Plant Site Class II Air Quality Dispersion Modeling Report

Version 2

November 2012

NorthMet Project

PolyMet Mining Incorporated

Hoyt Lakes, MN

This document provides the Class II dispersion modeling report for the Plant Site in the format requested by the Minnesota Pollution Control Agency (MPCA). This includes MPCA form AQDMR-01, four tables, two attachments and 33 figures. The AQDMR-01 did not have sufficient space to present the modeling results in Table 3 and Table 4, so tables with the required information were embedded into the form after Section 6. Tables 3 and 4 were also completed as requested by MPCA in their comments on version 1 of this report. The attachments, tables and figures are listed below.

Attachments (name references corresponding section of the AQDMP-01 (protocol) form):

Section 3 Supplemental Information
Supplemental Information on Ozone NAAQS

Tables (Embedded in AQDMR-01 Form after Section 6):

Table 3A NorthMet Plant Site Alone NAAQS/MAAQS Modeling Results
Table 3B Cumulative Impact NAAQS/MAAQS Modeling Results
Table 4A NorthMet Plant Site Alone Increment Modeling Results
Table 4B Cumulative Impact Increment Modeling Results

Figures:

Figure 1 EIS Cumulative NAAQS-Increment Receptor Grid
Figure 2 24 Hour PM10 Increment Plant Boundary Results
Figure 3 24 Hour PM10 NAAQS Scenario 1 Plant Boundary Results
Figure 4 24 Hour PM10 NAAQS Scenario 2 Plant Boundary Results
Figure 5 24 Hour PM10 Increment Cumulative Impact Results
Figure 6 24 Hour PM10 NAAQS Scenario 1 Cumulative Impact Results
Figure 7 24 Hour PM10 NAAQS Scenario 2 Cumulative Impact Results
Figure 8 24 Hour PM25 NAAQS Scenario 1 Plant Boundary Results
Figure 9 24 Hour PM25 NAAQS Scenario 2 Plant Boundary Results
Figure 10 24 Hour PM25 NAAQS Scenario 1 Cumulative Impact Results
Figure 11 24 Hour PM25 NAAQS Scenario 2 Cumulative Impact Results
Figure 12 Annual NOX Increment Plant Boundary Results
Figure 13 1 Hour NO2 NAAQS Plant Boundary Results
Figure 14 Annual NOX NAAQS Plant Boundary Results
Figure 15 Annual NOX Increment Cumulative Impact Results
Figure 16 1 Hour NO2 NAAQS Cumulative Impact Results

In addition to this document, requested electronic files will be provided via the Project Air FTP Site.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

AQDMR-01

Air Quality Dispersion Modeling Report(AQDMR)

Protocol Form for Criteria Pollutant Modeling

Doc Type: Air Dispersion Modeling

Acronym Information on Page 6

Instructions: Permit applicants required to conduct air dispersion modeling should submit two paper copies of the completed Air Quality Dispersion Modeling Report form (AQDMR-01) and all accompanying files to:

Air Quality Permit Document Coordinator
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Applicants may also submit an electronic version in addition to the two paper copies.

Electronic copies of the forms and accompanying files should be sent to: AirModeling.PCA@state.mn.us.

Facility Information

AQ tracking number: _____

AQ file no.: _____ AQ facility/permit ID no.: _____ Today's date (mm/dd/yyyy): 11/9/2012

Three-letter modeling facility ID (ex., XEK = Xcel Energy Allen S. King, MEC = Mankato Energy Center, etc.): PMP

Facility name: NorthMet Plant Site

Facility street address: 6500 County Road 666

City: Hoyt Lakes County: St. Louis

State: MN Zip code: 55750 Elevation at facility: 493 m

Facility contact: Kevin Pylka Protocol prepared by: Jennifer Koenen, Barr Engineering Co.

Facility contact phone: (218) 471 - 2162 Preparer phone: (952) 832 - 2682

Facility contact e-mail address: kpylka@polymetmining.com Preparer e-mail address: jkoenen@barr.com

Latitude, Longitude of facility (Decimal degrees to **four** decimal places): 47.5981 N, 92.1391 W

UTM coordinates of facility (NAD83, zone 15 extended **only**): x = 564,719.00 m East, y = 5,271,989.00 m North

This report is associated with:

- ☐ Permit application
- ☐ Permit requirement
- ☒ Other: EIS

Project Description (50 words or less)

PolyMet plans to construct and operate a mine, to reactivate portions of the LTV Steel Mining Company facility and to build a hydrometallurgical concentrate processing facility at the former LTVSMC site (Plant Site is subject of this report). More detail is available in the NorthMet Project Description Version 4 Submitted October 31, 2012.

Files to Accompany Modeling Report

Include the following files with the completed modeling report form. Use checkbox to indicate that all applicable files are included.

1. ☒ AERMOD input files (*.inp, *.adi, *.ami)
   ☒ AERMOD output files (*.out, *.ado, *.amo)
   ☒ AERMOD plot files (*.plt)
   ☒ AERMOD post files (*.pst) – If applicable
   ☒ AERMOD event files (*.evi, *.evo) – If applicable

☒ AERMOD miscellaneous/other files (MAXDCONT, ?, ?, etc.) – If applicable

2. AERMET files: ☒ *.sfc ☒*.pfl
3. BPIP-PRIME files: ☒ Input (*.bpi) ☒ Output (*.bpo, *.sum)
4. AERMAP files: ☒ Terrain (*.dem(s), *.tif (NED files)), ☐ Input (*.ami), ☒ Output (*.rou, *.sou, etc.)
5. Background data files: ☒ Background concentrations for applicable pollutants (seasonal, monthly, daily, hourly, etc.)
6. Modeling Results: ☒ Figures (*.jpeg, *.pdf), ☐ GIS Maps (*.shp)
7. AQDMPS-01 spreadsheet*: ☐
8. Other files and supporting documents (SMSv*.xls, Far sources, readme, etc.):

   Version 5 of the PolyMet Plant Site emission inventory was submitted on June 6, 2012 in lieu of the AQDMPS-01 spreadsheet as stated in the approved modeling protocol.

* *Provide the final spreadsheet (i.e. AQDMPS-01) and indicate/highlight changes.*

Section 1. Modeling Protocol

1. The Air Dispersion Modeling presented in this report is based on a Protocol that has been:

   ☒ Approved ☐ Conditionally approved ☒ *MPCA approval date (mm/dd/yyyy): 06/12/2012

   **This is the date given on AQDM PAN-01 form*
2. Does this Modeling submittal **completely** follow the Approved Protocol? ☐ Yes ☒ No

   If yes, proceed to Section 3.

   If no, proceed to Section 2.

Section 2. Changes to Modeling Protocol

Table 1: Protocol Changes (Please indicate which sections in Approved Protocol contain changes.)

Modeling protocol by sections

Section and section name	**Change/No change**
Files to accompany protocol	No Change
Section A *Purpose for Air Dispersion Modeling and Related Information*	No Change
Section B *EPA Pre-Processors and EPA Post-Processors*	No Change
Section C *Model Selection and Options (Key CO Pathway Inputs)*	Change
Section D *Emission Source Characterizations and Parameters (Key SO Pathway Inputs)*	No Change
Section E *Paved Roads Fugitive Dust (as per MPCA April 25, 2011 Policy)*	No Change
Section F *Receptors (RE Pathway)*	Change
Section G *Meteorological Data (ME Pathway)*	Change
Section H *SIL Analysis and Results*	No Change
Section I *Background Values*	Change
Section J *Nearby Sources*	Change
Section K *Anticipated Outputs (OU Pathway)*	No Change

Section 2.1: Detailed Changes to Modeling Protocol

Please provide specific information corresponding to those sections in Table 1 where changes are indicated.

Section A. Purpose for air dispersion modeling and related information

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

Section B. EPA pre-processors and EPA post-processors

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

Section C. Model selection and options (Key CO pathway inputs)

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 11/7/2012

Describe changes and/or indicate section item number(s):

5c. MPCA processed hourly ozone .dat files are no longer allowed, so user processed hourly ozone files were developed and submitted as part of response to report comments received on version 1 of this report.

Section D. Emission source characterizations and parameters (Key SO pathway inputs)

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

Section E. Paved roads fugitive dust

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

Section F. Receptors (RE pathway)

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 8/2/2012

Describe changes and/or indicate section item number(s):

NO2 1hour and NOX Annual Significant Impact Analysis was re-run with the updated NO2 emission rates and a revised Cumulative NAAQS and Increment receptor grid specific to NO2/NOX modeling was created. The SIL modeling analysis files are included with the supplemental files attached to this report.

Section G. Meteorological data (ME pathway)

MPCA approved change: ☐ Yes ☒ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

7b. Wind speed dependent calculation spreadsheet had an incorrect value for the minimum wind speed category value, which resulted in the number of events per wind speed category to be incorrect. This value was corrected and incorporated into final modeling. The methodology for how the wind speed dependent emission rates were determined was not changed.

Section H. SIL analysis and results

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

Section I. Background values

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 11/7/2012

Describe changes and/or indicate section item number(s):

2a. The MPCA generated single value 1 hour SO2 and NO2 background concentrations are no longer acceptable, therefore, the 1 hour NO2 and SO2 background concentrations were calculated using the 2008-2010 monitor values from the same monitors used for the Annual NOX background and the 3-hr, 24-hr, and annual SO2 background.

Section J. Nearby sources

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

3. The nearby source inputs spreadsheet has been updated to reflect changes to nearby facility inputs after review and discussions by MPCA. An updated nearby source input spreadsheet has been included and these values are incorporated into the final modeling.

Section K. Anticipated outputs (OU pathway)

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes and/or indicate section item number(s):

Section 3. Paved Roads Fugitive Dust (Optional)

Facilities that have indicated in AQDMP-01 form the exclusion of paved roads in the air dispersion modeling should provide the results of that modeling in Table 1. (See the AQDMP-01 form for details.)

Table 1: Paved Road Dust modeling results

	Averaging Period	NAAQS ($\mu g/m^3$)	Total Modeled NAAQS Concentration (includes Background and Nearby Sources) ($\mu g/m^3$)	% of NAAQS	PSD Class II Increments ($\mu g/m^3$)	Modeled Class II Increment Impact Concentrations ($\mu g/m^3$)	% of Class II Increments
PM_{10}	24-hour	150		0.00%	30		0.00%
	Annual	50		0.00%	17		0.00%
$PM_{2.5}$	24-hour	35		0.00%	9		0.00%
	Annual	15		0.00%	4		0.00%

Section 4. Modeling Results

Table 2: Pollutants and averaging periods (Indicate with an "X" all pollutant and averaging period(s) modeled.)

Pollutant	Averaging Period	Standard		Increment
		NAAQS	MAAQS	
CO	1-hr			
	8-hr			
Lead	Rolling 3 mo. Avg			
	Quarterly Avg			
NO_2	1-hr	X	X	
	Annual	X	X	X
SO_2	1-hr	X	X	

	3-hr	X	X	X
	24-hr	X	X	X
	Annual	X	X	X
PM_{10}	24-hr	X	X	X
	Annual	X	X	X
$PM_{2.5}$	24-hr	X	X	
	Annual	X	X	

Table 3: NAAQS/MAAQS modeling results (Enter modeling results along with the percent of standard.)

Pollutant	Averaging period	NAAQS standard (ug/m^3)	MAAQS standard (ug/m^3)	Total modeled concentration (includes background and nearby sources) (ug/m^3)	Percent of standard (%)	
					NAAQS	MAAQS
CO	1-hr	40,000	35,000			
	8-hr	10,000	10,000			
Lead	Rolling 3 mo. Avg	0.15	***			
	Quarterly Avg	1.5	1.5			
NO_2	1-hr	188	***	292	155	NA
	Annual	100	100	23	23	23
SO_2	1-hr	196	1300	893	456	69
	3-hr	***	1300/*915	784	NA	86
	24-hr	365	365	255	NA	70
	Annual	80	60	24	NA	40
PM_{10}	24-hr	150	150	77	51	51
	Annual	***	50	19	NA	38
$PM_{2.5}$	24-hr	35	65	34	96	52
	Annual	15	15	12	63	63

**SO2 3-hr for Northern Minnesota is 915 ug/m3.*

Table 4: Increment modeling results (Provide the increment modeling results along with the percent of standard.)

Pollutant	Averaging Period	Class II Increment (ug/m^3)	Total Modeled Concentration (includes other increment sources) (ug/m^3)	Percent of Standard (%)
NO_2	1-hr	***		
	Annual	25	0.86	3.5
SO_2	1-hr	***		
	3-hr	512	11	2.1
	24-hr	91	1.9	2.1
	Annual	20	0.17	0.8
PM_{10}	24-hr	30	18	59
	Annual	17	3.0	18
$PM_{2.5}$	24-hr	9		
	Annual	4		

Section 5. Discussion

Enter any discussion comments:

The Results in Tables 3 and 4 are for the Cumulative Results at the LTV ambient air boundary. Section 6 below includes more detailed modeling results tables which include the PolyMet plant site only results at the PolyMet ambient air boundary and results tables incorporating culpability. A detailed discussion of the modeled results is included in the Section 3 Supplemental Information included after the report forms.

Section 6. Modeling Results Figures/Maps

Insert a figure or map showing the facility emission sources, receptors, and the location of the modeled maximum concentration(s) for each applicable pollutant, corresponding averaging periods, and operating scenarios. Figures or maps should correspond to Section 3 NAAQS and Increment results.

[Paste here]

Attachment to Form AQDMR-01 - Table 3A

NorthMet Plant Site Alone NAAQS/MAAQS Modeling Results

Pollutant	Averaging Period	NAAQS (ug/m^3)	MAAQS (ug/m^3)	Modeled Result (ug/m^3) [1]	Background Concentration (ug/m^3) [2]	Total Result (ug/m^3)	% of NAAQS	% of MAAQS
NO_2	1 Hour	188	NA	88	89.6	177	94	NA
NO_X	Annual	100	100	3.2	17.6	21	21	21
SO2	1 Hour	196	1300	103	6.1	109	56	8
	3 Hour	NA	915	85	12.1	97	NA	11
	24 Hour	NA	365	35	5.5	40	NA	11
	Annual	NA	60	5.9	0.63	7	NA	11
PM_{10}	24 Hour	150	150	44	36	80	53	53
	Annual	NA	50	12	14	26	NA	53
$PM_{2.5}$	24 Hour	35	65	17	16.5	33	94	51
	Annual	15	15	5.8	5.8	12	77	77

[1] The modeled results follow the form of the standard described in the modeling protocol.
NO2 (1-hr): 5 year average High 8th High Concentration
NOX (annual): Maximum Annual Concentration out of 5 years
SO2 (1-hr): 5 year average High 4th High Concentration
SO2 (3,24-hr): Maximum High 2nd High Concentration out of 5 years
SO2 (annual): Maximum Annual Concentration out of 5 years
PM10 (24-hr): 5 year High 6th High Concentration
PM10 (annual): Maximum Annual Concentration out of 5 years
PM2.5 (24-hr): 5 year average High 8th High Concentration
PM2.5 (annual): Maximum Annual Concentration out of 5 years

[2] The background concentration value descriptions are as follows:
NO2 (1-hr): 2008-2010 Maximum Daily 1 hour 98th percentile average NOX Concentration from Blaine-Anoka Airport Monitor
NOX (annual): 2008-2010 Maximum Annual NOX Concentration from Blaine-Anoka Airport Monitor
SO2 (1-hr): 2008-2010 Maximum Daily 1 hour 99th percentile SO2 Concentration from Rosemount, MN Site 443 Monitor
SO2 (3,24-hr): 2008-2010 Maximum High 2nd High SO2 Concentration from Rosemount, MN Site 443 Monitor
SO2 (annual): 2008-2010 Maximum Annual SO2 Concentration from Rosemount, MN Site 443 Monitor
PM10 (24-hr): 2008-2010 Average High 2nd High PM10 Concentration from Virginia, MN Monitor
PM10 (annual): 2008-2010 Maximum Annual PM10 Concentration from Virginia, MN Monitor
PM2.5 (24-hr): 2008-2010 Average High 2nd High PM2.5 Concentration from Virginia, MN Monitor
PM2.5 (annual): 2008-2010 Maximum Annual PM2.5 Concentration from Virginia, MN Monitor

Attachment to Form AQDMR-01 - Table 3B

Cumulative Impact NAAQS/MAAQS Modeling Results

Pollutant	Averaging Period	NAAQS (ug/m^3)	MAAQS (ug/m^3)	Modeled Result (ug/m^3) [1]	PolyMet Plant Site Contribution to Modeled Results (ug/m^3)	SIL (ug/m^3)	Background Concentration (ug/m^3) [2]	Total Result (ug/m^3)	% of NAAQS	% of MAAQS
NO_2	1 Hour	188	NA	202	0.00167	7.52	89.6	292	155	NA
NO_X	Annual	100	100	5.6	NAAQS Attainment	1	17.6	23	23	23
SO2	1 Hour	196	1300	887	0.0024	7.83	6.1	893	456	69
	3 Hour	NA	915	772	MAAQS Attainment	25	12.1	784	NA	86
	24 Hour	NA	365	249	MAAQS Attainment	5	5.5	255	NA	70
	Annual	NA	60	24	MAAQS Attainment	1	0.63	24	NA	40
PM_{10}	24 Hour	150	150	**41**	NAAQS Attainment	5	36	77	51	51
	Annual	NA	50	**4.9**	MAAQS Attainment	1	14	19	NA	38
$PM_{2.5}$	24 Hour	35	65	**17**	NAAQS Attainment	1.2	16.5	34	96	52
	Annual	15	15	**3.7**	NAAQS Attainment	0.3	5.8	10	63	63

[1] The modeled results follow the form of the standard described in the modeling protocol.
NO2 (1-hr): 5 year average High 8th High Concentration
NOX (annual): Maximum Annual Concentration out of 5 years
SO2 (1-hr): 5 year average High 4th High Concentration
SO2 (3,24-hr): Maximum High 2nd High Concentration out of 5 years
SO2 (annual): Maximum Annual Concentration out of 5 years
PM10 (24-hr): 5 year High 6th High Concentration
PM10 (annual): Maximum Annual Concentration out of 5 years
PM2.5 (24-hr): 5 year average High 8th High Concentration
PM2.5 (annual): Maximum Annual Concentration out of 5 years

[2] The background concentration value descriptions are as follows:
NO2 (1-hr): 2008-2010 Maximum Daily 1 hour 98th percentile average NOX Concentration from Blaine-Anoka Airport Monitor
NOX (annual): 2008-2010 Maximum Annual NOX Concentration from Blaine-Anoka Airport Monitor
SO2 (1-hr): 2008-2010 Maximum Daily 1 hour 99th percentile SO2 Concentration from Rosemount, MN Site 443 Monitor
SO2 (3,24-hr): 2008-2010 Maximum High 2nd High SO2 Concentration from Rosemount, MN Site 443 Monitor
SO2 (annual): 2008-2010 Maximum Annual SO2 Concentration from Rosemount, MN Site 443 Monitor
PM10 (24-hr): 2008-2010 Average High 2nd High PM10 Concentration from Virginia, MN Monitor
PM10 (annual): 2008-2010 Maximum Annual PM10 Concentration from Virginia, MN Monitor
PM2.5 (24-hr): 2008-2010 Average High 2nd High PM2.5 Concentration from Virginia, MN Monitor
PM2.5 (annual): 2008-2010 Maximum Annual PM2.5 Concentration from Virginia, MN Monitor

Attachment to Form AQDMR-01 - Table 4A
NorthMet Plant Site Alone Increment Modeling Results

Pollutant	Averaging Period	Increment (ug/m^3)	Modeled Result (ug/m^3) [1]	% of Increment
NO_X	Annual	25	3.2	13
SO_2	3 Hour	512	85	17
	24 Hour	91	35	38
	Annual	20	5.9	29
PM_{10}	24 Hour	30	27	91
	Annual	17	-0.14	-0.82

[1] The modeled results follow the form of the standard described in the modeling protocol.
NOX (annual): Maximum Annual Concentration out of 5 years
SO2 (3,24-hr): Maximum High 2nd High Concentration out of 5 years
SO2 (annual): Maximum Annual Concentration out of 5 years
PM10 (24-hr): Increment - Maximum High 2nd High Concentration out of 5 years
PM10 (annual): Maximum Annual Concentration out of 5 years

Attachment to Form AQDMR-01 - Table 4B
Cumulative Impact Increment Modeling Results

Pollutant	Averaging Period	Increment (ug/m^3)	Modeled Result (ug/m^3) [1]	% of Increment
NO_X	Annual	25	0.86	3.5
SO_2	3 Hour	512	11	2.1
	24 Hour	91	1.9	2.1
	Annual	20	0.17	0.8
PM_{10}	24 Hour	30	**18**	59
	Annual	17	**3.0**	18

[1] The modeled results follow the form of the standard described in the modeling protocol.
NOX (annual): Maximum Annual Concentration out of 5 years
SO2 (3,24-hr): Maximum High 2nd High Concentration out of 5 years
SO2 (annual): Maximum Annual Concentration out of 5 years
PM10 (24-hr): Maximum High 2nd High Concentration out of 5 years
PM10 (annual): Maximum Annual Concentration out of 5 years

Acronyms

$\mu g/m^3$	Micrograms per cubic meter
AERMAP	AERMOD Terrain Preprocessor
AERMET	AERMOD Meteorological Preprocessor
AERMOD	AMS/EPA Regulatory Model
AQ	Air Quality
AQDMP-01	Air Quality Dispersion Modeling Protocol form
AQDMPS-01	Air Quality Dispersion Modeling Protocol Spreadsheet
BPIP-PRIME	Building Profile Input Program for PRIME
CO	Carbon Monoxide
EPA	U.S. Environmental Protection Agency
FAC	3-letter facility ID
MAAQS	Minnesota State Ambient Air Quality Standard
MPCA	Minnesota Pollution Control Agency
NAAQS	National Ambient Air Quality Standard
NO_2	Nitrogen Dioxide
OU	Operable Unit
Pb	Lead
PM_{10}	Particulate Matter less than 10 um in size
$PM_{2.5}$	Particulate Matter less than 2.5 um in size
PRIME	Plume Rise Model Enhancements
PSD	Prevention of Significant Deterioration Program
SIL	Significant Impact Level
SO_2	Sulfur Dioxide
SIP	State Implementation Plan
SMS	Standardized Mobile Source
UG/M3	Micrograms per cubic meter ($\mu g/m^3$)
UTM	Universal Transverse Mercator

Section 3 Supplemental Information

The Plant Site Class II modeling analysis focused on two impacts: Plant Site impacts at PolyMet's ambient air boundary and the combined impacts of the Plant Site with nearby facilities at a cumulative impacts boundary encompassing the shared properties of the NorthMet Plant Site (Plant Site), Mesabi Nugget, and Cliffs Erie Pellet Yard using the former LTV Steel Mining Company (LTVSMC) property boundary as the ambient air boundary. The modeling results discussion is arranged by pollutant and reference the modeling results tables and figures included with the Class II Plant Site Modeling Report.

