Arizona Department of Transportation
Environmental Planning

Project Level Carbon Monoxide (CO) and Particulate Matter (PM10) Consultation Document

SR 303L, 51st Ave to I-17 &
SR 303L, Lake Pleasant Parkway to 51st Avenue

Project No. 303 MA 136 F0562 01C & 303 MA 131 F0561 01C
Federal No. 303-A(203)T & 303-A(229)T

October 17, 2024

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried out by ADOT pursuant to 23 U.S.C. 326 and a Memorandum of Understanding dated December 20, 2023, and executed by FHWA and ADOT.

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Project- Level Conformity Interagency Consultation

Purpose and Description

The Arizona Department of Transportation's (ADOT) Project No. 303 MA 136 F0562 01C [Federal Reference Number 303-A(203)T] and Project No. 303 MA 131 F0561 01C [Federal Reference Number 303-A(229)T] are within the same general the State Route 303 Loop (Loop 303) project area and may be bid together. Therefore, per coordination with the US Environmental Protection Agency (EPA), for the purposes of air quality analysis, these two projects will be evaluated for CO & particulate matter (PM) hot spot analysis in one consultation document.

F0562 Project Setting and Description

ADOT Project No. 303 MA 136 F0562 01C is a project to prepare the final design for the proposed a third general-purpose lane (GPL) in each direction on the Loop 303 between 51st Avenue and Interstate 17 (I-17), as well as direct-connecting system ramps to and from Loop 303 to I-17. The project limits on Loop 303 are between milepost (MP) 136.00 near 51st Avenue to the Loop 303/I-17 interchange, and along I-17 between MP 220.65 near Dixileta Drive and MP 223.30 near Dove Valley Road within the City of Phoenix, in Maricopa County, Arizona. Temporary traffic control would extend 2 miles west along SR 303L, 1 mile north and south along I-17, and 1 mile east along Sonoran Desert Drive. In addition, spot overhead traffic sign installation improvements would occur on I-17 at MP 219.24 and MP 224.91.

Several northwest valley communities, including those along the Loop 303 corridor, have been identified as among the fastest growing in the region. New residential and commercial growth along the Loop 303 and I-17 corridors is contributing to increasing traffic congestion in this area. Loop 303 serves as one of the main travel routes in the west valley, stretching for approximately 35 miles from the City of Goodyear to I-17, where it becomes Sonoran Desert Drive.

This section of Loop 303 was built in 2011 as an interim facility with two 12-foot lanes in each direction of travel and a wide unpaved median, with the intention to increase capacity over time. The purpose of this project is to continue the planned expansion of the existing Loop 303 to meet future travel demands of this region, provide congestion relief for I-17 and surrounding communities, and accommodate the expanding business, residential, and economic area growth that is expected.

The scope of work for the project consists of:

- Adding a GPL in both directions on Loop 303 from just west of 51st Avenue to I-17
- Grading and paving the median along Loop 303
- Constructing flyover direct ramp connections (bridges) between Loop 303 and I-17
- Constructing new retaining walls along ramps where needed
- Widening the outside of I-17 to accommodate new ramp connections and lane tapers
- Restriping lanes on Loop 303 and I-17
- Removing and replacing pavement, curb, and gutter as needed along the existing Loop 303 and ramps
- Repairing concrete pavement on Loop 303 near MP 137.40
- Removing, replacing, and installing roadway loop detectors and CCTV equipment
- Removing, replacing and adding concrete barriers, as needed

- Removing and replacing end treatments, as needed
- Constructing noise abatement, if determined necessary through a noise evaluation
- Installing new drainage ditches and catchments, storm drains, catch basins, and manholes
- Extending existing drainage pipes, as necessary
- Installing permanent and temporary erosion control measures
- Removing, replacing and adding traffic signs, signals and ITS
- Removing, replacing, and adding overhead street lights, pull boxes, and conduit
- Installing overhead traffic structures on I-17 at northbound MP 219.24 and southbound MP 224.91
- Relocating existing utilities and installing new utilities including ITS conduit
- Staging and stockpiling equipment and construction materials within the project limits
- Vegetation removal, as needed
- Installing landscape and irrigation measures, as needed
- Removing temporary connector roads (previous I-17 connection)

The project would occur within the existing ADOT right-of-way (ROW) through private lands and ADOT easement through Arizona State Land Department (ASLD) lands. No new ROW, easement, or temporary construction easements are required. Construction funding for this project has not yet been programmed. If obtained, construction could begin as early as spring 2025 and is expected to take approximately two years.

F0561 Project Setting and Description

ADOT Project No. 303 MA 131 F0561 01C is proposing a roadway widening project on Loop 303 from MP 131.2 to MP 136.6 in the City of Peoria and City of Phoenix, Maricopa County, Arizona. The project would occur within ADOT ROW and ADOT easement on ASLD lands and Bureau of Reclamation (BOR) lands.

Loop 303 consists of two 12-foot through lanes in each direction with 10-foot minimum outside shoulders and 12-foot minimum inside shoulders. The purpose of this project is to increase capacity on Loop 303 by adding a GPL to provide a total of three 12-foot lanes in each direction.

The scope of work for this project includes:

- Widen Loop 303 toward the median to provide three lanes in each direction
- Construct new Loop 303 mainline and bridges at 67th Avenue
- Construct new pavement, curb and gutter, barriers, guardrails, and retaining walls, as needed
- Remove and reconstruct roadside barriers and/or guardrail, as needed
- Construct temporary roadway to facilitate repair and/or replacement of existing pavement and subgrade, as needed
- Remove temporary roadway, as needed
- Repair and/or replace existing pavement and subgrade, as needed
- Modify existing drainage facilities and construct new drainage facilities to accommodate new mainline improvements
- Install lighting, as needed
- Remove and reconstruct fence, as needed
- Remove existing signage and provide new signage, including embedded advance warning signs

- Obliterate and install roadway striping, raised pavement markers, and rumble strips
- Install Freeway Management System (FMS) infrastructure
- Remove/trim vegetation
- Install temporary and/or permanent stormwater measures, as needed
- Install irrigation and landscaping, as needed
- Construct new utilities and relocate utilities, as needed
- Conduct utility potholing and geotechnical investigations, as needed

No new ROW, easement, or temporary construction easements will be required for the project. Staging/stockpiling areas have yet to be determined and will be the responsibility of the contractor. Temporary lane closures and/or lane shifts will be necessary during construction. Temporary traffic control signing will be utilized to alert the travelling public of the upcoming traffic changes. The construction start date is dependent on funding. Once a funding source has been established, additional schedule information will be developed and distributed during final design. The anticipated construction duration is approximately 14 months.

These projects are within the Phoenix CO maintenance area and a nonattainment area for PM10 and Ozone. Though these projects are split, a combined proposed project is included in the *Maricopa Association of Governments (MAG) Regional Transportation Plan (RTP) MOMENTUM 2050*. In addition, the combined project is included in the *FY 2022-2025 MAG Transportation Improvement Program*.

