Air Quality Modeling Report

NO2, PM10, and PM2.5 Modeling

Prepared for
Karis Cold Storage
3815 S. Ashland, Chicago, IL

May 2022

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1 Introduction

This report summarizes the project air quality modeling for NO_2, PM_{10}, and $PM_{2.5}$ for a proposed cold storage facility located on the northeast corner of Ashland Avenue and Pershing Road in Chicago, Illinois. The modeling is required under Section 17-9-0117-G of the Municipal Code of Chicago and the methods are consistent with the Chicago Department of Public Health (CPDH) Air Quality Impact Evaluation interim guidance (issued September 2021). The modeling includes a natural gas-fired office heater (stationary source) and mobile sources related to the project including on-street vehicle traffic, on-street idling, on-property traffic, and on-property idling. The mobile source emissions were developed using the April 20, 2022 "Traffic Impact Study for 3815 S. Ashland Redevelopment" completed by Sam Schwartz and approved by CPDH. The throughputs from the traffic study for both traffic and idling were combined with the Illinois EPA (IEPA) MOVES emission factor lookup tables to calculate hourly specific emission rates for all mobile sources.

Barr processed publicly available Midway Airport surface data and Lincoln, IL upper air data for the five-year data period 2016 – 2020 using the most recent regulatory version of the AERMET meteorological pre-processor (v21112).

The overall receptor network used in the modeling is illustrated in Figure 1. The current design of the project including the footprint of the building and with the property access points are shown in Figure 2. All project modeled sources (both on-site and off-site), the fence line, and the storage warehouse footprint are included in Figure 3.

The modeling detailed in this report predicts concentrations that are below the 24-hour PM_{10}, 24-hour and annual $PM_{2.5}$, and 1-hour NO_2 Significant Impact Levels (SIL). Therefore, no cumulative modeling is necessary.

2 Modeling Methodology

2.1 Dispersion Model

The current version of the USEPA regulatory modeling system (AERMOD v21112) was used for this air dispersion analysis. Following CDPH's Air Quality Impact Evaluation Interim guidance, the model control options selected the URBANOPT to apply alternative instability due to urban heat island effects. The population density input was the CDPH recommended 2020 census data for the Chicago Metropolitan Statistical Area (9,618,502). NO_2 modeling included the tier 2 Ambient Ratio Method (ARM2) option which applies an internal calculation to account for assumed NO_2 concentrations due to chemical conversion with available background ozone concentrations. The default values of 0.5 and 0.9 were assumed.

2.2 Pollutants / Averaging Times Modeled

CPDH's Air Quality Impact Evaluation 2021 Interim Guidance requires a modeling evaluation for the NO_2 1-hour averaging period, PM_{10} 24-hour averaging period, and $PM_{2.5}$ 24-hour and annual averaging period

to demonstrate a proposed project's emissions will not exceed the applicable National Ambient Air Quality Standards (NAAQS). Further, the guidance suggests that a cumulative modeling analyses including representative background concentrations is not necessary if project modeled concentrations are less than the Significant Impact Levels (SILs) for each pollutant. As noted above, this modeling effort was completed with five years of meteorological data and all average concentrations are based on this five-year average. Table 1 lists the pollutants, averaging periods, and the SIL/NAAQS for each applicable standard.

Table 1 PM_{10}, $PM_{2.5}$, and NO_2 SIL and NAAQS

Pollutant	Averaging Period	SIL (ug/m^3) [1]	NAAQS (ug/m^3) [2]
PM_{10}	24-Hour	5	150
$PM_{2.5}$	24-Hour	1.2	35
$PM_{2.5}$	Annual	0.2	12
NO_2	1-Hour	7.52	188

[1] Form of the SILs: maximum modeled impacts for 24-hour PM_{10},
average of the maximum modeled concentrations for 24-hour $PM_{2.5}$,
average of the annual concentrations for annual $PM_{2.5}$. and
average of the maximum daily 1-hour modeled concentrations for 1-hour NO_2.
[2] Form of the NAAQS - 6th highest modeled concentrations for 24-hour PM_{10},
average of 98th percentile (8th high) modeled concentrations for 24-hour $PM_{2.5}$,
average of modeled concentrations for annual $PM_{2.5}$, and
average of maximum daily 1-hour 98th percentile (8th high) modeled impacts for 1-hour NO_2.

2.3 Source Characterization, Emissions, and Locations

The proposed redevelopment project at 3815 S. Ashland Ave will be a 96,000 square-foot cold-storage warehouse with two planned access points for refrigerated trucks and passenger vehicles. Consistent with the CDPH interim guidance, the mobile sources are modeled as a line of equally space volume sources with release heights based on the weighted average of the heights of vehicle types travelling along each segment. The side lengths are based on the 2-way road street width for off-site sources and the weighted average of the vehicle widths for mobile sources on-site. To provide for a conservative representation of the emissions, the maximum emission factors for diesel trucks (combination short) were selected.

Table 2 summarizes the proposed project modeled sources and Table 3 provides their elevations and model release parameters. Figure 2 shows the proposed project layout and Figure 3 identifies the sources listed in Table 2.

Table 2 Proposed Project Stationary and Mobile Source Modeled ID and Description

Modeled Source	Description
SPCHEAT	Office space heater (natural gas fired)
OSIDLE	On-site combination short-ton truck idling for loading / unloading
OSPARK01-03	On-site vehicle traffic traveling to south parking lot

Modeled Source	Description
OS001-023	On-site vehicle and combination short-ton truck traffic
PERSH001-049	Off-site vehicle and combination short-ton truck traffic on Pershing Road
ASH001-054	Off-site vehicle and combination short-ton truck traffic on Ashland Ave
38ST001-083	Off-site vehicle and combination short-ton truck traffic on 38th Street