Note: in comments provided by MPCA on the Mesabi Nugget modeling inputs used for cumulative assessments, they recommended excluding the sources from the Mesabi Nugget Phase II (Mesabi Mining) EIS, because MPCA does not have a current project description or permit application for this project. PolyMet elected not to rerun the particulate modeling without the Phase II sources, because the modeling with them produced acceptable results and these results would reflect higher total emissions than the approach recommended by MPCA (i.e. the reported cumulative results are conservative).

PM_{10}: 24 Hour and Annual Increment and NAAQS

The PM_{10} Analysis included two different wind erosion Tailings Basin scenarios for the Plant Site called Scenario 1 and Scenario 2. In the initial stages of modeling the Tailings Basin, it was determined that it was overly conservative to assume the entire beach area as erodible because only a portion of the total beach acreage would be active and erodible while the remainder would be vegetated or otherwise stabilized. The active acreages were evaluated along the entire beach area and the locations that provided the maximum impacts to the PolyMet receptors were assumed as the worst case. These locations tended to be at the south end, closest to the southern ambient air boundary. Figure 5 in the Plant Site protocol showed the entire erodible beach area and the Plant Site only PM_{10} 24-hour NAAQS results in Figures 3 and 4 of this document show the erodible beach areas represented by Scenarios 1 and 2 in red.

As stated in the Plant Site protocol, "Final results will be used to determine need for inclusion of paved roads in submitted modeling". The MPCA paved road guidance policy indicates that PM_{10} and $PM_{2.5}$ NAAQS results greater than 95% or PM_{10} Increment results greater than 75% of the standard require the inclusion of paved roads in the modeling analysis. The Plant Site only PM_{10} Increment results are below their respective increments of 30 and 17 $\mu g/m^3$ as shown in Table 4A and the maximum impacts are at the boundary due south of the tailings basin as shown in Figure 2. However, the 24 hour PM_{10} Increment result is greater than 75% of the Increment, which would require the paved road to be included in the analysis.

The Plant Site paved road was present at the baseline date and used during operations of the LTVSMC plant. PolyMet is proposing to use this paved road for the same types of activities, so there would be no net increment consumption along the paved road. Traffic on paved roads for LTVSMC and the Project would include employee vehicles, company owned light trucks and service vehicles and deliveries of

goods by over-the-road trucks (i.e. 80,000 pounds maximum weight). LTVSMC shipped taconite pellets predominantly by rail and the Project will also ship large volume products (i.e. flotation concentrates) primarily by rail and the lower volume products (Nickel/Cobalt hydroxide and PGM concentrate) primarily by over-the-road truck. The truck traffic from Project product shipping will be relatively low at an average rate of 2-3 trucks per day for Ni/Co hydroxide and 1 to 2 trucks per month for PGM concentrate. Most Project process consumables used in large quantities will be shipped by rail - lime will have the highest volume routinely shipped by truck at an approximate rate of 22 over-the-road trucks per month. Overall, traffic at the baseline date for LTVSMC would be expected to be greater than for the Project due to the higher operating capacity of the plant (100,000 tons per day versus 32,000 tons per day) and the associated higher staffing levels (approximately 1,400 versus 360 full time employees).

The 24-hour and annual PM_{10} NAAQS results for the Plant Site are around 50% of their respective NAAQS/MAAQS as shown in Table 3A. Figures 3 and 4 show the 24 hour PM_{10} NAAQS results for the Plant Site only. The maximum results are located at the ambient air boundary south of the Tailings Basin.

PM_{10} cumulative impact results for the 24 hour Increment were 59% of the 30 $\mu g/m^3$ standard and the annual increment results were 18% of the standard as shown in Table 4B. Figure 5 shows the maximum concentration is located south of the NorthMet Mine Site in that scenario.

PM_{10} cumulative Impact results for the 24 hour NAAQS were 51% the 150 $\mu g/m^3$ standard and the annual MAAQS results were 38% of the standard as shown in Table 3B. Figures 6 and 7 show the maximum concentrations located at Mesabi Nugget's ambient air boundary west of the proposed Mesabi Mining Phase II tailings basin.

The above cumulative results did not include the paved roads at the Mesabi Nugget facility and the results are below the level that would require them to be added per MPCA policy.

$PM_{2.5}$: 24 Hour and Annual NAAQS

The $PM_{2.5}$ Analysis included the same two wind erosion Tailings Basin scenarios for the Plant Site as the PM_{10} analysis: Scenario 1 and Scenario 2. The $PM_{2.5}$ 24-hour NAAQS results in Figures 8 and 9 show the erodible beach areas represented for Scenarios 1 and 2 in red.

As stated in the Plant Site protocol, "Final results will be used to determine need for inclusion of paved roads in submitted modeling". The MPCA paved road guidance policy requires that PM_{10} and $PM_{2.5}$ NAAQS results greater than 95% or PM_{10} Increment results greater than 75% of the standards require the inclusion of paved roads in the modeling analysis. The Plant Site only $PM_{2.5}$ NAAQS results are below their respective NAAQS of 35 and 15 $\mu g/m^3$ as shown in Table 3A and the maximum impacts are at the boundary due south of the tailings basin as shown in Figures 8 and 9. Both of these results are less than 95% of the NAAQS which does not require the paved road to be included.

$PM_{2.5}$ Cumulative Impact results for the 24 hour and annual NAAQS were below the 35 and 15 $\mu g/m^3$ standard as shown in Table 3B. Figures 10 and 11 show the maximum impacts are located at the boundary of Mesabi Nugget due west of the proposed tailings basin.

NO_2: 1 Hour NAAQS and Annual Increment and NAAQS

The annual NO_X Increment modeling results for the Plant Site at its own ambient air boundary were 13% of the increment of 25 $\mu g/m^3$ as shown in Table 4A. Figure 12 shows the maximum impact is at the boundary next to the new administration building. The most likely culpable NO_X source near that area is the administration building boiler. The Plant Site NAAQS results in Table 3A show the 1-hour and annual impacts are 94% and 21% of their respective standards. Figure 13 shows the 1-hour NO_2 maximum impacts at the boundary west of the Area 1 Shop due to space heater emissions emitted from its associated building vent. The annual NO_X NAAQS results shown in Figure 14 indicate the Administration Building Boiler is also the culpable source as was the case in the annual increment results.

The annual NO_X Cumulative Increment results are 3.5% of the standard of 25 $\mu g/m^3$ as shown in Table 4B. Figure 15 shows the maximum impacts occurring in two areas: west of the Mesabi Nugget Phase I plant and southeast of the Plant Site.

Cumulative impacts for 1-hour NO_2 NAAQS were modeled as a single 5 year run using the Ozone Limiting Method (OLM) in AERMOD. The maximum concentration was 155% of the NAAQS of 188 $\mu g/m^3$ as shown in Table 3B. Figure 16 shows the maximum impacts occurring throughout the western half of the receptor grid due to the nearby facilities (Arcelor Mittal, Virginia Public Utilities, Laskin Energy, and Minntac) that were included in the cumulative modeling. Figure 17 shows the Plant Site contribution to the 1-hour modeled concentrations shown in Figure 16. The Plant Site contributes 0.002 $\mu g/m^3$ to the maximum modeled 1-hour concentration and less than the SIL of 7.52 $\mu g/m^3$ for the receptors exceeding the NAAQS in Figure 16. The spreadsheet "NOX_results.xlsx" included with this report lists the contributions by facility for the 1-hour NO_2 modeled NAAQS concentrations. The annual NO_X results were 23% of the 100 $\mu g/m^3$ NAAQS and the maximum impacts shown in Figure 18 were at the western edge of the receptor grid indicating the previously mentioned nearby facilities being the culpable sources.

NAAQS and MAAQS are applicable requirements. MPCA will evaluate any exceedences as part of the air permitting process.

SO_2: 1 Hour NAAQS and 3 Hour, 24 Hour, and Annual Increment and NAAQS

The 3-hour, 24-hour, and annual SO_2 increment modeling results for the Plant Site at its own ambient air boundary are all substantially below their respective Increments (<50%) as shown in Table 4A. Figures 19, 20, and 21 show the maximum impacts at the boundary due south of the Plant Site. The Plant Site NAAQS results in Table 3A show that the 1-hour, 24-hour, and annual NAAQS impacts are all below the respective standards with 1-hour SO_2 having the lowest margin with 56% of its NAAQS of 196 $\mu g/m^3$. Figures 22, 23, 24, and 25 show the 1 hour SO_2 maximum impacts in the same location as the increment results; due south of the Plant Site at the ambient air boundary.

The 3-hour, 24-hour, and annual SO_2 Cumulative Increment results are all less than 5% of the standards as shown in Table 4B. Figures 26, 27, and 28 show the short term maximum impacts occurring west of the Mesabi Nugget Phase I plant and the annual maximum impacts occur there as well as southeast of the Plant Site.

Cumulative impacts for 1-hour SO_2 NAAQS were modeled as a single 5 year run in AERMOD. The maximum concentration was 456% of the NAAQS of 196 $\mu g/m^3$ as shown in Table 3B. Figure 29 shows the maximum impacts occurring at the southern edge of the Mesabi Nugget ambient air boundary and the western edge of the receptor grid due to nearby facilities Laskin Energy and Virginia Public Utilities that were included in the cumulative modeling. Figure 30 shows the Plant Site contribution to the 1-hour modeled concentrations shown in Figure 29. The Plant Site contributes 0.002 $\mu g/m^3$ to the maximum modeled 1-hour concentration and less than the 7.83 $\mu g/m^3$ SIL for the receptors exceeding the NAAQS in Figure 29. The spreadsheet "SO2_ results.xlsx" included with this report lists the contributions by facility for the 1-hour SO_2 modeled NAAQS concentrations. The 3-hour MAAQS is 915 $\mu g/m^3$ and the model results are 86% of this MAAQS. The 24-hour SO_2 results were 70% of their 365 $\mu g/m^3$ Minnesota Ambient Air Quality Standard (MAAQS). The Annual SO_2 results were 40% of their 60 $\mu g/m^3$ Minnesota Ambient Air Quality Standard (MAAQS). Figures 31, 32, and 33 show the maximum impacts were at the western edge of the receptor grid indicating the nearby facility Virginia Public Utilities being the culpable source.

As noted above, NAAQS and MAAQS are applicable requirements that will be addressed by MPCA in permitting.

Supplemental Information on Ozone NAAQS

Modeling for the NorthMet Project (Project) is being conducted and reported separately for the Mine Site and the Plant Site. In response to comments received on the Class II modeling protocol for the Plant Site, the following information on ozone formation is being included with the Plant Site Class II modeling results. However, the emission values referenced for the Project include both the Mine Site and Plant Site stationary source emissions, so the analysis applies to the entire project.

One of the primary differences in this ozone impacts analysis as compared to the other pollutants for which air quality impacts have been assessed is that dispersion modeling of ozone impacts is not technically or practically feasible[1] for determining an individual project's contribution to ground-level ozone concentrations either near the facility or at a long distance from the facility.

Ozone Formation, Fate and Transport

Ozone is formed through complex photochemical reactions between NO_X, VOC, other non-regulated compounds (e.g., OH^-), sunlight, and meteorological conditions of wind speed, wind direction, temperature, and humidity. Elevated ozone concentrations occur primarily during stable / stagnant atmospheric conditions in urban airsheds.[2] Minnesota generally does not experience long duration stagnation periods due to its geographic location and climate.

Ozone transport can be an important contributor to a region's ozone concentrations[3], however, due to its distance from metropolitan areas and prevailing winds, northern Minnesota is not typically affected by long range ozone transport.

Ozone concentrations from 2008-2010 for Voyageurs National Park (VNP) are shown in Table 1 and are below the applicable standard. VNP is located approximately 82 miles northwest of the Plant Site and is the only year-round ozone monitoring station in northern Minnesota.[4]

---

[1] 40 CFR Part 51 Appendix W – Guideline on Air Quality Models - Section 5.2.1.a.
[2] MPCA, 2011. Air Quality in Minnesota. 2011 Report to the Legislature. *Ozone concentrations tend to be highest just outside urban areas, since other pollutants emitted in urban centers actually destroy ground level ozone. As a result, MPCA does not monitor ozone in urban centers such as Minneapolis and St. Paul, but does in surrounding suburban areas.*
[3] See for example the Clean Air Interstate Rule (CAIR) replacement, called the Transport Rule, modifying 40 CFR Parts 51, 72, 73, 74, 77, 78, 96.

Table 1: Voyageurs National Park 8 Hour Ozone NAAQS Monitor

YEAR	8 Hour High 4th High Concentration (ppm)	NAAQS (ppm)	% NAAQS	Data Source
2008	0.059	0.08	74%	EPA Airdata website
2009	0.062	0.08	77%	EPA Airdata website
2010	0.067	0.08	84%	EPA Airdata website
AVERAGE	0.063	0.08	78%	

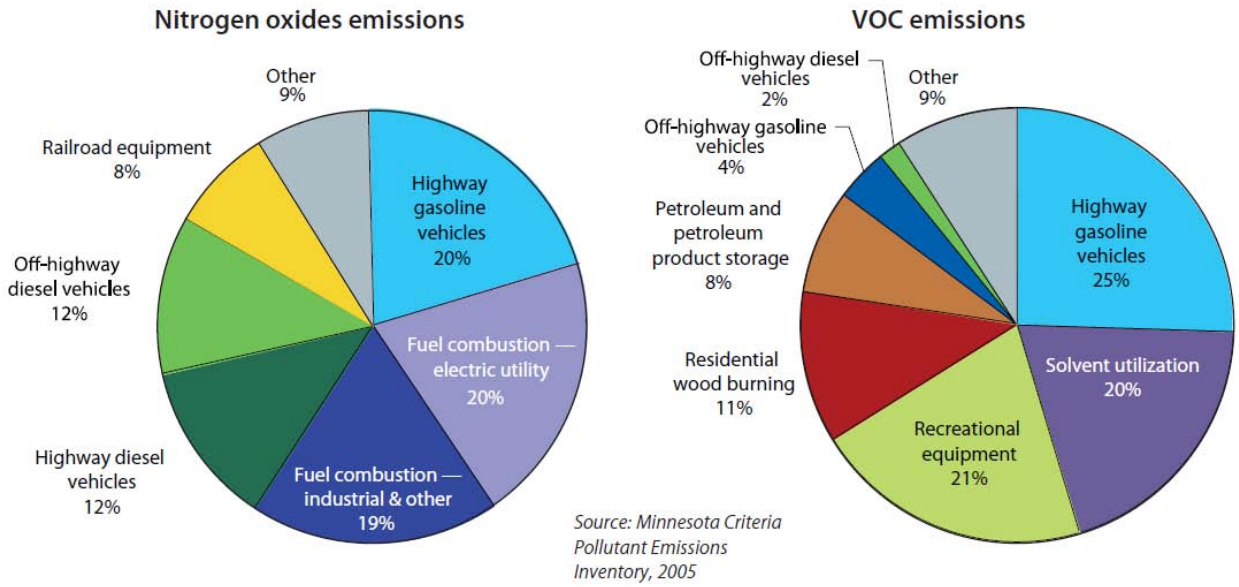
To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm (80 ppb).

Ozone Precursor Emission Levels

NO_X and VOC emissions are both ozone precursors. NO_X emissions are primarily anthropogenic, whereas VOCs are emitted both from biogenic and anthropogenic sources (http://www.epa.gov/ord/sciencenews/scinews_trees-and-air-pollution.htm). Figure 1 shows the primary anthropogenic emission source types for NO_X and VOCs in Minnesota.

[4] The MPCA conducts ozone monitoring at other stations in northern Minnesota from April through September.

Figure 1: Minnesota Ozone Precursor Emissions by Source Type[5]



Ozone concentrations are dependent on sunlight, heat and emissions of NO_X and VOCs. The main source of NO_X is emissions from burning fuels. Stationary sources such as electric utilities account for nearly 40 percent of NO_X emissions. Another 32 percent comes from gasoline and diesel highway vehicles. Major sources of VOCs include evaporation from and combustion of gasoline in highway and recreational vehicles (46 percent), use of solvents (20 percent) and residential wood burning (11 percent).

Project NO_X and VOC Emissions Analysis

The emission inventory spreadsheets submitted with version 2 of the Class I Modeling results list controlled potential emissions for the Project (Plant Site and Mine Site) stationary sources of 49 tpy VOC and 95 tpy NO_X.

Table 2 compares reported actual statewide emissions in 2008 with emissions increases that would result from the Project and with changes associated with reasonably foreseeable projects in northeastern Minnesota (as reported in Table 1 of the Cumulative Visibility Report (version 3, January 2012)).

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[5] Source: MPCA. Air Quality in Minnesota: Emerging Trends. 2009 Report to the Legislature

Statewide VOC emissions from 1999 are also included in Table 2[6]. The table illustrates that proposed Project emissions would be negligible compared to statewide emissions.

Table 2. Statewide Actual Emissions Compared with Proposed and Reasonably Foreseeable Emissions

NO_X	2008 Actuals	Proposed Project	Reasonably Foreseeable Changes in NE MN
Stationary sources (tons/yr)	129,000	95	-3,292
All sources (tons/yr)	391,000	--	--
% 2008, stationary	--	0.07%	-11.6%
% 2008, total	--	0.02%	-3.8%
VOC	**1999 Actuals**	**Proposed ESMM Project**	**Reasonably Foreseeable Changes in NE MN**
Stationary sources (tons/yr)	32,500	49	--
All sources (tons/yr)	397,000	--	--
% 1999, stationary	--	0.2%	--
% 1999, total	--	0.01%	--

Summary

In conclusion, while ozone formation is complex and not directly linear with respect to emissions, given the low Project NO_X and VOC emissions relative to statewide emissions, as well as the generally uniform ozone concentrations in northern Minnesota and its favorable location (relative to ozone formation), there is no reason to believe that the Project would have an impact on ozone concentrations either near to or far from the facility. Because ozone concentrations at the nearest receptor (VNP) are currently 78% of the standard (Table 1), there is no reason to expect emissions from the Project would alter compliance status at VNP with respect to the ozone standard.