Figure 1. Project Vincinity Map

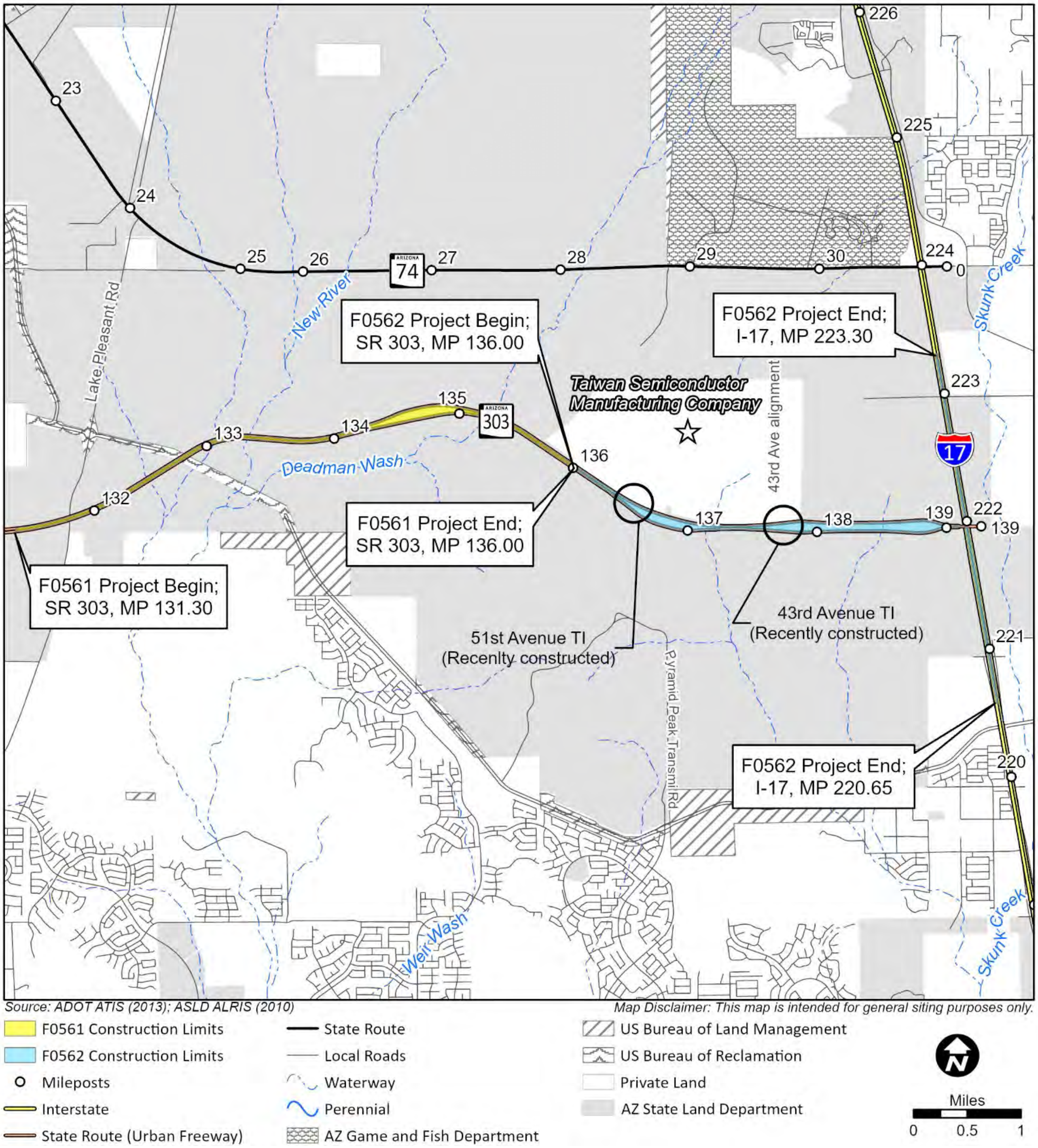


Figure 2. Project Improvments

Source: [Loop 303, Lake Pleasant Parkway to I-17 Improvements | Department of Transportation (azdot.gov)]

CO Project Assessment – Part A

The following questionnaire is used to compare the proposed project to a list of project types in 40 CFR 93.123(a) requiring a quantitative analysis of local CO emissions (Hot-spots) in nonattainment or maintenance areas, which include:

i) Projects in or affecting locations, areas, or categories of sites which are identified in the applicable implementation plan as sites of violation or possible violation;
ii) Projects affecting intersections that are at Level-of-Service D, E, or F, or those that will change to Level-of-Service D, E, or F because of increased traffic volumes related to the project;
iii) Any project affecting one or more of the top three intersections in the nonattainment or maintenance area with highest traffic volumes, as identified in the applicable implementation plan; and
iv) Any project affecting one or more of the top three intersections in the nonattainment or maintenance area with the worst level of service, as identified in the applicable implementation plan.

If the project matches one of the listed project types in 40 CFR 93.123(a)(1) above, it is considered a project of local air quality concern and the hot-spot demonstration must be based on quantitative analysis methods in accordance to 40 CFR 93.116(a) and the consultation requirements of 40 CFR 93.105(c)(1)(i).

Projects Affecting CO Sites of Violation or Possible Violation

Does the project affect locations, areas or categories of sites that are identified in the CO applicable plan or implementation plan submissions, as appropriate, as sites of violation or potential violation?

NO – This project does not affect locations, areas or categories of sites that are identified in the MAG 2013 Carbon Monoxide Maintenance Plan for Maricopa County as sites of violation or potential violation.

Projects with Congested Intersections

Is this a project that affects a congested intersection (LOS D or greater) will change LOS to D or greater because of increased traffic volumes related to the project?

YES – For F0561 project, the project would not affect a congested intersection will change LOS to D or greater because of increased traffic volumes. For F0562 project, among the 10 intersections, 3 intersections in AM peak hour and 3 intersections in PM peak hour operate at LOS D or greater under existing condition. One intersection would result in LOS D in the 2050 build scenario. ADT volume increase at intersections range from –48,545 vehicles to23,598 vehicle and truck ADT volume increase at intersections range from -5,748 vehicle to 1,681 vehicles.

Table 1A – Freeway Mainline & Intersection ADT and Truck ADT in Existing, No Build and Build Conditions (F0561)

AADT and Truck Volumes		2023 Existing		2050 No-Build		2050 Build		Difference (Build - No- Build)		
		ADT	Truck (%)	ADT	Truck (%)	ADT	Truck (%)	ADT	Truck ADT	Truck (%)
Mainline	SR 303L East of 67th Ave. to 51st Ave	17,199	12.38%	53,374	10.31%	98,509	11.23%	45,136	5,563	0.92%
Mainline	SR303L between 67th Ave. & Lake Pleasant Parkway	17,199	12.38%	53,374	10.31%	96,298	11.40%	42,924	5,474	1.09%
Mainline	SR 303L West of Lake Pleasant Parkway	21,852	12.93%	61,119	9.77%	93,309	12.22%	32,190	5,430	2.45%
Intersection	Lake Pleasant Parkway & SB SR303L	10,406	9.62%	46,587	3.30%	27,170	6.67%	-19,417	276	3.37%
Intersection	Lake Pleasant Parkway & NB SR303L	8,748	8.29%	43,500	3.11%	25,244	5.94%	-18,256	146	2.83%
Intersection	67th Avenue & SB SR303L	---	---	---	---	37,853	11.83%	---	---	---
Intersection	67th Avenue & NB SR303L	---	---	---	---	24,445	9.54%	---	---	---

Note: Truck% includes heavy truck and medium truck. ADT at intersections include volumes on approach lanes.
Source: MAG traffic demand model received from Kimley Horn on April 3, 2024

Table 1B – Freeway Mainline & Intersection ADT and Truck ADT in Existing, No Build and Build Conditions (F0562)