Table 3 Volume Source Locations, Elevation, and Modeled Release Parameters

Modeled Source	Elevation (m)	Side Length (m)	Release Height (m)	Sigma Y_O (m)	Sigma Z_O (m)
SPCHEAT	180.46	12.19	4.88	2.84	4.54
OSIDLE	180.22	15.54	7.62	3.61	7.09
OSPARK01-03	~180.5	7.78	1.55	3.62	1.45
OS001-012	~180.0	8.42	3.44	3.92	3.20
OS013-023	~179.9	8.44	3.50	3.92	3.25
PERSH001-016	~181.3	9.05	1.55	4.21	1.45
PERSH017-023	~181.0	9.05	3.44	4.21	3.20
PERSH024-029	~180.5	8.98	3.39	4.17	3.16
PERSH030-049	~179.9	9.05	3.48	4.21	3.24
ASH001-011	~181.1	9.05	3.41	4.21	3.18
ASH012-017	~180.9	9.05	3.44	4.21	3.20
ASH018-024	~180.6	9.05	3.41	4.21	3.18
ASH025-030	~181.0	7.98	3.07	3.71	2.86
ASH031-038	~181.1	9.05	3.48	4.21	3.24
ASH039-044	~180.5	8.98	3.47	4.18	3.23
ASH045-054	~180.2	9.05	3.48	4.21	3.24
38ST001-033	~179.7	9.05	1.55	4.21	1.45
38ST034-049	~180.2	9.05	3.49	4.21	3.25
38ST050-057	~180.9	7.98	3.07	3.71	2.86
38ST058-083	~181.0	9.05	1.55	4.21	1.45

2.3.1 Emission Rates Calculations and Assumptions

The proposed project will require refrigerated trucks and light vehicles to regularly visit the site throughout the entire day, so the modeling evaluation did not include hourly restrictions on when mobile emissions will occur. Consistent with information requested by CDPH, the project's traffic study provided an hour-by-hour breakdown of the number of trucks and vehicles anticipated per day. The study was used to develop a variable hour-of-day (HROFDY) emission rate to model. Table 4 provides the hourly vehicle counts assumed for every day of the 5-year modeling period.

Table 4 Hourly Vehicle Counts

Time (central)	Passenger Car	Combination Short-Haul Truck
12:00am – 1:00am	0	0
1:00am – 2:00am	1	0
2:00am – 3:00am	0	1
3:00am – 4:00am	0	1
4:00am – 5:00am	1	1
5:00am – 6:00am	4	2
6:00am – 7:00am	9	3
7:00am – 8:00am	15	2
8:00am – 9:00am	8	3
9:00am – 10:00am	8	6
10:00am – 11:00am	6	6
11:00am – 12:00pm	7	7
12:00pm – 1:00pm	13	4
1:00pm – 2:00pm	7	5
2:00pm – 3:00pm	10	4
3:00pm – 4:00pm	12	6
4:00pm – 5:00pm	11	4
5:00pm – 6:00pm	10	3
6:00pm – 7:00pm	7	1
7:00pm – 8:00pm	2	0
8:00pm – 9:00pm	1	1
9:00pm – 10:00pm	4	0
10:00pm – 11:00pm	2	0
11:00pm – 12:00am	2	0
Daily Total	**140**	**60**

The Illinois Environmental Protection Agency (IEPA) developed specific mobile source emissions factors for Cook County using the most current USEPA MOVES modeling system (MOVES3). The Microsoft Excel lookup table "CookCountyIL_MOVES_LookupTable_2021-2030_On-Road_CDB.xlsx" was provided upon request from IEPA and includes default PM_{10}, $PM_{2.5}$ and NO_X emission factors for multiple vehicle types, road types, and vehicle speeds. All off-site roads in the area are posted 30 mph zones and the on-site traffic is assumed to travel at speeds no more than 5 mph. The project traffic counts assumed 2024 as a future build year, so 2023 was selected as the operational year in the MOVES emission factor lookup table as the 2023 emission factors are higher than 2024 (i.e., more conservative). Table 5 lists the emission factors applied to the project mobile sources in the emission calculations.

Table 5 Project Mobile Emission Factors

Vehicle Type	Year	Fuel	Speed	Pollutant	Emission Factor (g/VMT)
Off-site traffic / idling					
Combination Short-Haul Truck	2023	diesel	27.5-32.5	NO_X	8.216
Combination Short-Haul Truck	2023	diesel	27.5-32.5	PM_{10}	0.241
Combination Short-Haul Truck	2023	diesel	27.5-32.5	$PM_{2.5}$	0.222
Passenger Vehicle	2023	gasoline	27.5-32.5	NO_X	0.053
Passenger Vehicle	2023	gasoline	27.5-32.5	PM_{10}	0.00156
Passenger Vehicle	2023	gasoline	27.5-32.5	$PM_{2.5}$	0.00138
On-site traffic / idling					
Combination Short-Haul Truck	2023	diesel	2.5-7.5	NO_X	25.247
Combination Short-Haul Truck	2023	diesel	2.5-7.5	PM_{10}	0.540
Combination Short-Haul Truck	2023	diesel	2.5-7.5	$PM_{2.5}$	0.497
Passenger Vehicle	2023	gasoline	2.5-7.5	NO_X	0.074
Passenger Vehicle	2023	gasoline	2.5-7.5	PM_{10}	0.0044
Passenger Vehicle	2023	gasoline	2.5-7.5	$PM_{2.5}$	0.0039

Idling emissions are applied at multiple intersections surrounding the project, at both property access points, and on-site for the loading/unloading of trucks. Zero idling was assumed for on-site passenger vehicles since their primary role on-site would be employee traffic entering and parking in the south lot. The City of Chicago Municipal Code 9-80-095 requires all diesel-powered vehicles with the engine running while idling not to exceed "more than a total of 3 minutes within any 60-minute period." The proposed project will not allow the diesel trucks to idle for more than 1 minute while on-site waiting to load or unload. Table 6 lists the idling emission factors applied to project vehicles in the emission calculations.

Table 6 Project Idling Emission Factors

Vehicle Type	Year	Fuel	Pollutant	Emission Factor (g/hr)
Combination Short-Haul Truck	2023	diesel	NO_X	57.65
Combination Short-Haul Truck	2023	diesel	PM_{10}	1.72
Combination Short-Haul Truck	2023	diesel	$PM_{2.5}$	1.58
Passenger Vehicle	2023	gasoline	NO_X	0.193
Passenger Vehicle	2023	gasoline	PM_{10}	0.0180
Passenger Vehicle	2023	gasoline	$PM_{2.5}$	0.0159

Traffic emissions are calculated based on the maximum vehicle miles travelled (VMT) on each road segment. The distances for the road segments modeled were measured using a geographic information system software (ArcGIS). The total VMT was calculated using the traffic counts on each segment multiplied by the length of each segment to obtain an emission rate in grams/hour. These traffic emissions are then divided by 3,600 seconds/hour to obtain a modeled grams/second emission rate for input into the modeling.

