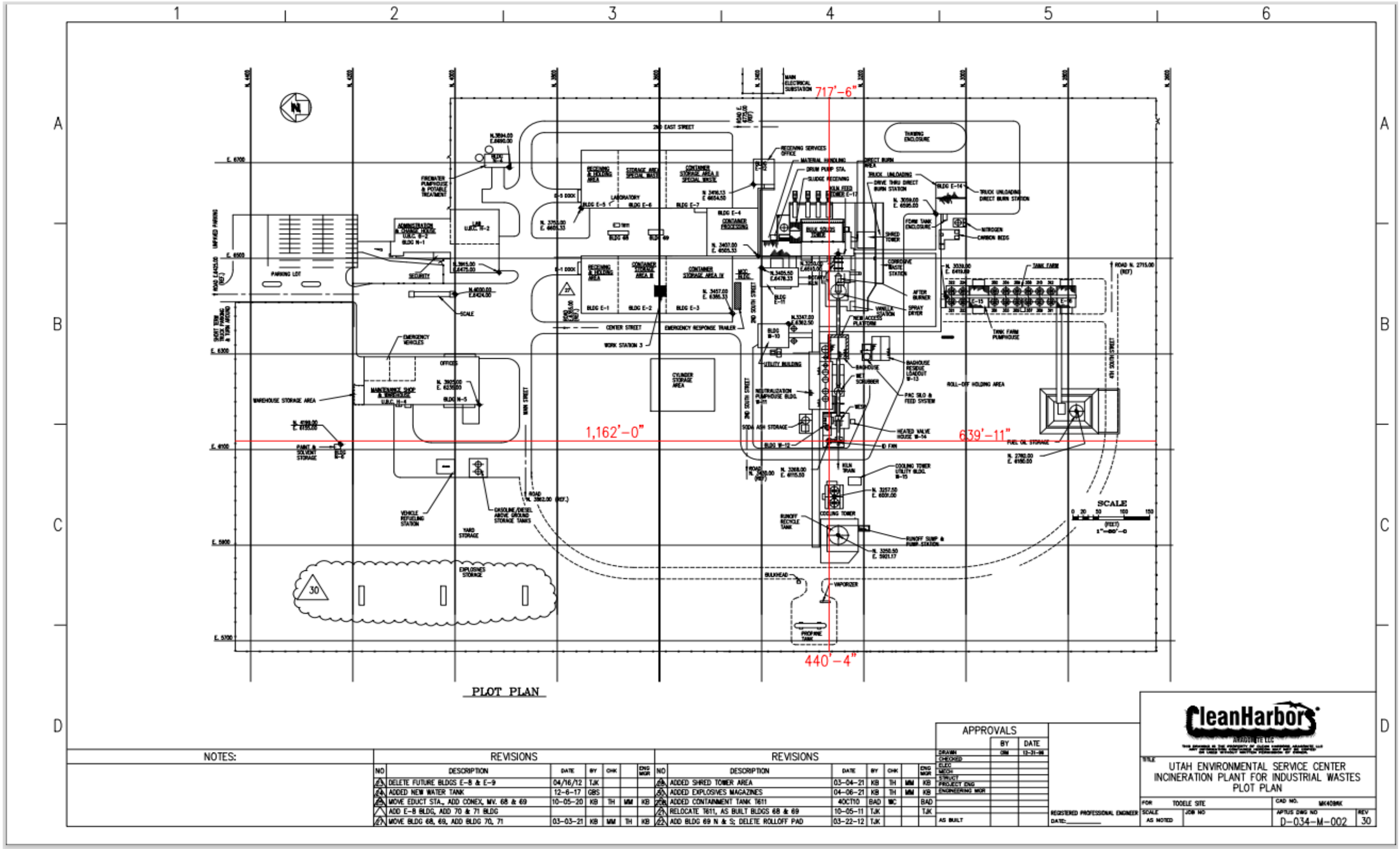

Figure M-1. Facility Map

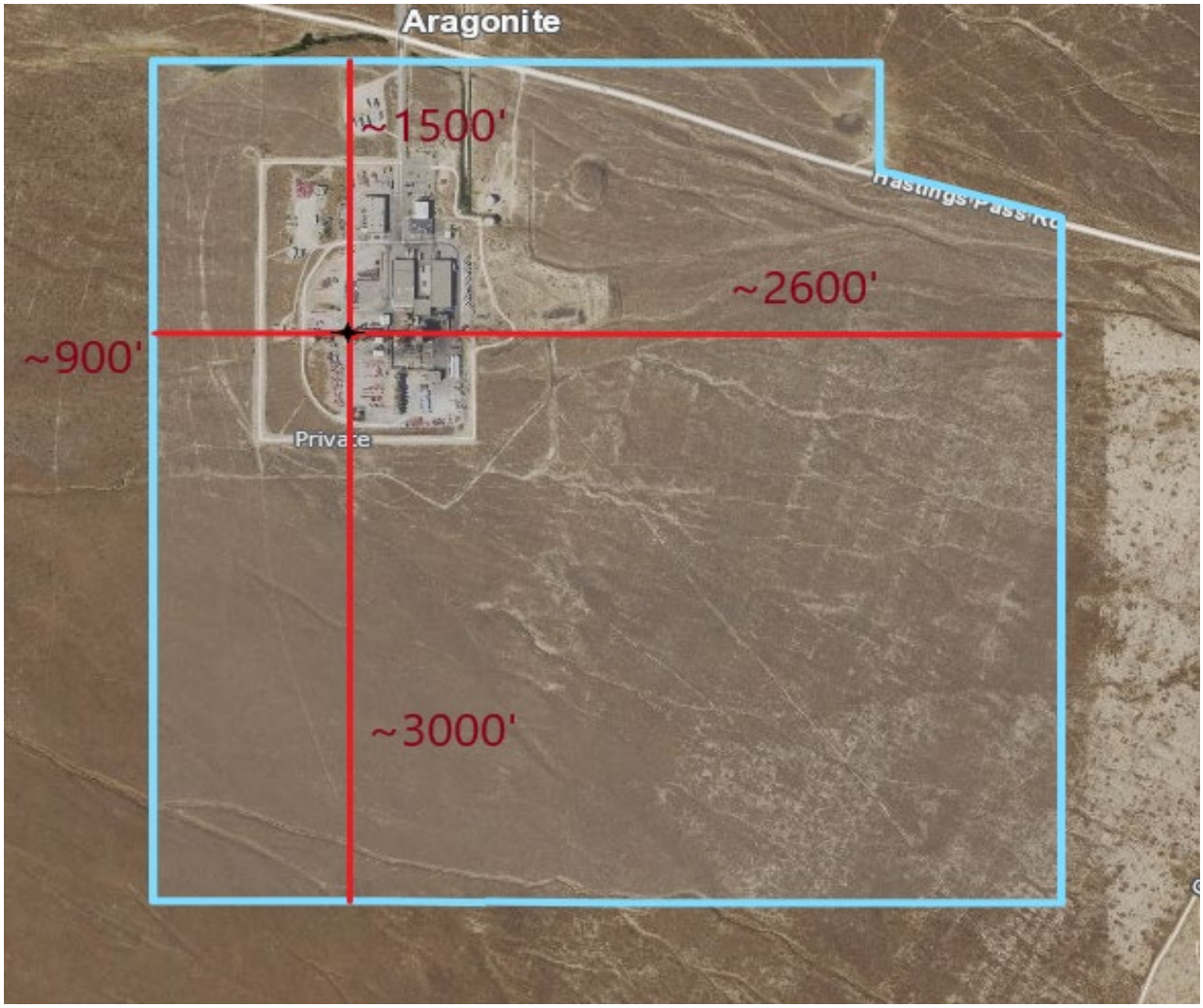

Figure M-2. Property Map

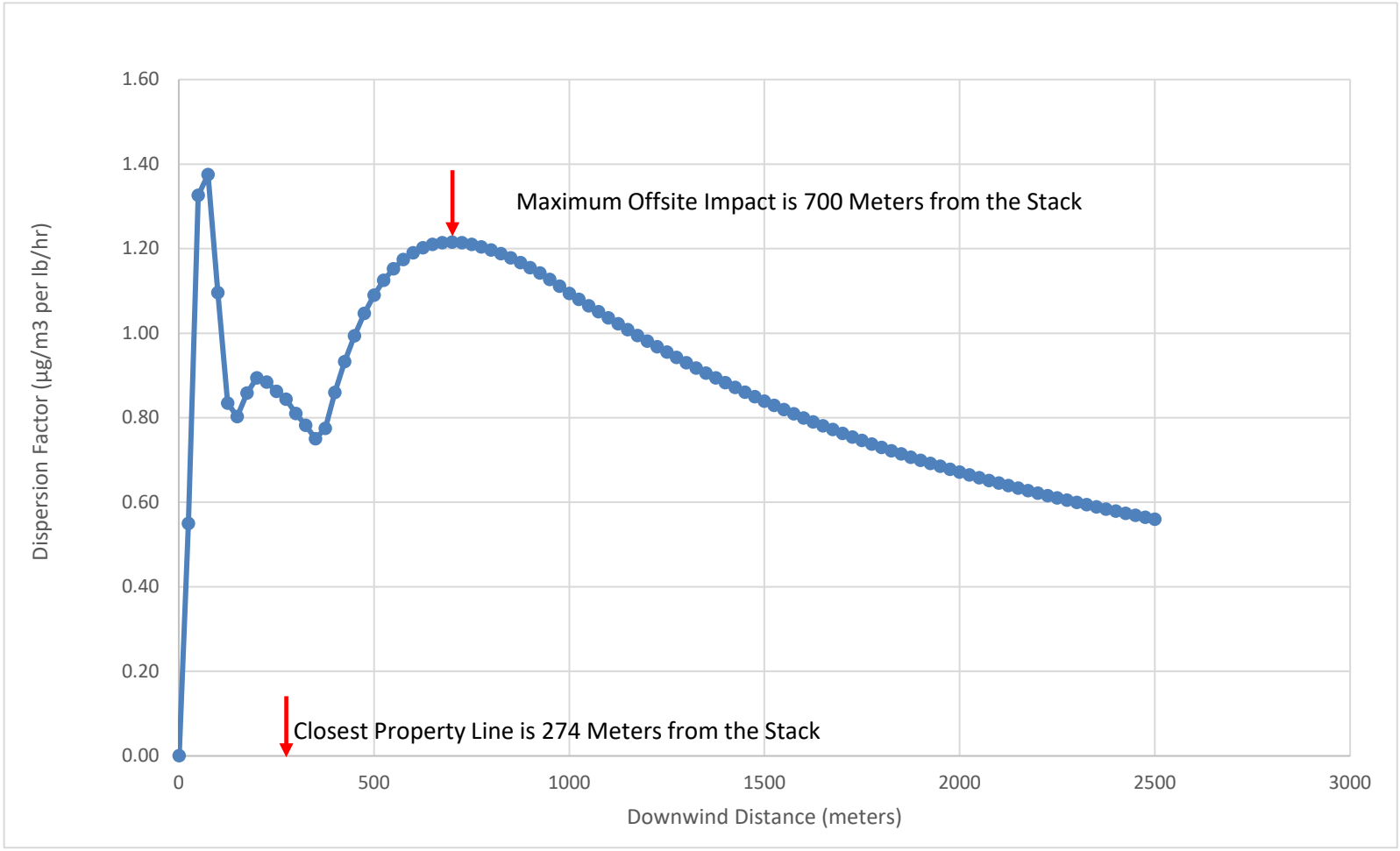

Figure M-3. Dispersion Factor Versus Downwind Distance

Attachment A
AERSCREEN Input and Output

AERSCREEN 16216 / AERMOD 18081
04/02/25

21:03:31

TITLE: Clean Harbors Aragonite PFAS Test - November 2024 Dispersion

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********** STACK PARAMETERS **********