AADT and Truck Volumes		2023 Existing		2050 No-Build		2050 Build		Difference (Build - No- Build)		
		ADT	Truck (%)	ADT	Truck (%)	ADT	Truck (%)	ADT	Truck ADT	Truck (%)
Mainline	SR 303L between 51st Ave & 43rd	27,289	13.77%	73,709	11.15%	115,512	12.98%	41,803	6,776	1.83%
Mainline	Sonoran Desert Dr between 43rd Ave & I-17	29,947	14.74%	77,899	11.19%	95,411	13.21%	17,512	3,880	2.01%
Mainline	I-17 south of Dexileta Dr	141,166	13.48%	250,198	16.45%	194,016	16.65%	-56,181	-8,857	0.20%
Mainline	I-17 between Dexileta Dr & Sonoran Desert Dr	138,861	13.58%	239,749	16.81%	233,692	17.84%	-6,057	1,389	1.03%
Mainline	I-17 between Sonoran Desert Dr & Dove Valley Rd	110,845	14.03%	180,162	18.85%	140,367	21.52%	-39,796	-3,765	2.66%
Mainline	I-17 between Dove Valley Rd & Carefree Hwy	117,668	13.80%	176,817	19.04%	153,885	20.33%	-22,932	-2,389	1.28%
Intersection	51st Avenue & SB SR 303L	7,017	19.59%	36,074	7.72%	42,525	8.95%	6,451	1,024	1.24%
Intersection	51st Avenue & NB SR 303L	5,853	18.85%	16,848	7.13%	34,279	7.35%	17,431	1,320	0.23%
Intersection	43rd Avenue & SB SR 303L	7,399	17.94%	23,716	8.25%	37,660	7.89%	13,944	1,016	-0.36%
Intersection	43rd Avenue & NB SR 303L	947	12.25%	10,009	8.22%	33,607	7.45%	23,598	1,681	-0.77%
Intersection	Dexileta Dr & NB I-17	---	---	---	---	14,663	6.67%	---	---	---
Intersection	Dexileta Dr & SB I-17	---	---	---	---	12,655	6.97%	---	---	---
Intersection	Sonoran Desert Dr & NB I-17	29,881	12.78%	70,907	9.45%	44,042	7.97%	-26,865	-3,188	-1.48%
Intersection	Sonoran Desert Dr & SB I-17	35,570	13.84%	86,569	10.63%	38,024	9.09%	-48,545	-5,748	-1.54%
Intersection	Dove Valley Rd & NB I-17	16,196	8.21%	39,348	4.52%	35,082	3.65%	-4,266	-499	-0.87%
Intersection	Dove Valley Rd & SB I-17	11,023	9.09%	49,700	5.57%	35,605	3.40%	-14,095	-1,558	-2.17%

Note: Truck% includes heavy truck and medium truck. ADT at intersections include volumes on approach lanes.
Source: MAG traffic demand model received from Jacobs on March 11, April 16, 2024, and May 10, 2024

Table 2A – Intersections LOS in the Project Area (F0561)

Level of Service (LOS)		2023 Existing		2050 No-Build		2050 Build	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
		LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)
Overall Intersection LOS	67th Avenue & SB SR 303L	---	---	---	---	C (20.9)	B (19.9)
	67th Avenue & NB SR 303L	---	---	---	---	B (15.9)	B (13.8)

Notes:
67th Avenue TI does not currently exist.
Lake Pleasant Parkway intersections have LOS C or better in 2020 existing, and 2040 Build per Final Traffic Report, SR303, Lake Pleasant Parkway to I-17 (completed in 2022).
Source: Initial Traffic Memo provided by Kimley Horn on April 3, 2024.

Table 2B – Intersections LOS in the Project Area (F0562)

Level of Service (LOS)		2023 Existing		2050 No-Build		2050 Build	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
		LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)
Overall Intersection LOS	51st Avenue & SB SR 303L	A (0)	A (0)	B (11.9)	B (12.3)	B (14.8)	B (12.1)
	51st Avenue & NB SR 303L	A (0)	A (0)	C (23.5)	A (8.8)	D (42.5)	B (13.7)
	43rd Avenue & SB SR 303L	B (10.1)	A (5.0)	C (20.5)	B (19.7)	C (20.5)	B (19.8)
	43rd Avenue & NB SR 303L	B (11.3)	A (7.7)	B (16.8)	B (13.6)	C (28.2)	C (20.5)
	Dexileta Dr & NB I-17	---	---	A (0)	A (0)	A (0)	A (0)
	Dexileta Dr & SB I-17	---	---	A (0)	A (0)	A (0)	A (0)
	Sonoran Desert Dr & NB I-17	E (63.5)	F (195.8)	F (358.1)	F (329.4)	B (18.0)	B (19.4)
	Sonoran Desert Dr & SB I-17	E (74.6)	F (87.5)	F (375.7)	F (447.9)	B (16.8)	B (15.0)
	Dove Valley Rd & NB I-17	C (33.3)	C (34.7)	C (33.7)	C (27.2)	C (27.1)	C (26.1)
	Dove Valley Rd & SB I-17	D (46.8)	D (38.8)	C (30.9)	D (50.1)	C (26.5)	C (25.4)

Notes:
Source: LOS data provided by Jacobs on April 8 and April 15, 2024.

Projects Affecting Intersections with Highest Traffic Volumes
Does the project affect one or more of the top three intersections in the CO maintenance area with highest traffic volumes identified in the CO applicable implementation plan?

*Three Highest Intersections in Current Plans

MAG[1]
16th St & Camelback Rd
107th Ave & Grand Ave
Priest Dr & Southern Ave

[1]MAG 2013 Carbon Monoxide Maintenance Plan for the Maricopa County Area

NO. This project does not affect one or more of the top three intersection in the carbon monoxide maintenance area with the highest traffic volumes identified in the MAG 2013 Carbon Monoxide Maintenance Plan for Maricopa County.

Projects Affecting Intersections with the Worst Level of Services
Does the project affect one or more of the top three intersections in the CO maintenance area with the worst level of services identified in the CO applicable implementation plan?

NO – This project does not affect one or more of the top three intersections with the worst LOS in the MAG 2013 Carbon Monoxide Maintenance Plan for Maricopa County.

*Three Worst LOS Intersections in Current Plans

MAG[1]
7th Ave & Van Buren St
German Rd & Gilbert Rd
Thomas Rd & 27th Ave

[1]Same as above

Project Assessment – Part B

Hot-Spot Determination

Decide which type of hot-spot analysis is required for the project by choosing a category below.

☒ **If answered "Yes" to any of the questions in the Project Assessment – Part A**

- A quantitative CO hot-spot analysis is required under 40 CFR 93.123(a)(1).

☒ Check **If** a formal air quality report for conformity is required for this project.

- The applicable air quality models, data bases, and other requirements specified in 40 CFR part 51, Appendix W (Guideline on Air Quality Models) should be completed using **"Project Level CO Quantitative Hot-Spot Analysis – Consultation Document"** circulated through interagency consultation for review and comments for 30 days prior to commencing any modeling activities.

- **Or**

☐ Check **If** the project fits the condition of the "**CO Categorical Hot-Spot Finding**".
In the January 24, 2008, Transportation Conformity Rule Amendments, EPA included a provision at 40 CFR 93.123(a)(3) to allow the U.S. DOT, in consultation with EPA, to make categorical hot-spot findings in CO nonattainment and maintenance areas if appropriate modeling showed that a type of highway or transit project would not cause or contribute to a new or worsened air quality violation of the CO NAAQS or delay timely attainment of the NAAQS or

required interim milestone(s), as required under 40 CFR 93.116(a).

Projects Fitting the Condition of the CO Categorical Hot-Spot Finding
Do the project's parameters fall within the acceptable range of modeled parameters (Use "Table 1: Project Parameters and Acceptable Ranges for CO Categorical Hot-Spot Finding" or enter the project information into FHWA's web based tool: https://www.fhwa.dot.gov/environment/air_quality/conformity/policy_and_guidance/cmcf_2017/tool.cfm)?

NO – This project's parameters do not fall within the acceptable range of modeling parameters for a CO Categorical Hot-spot Finding in Appendix Table 1 on next page.

Table 1: Project Parameters and Acceptable Ranges for CO Categorical Hot-Spot Finding for Urban Intersection

Parameter	**Acceptable Range**
Analysis year	Greater than or equal to 2017
Angle of cross streets for intersection (degrees)	90
Maximum grade for the intersection (%)	Less than or equal to 2
Maximum grade on cross street for the intersection (%)	0
Number of through lanes	Less than or equal to 4
Number of left turn lanes	Less than or equal to 2
Lane width (ft)	12
Median width (ft)	0
Peak hour average approach speed (mph)	Greater than or equal to 25
Peak hour approach volume (vph)	Less than or equal to 2640
Peak hour Level of Service	A through E
Ambient temperature (°F)	Greater than or equal to -10
Heavy-duty trucks (%)	Greater than or equal to 5
1-hour background CO concentrations (ppm)	Less than or equal to 32.6
8-hour background CO concentrations (ppm)	Less than or equal to 7.3
Persistence factor	Less than or equal to 0.7

☐ **If answered "No" to all of the questions in the Project Assessment – Part A**