[6] 1999 VOC emissions from MPCA website. http://www.pca.state.mn.us/index.php/topics/environmental-data/eda-environmental-data-access/eda-air-quality-searches/eda-air-quality-search-pollutant-data.html

- Cumulative Receptors
- Mesabi Nugget
- NorthMet Mine Site
- NorthShore Mine
- Mesabi Nugget AAB
- NorthMet Plant Site AAB
- St Louis County Tax Records

**Northshore Peter Mitchell Mine on-site receptors based on St. Louis County tax property records.

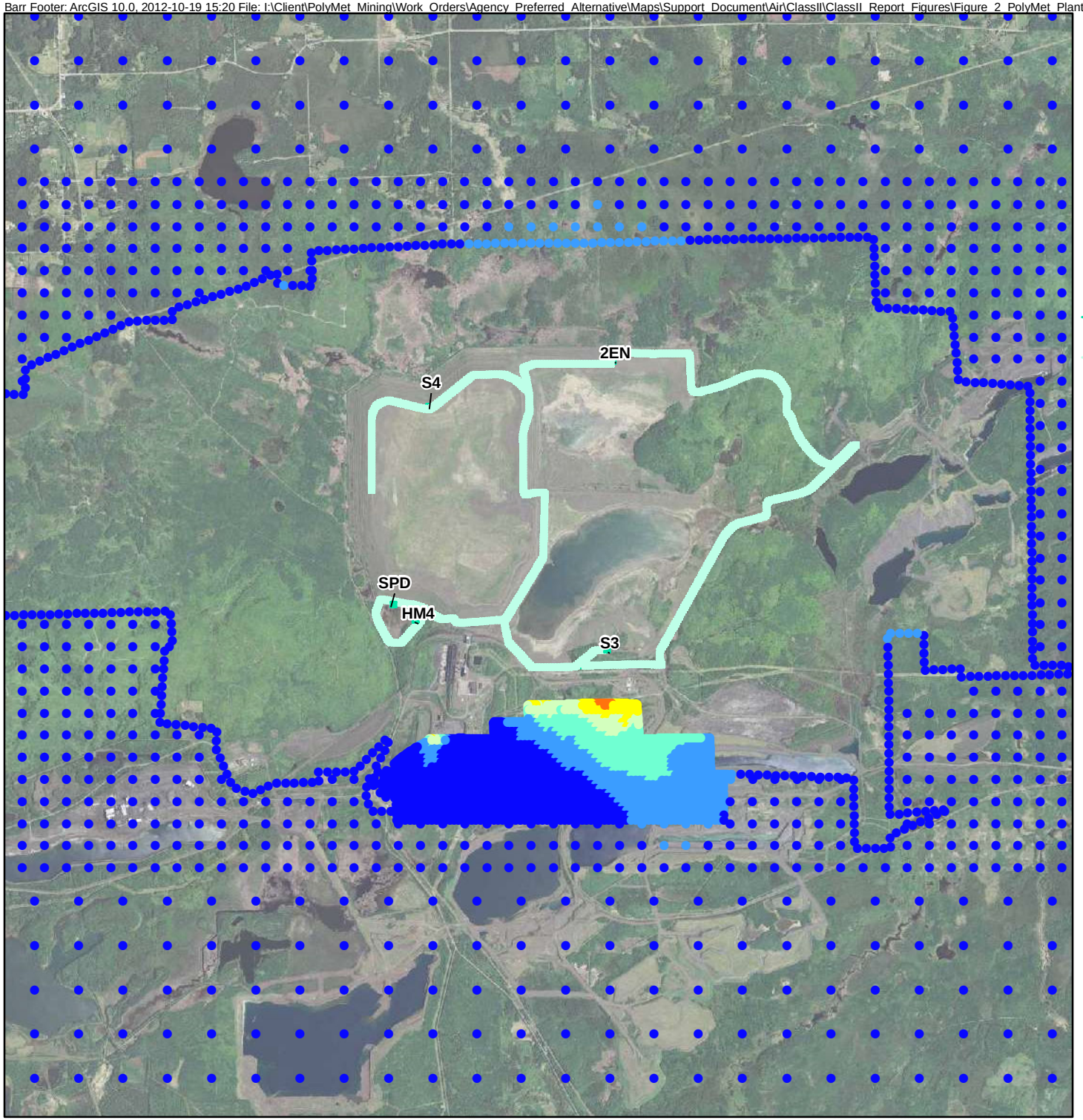
N

Kilometers

5 0 5 10

Figure 1

EIS CUMULATIVE NAAQS/INCREMENT
RECEPTOR GRID
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H2H Concentration (ug/m^3)

- 0 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 27
- Tailings Construction Handling
- Tailings Construction Roads

PM_{10} 24 Hour Increment is 30 ug/m^3.

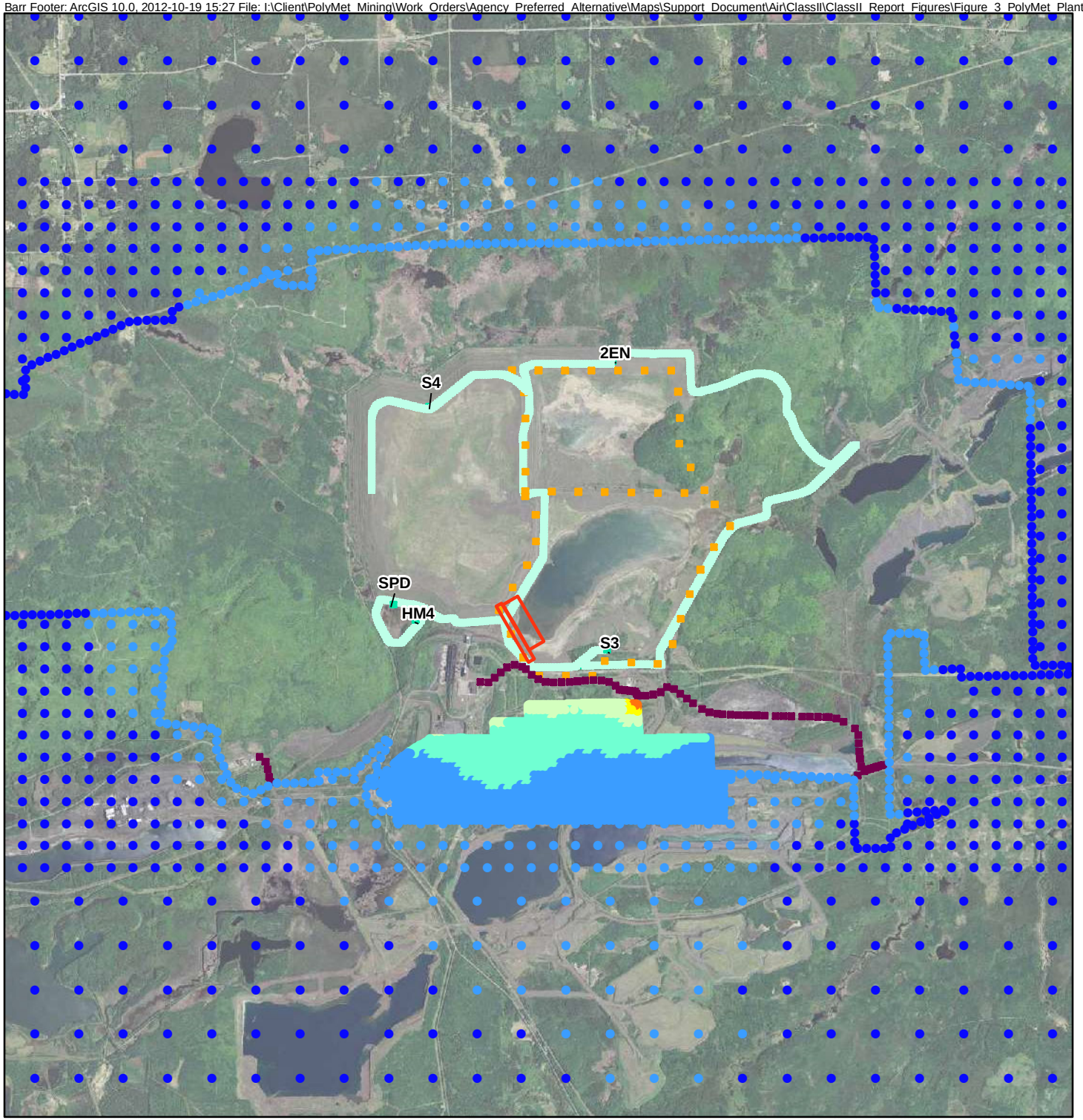
N

Meters

1,000 0 1,000

Figure 2

24 HOUR PM_{10} INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H6H Concentration ug/m^3

- 36 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 75
- 76 - 80
- Tailings Basin Erodible Beach Area
- Dunka Road Traffic
- Tailings Construction Handling
- Tailings Construction Roads
- Tailings Maintenance Traffic

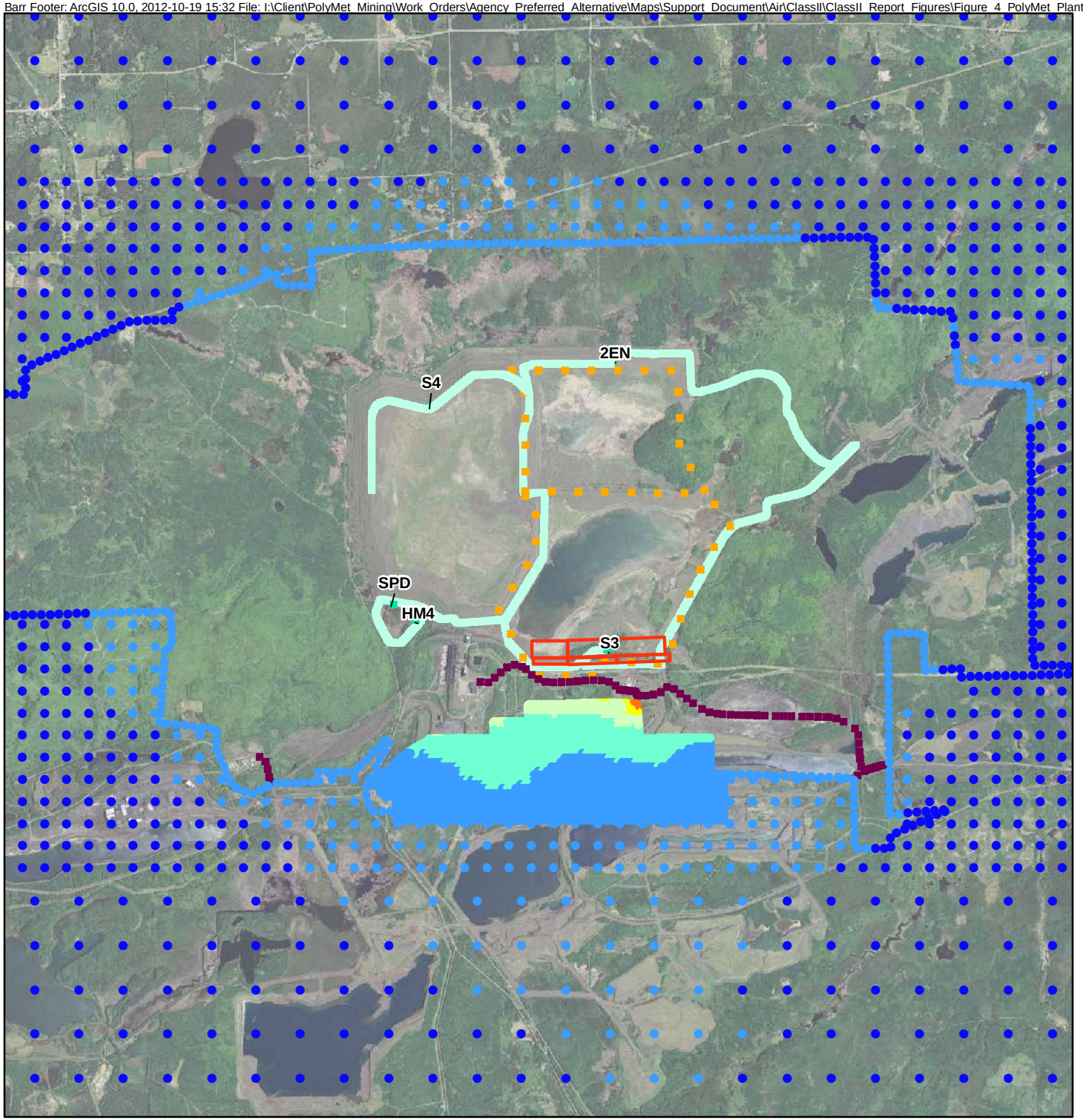
PM_{10} 24 Hour NAAQS is 150 ug/m^3.
Background Concentration Included = 36 ug/m^3

N

Meters
1,000 0 1,000

Figure 3

24 HOUR PM_{10} NAAQS RESULTS
TAILINGS BASIN SCENARIO 1
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H6H Concentration ug/m^3

- 36 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 75
- 76 - 80
- Tailings Basin Erodible Beach Area
- Dunka Road Traffic
- Tailings Construction Handling
- Tailings Construction Roads
- Tailings Maintenance Traffic

PM_{10} 24 Hour NAAQS is 150 ug/m^3.
Background Concentration Included = 36 ug/m^3

N

Meters
1,000 0 1,000

Figure 4

24 HOUR PM_{10} NAAQS RESULTS
TAILINGS BASIN SCENARIO 2
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

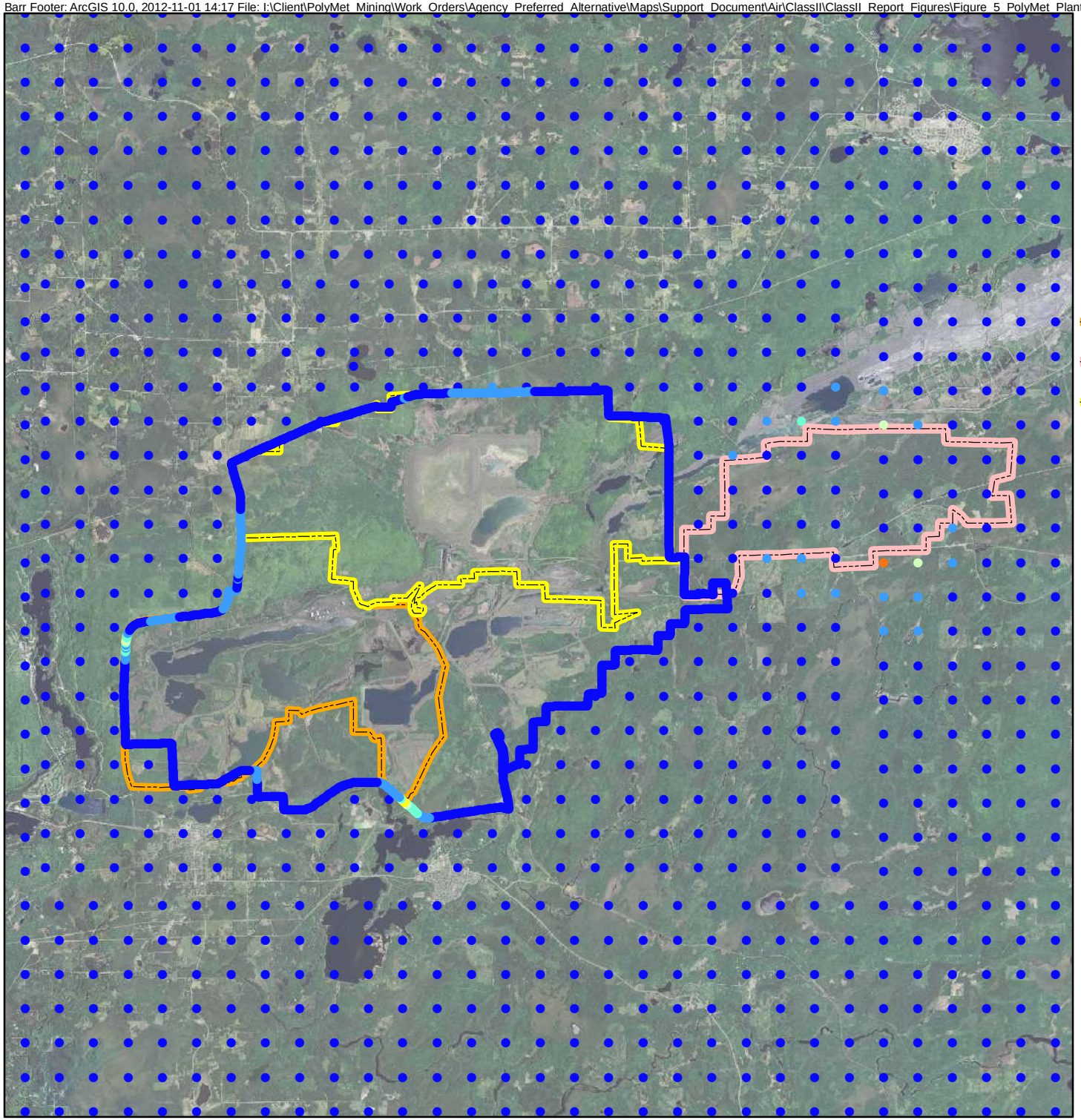
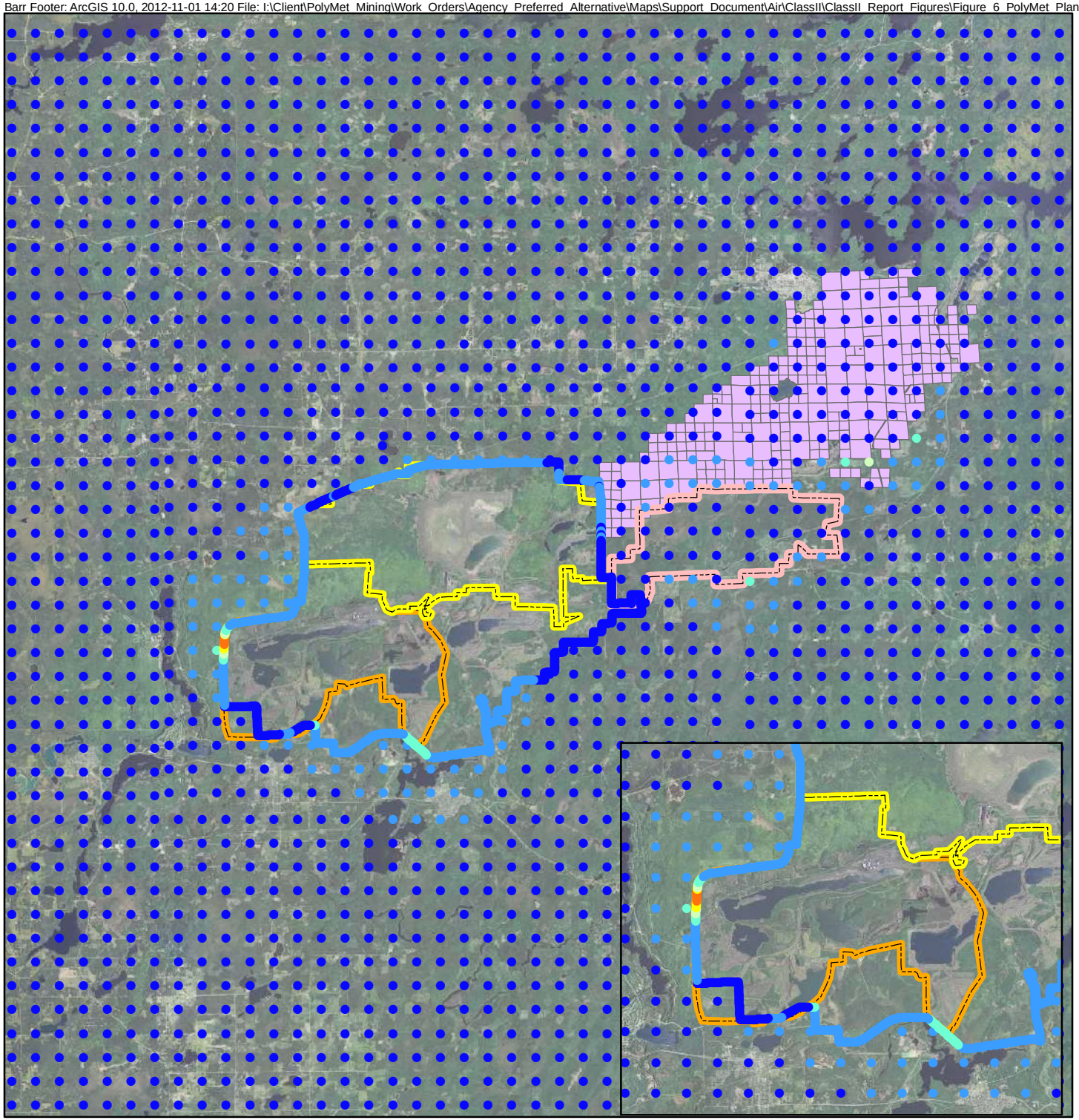


Figure 5

24 HOUR PM_{10} CUMULATIVE IMPACT INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H6H Concentration ug/m^3

- 36 - 40
- 41 - 50
- 51 - 60
- 61 - 65
- 66 - 70
- 71 - 77
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

PM_{10} 24 Hour NAAQS is 150 ug/m^3.
Background Concentration Included = 36 ug/m^3.