SOURCE EMISSION RATE:	0.1260	g/s	1.000	lb/hr
STACK HEIGHT:	45.42	meters	149.00	feet
STACK INNER DIAMETER:	1.524	meters	60.00	inches
PLUME EXIT TEMPERATURE:	337.6	K	148.0	Deg F
PLUME EXIT VELOCITY:	15.025	m/s	49.29	ft/s
STACK AIR FLOW RATE:	58074	ACFM		
RURAL OR URBAN:	RURAL			
INITIAL PROBE DISTANCE =	5000.	meters	16404.	feet

********** BUILDING DOWNWASH PARAMETERS **********

BUILDING HEIGHT:	16.8	meters	55.0	feet
MAX BUILDING DIMENSION:	13.7	meters	45.0	feet
MIN BUILDING DIMENSION:	9.1	meters	30.0	feet
BUILDING ORIENTATION TO NORTH:	90.	degrees		
STACK DIRECTION FROM CENTER:	275.	degrees		
STACK DISTANCE FROM CENTER:	61.0	meters	200.0	feet

********** FLOW SECTOR ANALYSIS **********

25 meter receptor spacing: 1. meters - 5000. meters

FLOW SECTOR	BUILD WIDTH	BUILD LENGTH	XBADJ	YBADJ	MAX 1-HR CONC	DIST (m)	TEMPORAL PERIOD
10*	0.00	0.00	0.00	0.00	1.375	75.0	AUT
20	0.00	0.00	0.00	0.00	1.375	75.0	AUT
30	0.00	0.00	0.00	0.00	1.375	75.0	AUT
40	0.00	0.00	0.00	0.00	1.375	75.0	AUT
50	0.00	0.00	0.00	0.00	1.375	75.0	AUT
60	0.00	0.00	0.00	0.00	1.375	75.0	AUT
70	0.00	0.00	0.00	0.00	1.375	75.0	AUT
80	0.00	0.00	0.00	0.00	1.375	75.0	AUT
90	0.00	0.00	0.00	0.00	1.375	75.0	AUT
100	0.00	0.00	0.00	0.00	1.375	75.0	AUT
110	0.00	0.00	0.00	0.00	1.375	75.0	AUT
120	0.00	0.00	0.00	0.00	1.375	75.0	AUT
130	0.00	0.00	0.00	0.00	1.375	75.0	AUT
140	0.00	0.00	0.00	0.00	1.375	75.0	AUT
150	0.00	0.00	0.00	0.00	1.375	75.0	AUT
160	0.00	0.00	0.00	0.00	1.375	75.0	AUT
170	0.00	0.00	0.00	0.00	1.375	75.0	AUT
180	0.00	0.00	0.00	0.00	1.375	75.0	AUT
190	0.00	0.00	0.00	0.00	1.375	75.0	AUT
200	0.00	0.00	0.00	0.00	1.375	75.0	AUT
210	0.00	0.00	0.00	0.00	1.375	75.0	AUT
220	0.00	0.00	0.00	0.00	1.375	75.0	AUT
230	0.00	0.00	0.00	0.00	1.375	75.0	AUT
240	0.00	0.00	0.00	0.00	1.375	75.0	AUT

```
           250     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           260     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           270     9.15     13.72   -67.59     5.31   1.375        75.0
AUT
           280    11.39     15.10   -68.28    -5.31   1.375        75.0
AUT
           290     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           300     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           310     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           320     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           330     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           340     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           350     0.00      0.00     0.00     0.00   1.375        75.0
AUT
           360     0.00      0.00     0.00     0.00   1.375        75.0
AUT
 * = worst case flow sector


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 **********************  MAKEMET METEOROLOGY PARAMETERS
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 MIN/MAX TEMPERATURE:    249.8 / 310.9 (K)

 MINIMUM WIND SPEED:       0.5 m/s

 ANEMOMETER HEIGHT:     10.000 meters

 SURFACE CHARACTERISTICS INPUT: AERMET SEASONAL TABLES

 DOMINANT SURFACE PROFILE: Desert Shrubland
 DOMINANT CLIMATE TYPE:    Dry Conditions
 DOMINANT SEASON:          Autumn

 ALBEDO:                  0.28
 BOWEN RATIO:            10.00
 ROUGHNESS LENGTH:       0.300 (meters)

 SURFACE FRICTION VELOCITY (U*) NOT ADUSTED
```

METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT

YR	MO	DY	JDY	HR
10	02	06	6	12

H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS
401.96	0.141	1.800	0.020	826.	122.	-1.0	0.300	10.00	0.28	0.50

HT	REF TA	HT
10.0	310.9	2.0

WIND SPEED AT STACK HEIGHT (non-downwash): 0.7 m/s
STACK-TIP DOWNWASH ADJUSTED STACK HEIGHT: 45.4 meters
ESTIMATED FINAL PLUME RISE (non-downwash): 102.3 meters
ESTIMATED FINAL PLUME HEIGHT (non-downwash): 147.7 meters

METEOROLOGY CONDITIONS USED TO PREDICT AMBIENT BOUNDARY IMPACT

YR	MO	DY	JDY	HR
10	01	01	6	12

H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS
10.79	0.077	0.300	0.020	77.	49.	-3.3	0.150	10.00	0.45	0.50

HT	REF TA	HT
10.0	249.8	2.0

WIND SPEED AT STACK HEIGHT (non-downwash): 0.6 m/s
STACK-TIP DOWNWASH ADJUSTED STACK HEIGHT: 45.4 meters
ESTIMATED FINAL PLUME RISE (non-downwash): 325.4 meters
ESTIMATED FINAL PLUME HEIGHT (non-downwash): 370.8 meters

********** AERSCREEN AUTOMATED DISTANCES **********

OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE

DIST (m)	MAXIMUM 1-HR CONC (ug/m3)	DIST (m)	MAXIMUM 1-HR CONC (ug/m3)
1.00	0.3919E-03	2525.00	0.5552
25.00	0.5499	2550.00	0.5507
50.00	1.326	2575.00	0.5463
75.00	1.375	2600.00	0.5419
100.00	1.096	2625.00	0.5376
125.00	0.8344	2650.00	0.5334
150.00	0.8028	2675.00	0.5293
175.00	0.8583	2700.00	0.5252
200.00	0.8943	2725.00	0.5213
225.00	0.8840	2750.00	0.5173
250.00	0.8623	2775.00	0.5134
275.00	0.8440	2800.00	0.5096
300.00	0.8097	2825.00	0.5059
325.00	0.7823	2850.00	0.5022
350.00	0.7505	2875.00	0.4985
375.00	0.7749	2900.00	0.4955
400.00	0.8594	2925.00	0.4945
425.00	0.9326	2950.00	0.4934
450.00	0.9948	2975.00	0.4923
475.00	1.047	3000.00	0.4911
500.00	1.090	3025.00	0.4900
525.00	1.125	3050.00	0.4888
550.00	1.152	3075.00	0.4876
575.00	1.174	3100.00	0.4863
600.00	1.190	3125.00	0.4851
625.00	1.202	3150.00	0.4838
650.00	1.210	3175.00	0.4826
675.00	1.214	3200.00	0.4813
700.00	1.215	3225.00	0.4800
725.00	1.214	3250.00	0.4787
750.00	1.210	3275.00	0.4774
775.00	1.204	3300.00	0.4760
800.00	1.197	3325.00	0.4747
825.00	1.188	3350.00	0.4733
850.00	1.178	3375.00	0.4719
875.00	1.167	3400.00	0.4706
900.00	1.155	3425.00	0.4692
925.00	1.142	3450.00	0.4678
950.00	1.127	3475.00	0.4664
975.00	1.111	3500.00	0.4650
1000.00	1.094	3525.00	0.4636
1025.00	1.080	3550.00	0.4621
1050.00	1.065	3575.00	0.4607
1075.00	1.051	3600.00	0.4593
1100.00	1.036	3625.00	0.4579
1125.00	1.022	3650.00	0.4564