The idling emissions are calculated based on the estimated future build traffic study Levels of Service (LOS) delay in seconds per vehicle at each modeled intersection in Table 6 of the "Traffic Impact Study for 3815 S. Ashland Redevelopment". To calculate the idling and traffic emissions per road segment, the total vehicles listed in Table 4 were apportioned onto each road segment based on the assumed paths in the Traffic Impact Study. In the same way as traffic emissions, the total number of vehicles for each hour are multiplied by the anticipate delay at each intersection to arrive at a total amount of vehicle delay (minutes). This is multiplied by the grams/hour emission factor divided by 60 minutes/hour to obtain grams / hour for each hour. These emissions are divided by 3,600 seconds/hour to obtain the modeled grams /second emission rate for input into the modeling.

Figure 4 provides the breakdown of passenger vehicle and truck traffic onto each modeled road segment. From this information, the hour-by-hour vehicle counts were multiplied by the fraction on each segment, and this was the assumed vehicles/hour throughput. The emission calculation spreadsheet "AshlandProject_EmissionCalculations.xls" green colored tabs "PM10 Traffic Emissions", "PM2.5 Traffic Emissions", and "NOX Traffic Emissions" contain the detailed calculations for both traffic and idling.

2.4 Structure Information

Since there are no modeled point sources for this project, no building/structure information was needed.

2.5 Receptor Grid

As noted in Section 1.0, Figure 1 illustrates the overall receptor network extent. The receptor network selected for the initial modeling was constructed using the CDPH interim guidance (Section 3.5): 25-meter spacing at the fence line, 50-meter spacing to a 500-meter extent from the boundary, 100 m

spacing up to 1.5 km from the boundary. A total of 1,167 receptors were evaluated in this modeling analyses.

2.6 Terrain Elevations

The terrain heights for all the receptors and sources were obtained using a 1 arc second (30 meter) USGS Seamless National Elevation Database (NED) file downloaded from the Lakes Environmental WebGIS archive (http://www.webgis.com). A 1/3 arc second (10 meter) NED file was not available in the Lakes database for this project area. The terrain elevations are remarkably consistent in the study area and additional refinement of the terrain data would be very unlikely to change the modeled results.

2.7 Meteorological Data

Barr processed surface meteorological data from Midway Airport (14819) because of its proximity to the project site. The project site is approximately five miles from the meteorological tower to the east-northeast and has a base elevation of 188 m. The upper air data was obtained from Lincoln, IL.

This dataset was processed using AERMET v2112 for 2016-2020 which includes the updated friction velocity treatment under low-wind speed conditions (adjusted u*) approved by EPA for regulatory use as part of the January 2017 Guideline on Air Quality Models final rulemaking and 2016 National Landcover Dataset Coverage for characterizing the land use in the 1 km radius surrounding the surface station.

3 Modeling Results

The proposed project PM_{10} 24-hour, $PM_{2.5}$ 24-hour and annual, and NO_2 1-hour maximum high 1st high modeled results were below their applicable SILs listed in Table 1, therefore the project ambient air impacts are considered insignificant for these pollutants. Table 7 lists the modeling results compared to their appropriate ambient air standards. Figures 5 through 8 show the modeled impacts on the entire receptor grid for each pollutant and averaging period. The modeling input and output files accompany this report as a separate electronic attachment (Attachment 2).

Table 7 Proposed Project Ambient Air Results

Pollutant/Averaging Time	SIL (µg/m^3)	Project Impacts (µg/m^3)	Percent of SIL (%)
PM_{10} / 24-hour	5	0.12	2.5
$PM_{2.5}$ / 24-hour	1.2	0.11	9.2
$PM_{2.5}$ / Annual	0.2	0.03	14.3
NO_2 / 1-hour	7.52	4.33	57.6