N

Kilometers
5 0 5

Figure 6

24 HOUR PM_{10} CUMULATIVE IMPACT NAAQS RESULTS
TAILINGS BASIN SCENARIO 1
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

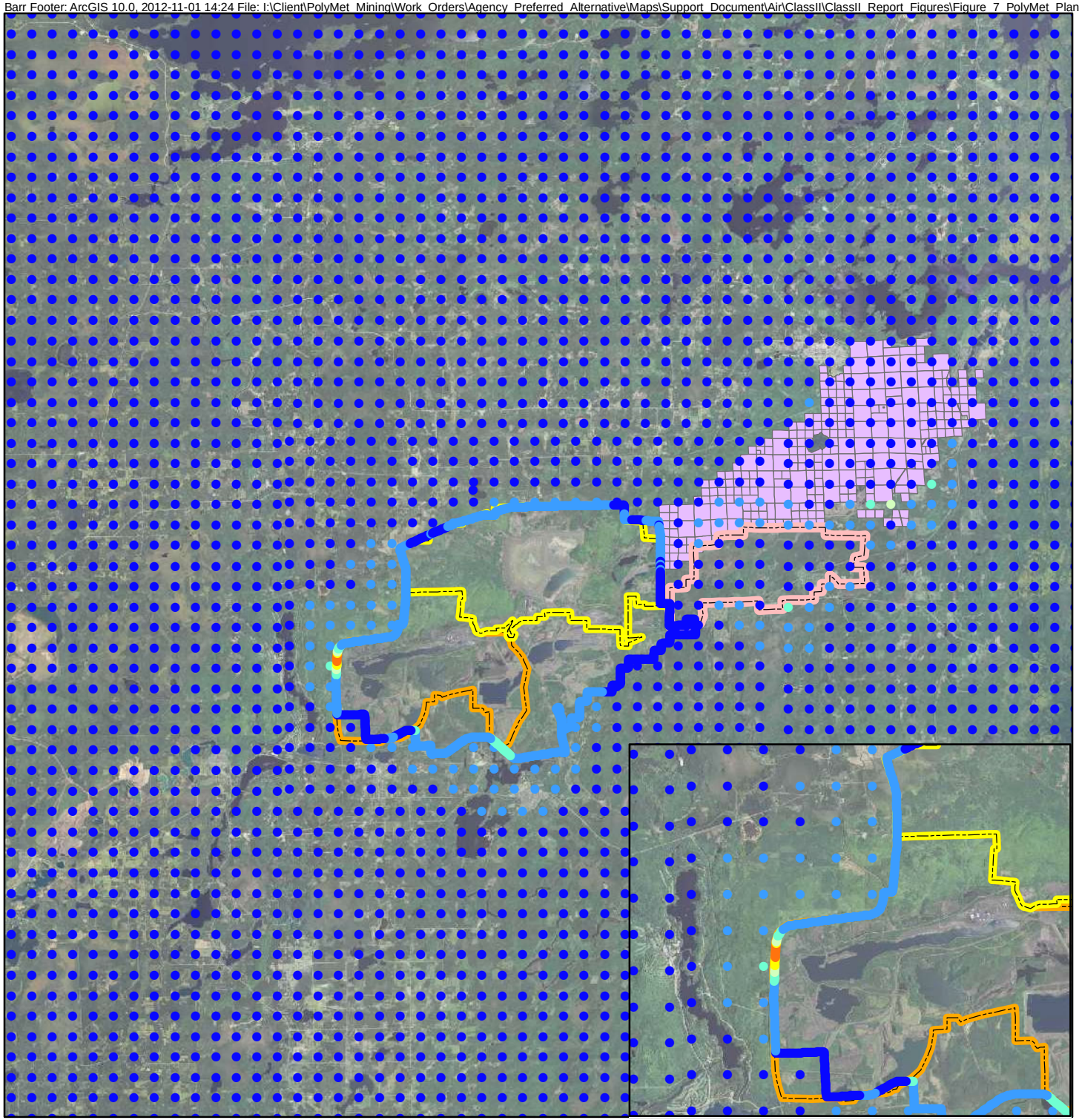
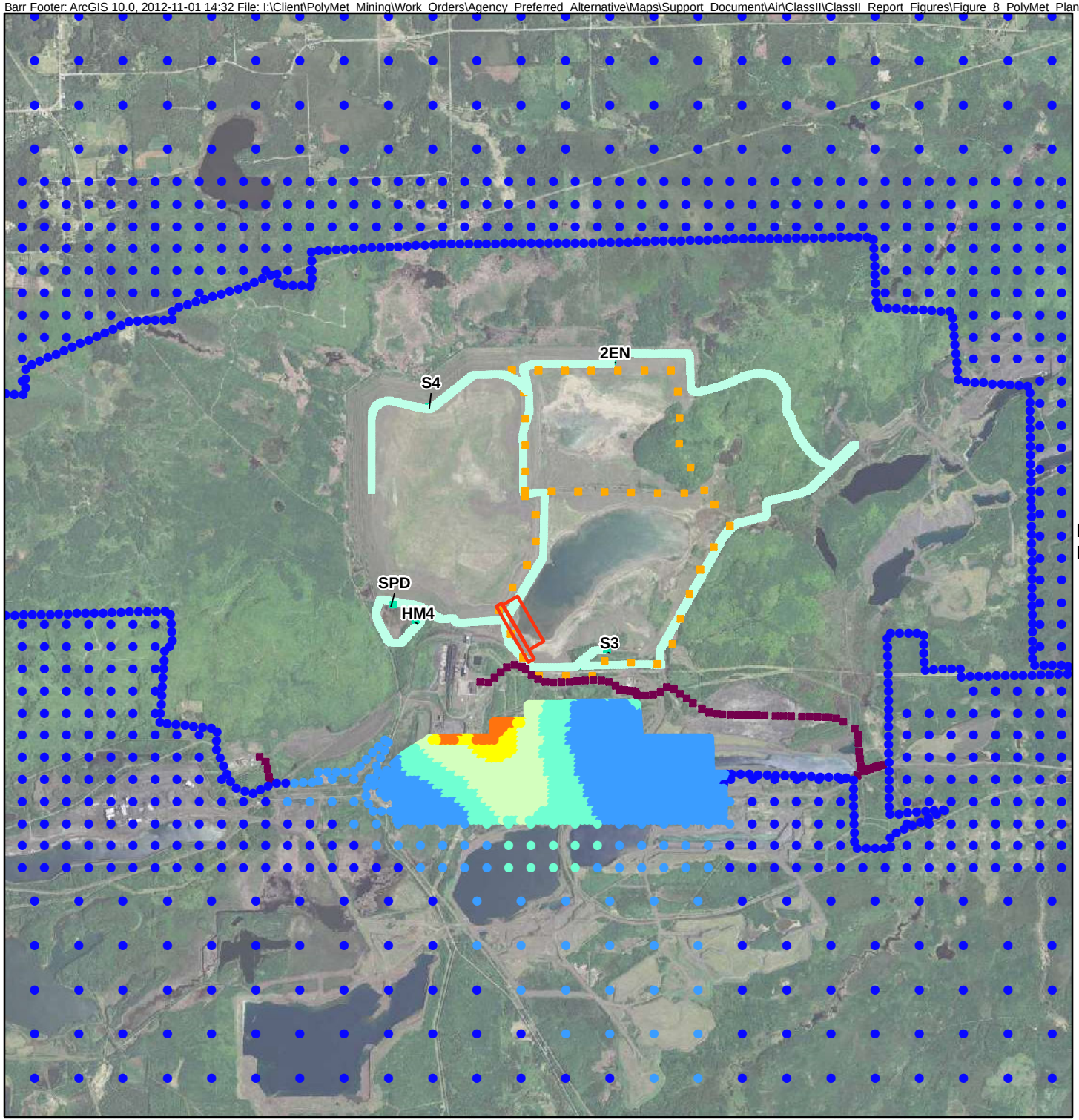


Figure 7

24 HOUR PM_{10} CUMULATIVE IMPACT NAAQS RESULTS
TAILINGS BASIN SCENARIO 2
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H8H Concentration ug/m^3

- 17 - 20
- 21 - 23
- 24 - 25
- 26 - 28
- 29 - 30
- 31 - 33
- Tailings Basin Erodible Beach Area
- Dunka Road Traffic
- Tailings Construction Handling
- Tailings Construction Roads
- Tailings Maintenance Traffic

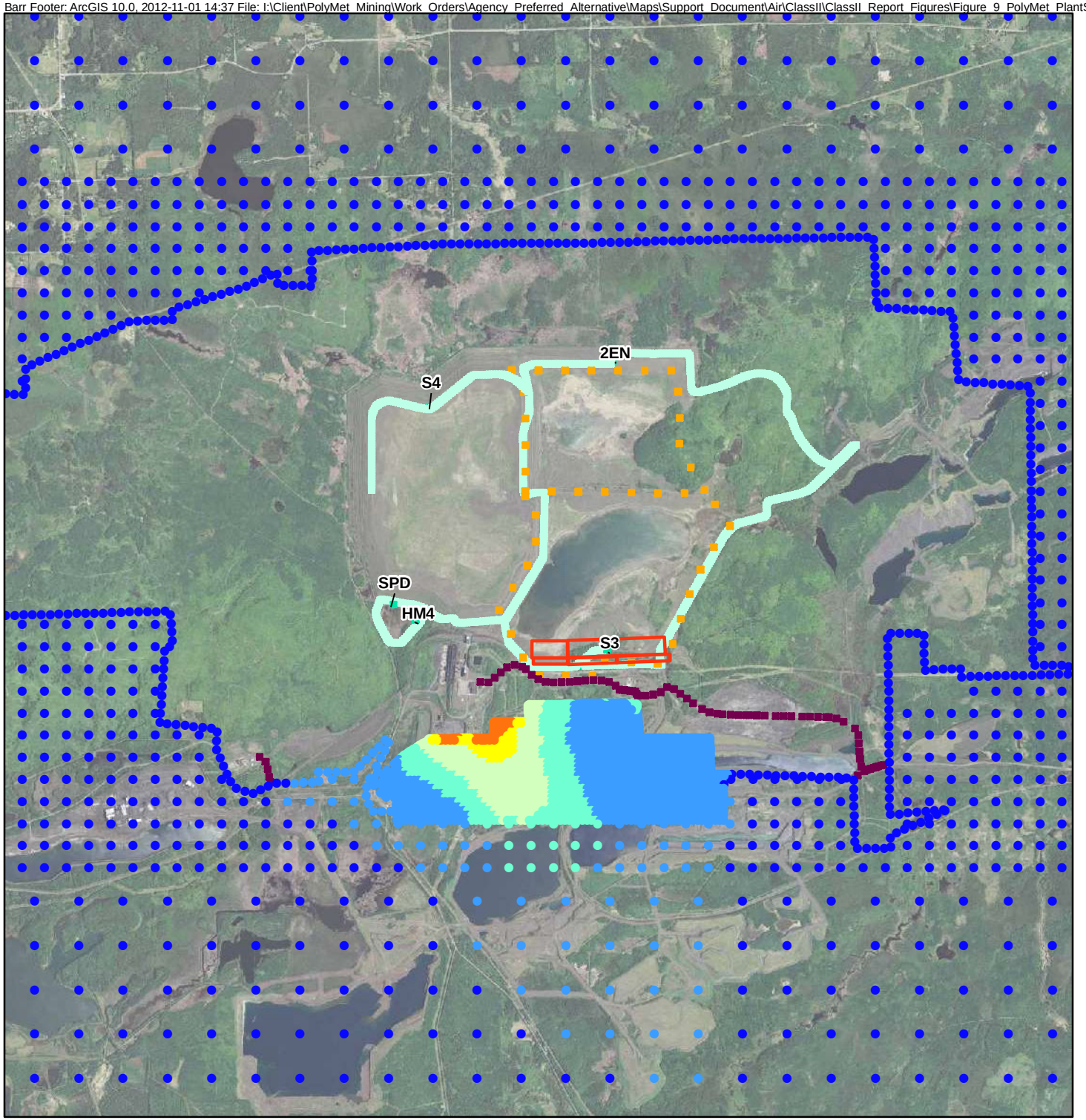
$PM_{2.5}$ 24 Hour NAAQS is 35 ug/m^3.
Background Concentration Included = 16.5 ug/m^3

N

Meters
1,000 0 1,000

Figure 8

24 HOUR $PM_{2.5}$ NAAQS RESULTS
TAILINGS BASIN SCENARIO 1
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H8H Concentration ug/m^3

- 17 - 20
- 21 - 23
- 24 - 25
- 26 - 28
- 29 - 30
- 31 - 33
- Tailings Basin Erodible Beach Area
- Dunka Road Traffic
- Tailings Construction Handling
- Tailings Construction Roads
- Tailings Maintenance Traffic

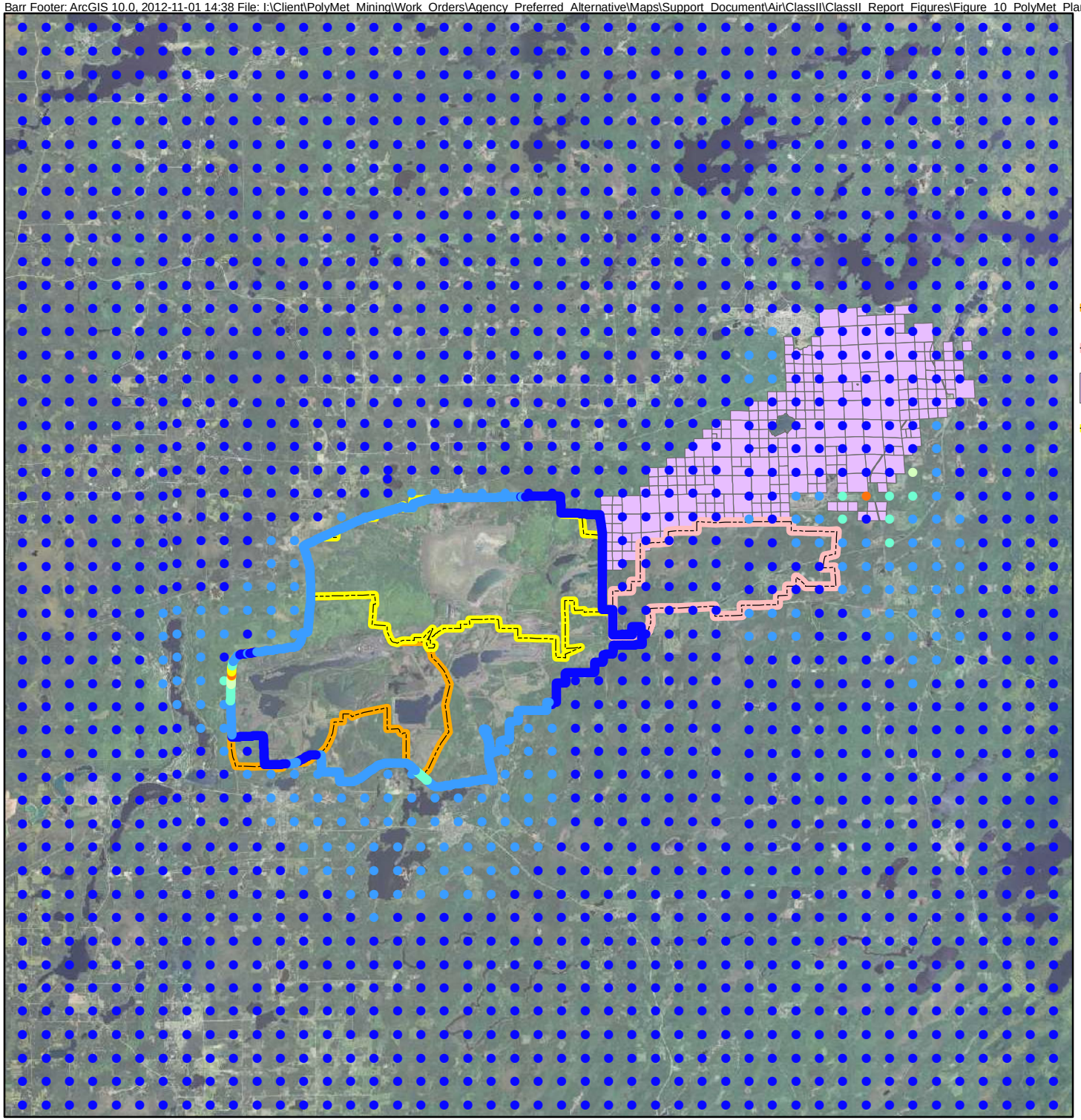
$PM_{2.5}$ 24 Hour NAAQS is 35 ug/m^3.
Background Concentration Included = 16.5 ug/m^3

N

Meters
1,000 0 1,000

Figure 9

24 HOUR $PM_{2.5}$ NAAQS RESULTS
TAILINGS BASIN SCENARIO 2
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H8H Concentration ug/m^3

- 17 - 20
- 21 - 24
- 25 - 28
- 29 - 30
- 31 - 32
- 33 - 34
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

$PM_{2.5}$ 24 Hour NAAQS is 35 ug/m^3.
Background Concentration Included = 16.5 ug/m^3

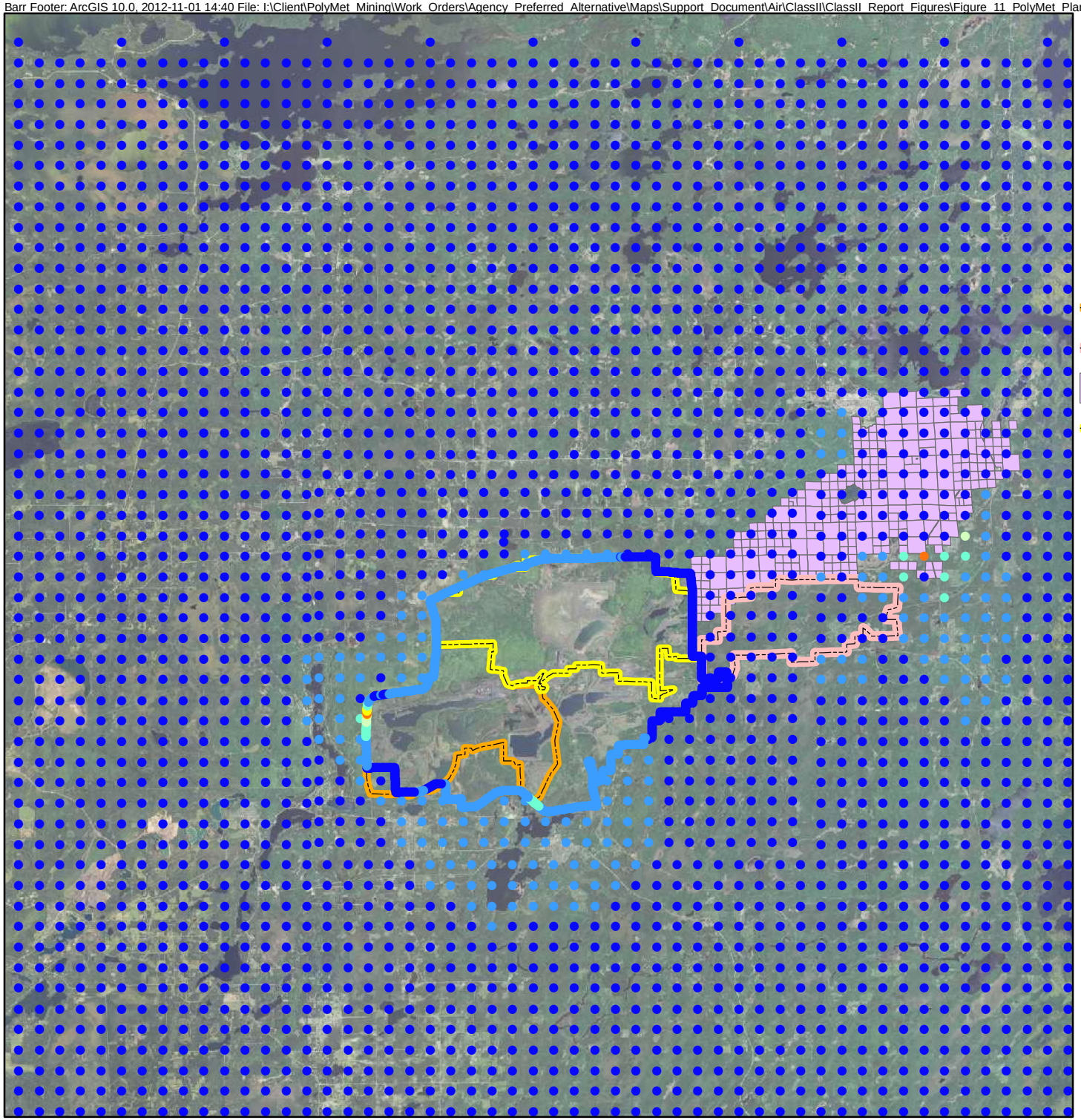
N

Kilometers

5 0 5

Figure 10

24 HOUR $PM_{2.5}$ CUMULATIVE IMPACT NAAQS RESULTS
TAILINGS BASIN SCENARIO 1
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H8H Concentration ug/m^3

- 17 - 20
- 21 - 24
- 25 - 28
- 29 - 30
- 31 - 32
- 33 - 34
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

$PM_{2.5}$ 24 Hour NAAQS is 35 ug/m^3.
Background Concentration Included = 16.5 ug/m^3

N

Kilometers

5 0 5

Figure 11

24 HOUR $PM_{2.5}$ CUMULATIVE IMPACT NAAQS RESULTS
TAILINGS BASIN SCENARIO 2
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