- A qualitative CO analysis is required under 40 CFR 93.123(a)(2). The demonstrations required by 40 CFR 93.116 Localized CO, PM10, and PM2.5 violations (hot-spots) may be based on either:
- **(i) Quantitative methods that represent reasonable and common professional practice;**
  ☐ Check **If** an Air Quality Report includes CO modeling for NEPA EA/EIS use this report to satisfy option (i)
- **Or**
- **(ii) A qualitative consideration of local factors, if this can provide a clear demonstration that the requirements of 40 CFR 93.116 are met.**
  ☐ Check **If** there is an Air Quality Report that does not include CO modeling for NEPA EA/EIS use this report to satisfy (ii)
  ☐ Check **If** the project is a CE under NEPA that does not require Air Quality Report for NEPA EA/EIS use this Questionnaire to add additional justification to satisfy (ii)

The F0562 project requires a quantitative hot-spot analysis for carbon monoxide. The intersections to be modeled were determined using EPA's Guideline for Modeling Carbon Monoxide from Roadway Intersections (EPA, 1992). The intersections with the highest volumes and longest delays were identified for the 2050 build alternative. The top three intersections ranked by volume are as follows:

- Sonoran Desert Dr & NB I-17
- 51st Avenue & SB SR 303L
- Sonoran Desert Dr & SB I-17

The top three intersections ranked by LOS and delay are as follows:

- 51st Avenue & NB SR 303L (AM Peak Hour)
- 43rd Avenue & NB SR 303L (AM Peak Hour)
- Dove Valley Rd & NB I-17 (AM Peak Hour)

Based on the top intersections ranked by volume and by LOS and delay, the intersection modeling analysis will be performed for the following four TI intersections' peak hours of the days:

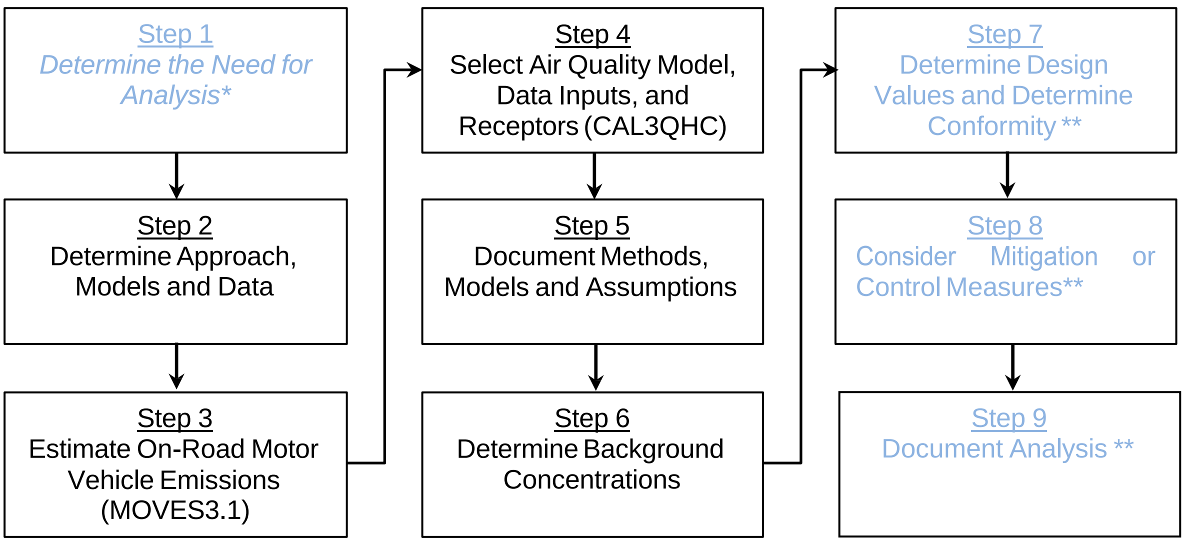
- 51st Avenue & SB SR 303L
- 51st Avenue & NB SR 303L
- 43rd Avenue & NB SR 303L
- Sonoran Desert Dr & NB I-17
- Sonoran Desert Dr & SB I-17
- Dove Valley Rd & NB I-17

Modeling will be performed under the worst case scenario using the 2026 MOVES emission rates (the highest CO emission rates) with the 2050 traffic data (the maximum traffic volumes). 2026 is selected because it is the opening year. It is assumed that if the selected worst-case intersections do not show an exceedance of the NAAQS, none of the intersections will. Refer to the enclosed supplemental traffic study.

Project Level CO Quantitative Hot-Spot Analysis – Consultation Document

Completing a Carbon Monoxide (CO) Hot-Spot Analysis

The general steps required to complete a quantitative CO hot-spot analysis are outlined below and described in detail in the EPA Office of Transportation and Air Quality guidance document "Using MOVES3.1 in Project-Level Carbon Monoxide Analyses" EPA-420-B-21-047, December 2021, and "Guideline for Modeling Carbon Monoxide from Roadway Intersections" EPA-454/R-92-005, November 1992.



* Described in the previous section

** These Steps will be described and documented in a final air quality analysis report.

Step 2: Determine the Approach, Models, and Data

a. Describe the project area (area substantially affected by the project, 58 FR 62212) and emission sources.
b. Determine general approach and analysis year(s) – year(s) of peak emissions during the time frame of the transportation plan (69 FR 40056).
c. Determine CO National Ambient Air Quality Standards (NAAQS) to be evaluated.
d. Select emissions and dispersion models and methods to be used.
e. Obtain project-specific data (e.g., fleet mix, peak-hour volumes and average speed).

Step 3: Estimate On-Road Motor Vehicle Emissions with MOVES3.1

a. Generate RunSpec and enter project-specific data into Project Data Manager
b. Estimate on-road motor vehicle emissions.

Step 4: Select Air Quality Model, Data Inputs, and Receptors for CAL3QHC

a. Obtain and input required site data (e.g., meteorological).
b. Input MOVES outputs (emission factors).

c. Determine number and location of receptors, roadway links, and signal timing.
d. Run air quality dispersion model and obtain concentration results.

Step 5: Document Methods, Models and Assumptions

a. Summarize the methods, models and assumptions based on Step 3 & 4 (see the example in Table 1).
b. Submit the summary document to ADOT for review.

Step 6: Determine Background Concentrations

a. Determine background concentrations from nearby and other emission sources excluding the emissions from the project itself.

Step 7: Calculate Design Values and Determine Conformity

a. Add step 5 results to background concentrations to obtain values for the Build scenario.
b. Determine if the design values allow the project to conform.

Step 8: Consider Mitigation or Control Measures

a. Consider measures to reduce emissions and redo the analysis. If mitigation measures are required for project conformity, they must be included in the applicable SIP and be enforceable.
b. Determine if the design values from allow the project to conform after implementing mitigation or control measures.

Step 9: Document Analysis

a. Determine if the project conforms or not based on the results of step 7 or step 8.
To support the conclusion that a project meets conformity under 40 CFR 93.116 and 93.123, at a minimum the documentation will include:

- *Description of proposed project, when it is expected to open, and projected travel activity data.*
- *Analysis year(s) examined and factors considering in determining year(s) of peak emissions.*
- *Emissions modeling data, model used with inputs and results, and how characterization of project links.*
- *Model inputs and results for road dust, construction emissions, and emissions from other source if needed.*
- *Air Quality modeling data, included model used, inputs and results and receptors.*
- *How background concentrations were determined.*
- *Any mitigation and control measures implemented, including public involvement or consultation if needed.*
- *How interagency and public participation requirements were met.*
- *Conclusion that the proposed project meets conformity requirements.*
- *Sources of data for modeling.*