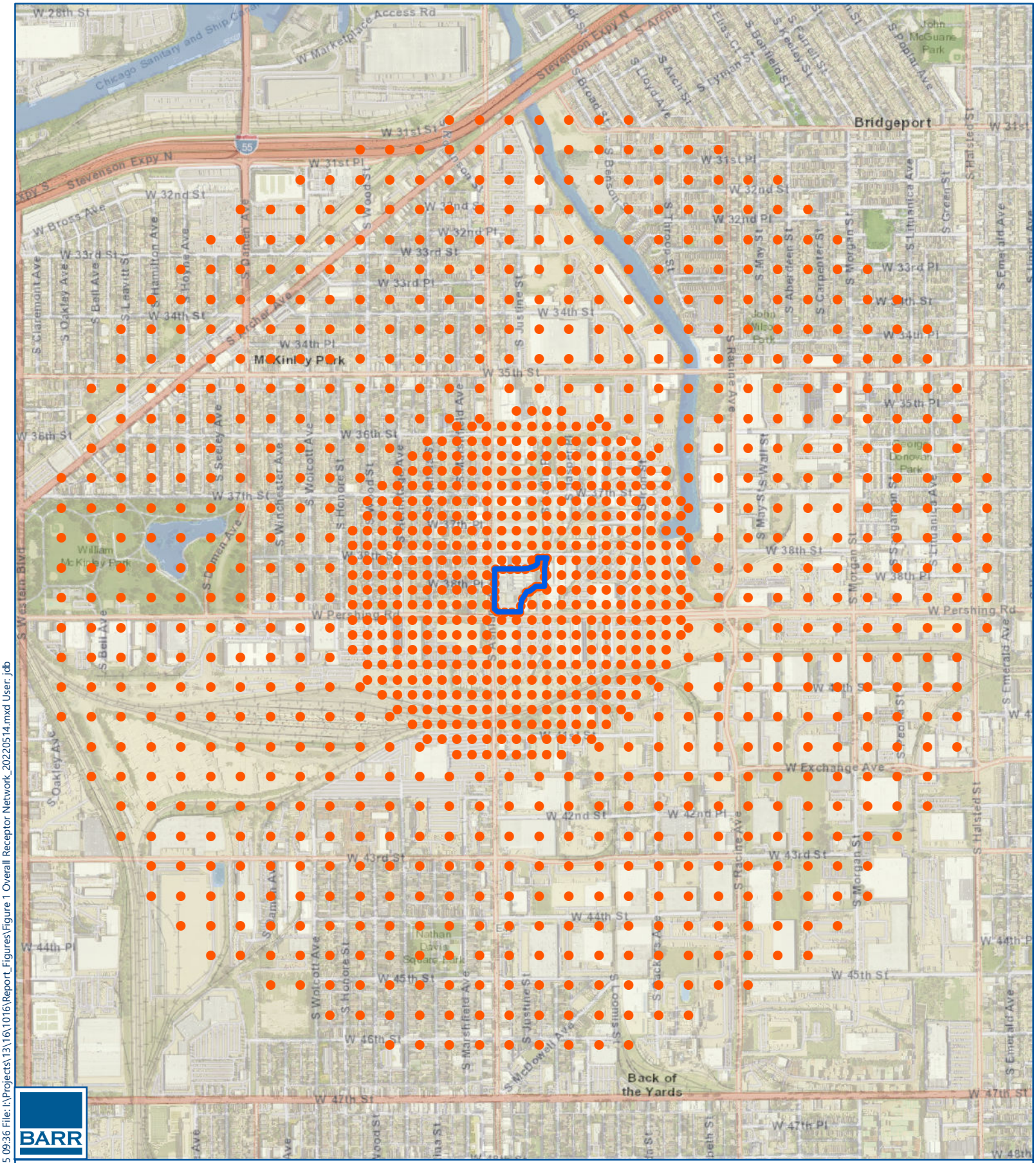
4 Summary/Conclusion

This modeling exercise was completed to fulfill the City of Chicago's Municipal Code Section 17-9-0017-G.1 Regulation "The site plan review application must include a traffic study and an air quality impact evaluation." The proposed project emission calculations and modeling input and output files are included electronically as Attachment 2 to this modeling report.

The predicted PM_{10}, $PM_{2.5}$, and NO_2 concentrations are less than the applicable SILs. Therefore, no cumulative analysis is necessary. Ultimately, this modeling exercise demonstrates that the proposed project will not result in any significant ambient air impacts on the community surrounding the project.