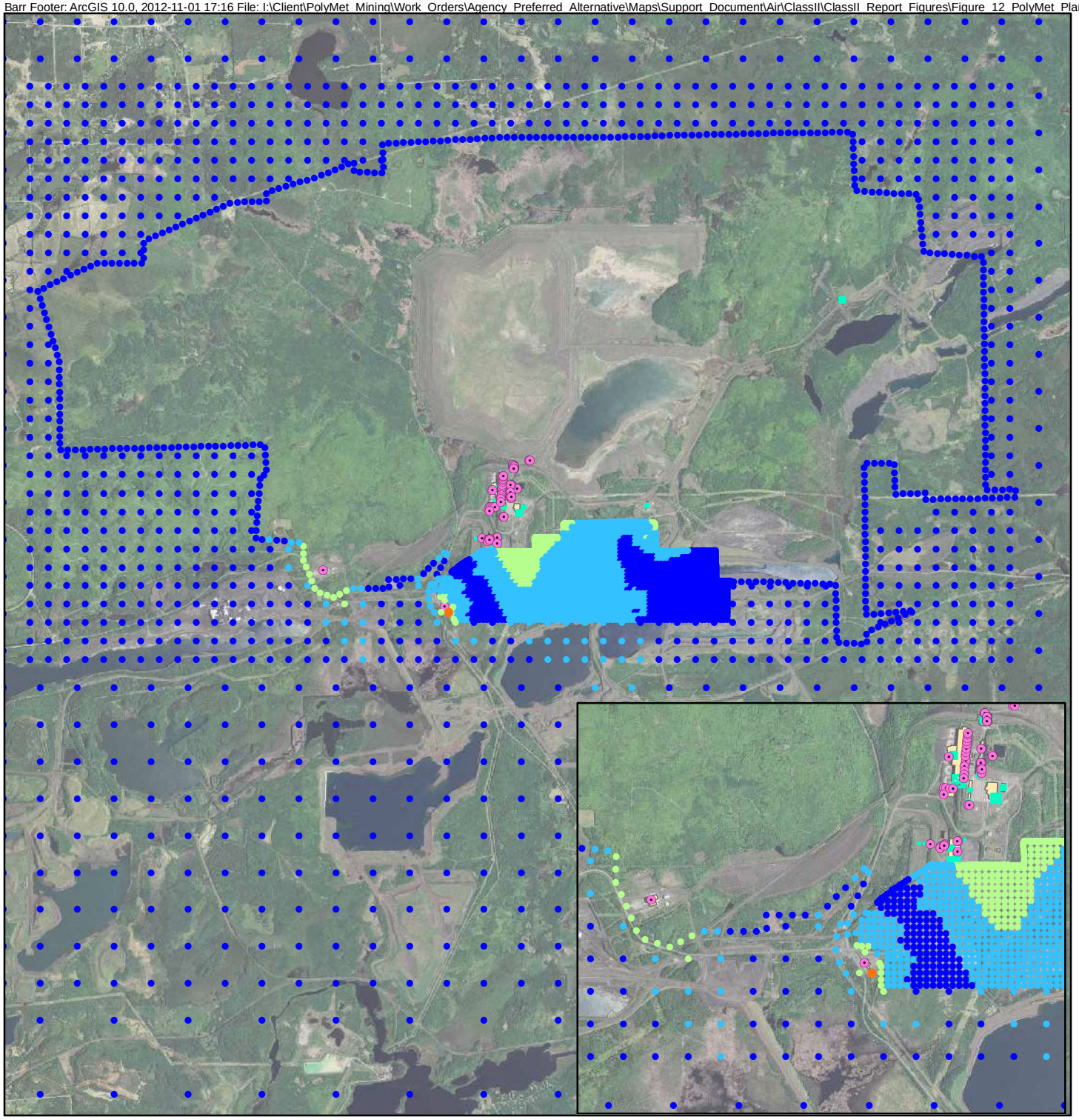
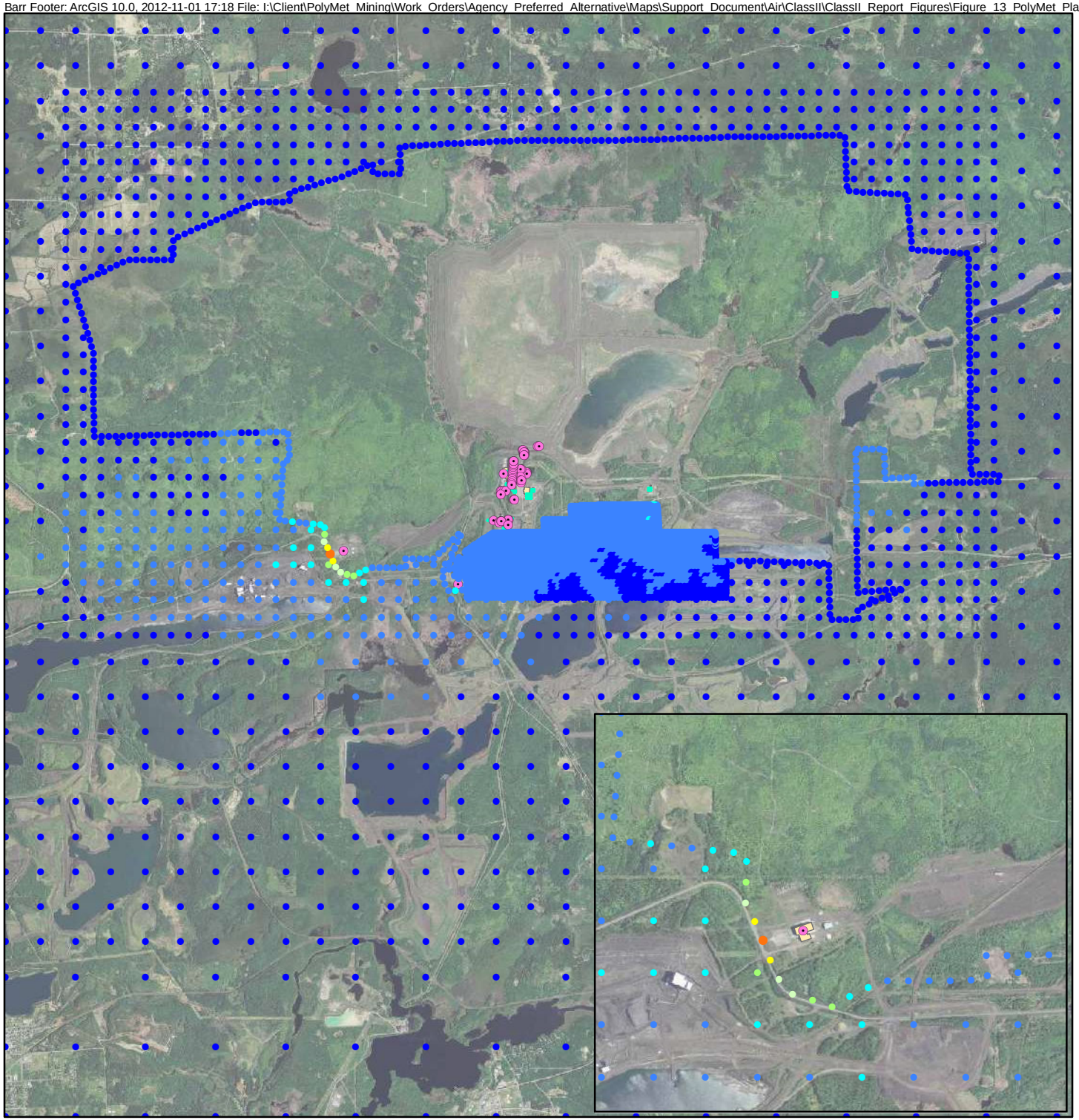


Figure 12

ANNUAL NO_X INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H8H Concentration ug/m^3

- 91 - 100
- 101 - 120
- 121 - 140
- 141 - 150
- 151 - 160
- 161 - 170
- 171 - 177
- Point Sources
- Volume Sources

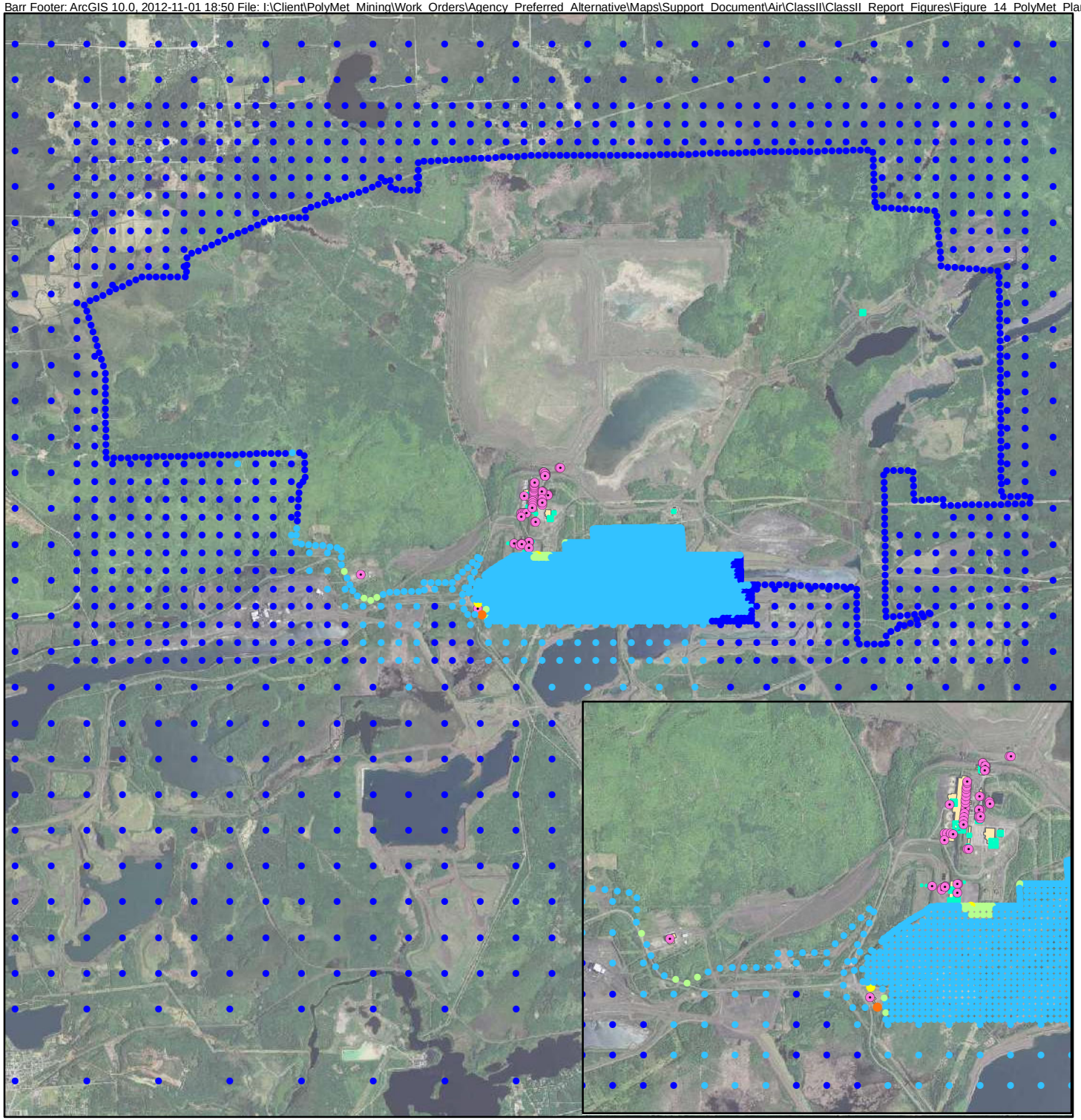
NO_2 1 Hour NAAQS is 188 ug/m^3.
Background Concentration Included = 89.6 ug/m^3

N

Meters
1,000 0 1,000

Figure 13

1 HOUR NO_2 NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



Max Concentration ug/m^3

- 17.6 - 18.0
- 18.1 - 19.0
- 19.1 - 19.5
- 19.6 - 20.5
- 20.6 - 20.8
- Point Sources
- Volume Sources
- BPIP Structures

NO_X Annual NAAQS is 100 ug/m^3.
Background Concentration Included = 17.6 ug/m^3

N

Meters
1,000 0 1,000

Figure 14

ANNUAL NO_X NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

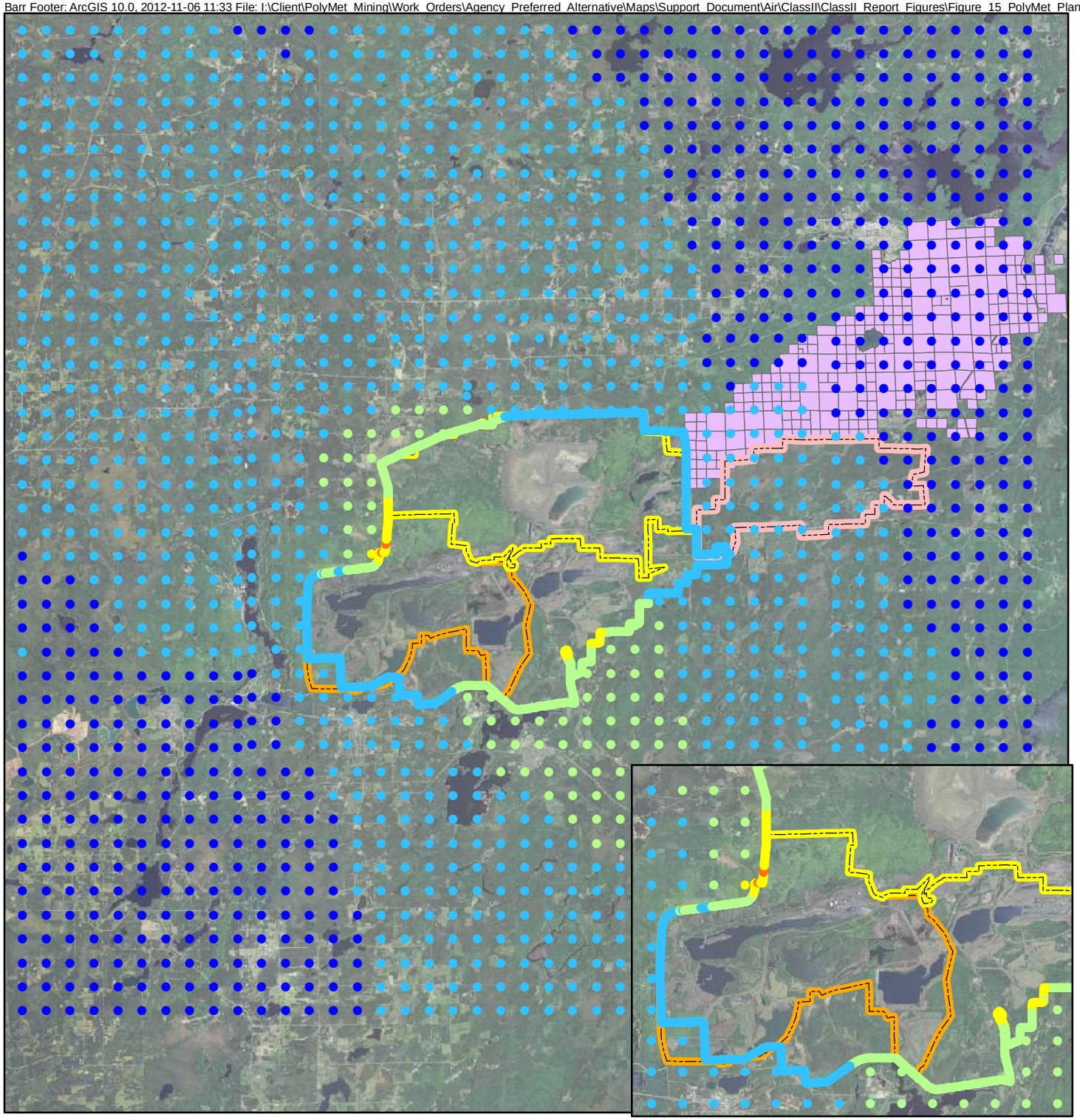
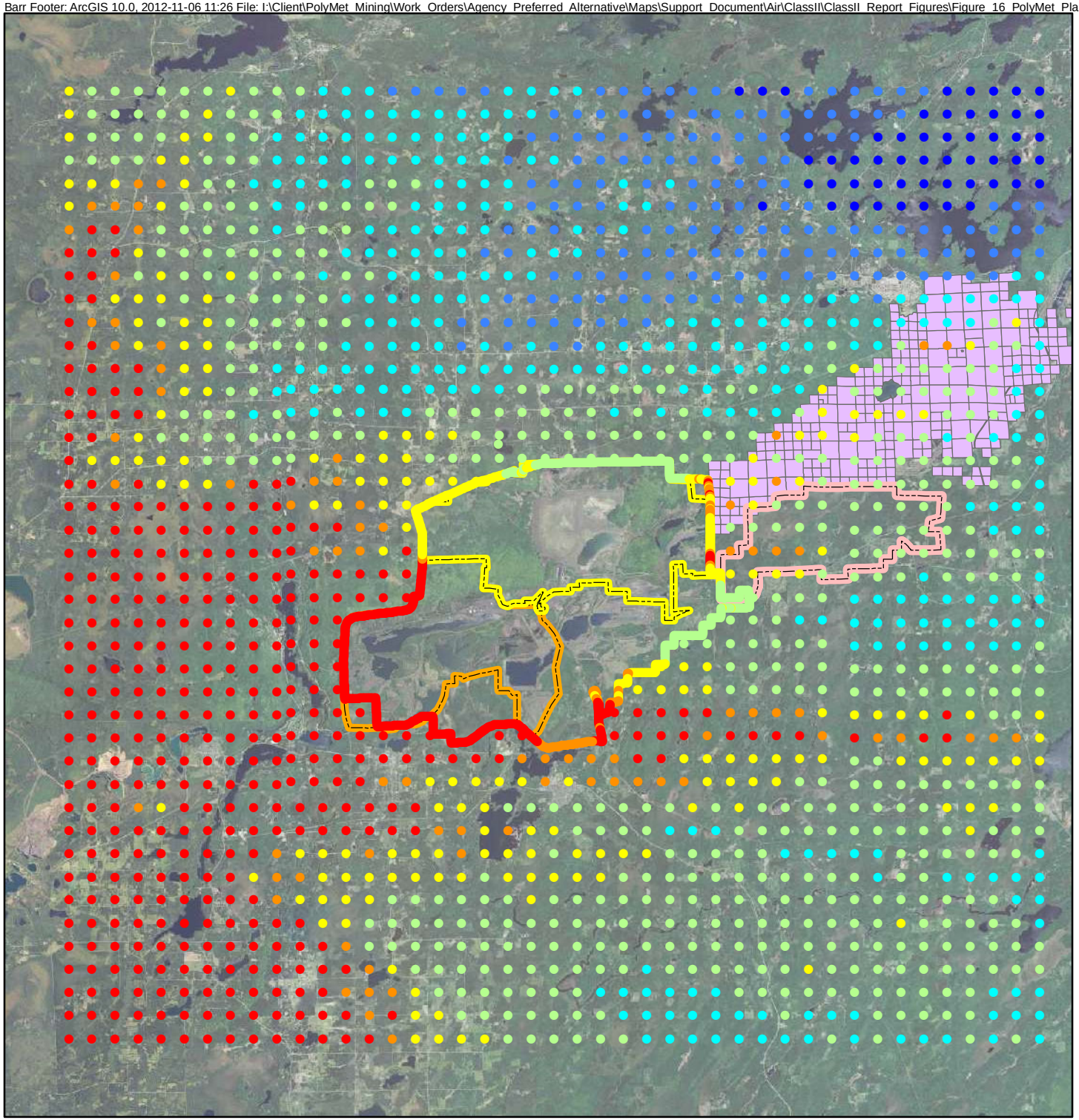


Figure 15

Annual NO_X CUMULATIVE
IMPACT INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H8H Concentration ug/m^3

- 142 - 149
- 150 - 159
- 160 - 169
- 170 - 179
- 180 - 185
- 186 - 188
- 189 - 292
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- PolyMet Plant Site AAB
- St Louis County Tax Records

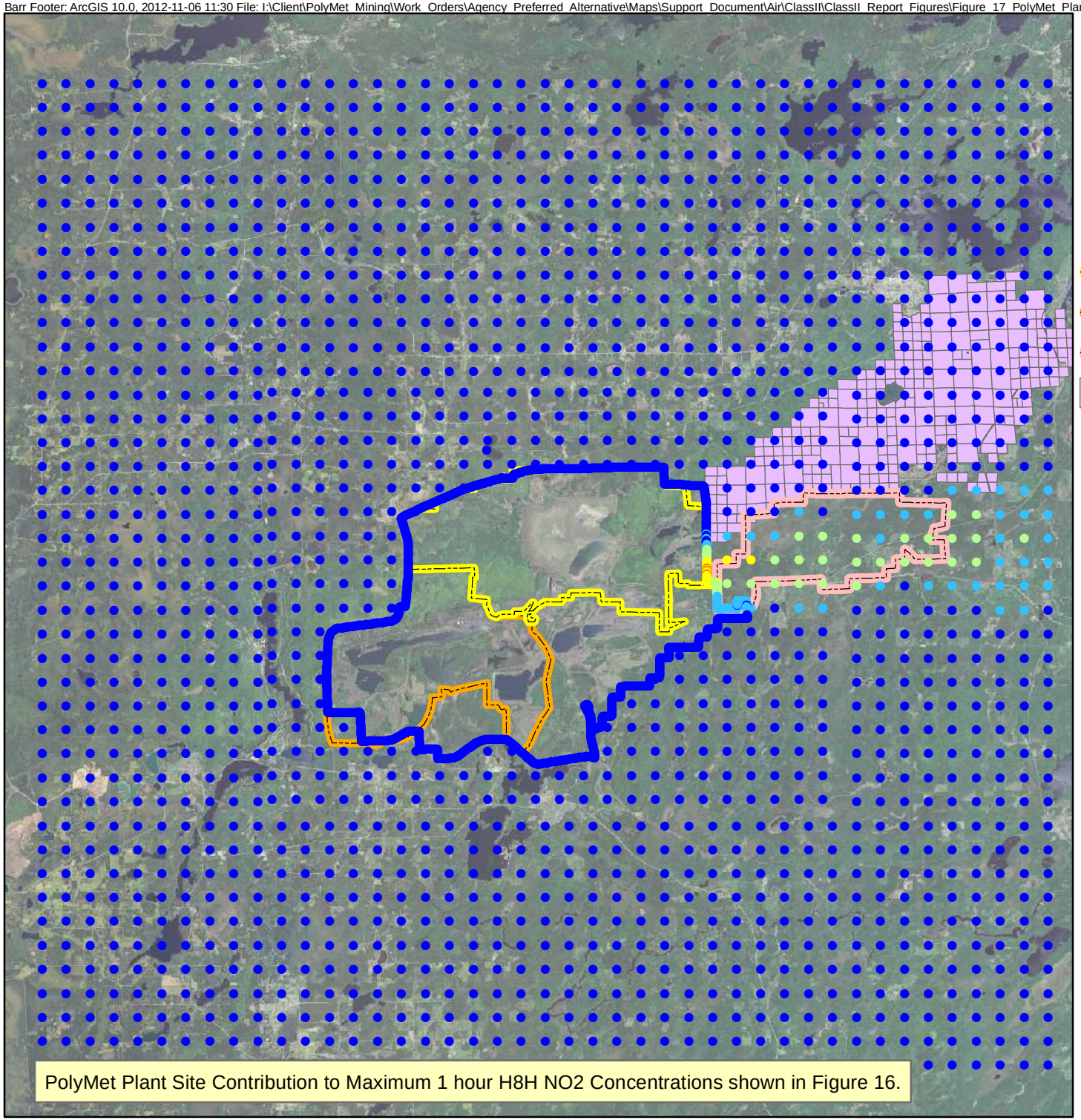
NO_2 1 Hour NAAQS is 188 ug/m^3.
Background Concentration Included = 89.6 ug/m^3

N

Kilometers
5 0 5

Figure 16

1 HOUR NO_2 CUMULATIVE IMPACT NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



PolyMet Plant Site Contribution to Maximum 1 hour H8H NO2 Concentrations shown in Figure 16.