1150.00	1.008
1175.00	0.9946
1200.00	0.9812
1225.00	0.9680
1250.00	0.9550
1275.00	0.9423
1300.00	0.9299
1325.00	0.9177
1350.00	0.9057
1375.00	0.8940
1400.00	0.8826
1425.00	0.8714
1450.00	0.8604
1475.00	0.8497
1500.00	0.8392
1525.00	0.8289
1550.00	0.8189
1575.00	0.8090
1600.00	0.7994
1625.00	0.7900
1650.00	0.7809
1675.00	0.7719
1700.00	0.7631
1725.00	0.7545
1750.00	0.7461
1775.00	0.7378
1800.00	0.7298
1825.00	0.7219
1850.00	0.7142
1875.00	0.7066
1900.00	0.6993
1925.00	0.6920
1950.00	0.6849
1975.00	0.6780
2000.00	0.6712
2025.00	0.6645
2050.00	0.6580
2075.00	0.6516
2100.00	0.6453
2125.00	0.6392
2150.00	0.6332
2175.00	0.6273
2200.00	0.6215
2225.00	0.6158
2250.00	0.6102
2275.00	0.6047
2300.00	0.5994
2325.00	0.5941
2350.00	0.5889
2375.00	0.5838
2400.00	0.5788
2425.00	0.5739
2450.00	0.5691
2475.00	0.5644
3675.00	0.4550
3700.00	0.4535
3725.00	0.4521
3750.00	0.4506
3775.00	0.4492
3800.00	0.4477
3825.00	0.4463
3850.00	0.4448
3875.00	0.4434
3900.00	0.4419
3925.00	0.4404
3950.00	0.4390
3975.00	0.4375
4000.00	0.4361
4025.00	0.4346
4050.00	0.4332
4075.00	0.4317
4100.00	0.4303
4125.00	0.4288
4150.00	0.4274
4175.00	0.4259
4200.00	0.4245
4225.00	0.4231
4250.00	0.4216
4275.00	0.4202
4300.00	0.4188
4325.00	0.4173
4350.00	0.4159
4375.00	0.4145
4400.00	0.4131
4425.00	0.4117
4450.00	0.4102
4475.00	0.4088
4500.00	0.4074
4525.00	0.4061
4550.00	0.4047
4575.00	0.4033
4600.00	0.4019
4625.00	0.4005
4650.00	0.3991
4675.00	0.3978
4700.00	0.3964
4725.00	0.3951
4750.00	0.3937
4775.00	0.3924
4800.00	0.3910
4825.00	0.3897
4850.00	0.3883
4875.00	0.3870
4900.00	0.3857
4925.00	0.3844
4950.00	0.3831
4975.00	0.3818
5000.00	0.3805

2500.00 0.5597

********** AERSCREEN MAXIMUM IMPACT SUMMARY **********

CALCULATION PROCEDURE	MAXIMUM 1-HOUR CONC (ug/m3)	SCALED 3-HOUR CONC (ug/m3)	SCALED 8-HOUR CONC (ug/m3)	SCALED 24-HOUR CONC (ug/m3)	SCALED ANNUAL CONC (ug/m3)
FLAT TERRAIN	1.437	1.437	1.294	0.8624	0.1437

DISTANCE FROM SOURCE 63.00 meters directed toward 10 degrees

IMPACT AT THE AMBIENT BOUNDARY	0.3919E-03	0.3919E-03	0.3527E-03	0.2351E-03	0.3919E-04

DISTANCE FROM SOURCE 1.00 meters directed toward 10 degrees