Attachment 1 –

Figures


Bridgeport
McKinley Park
Back of the Yards
Stevenson Expy N
W 31st St
W 32nd St
W 33rd St
W 34th St
W 35th St
W 36th St
W 37th St
W 38th St
W Pershing Rd
W Exchange Ave
W 42nd St
W 43rd St
W 44th St
W 45th St
W 47th St
S Western Blvd
S Ashland Ave
S Halsted St
S Racine Ave
S Morgan St
S Wood St
S Damen Ave
S Archer Ave
William McKinley Park
Nathan Davis Square Park
John McGuane Park
Donoghue Park
Fenceline
Receptors
N
0
200
400
600
Meters
Overall Receptor Network
3815 S. Ashland Avenue Redevelopment
Chicago, IL
FIGURE 1
BARR
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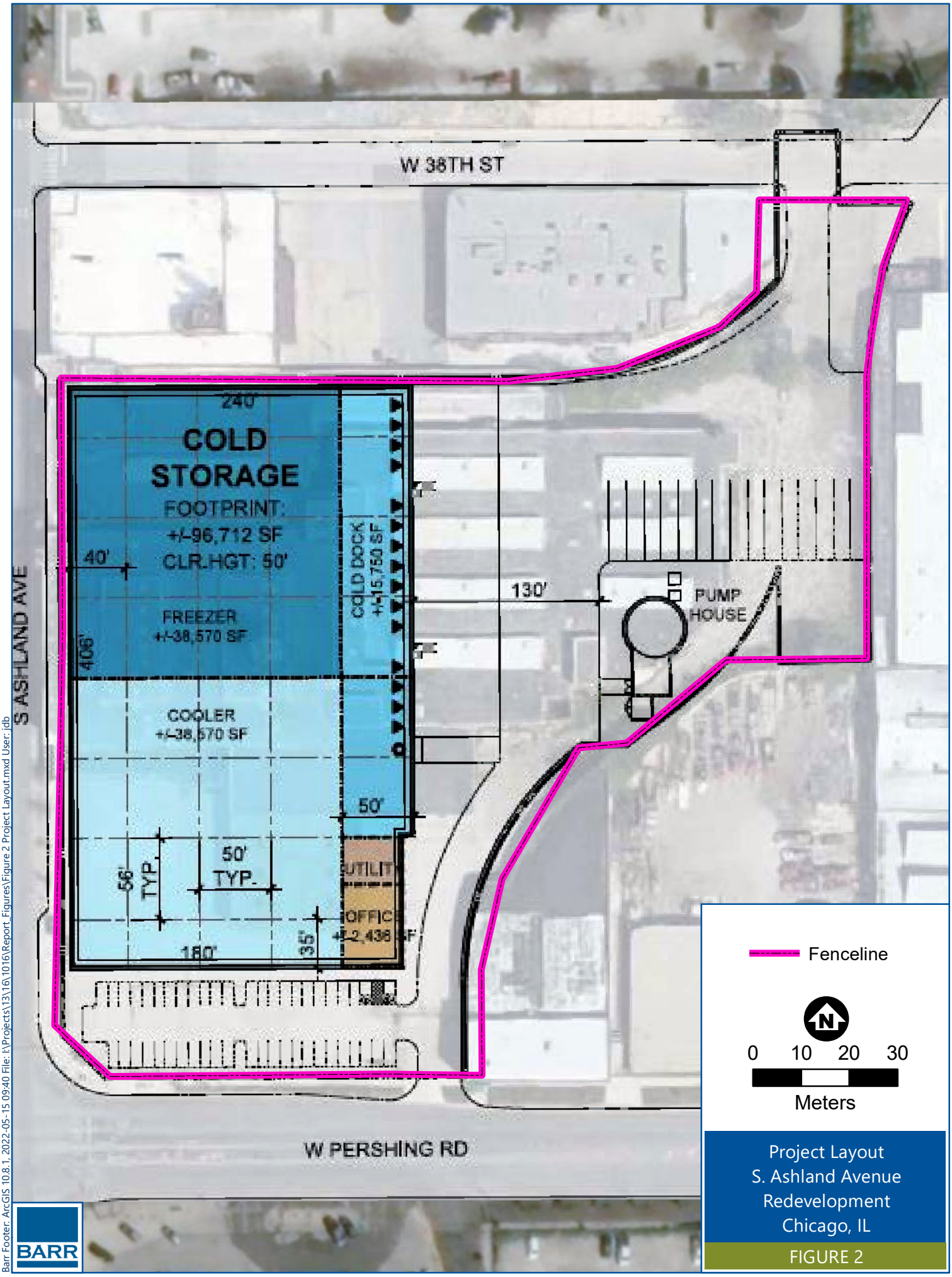
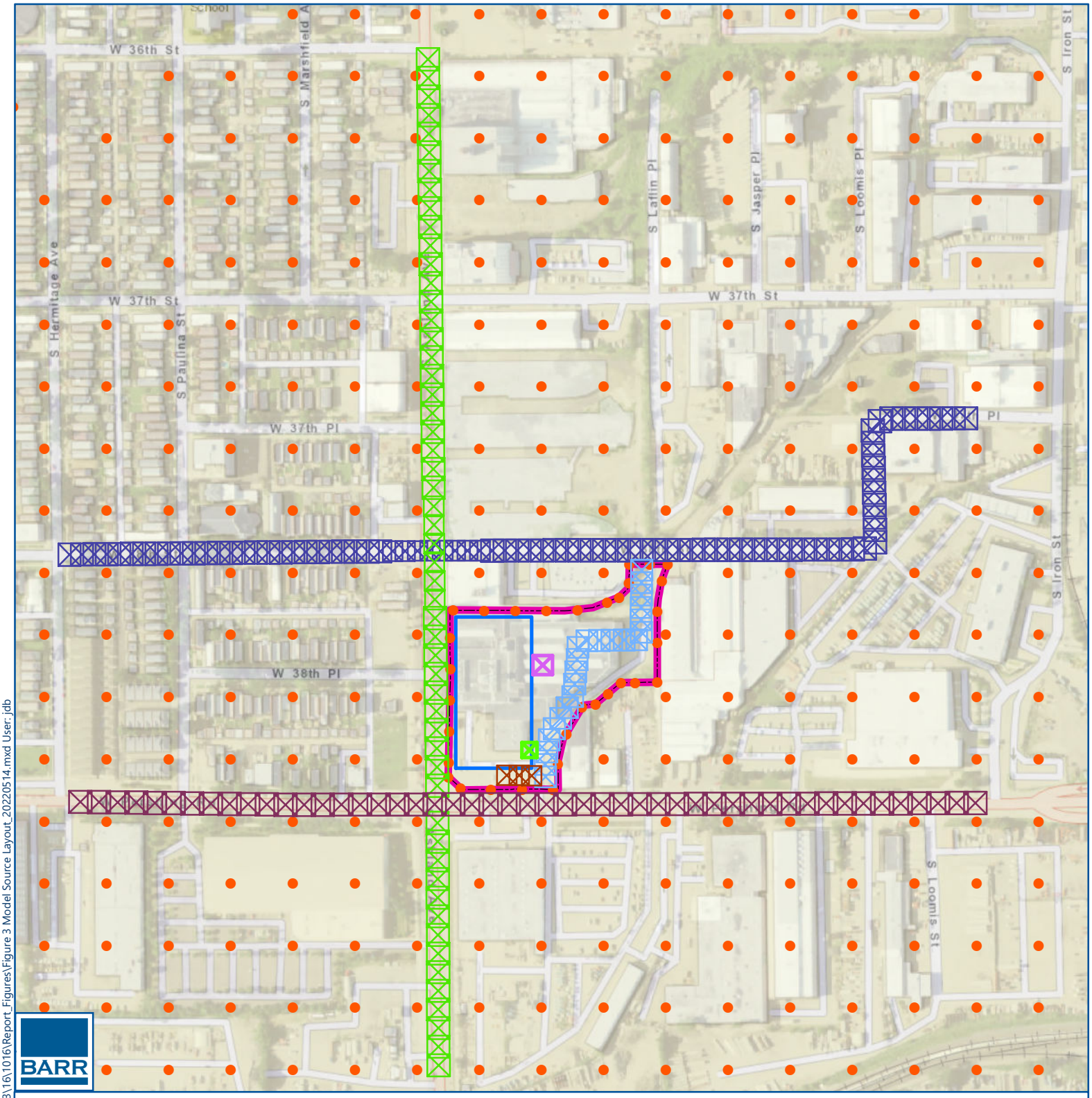