Figure 17

1 HOUR NO_2 CUMULATIVE
IMPACT NAAQS
POLYMET PLANT SITE CULPABILITY
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

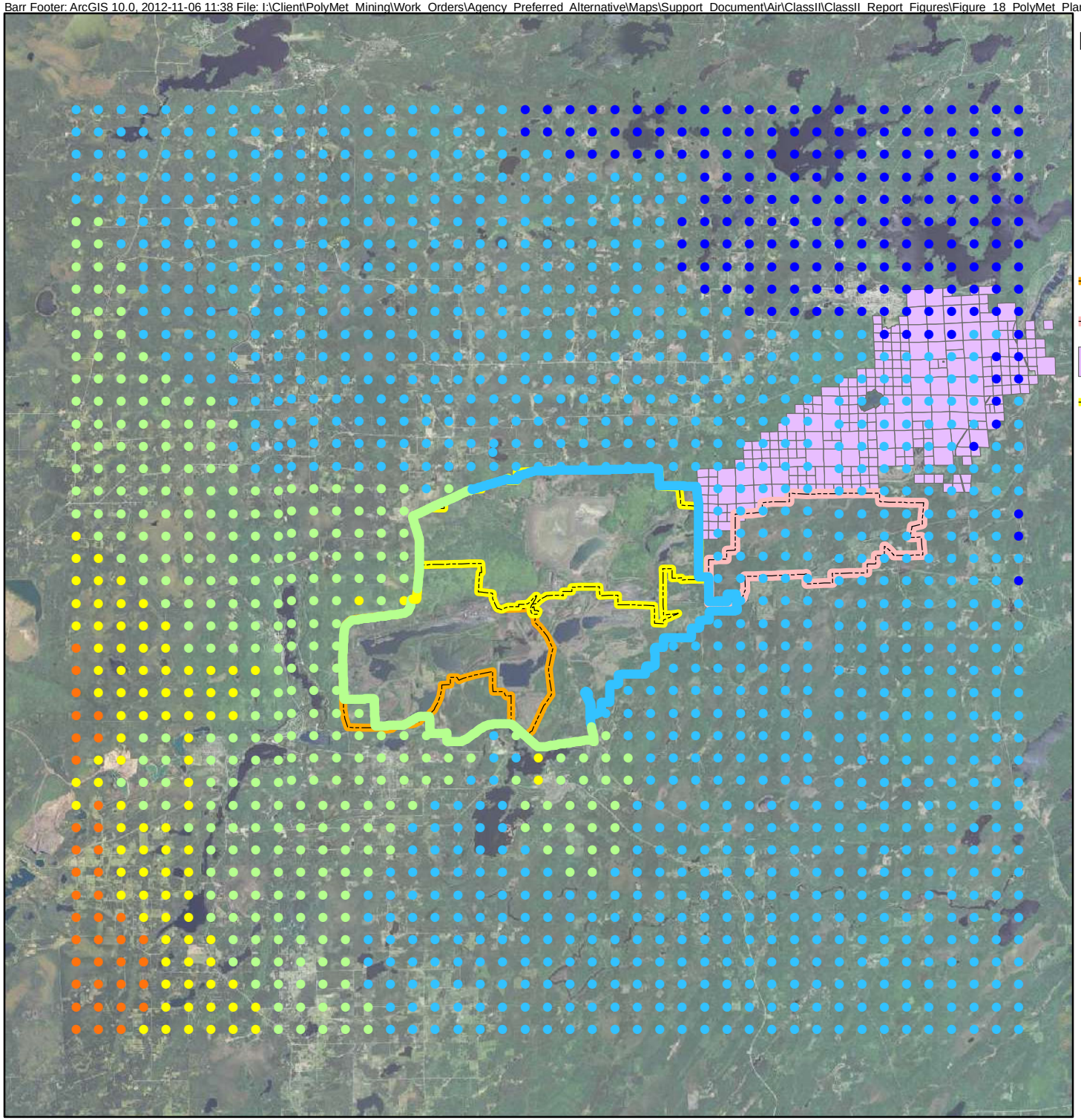


Figure 18

Annual NO_X CUMULATIVE IMPACT NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

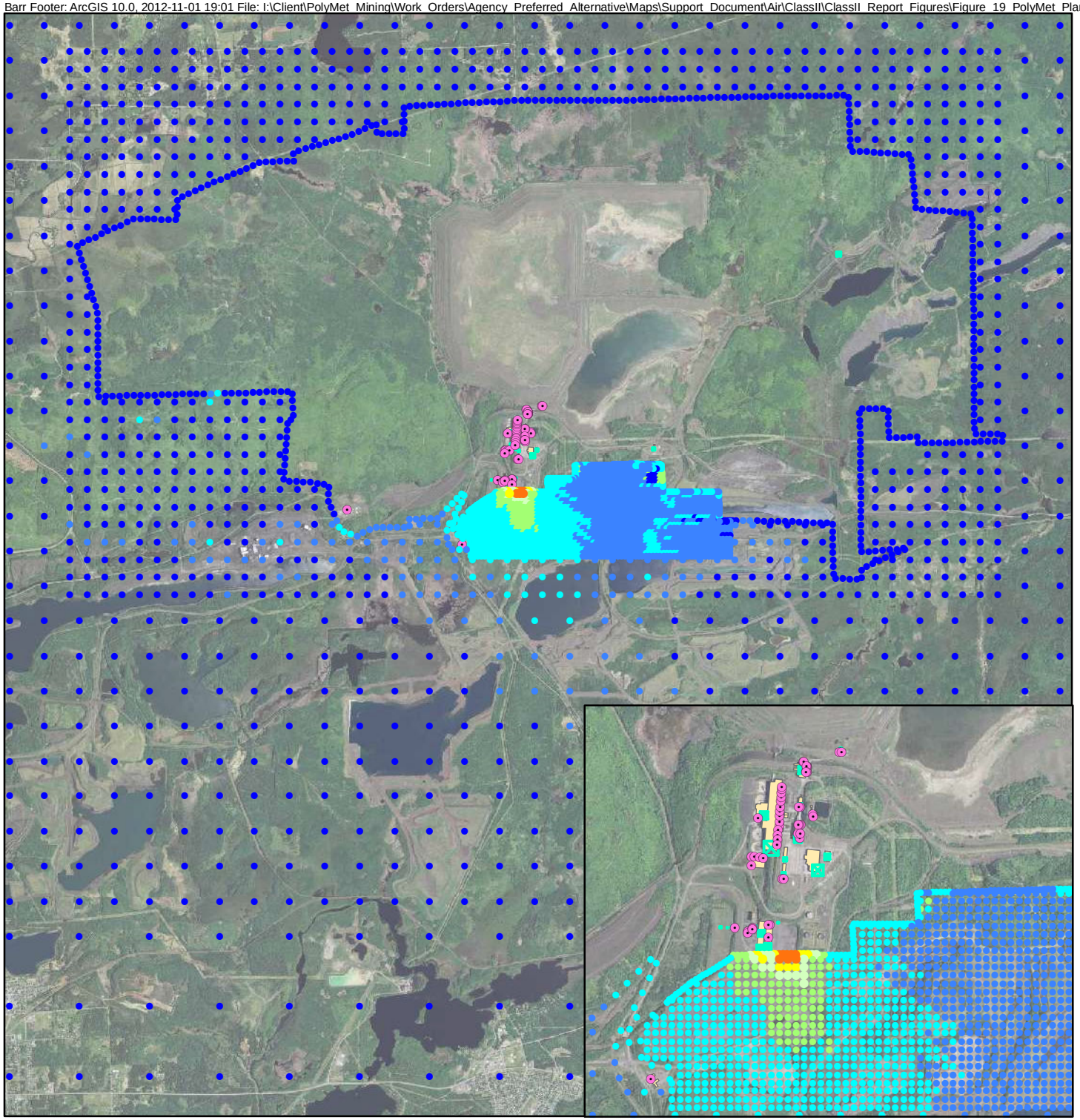


Figure 19

3 HOUR SO_2 INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

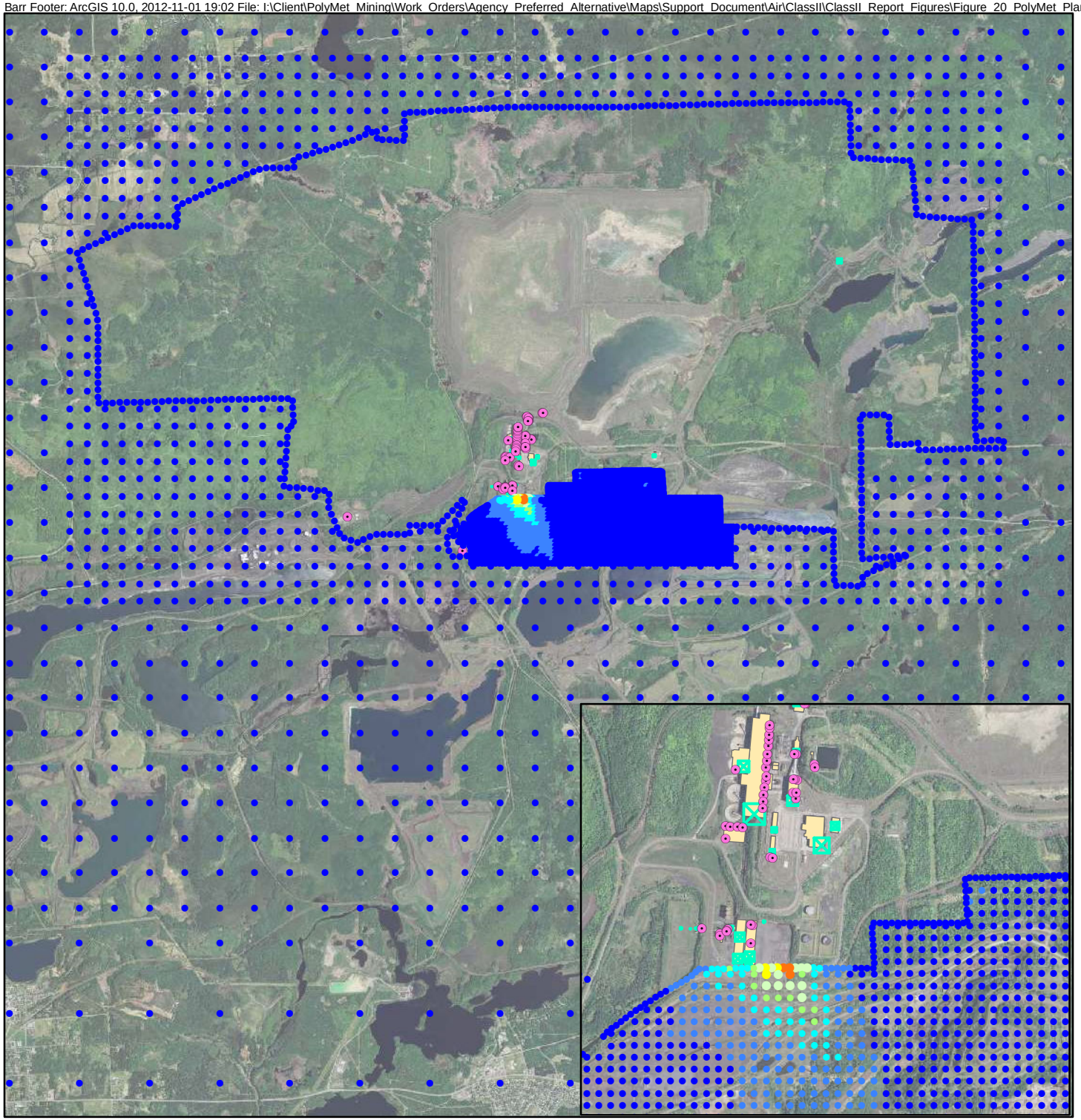


Figure 20

24 HOUR SO_2 INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

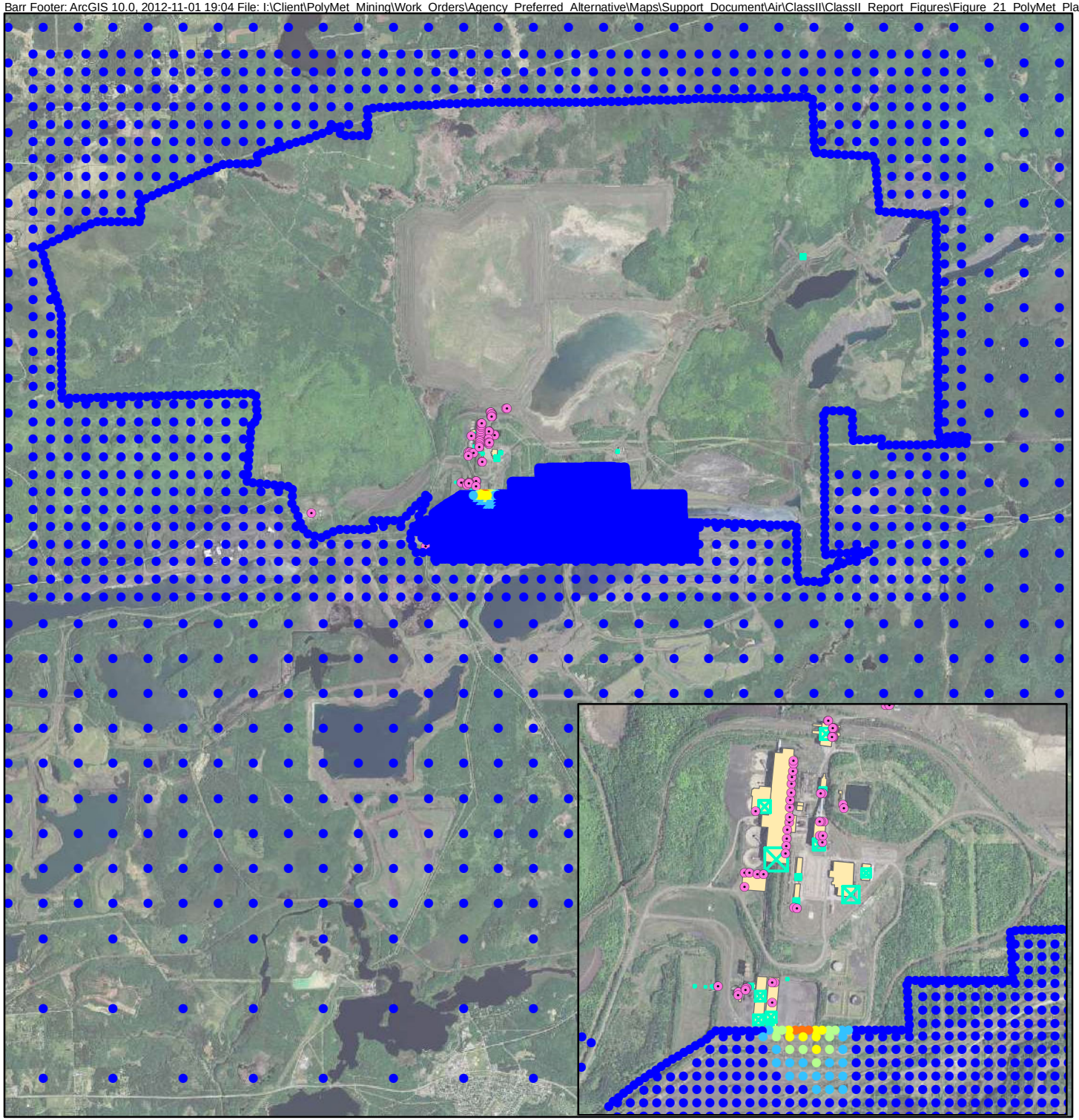


Figure 21

ANNUAL SO_2 INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

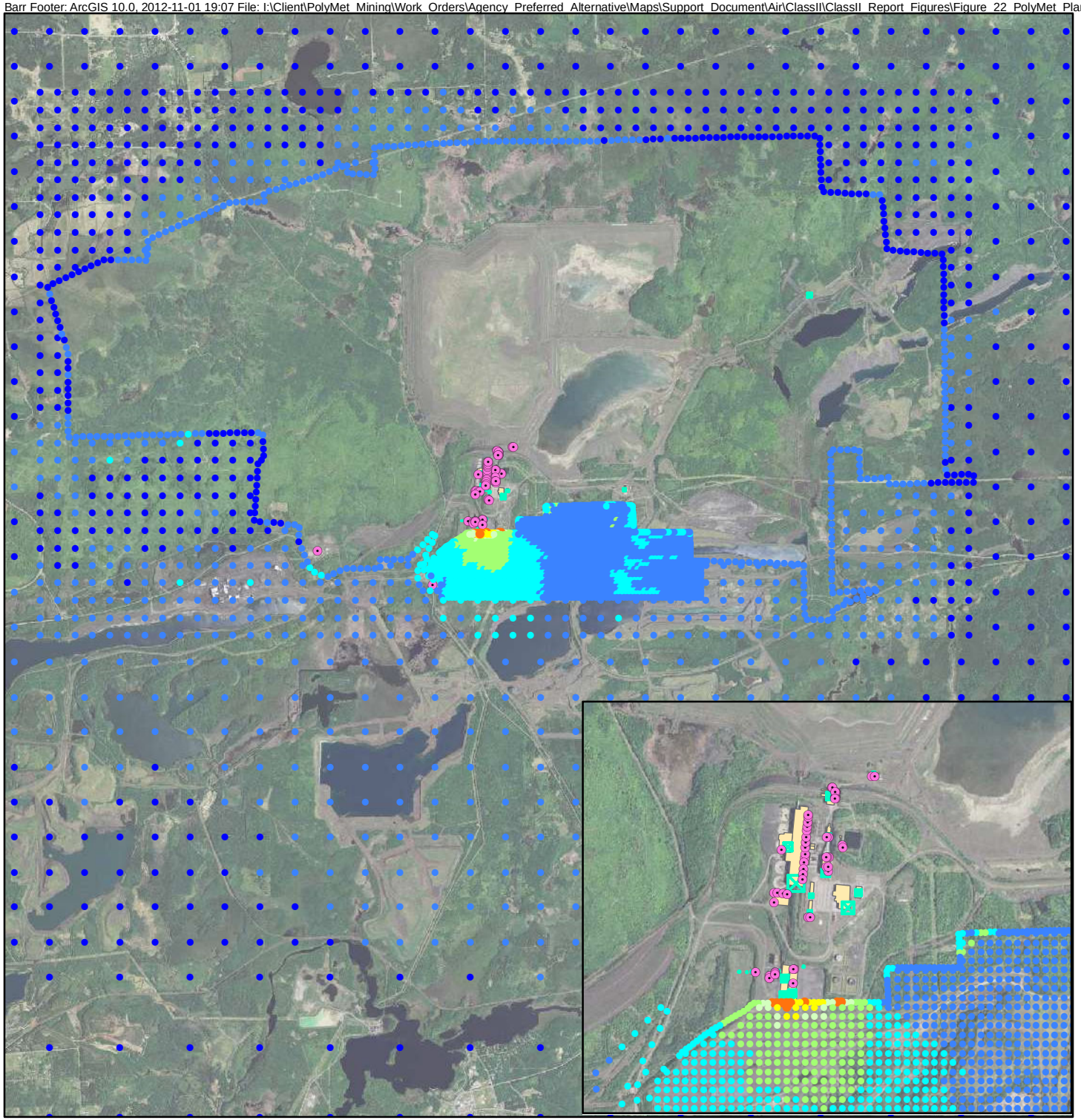
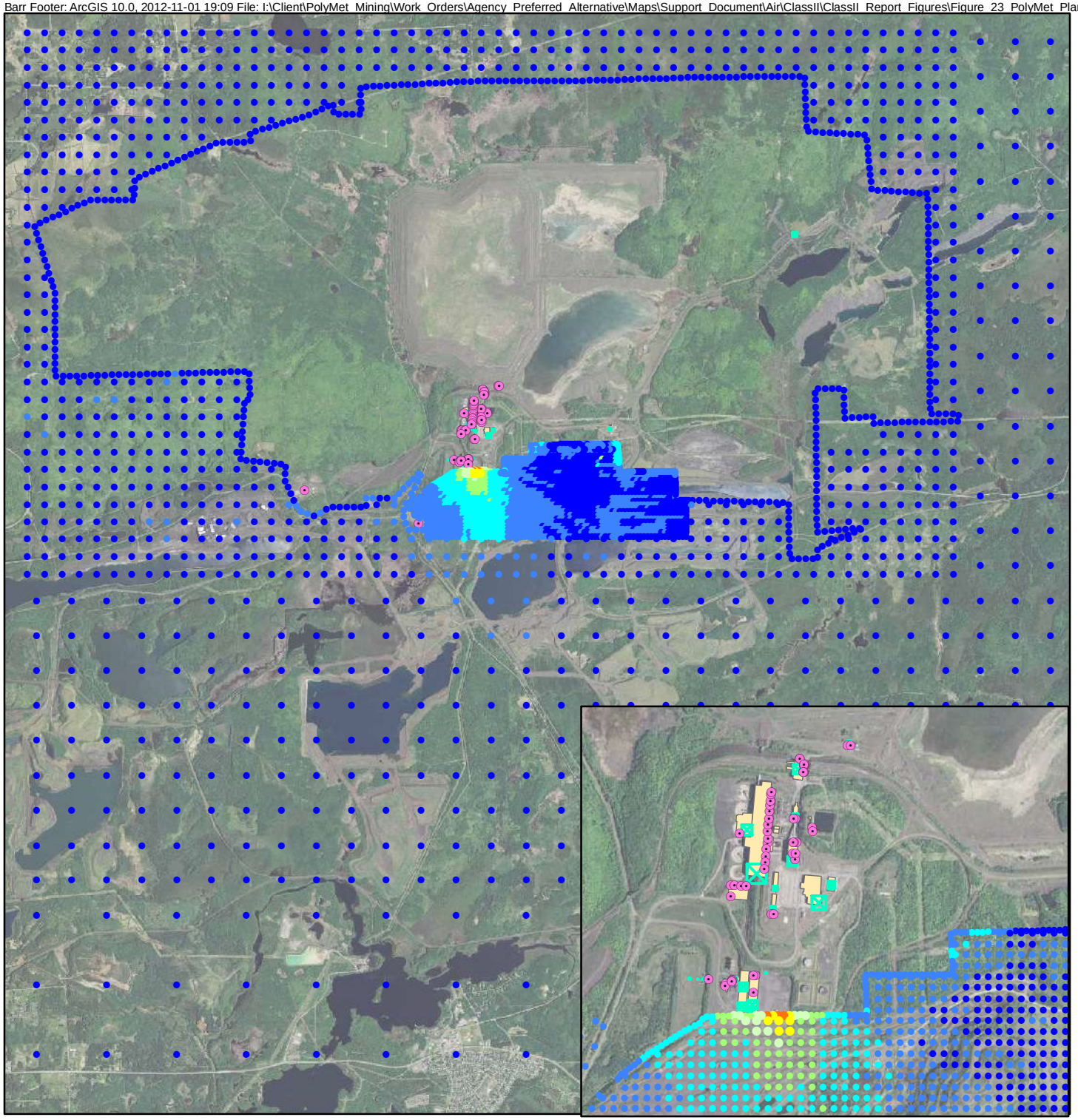