Methods, Models and Assumptions for CO

Table 1. Methods, Models and Assumptions		
Estimate On-Road Motor Vehicle Emissions (Step 3)		
MOVES3.1	**Description**	**Data Source**
Scale	*On road, Project, Inventory*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.2
Time Span	*EPA 1992 Guideline conservatively uses a typical peak-hour traffic activity in one MOVES run to generate emission rates: The worst case scenario using the January, weekdays, hours of 7:00- 7:59 in 2026 MOVES emission rates (the highest CO emission rates) with the 2050 traffic data (the maximum traffic volumes) will be selected.*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.3
Geographic Bounds	*Maricopa County*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.4
Onroad Vehicles	*All Fuels and Source Use Types will be selected*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.5
Road Type	*Urban Restricted and Urban Unrestricted access*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.6
Pollutants and Processes	*CO Running Exhaust, CO Crankcase Running Exhaust*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.7
Output	*Database will be created, Grams, Miles, Distance Traveled, Population will be selected. Emissions process will be selected in the Output Emissions Detail. Emission rates for each process can be appropriately summed to calculate aggregate CO emission rates for each link.*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.3.10
Project Data Manager	*Database and MOVES3.1 templates will be created to include local project data and information provided by MPO, e.g., MAG's or PAG's I/M programs, Age Distribution data which are consistent with the regional models. The average temperature and humidity in January for metrology data and the default MOVES fuel data will be used. Links and Link Source Type will be specific to project as provided by the traffic analysis, any missing information will use default MOVES3.1 data. After running MOVES, the MOVES CO_CAL3QHC_EF post-processing script is run.*	EPA 1992 Guideline, Section 4.7.1., Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.1, 2.4 for Links; the required data necessary to be consistent with regional emissions analysis (40 CFR 93.123(c)(3)). See Table 2 below for details.
Select Air Quality Model, Data Inputs, and Receptors (Step 4)		
CAL3QHC	**Description**	**Data Source**

Emissions Sources	*Emissions Rates in grams/mile will be developed using the inputs described in MOVES3.1 section above. The free flow and queue links defined for modeling with MOVES3.1 will be used as input into CAL3QHC.*	1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections, EPA-454/R-92-005, November 1992. Section 3.2 & 4.2.3.1 of Appendix W to 40 CFR Part 51, CO screening analyses of intersection projects should use the CAL3QHC dispersion model.
Receptor Locations	*At least 3m from the roadways at a height of 1.8m, nearby occupied lot, vacant lot, sidewalks, and any locations near breathing height (1.8m) to which the general public has continuous access.*	1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections, Section 2.2
Traffic and Geometric Design	*Lane Configuration, Lane Width, Signalization, Turning Movements, Median Width, Traffic Volume, Level of Service, Grade, % of Heavy-Duty Trucks, and Peak Hour Average Approach Speed.*	1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections, Section 4.7.4
Meteorology	*Temperature, Wind Speed, Wind Direction, Atmospheric Stability Class, Mixing Heights and Surface Roughness.*	1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections, Section 4.7.1
Persistence Factor	*Local persistence factor based on monitoring data. If it is not available, use a default persistence factor of 0.7. Will use persistence factor of 0.7 because local measured monitored concentrations are not available.*	1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections, Section 4.7.2
Determine Background Concentrations (Step 6)		
Background Monitor	*The West Phoenix (WP) monitor located at 39th Avenue & Earll Drive in Phoenix was selected as background CO monitor because it is closest to the project site and has similar environment settings as the project corridor. Three years of monitoring data (2021--2023) show a maximum 8-hour value of 3.5 ppm. 5.0 ppm (which is the 8-hour concentration divided by a persistence factor of 0.7) will be added to the maximum modeled hourly concentration for comparison to the NAAQS. 3.5 ppm will be added to the maximum 8-hour modeled concentration. The same background values will be used for all analysis years.*	1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections, Section 4.7.3

Table 2. Project Data Manager Inputs

Input	Level of Detail/notes	Possible Data Source
Meteorology	*Same for build and no-build scenarios. The average temperature and humidity were determined by averaging temperature values for January 2021, 2022, and 2023 at the Phoenix Sky Harbor International Airport Station. (source: National Weather Service)* *The average temperature of 55.5 degrees F and the average relative humidity of 43.7% were uses in all MOVES runs, regardless of analysis year or time of day.*	ADEQ, MPO EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.1
Age Distribution	*Same for build and no-build scenarios, unless something about the project would change them: The latest local age distribution data from MAG regional CO conformity analysis (Approved Sprint 2023) will be used. No change would be*	ADOT, MPO EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.2
Fuel	*Same for build and no-build scenarios. MOVES default fuel supply and formulation information will be used.*	MPO, MOVES defaults EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.3
I/M Programs	*Same for build and no-build scenarios. Projects in Area A and B should define the I/M programs. Use MPO data. If not available, may use the MOVES default I/M programs but review the details and make any necessary changes before use. Will use I/M local data from MAG AQ conformity analysis.*	MPO, MOVES defaults EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.4
Retrofit Data	*If necessary. For example, a bus terminal project might include plans to mitigate emissions by retrofitting the bus fleet.*	Project specific modeling EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.5
Links	*Four selected TI intersections (51st Ave & SR303L, 43rd Ave & SR303L, Sonoran Desert Dr & I-17, and Dove Valley Rd & I-17) will be divided into links and each link's length (in miles), traffic volume (vehicle per hour), average speed (miles per hour) and road grade (percent) will be specified. Other roadway segments within 1000 feet of the intersection will be included. (See attachment for graphical representation of model setup)*	Project specific modeling, ADOT, MPO EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.6
Link Source Types	*Option 2 in the EPA's CO MOVES3 Guidance Section 2.4.7 will be used.*	Project specific modeling, ADOT, MPO EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.7
Link Drive Schedules, Operating Mode	*Average speeds and road types through the Links Importer will be used. Option 1 was used because of data availability.*	Project specific modeling, ADOT, MPO EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.8, 2.4.9

Off-Network, Hotelling	*If necessary. For example, a project analysis includes areas where vehicles are not driving on the project links, but still contributing to the project's emissions.*	EPA Using MOVES3 in Project-Level Carbon Monoxide Analyses, Section 2.4.10

Table 3. Construction Emissions *(Only if Applicable)*		
Construction Emissions	*Construction Emissions need to be addressed if construction lasts longer than 5 years at any individual site. In the context of CO, this is usually excess CO emissions due to traffic delay and/or detours.*	40CFR93.123(c)(5)"Each site which is affected by construction-related activities shall be considered separately, using established "Guideline" methods." If applicable, include analysis as an Appendix to the Air Quality Report.

Preliminary Link Configurations and Receptor Placements for CO Hot-Spot Analysis

The following graphics present the preliminary link configurations and receptor placements for the four intersections that will be modeled as part of the CO hot-spot analysis in CAL3QHC. The following applies to all figures:

- Free flow links extend 1000 feet away from center of signalized intersection
- Graphic representation of free flow links includes 10 foot mixing zone
- Traffic activity within 1000 feet from intersections are included
- Yellow circles are receptors located on the existing R/W (more than 10 feet from the edge of roadway).
- Receptors are spaced at 25-meter intervals at the height of 1.8 meters outside of the mixing zone.
- Receptor location coordinates will be provided by a separate file