Volume Sources

- 38th Street
- Ashland Ave
- Pershing Rd
- On Site
- On Site Park
- On Site Truck Load
- Space Heater

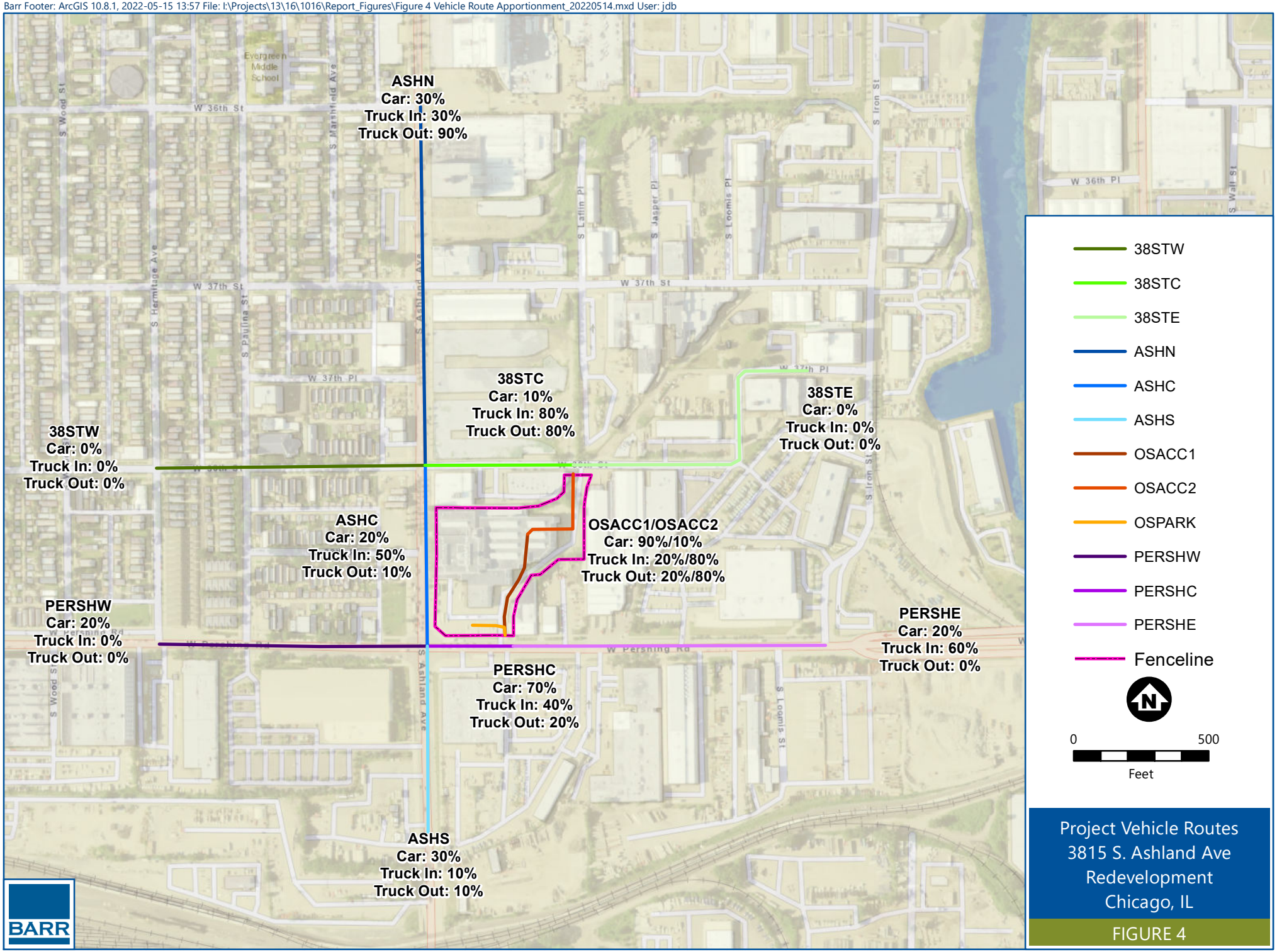
- Receptors
- Building

0 50 100 150

Meters

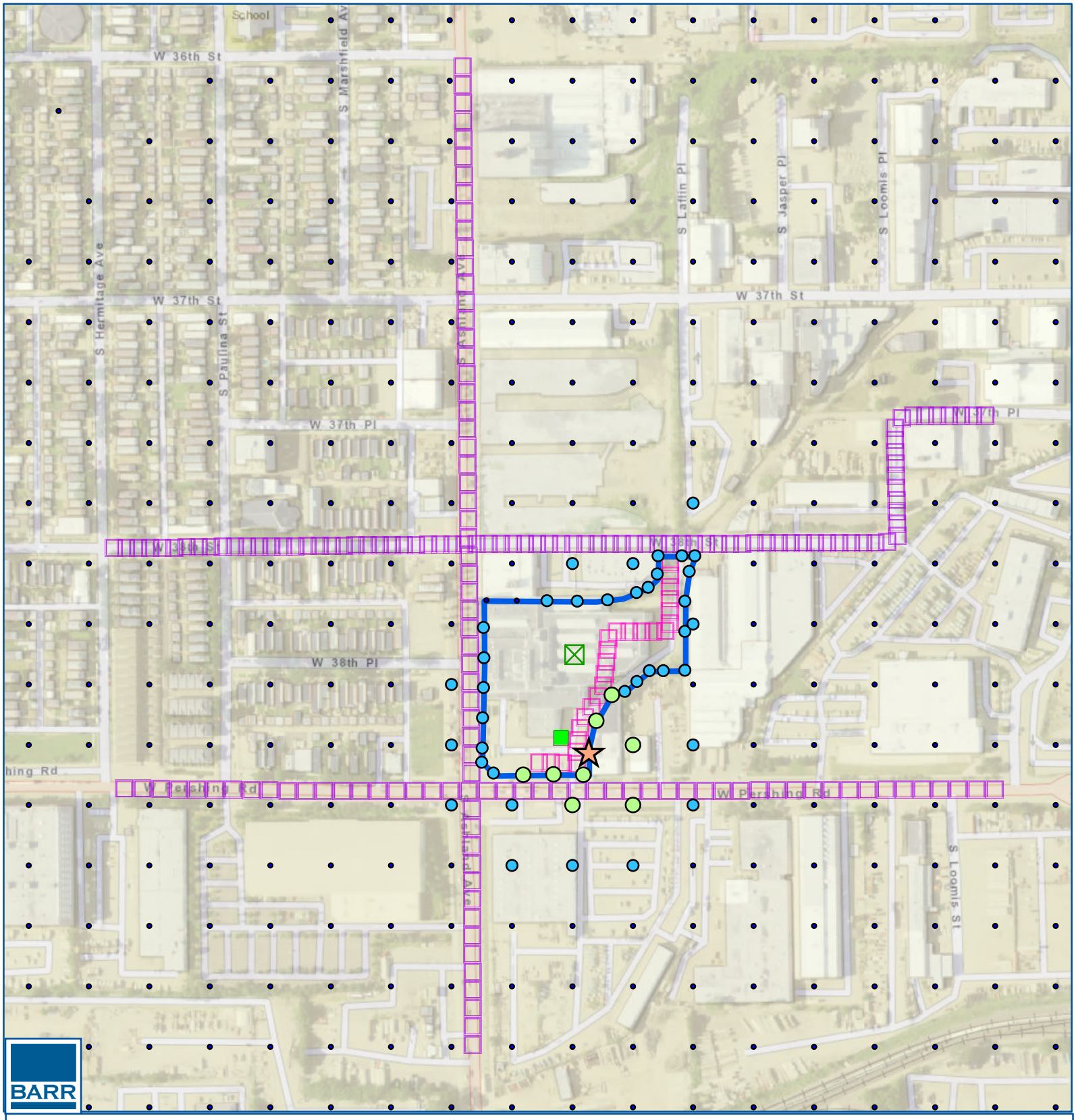
Model Source Layout
3815 S. Ashland Avenue
Redevelopment
Chicago, IL

FIGURE 3



Project Vehicle Routes
3815 S. Ashland Ave
Redevelopment
Chicago, IL

FIGURE 4



PM_{10} 24-hour SIL (%)

- <0.5%
- 0.5% - 1%
- 1% - 2%
- >2%
- Maximum prediction

- Off-propertyTraffic
- On-property traffic
- Truck Load Idling
- Space Heater
- Fenceline

PM_{10} Significant Impact Level
5 µg/m^3
Highest 24-hour concentration

Maximum prediction
0.12 µg/m^3

0 50 100 150
Meters

24-Hour PM_{10} SIL
Predicted Concentrations
3815 S. Ashland Avenue
Redevelopment
Chicago, IL