Figure 22

1 HOUR SO_2 NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H2H Concentration ug/m^3

- 12 - 20
- 21 - 30
- 31 - 50
- 51 - 70
- 71 - 80
- 81 - 90
- 91 - 97
- Point Sources
- Volume Sources
- BPIP Structures

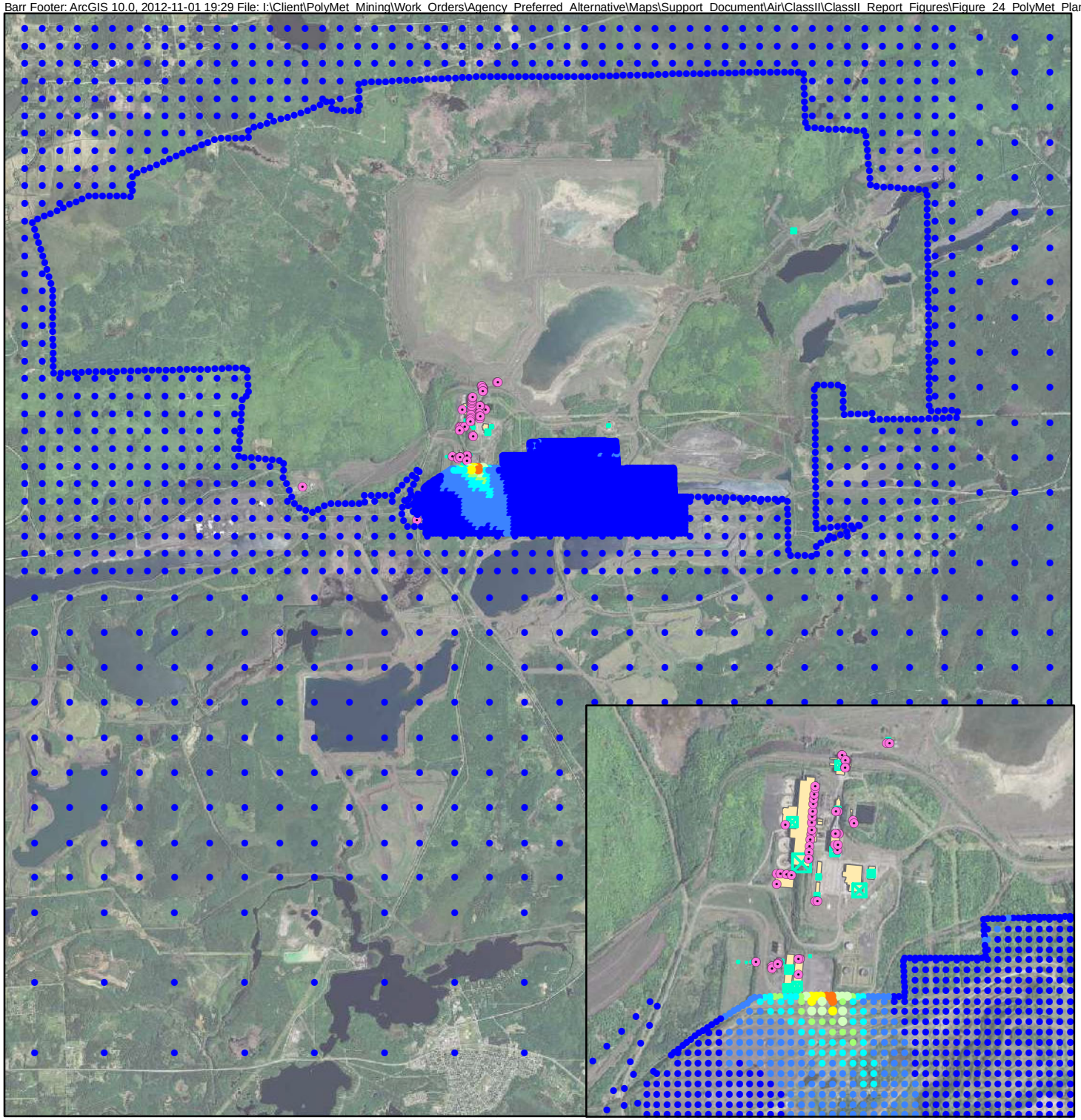
SO_2 3 Hour NAAQS is 915 ug/m^3.
Background Concentration Included = 12 ug/m^3.

N

Meters
1,000 0 1,000

Figure 23

3 HOUR SO_2 NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H2H Concentration ug/m^3

- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- Point Sources
- Volume Sources
- BPIP Structures

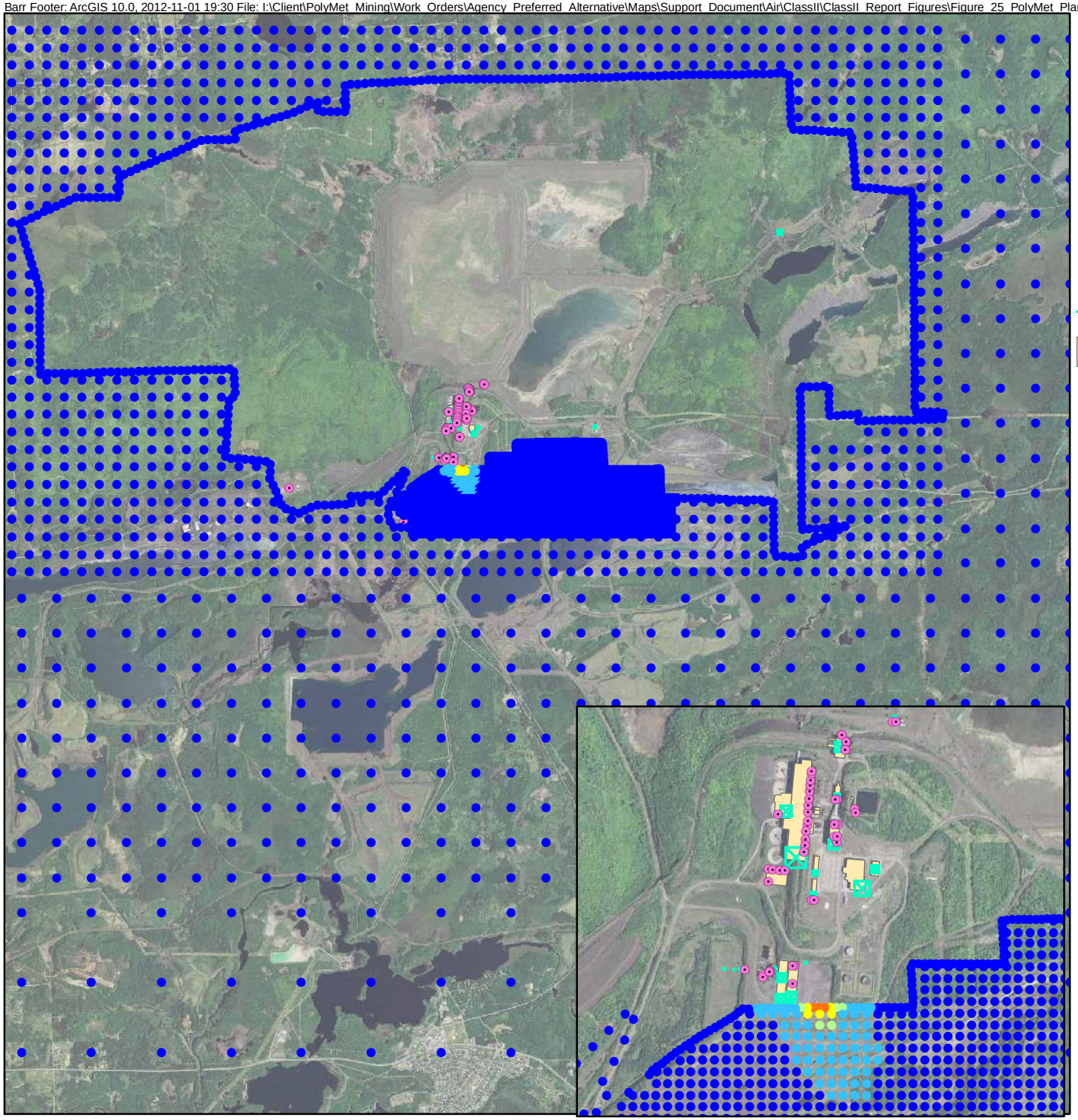
SO_2 24 Hour NAAQS is 365 ug/m^3.
Background Concentration Included = 5.5 ug/m^3.

N

Meters
1,000 0 1,000

Figure 24

24 HOUR SO_2 MAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



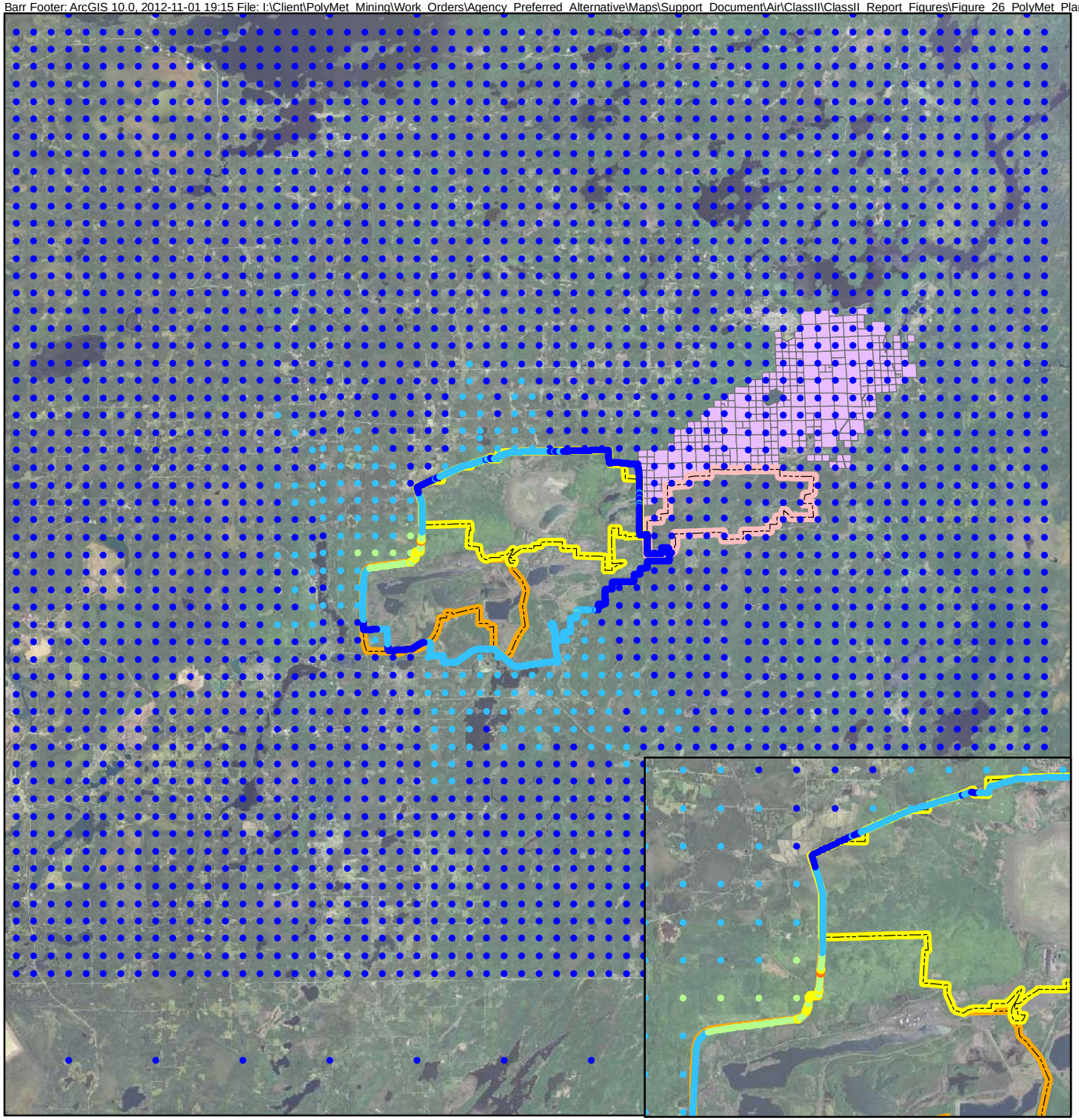
SO_2 Annual NAAQS is 60 ug/m^3.
Background Concentration Included = 0.63 ug/m^3.

N

Meters
1,000 0 1,000

Figure 25

ANNUAL SO_2 MAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H2H Concentration ug/m^3

- 1 - 3
- 4 - 5
- 6 - 7
- 8 - 9
- 10 - 11
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

SO_2 3 Hour Increment is 512 ug/m^3.

N

Kilometers

5 0 5

Figure 26

3 Hour SO_2 CUMULATIVE IMPACT INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN

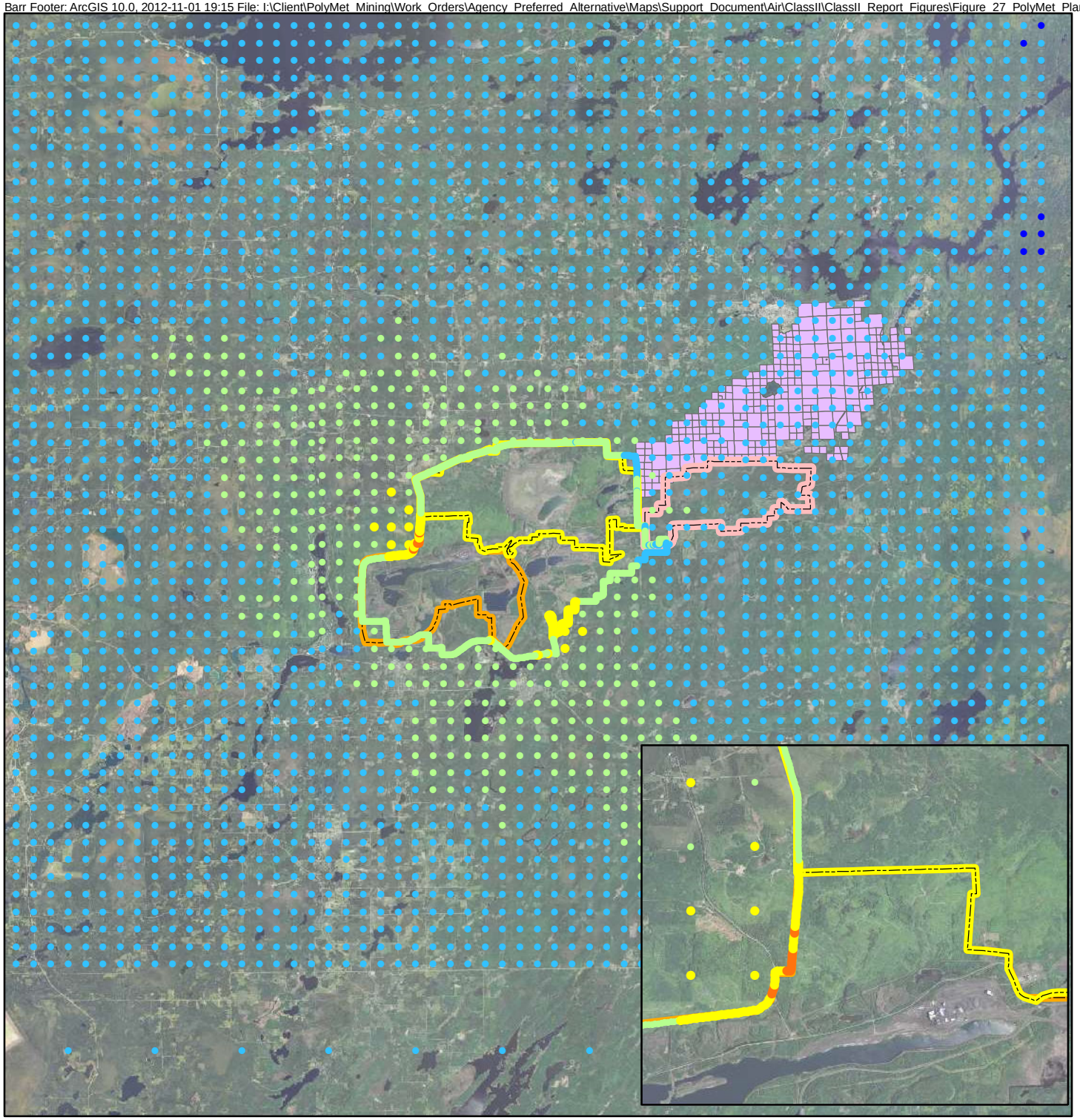
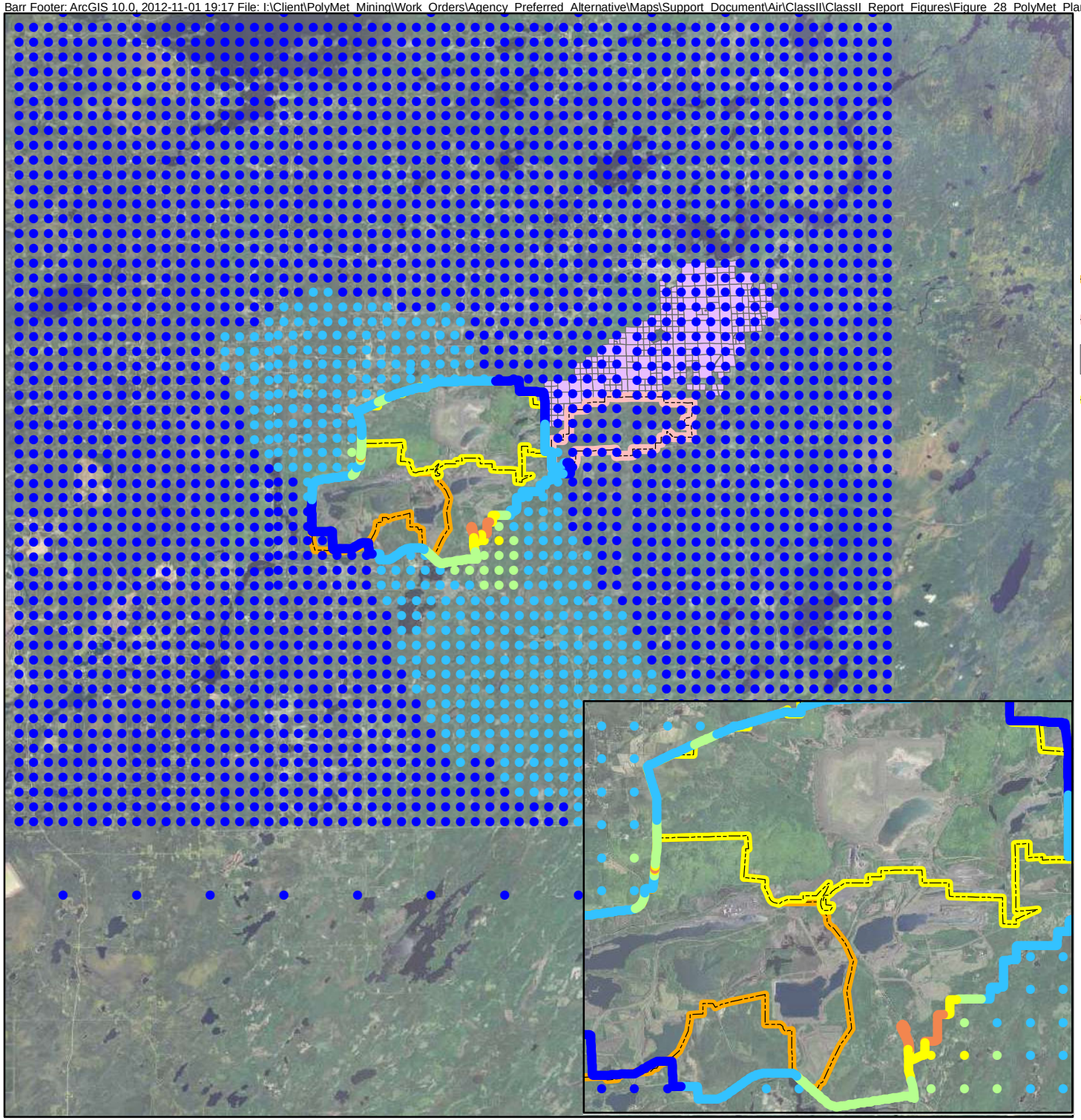


Figure 27

24 Hour SO_2 CUMULATIVE
IMPACT INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



Max Concentration ug/m^3

- 0.01 - 0.05
- 0.06 - 0.10
- 0.11 - 0.13
- 0.14 - 0.15
- 0.16 - 0.17
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

SO_2 Annual Increment is 20 ug/m^3.