Figure 1. SR303 and 51st Avenue TI Receptors and Roadway Links

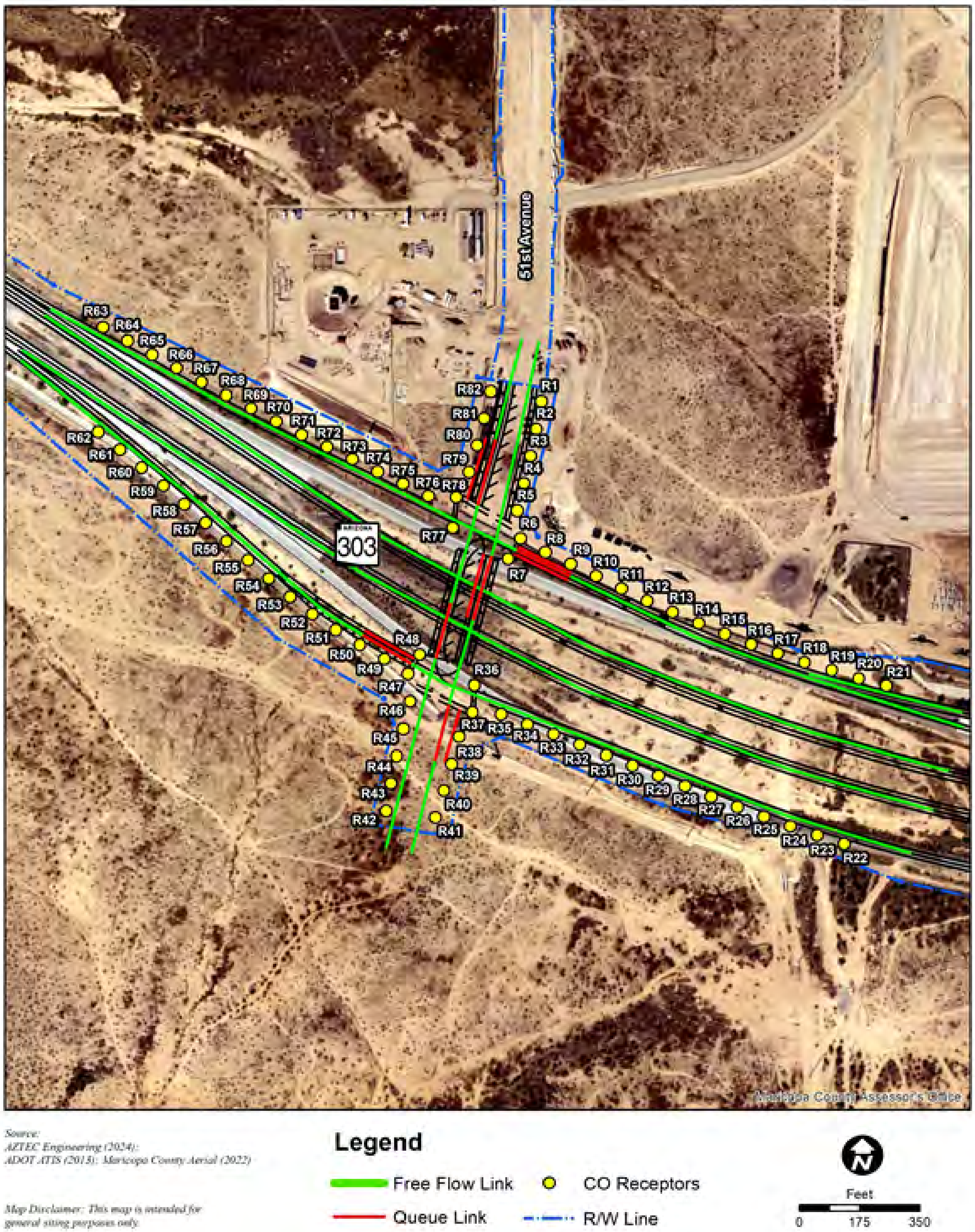


Figure 2. SR303 and 43rd Avenue TI Receptors and Roadway Links

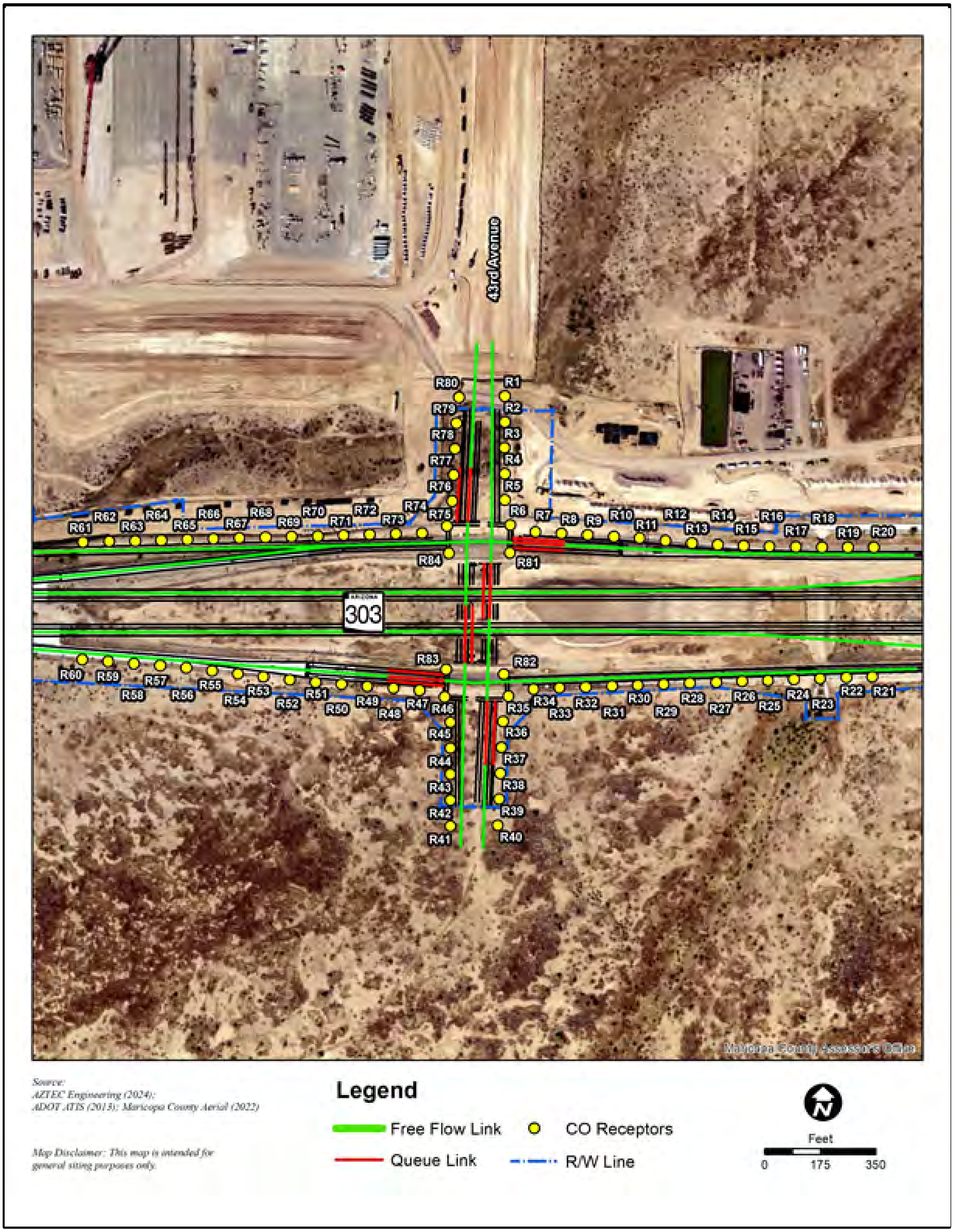


Figure 3. I-17 and Sonoran Desert Dr TI Receptors and Roadway Links

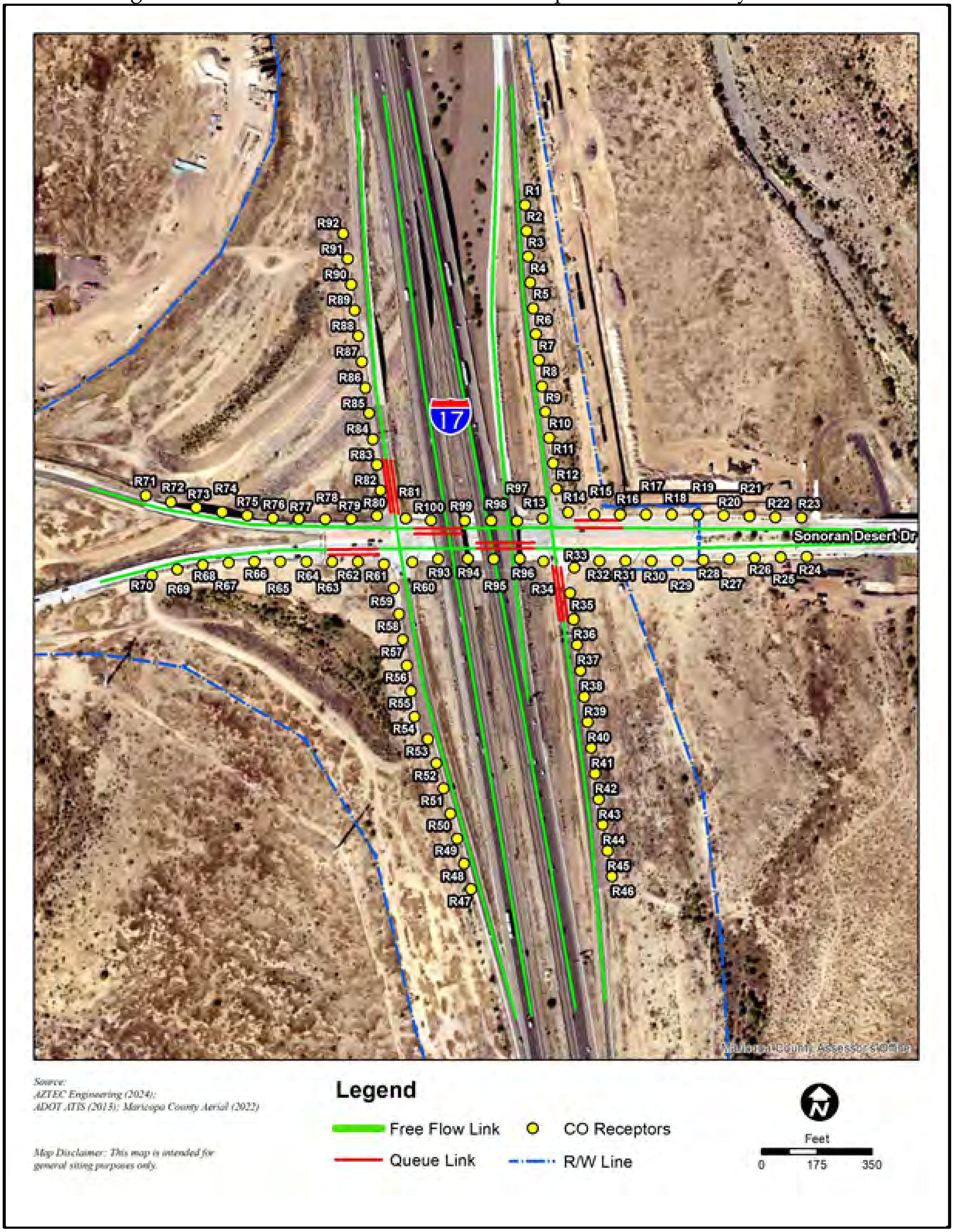
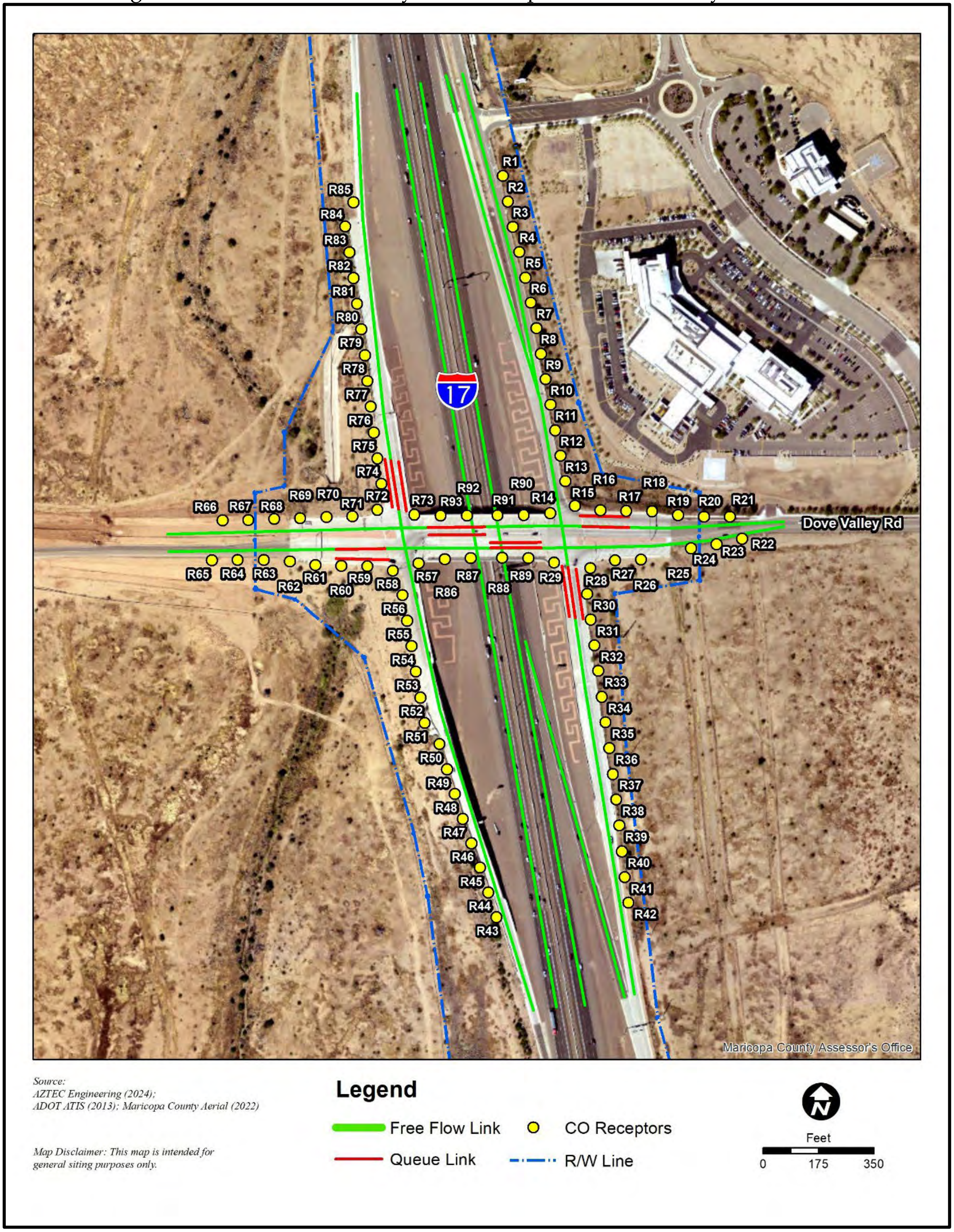


Figure 4. I-17 and Dove Valley Rd TI Receptors and Roadway Links



West Phoenix (WP) (04-013-0019)

Site Location	39th Ave. & Earll Dr., Phoenix
Spatial Scale	Neighborhood
Site Type	Population Exposure for CO, NO_2, O_3, PM_{10}, and Highest Concentration for $PM_{2.5}$

Site Description: This site began operating in January 1984. This SLAMS location monitors for CO, NO_2, O_3, PM_{10}, and $PM_{2.5}$. Meteorological monitoring includes ambient temperature, barometric pressure, and wind speed/direction. The site is in an area of stable, high-density, residential properties. This is the QA collocation site for $PM_{2.5}$ where one filter based $PM_{2.5}$ FRM sampler operates alongside a continuous $PM_{2.5}$ FEM analyzer as per *40 CFR Part 58 Appendix A*.

Project Assessment

The following questionnaire is used to compare the proposed project to a list of project types in 40 CFR 93.123(b) requiring a quantitative analysis of local particulate emissions (Hot- spots) in nonattainment or maintenance areas, which include:

- i) New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles;
- ii) Projects affecting intersections that are at Level-of-Service D, E, or F with a significant number of diesel vehicles, or those that will change to Level-of-Service D, E, or F because of an increase in traffic volumes from a significant number of diesel vehicles related to the project;
- iii) New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location;
- iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and
- v) Projects in or affecting locations, areas, or categories of sites which are identified in the PM_{10} or $PM_{2.5}$ applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation.

If the project matches one of the listed project types in 40 CFR 123(b)(1) above, it is considered a project of local air quality concern and the hot-spot demonstration must be based on quantitative analysis methods in accordance to 40 CFR 93.116(a) and the consultation requirements of 40 CFR 93.105(c)(1)(i). If the project does not require a PM hot- spot analysis, a qualitative assessment will be developed that demonstrates that the project will not contribute to any new localized violations, increase the frequency of severity of any existing violations, or delay the timely attainment of any NAAQS or any required emission reductions or milestones in any nonattainment or maintenance area.