FIGURE 5

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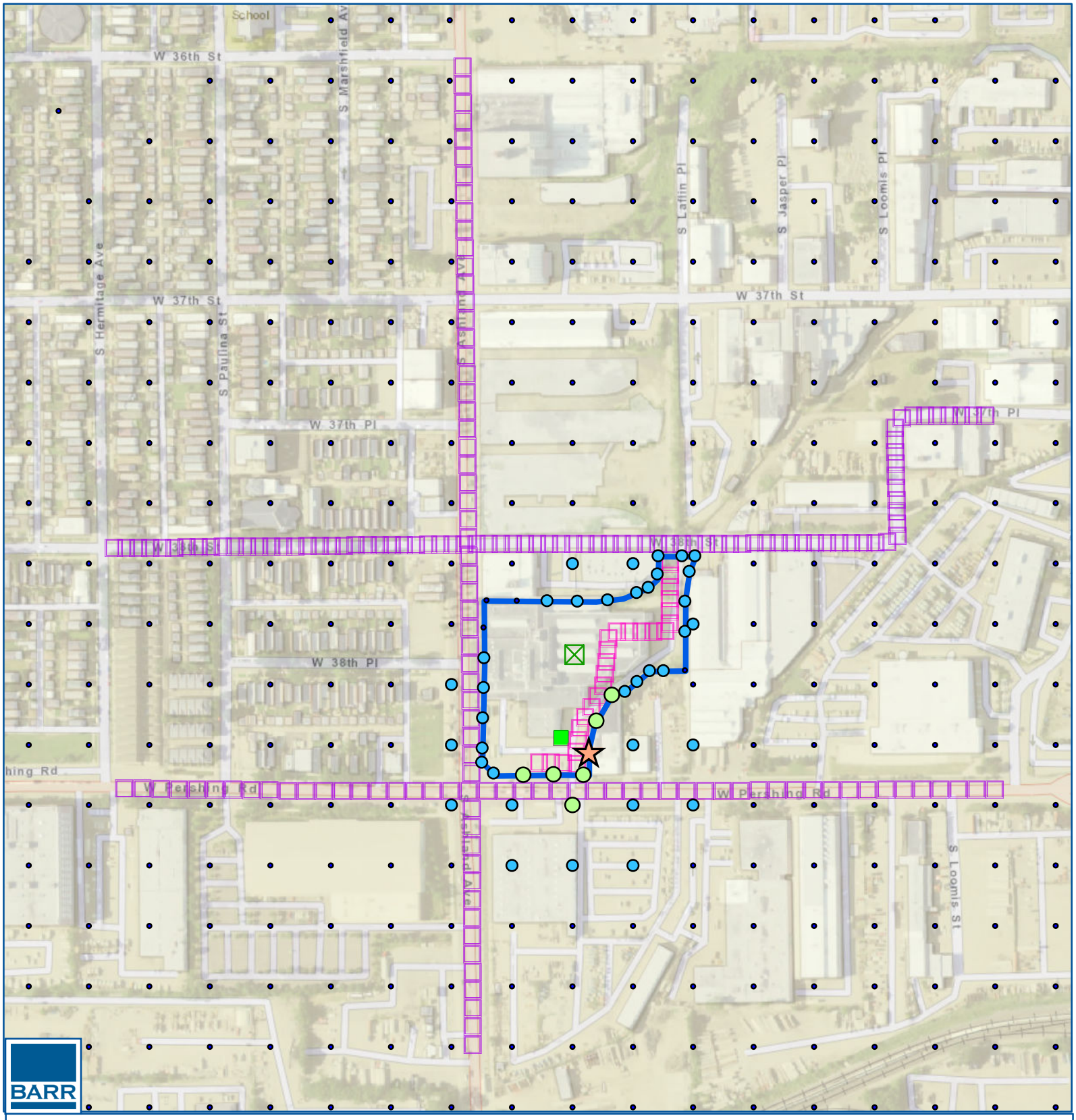

$PM_{2.5}$ 24-hour SIL (%)

- <2%
- 2% - 4%
- 4% - 8%
- >8%
- Maximum prediction

- Off-propertyTraffic
- On-property traffic
- Truck Load Idling
- Space Heater
- Fenceline

$PM_{2.5}$ Significant Impact Level
1.2 µg/m^3
Average of highest 24-hour concentrations

Maximum prediction
0.11 µg/m^3

0 50 100 150
Meters

24-Hour $PM_{2.5}$ SIL
Predicted Concentrations
3815 S. Ashland Avenue
Redevelopment
Chicago, IL

FIGURE 6

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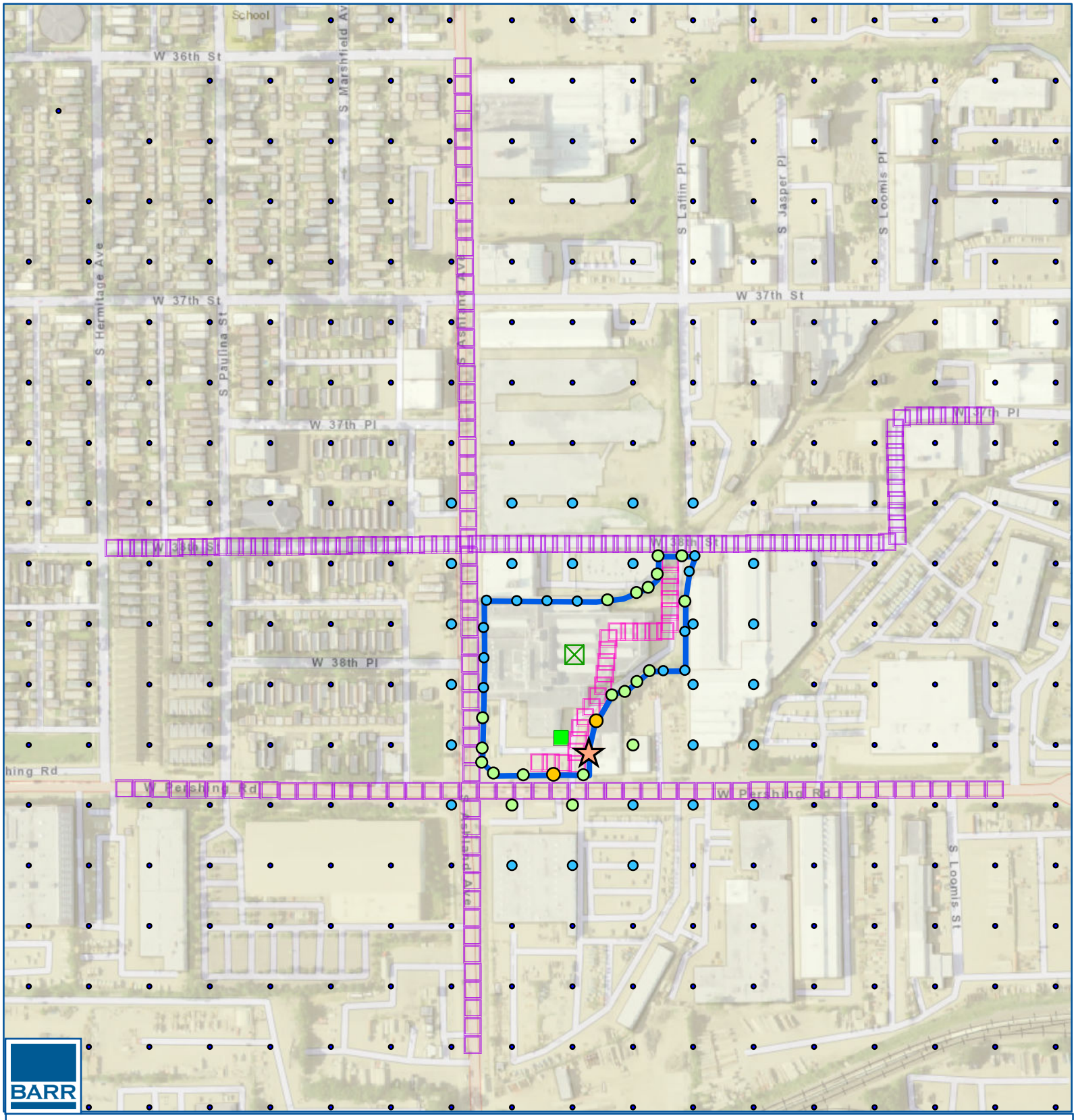