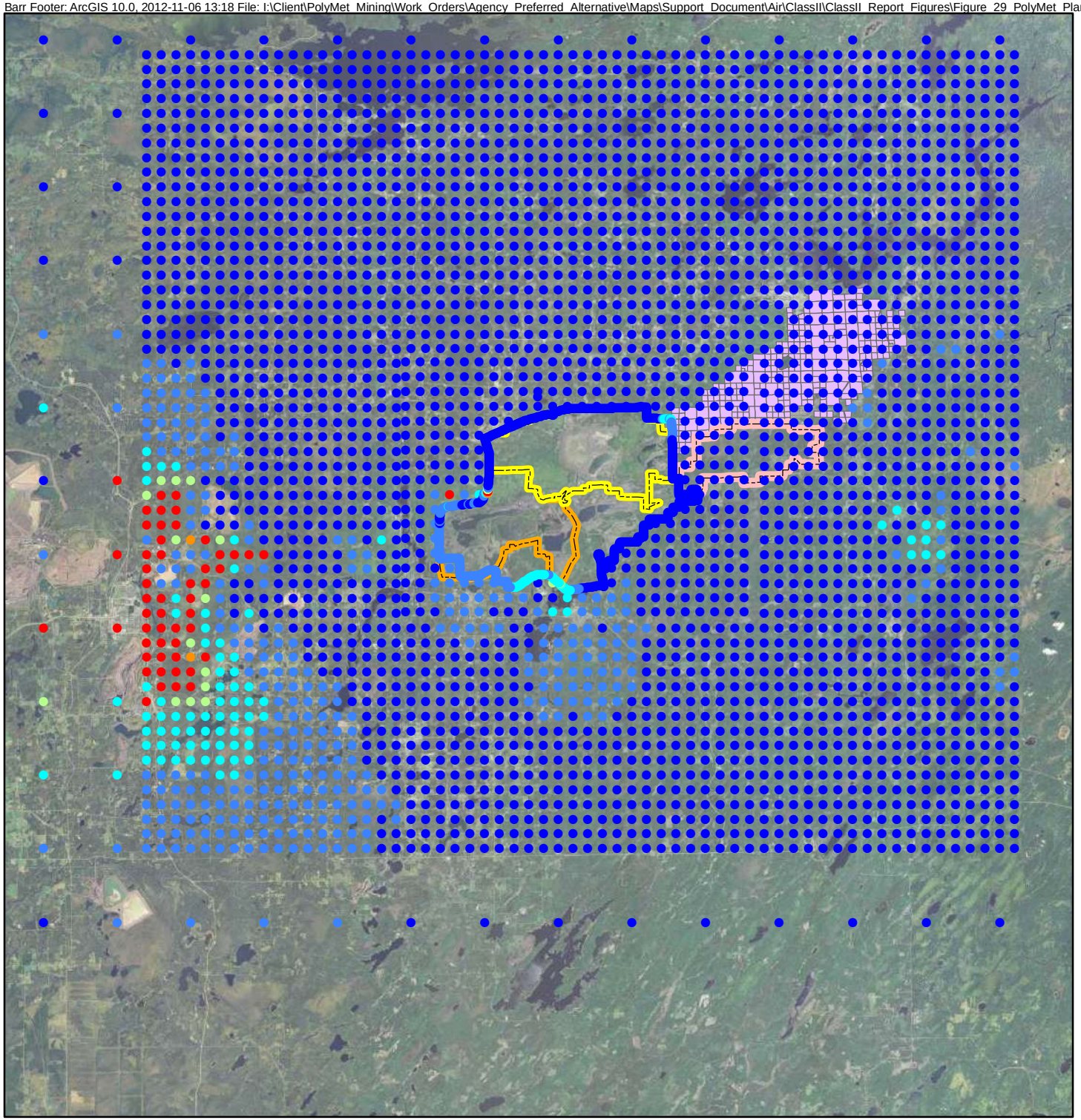
N

Kilometers

5 0 5

Figure 28

Annual SO_2 CUMULATIVE IMPACT INCREMENT RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H4H Concentration ug/m^3

- 61 - 100
- 101 - 130
- 131 - 160
- 161 - 180
- 181 - 190
- 191 - 196
- 197 - 925
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

SO_2 1 Hour NAAQS is 196 ug/m^3.
Background Concentration Included = 6.1 ug/m^3.

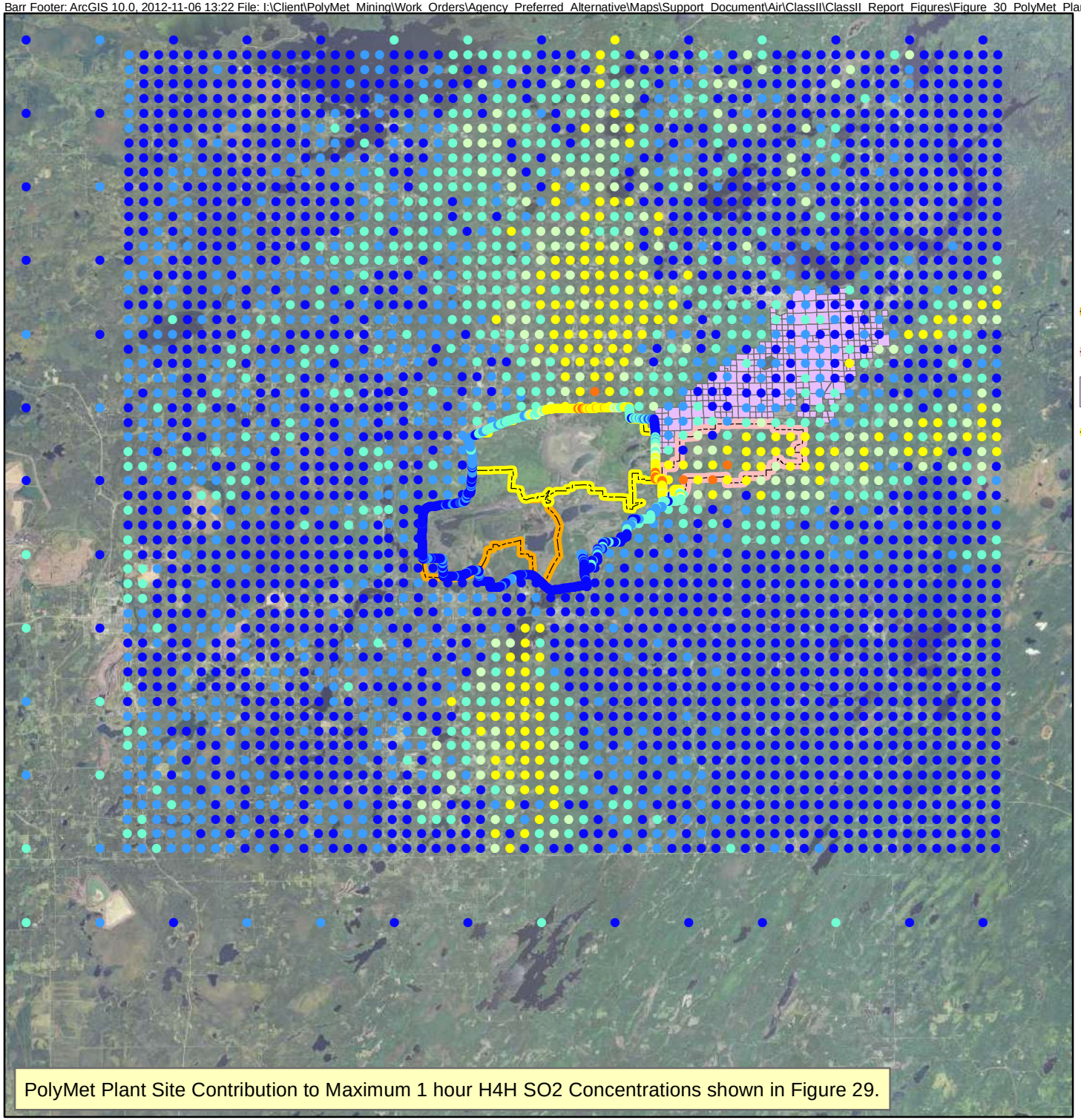
N

Kilometers

5 0 5

Figure 29

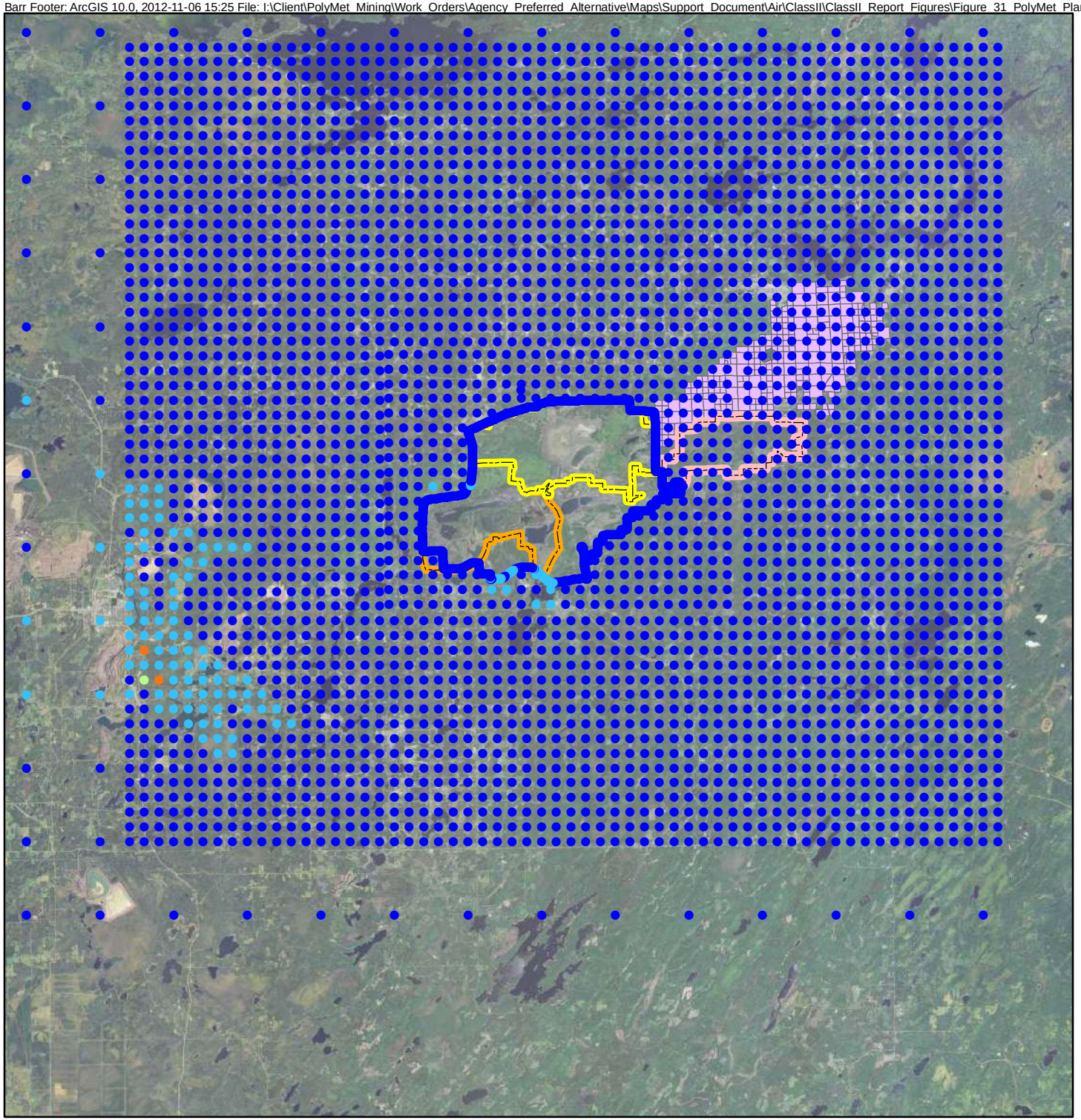
1 HOUR SO_2 CUMULATIVE IMPACT NAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



PolyMet Plant Site Contribution to Maximum 1 hour H4H SO2 Concentrations shown in Figure 29.

Figure 30

1 HOUR SO_2 CUMULATIVE
IMPACT NAAQS
POLYMET PLANT SITE CULPABILITY
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H2H Concentration ug/m^3

- 27 - 100
- 101 - 500
- 501 - 600
- 601 - 700
- 701 - 784
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

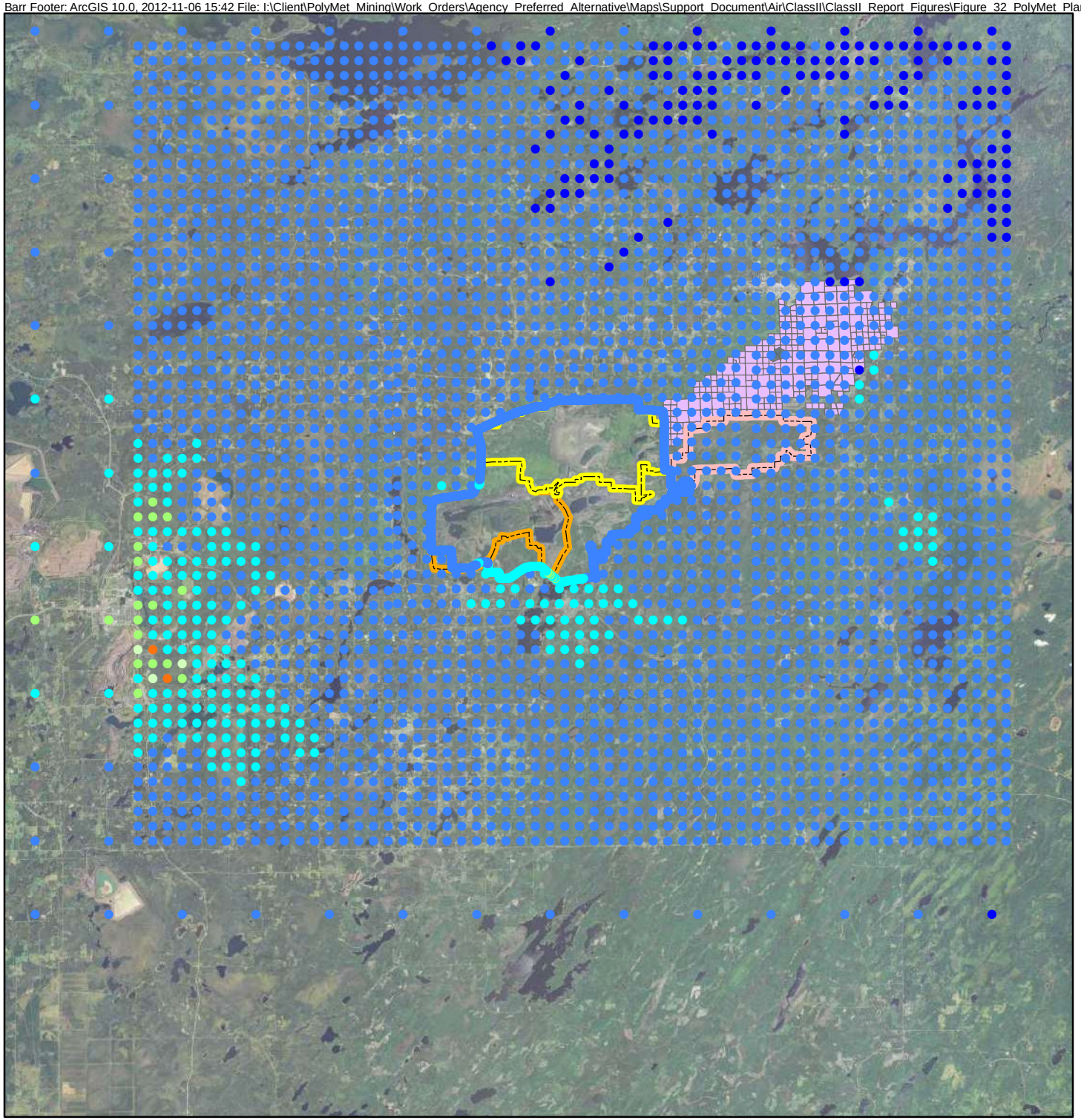
SO_2 3 Hour MAAQS is 915 ug/m^3.
Background Concentration Included = 12 ug/m^3.

N

Kilometers
5 0 5

Figure 31

3 Hour SO_2 CUMULATIVE IMPACT MAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



H2H Concentration ug/m^3

- 9 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 255
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

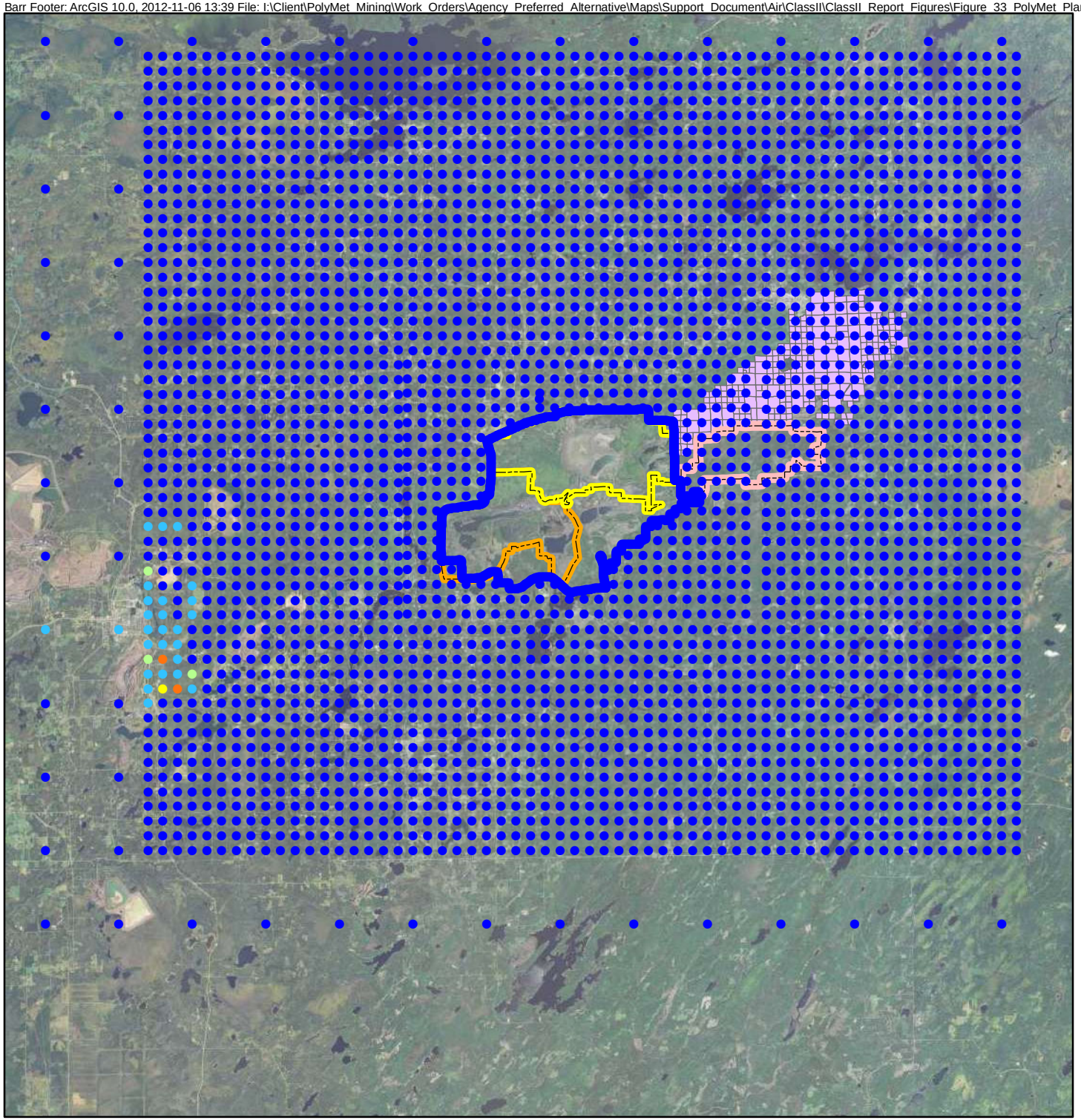
SO_2 24 Hour NAAQS is 365 ug/m^3.
Background Concentration Included = 5.5 ug/m^3.

N

Kilometers
5 0 5

Figure 32

24 Hour SO_2 CUMULATIVE IMPACT MAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN



Max Concentration ug/m^3

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 24
- Mesabi Nugget AAB
- PolyMet Mine Site AAB
- St Louis County Tax Records
- PolyMet Plant Site AAB

SO_2 Annual NAAQS is 60 ug/m^3.
Background Concentration Included = 0.63 ug/m^3.

N

Kilometers
5 0 5

Figure 33

ANNUAL SO_2 CUMULATIVE IMPACT MAAQS RESULTS
PolyMet Plant Site EIS
Class II Modeling Report
NorthMet Project
Hoyt Lakes, MN