$PM_{2.5}$ Annual SIL (%)

- <2%
- 2% - 5%
- 5% - 10%
- >10%
- Maximum prediction

- Off-propertyTraffic
- On-property traffic
- Truck Load Idling
- Space Heater
- Fenceline

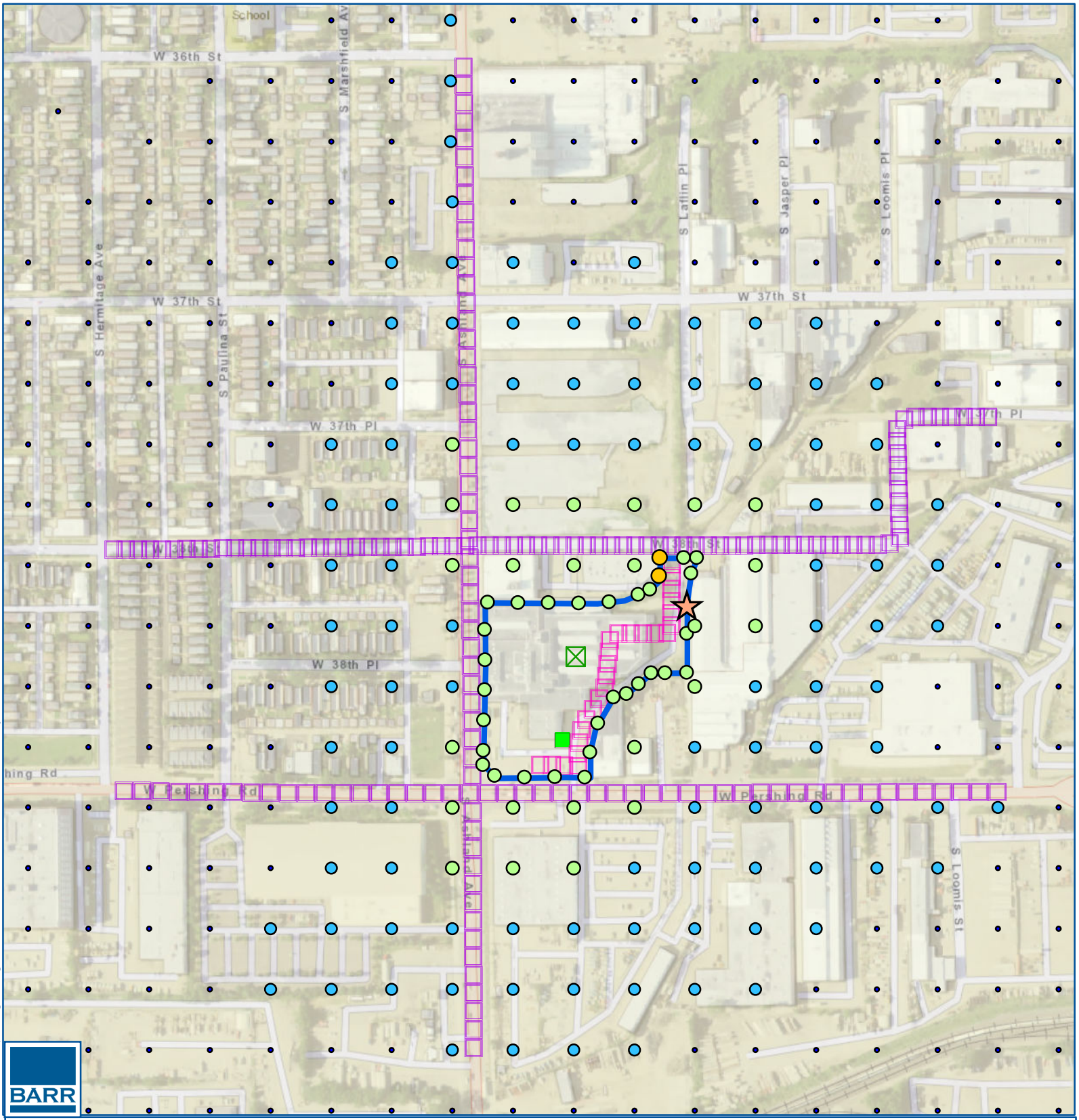
Annual $PM_{2.5}$
Significant Impact Level
0.2 µg/m^3
Average of annual concentrations

Maximum prediction
0.03 µg/m^3

0 50 100 150
Meters

Annual $PM_{2.5}$ SIL
Predicted Concentrations
3815 S. Ashland Avenue
Redevelopment
Chicago, IL

FIGURE 7



NO_2 1-hour SIL (%)

- <10%
- 10% - 20%
- 20% - 50%
- >50%
- Maximum prediction

- Off-propertyTraffic
- On-property traffic
- Truck Load Idling
- Space Heater
- Fenceline

1-hour NO_2 Significant Impact Level 7.52 µg/m^3
Average of maximum daily 1-hour concentrations

Maximum prediction 4.33 µg/m^3

0 50 100 150
Meters

1-hour NO_2 SIL Predicted Concentrations
3815 S. Ashland Avenue Redevelopment
Chicago, IL

FIGURE 8

Barr Footer: ArcGIS 10.8.1. 2022-05-15 13:59 File: I:\Projects\13\16\1016\Report_Figures\Figure 8 1-hour NO2 SIL Results_20220514.mxd User: jdb

Attachment 2 –

Supplemental Modeling Files