On March 10, 2006, EPA published *PM2.5 and PM10 Hot-Spot Analyses in Project-Level Transportation Conformity Determinations for the New PM2.5 and Existing PM10 National Ambient Air Quality Standards; Final Rule* describing the types of projects that would be considered a project of air quality concern and that require a hot-spot analysis (71 FR 12468- 12511). Specifically on page 12491, EPA provides the following clarification: "Some examples of *projects of air quality concern* that would be covered by § 93.123(b)(1)(i) and (ii) are: A project on a new highway or expressway that serves a significant volume of diesel truck traffic, such as facilities with greater than 125,000 annual average daily traffic (AADT) and 8% or more of such AADT is diesel truck traffic;" .." Expansion of an existing highway or other facility that affects a congested intersection (operated at Level-of-Service D, E, or F) that has a significant increase in the number of diesel trucks;" These examples will be used as the baseline for determining if the project is a project of air quality concern.

New Highway Capacity

Is this a new highway project that has a significant number of diesel vehicles? *Example: total traffic volumes ≥125,000 annual average daily traffic (AADT) and truck volumes ≥10,000 diesel trucks per day (8% of total traffic).*

NO – This project is not a new highway project.

Expanded Highway Capacity

Is this an expanded highway projects that have a significant increase in the number of diesel vehicles? *Example: the build scenario of the expanded highway or expressway causes a significant increase in the number of diesel trucks compared with the no-build scenario, truck volumes > 8% of the total traffic.*

YES – This highway project has a significant increase in the number of diesel vehicles. The ADT and truck percentage for the Build alternative were compared to the No Build alternative on 3 mainline sections and 4 intersections along the project corridor for F0561 project, as summarized in Table 1A. The percentage increase in the medium and heavy trucks ranges from a 0.92% to 2.45% on mainline and from 2.83% to 3.37% at the intersections, and the total increase in medium and heavy truck ranging from 5,430 to 5,563 vehicles on mainline and from 146 to 276 vehicles at the intersections. Table 1B summarizes ADT and truck percentage for the Build alternative compared to the No Build alternative on 6 mainline sections and 10 intersections for F0562 project. The percentage increase in the medium and heavy trucks ranges from a 0% to 13.21% on mainline and from 0% to 9.09% at the intersections, and the total increase in medium and heavy truck ranging from -10,604 to 12,601 vehicles on mainline and from 0 to 3,455 vehicles at the intersections.

Table 1A – Freeway Mainline & Intersection ADT and Truck ADT in Existing, No Build and Build Conditions (F0561)

AADT and Truck Volumes		2023 Existing		2050 No-Build		2050 Build		Difference (Build - No- Build)		
		ADT	Truck (%)	ADT	Truck (%)	ADT	Truck (%)	ADT	Truck ADT	Truck (%)
Mainline	SR 303L East of 67th Ave. to 51st Ave	17,199	12.38%	53,374	10.31%	98,509	11.23%	45,136	5,563	0.92%
	SR303L between 67th Ave. & Lake Pleasant Parkway	17,199	12.38%	53,374	10.31%	96,298	11.40%	42,924	5,474	1.09%
	SR 303L West of Lake Pleasant Parkway	21,852	12.93%	61,119	9.77%	93,309	12.22%	32,190	5,430	2.45%
Intersection	Lake Pleasant Parkway & SB SR303L	10,406	9.62%	46,587	3.30%	27,170	6.67%	-19,417	276	3.37%
	Lake Pleasant Parkway & NB SR303L	8,748	8.29%	43,500	3.11%	25,244	5.94%	-18,256	146	2.83%
	67th Avenue & SB SR303L	---	---	---	---	37,853	11.83%	---	---	---
	67th Avenue & NB SR303L	---	---	---	---	24,445	9.54%	---	---	---

Note: Truck% includes heavy truck and medium truck. ADT at intersections include volumes on approach lanes.
Source: MAG traffic demand model received from Kimley Horn on April 3, 2024

Table 1B – Freeway Mainline & Intersection ADT and Truck ADT in Existing, No Build and Build Conditions (F0562)

AADT and Truck Volumes		2023 Existing		2050 No-Build		2050 Build		Difference (Build - No- Build)		
		ADT	Truck (%)	ADT	Truck (%)	ADT	Truck (%)	ADT	Truck ADT	Truck (%)
Mainline	SR 303L between 51st Ave & 43rd	27,289	13.77%	73,709	11.15%	115,512	12.98%	41,803	6,776	1.83%
	Sonoran Desert Dr between 43rd Ave & I-17	29,947	14.74%	77,899	11.19%	95,411	13.21%	17,512	3,880	2.01%
	I-17 south of Dexileta Dr	141,166	13.48%	250,198	16.45%	194,016	16.65%	-56,181	-8,857	0.20%
	I-17 between Dexileta Dr & Sonoran Desert Dr	138,861	13.58%	239,749	16.81%	233,692	17.84%	-6,057	1,389	1.03%
	I-17 between Sonoran Desert Dr & Dove Valley Rd	110,845	14.03%	180,162	18.85%	140,367	21.52%	-39,796	-3,765	2.66%
	I-17 between Dove Valley Rd & Carefree Hwy	117,668	13.80%	176,817	19.04%	153,885	20.33%	-22,932	-2,389	1.28%
Intersection	51st Avenue & SB SR 303L	7,017	19.59%	36,074	7.72%	42,525	8.95%	6,451	1,024	1.24%
	51st Avenue & NB SR 303L	5,853	18.85%	16,848	7.13%	34,279	7.35%	17,431	1,320	0.23%
	43rd Avenue & SB SR 303L	7,399	17.94%	23,716	8.25%	37,660	7.89%	13,944	1,016	-0.36%
	43rd Avenue & NB SR 303L	947	12.25%	10,009	8.22%	33,607	7.45%	23,598	1,681	-0.77%
	Dexileta Dr & NB I-17	---	---	---	---	14,663	6.67%	---	---	---
	Dexileta Dr & SB I-17	---	---	---	---	12,655	6.97%	---	---	---
	Sonoran Desert Dr & NB I-17	29,881	12.78%	70,907	9.45%	44,042	7.97%	-26,865	-3,188	-1.48%
	Sonoran Desert Dr & SB I-17	35,570	13.84%	86,569	10.63%	38,024	9.09%	-48,545	-5,748	-1.54%
	Dove Valley Rd & NB I-17	16,196	8.21%	39,348	4.52%	35,082	3.65%	-4,266	-499	-0.87%
	Dove Valley Rd & SB I-17	11,023	9.09%	49,700	5.57%	35,605	3.40%	-14,095	-1,558	-2.17%

Note: Truck% includes heavy truck and medium truck. ADT at intersections include volumes on approach lanes.
Source: MAG traffic demand model received from Jacobs on March 11, April 16, 2024, and May 10, 2024

Projects with Congested Intersections

Is this a project that affects a congested intersection (LOS D or greater) that has a significant number of diesel trucks, OR will change LOS to D or greater because of an increase in traffic volumes from a significant number of diesel trucks related to the project?

> **YES**. For F0561 project, none of the intersections would experience LOS D or greater, as shown in Table 2A. F0562 project is a project that affects a congested intersection of LOS D or will change LOS to D or greater which has a significant number of diesel trucks, see Table 2B. The intersection operation analysis shows 3 intersections have a LOS of D, E, or F under existing condition with 1,002 to 4,923 truck ADT, and 1 intersection has a LOS D in 2050 Build with 2,520 truck ADT, as shown in previous Table 1B.

Table 2A – Intersections LOS in the Project Area (F0561)

Level of Service (LOS)		2023 Existing		2050 No-Build		2050 Build	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
		LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)
Overall Intersection LOS	67th Avenue & SB SR 303L	---	---	---	---	C (20.8)	B (19.9)
	67th Avenue & NB SR 303L	---	---	---	---	B (15.9)	B (13.8)

Notes:
67th Avenue TI does not currently exist.
Lake Pleasant Parkway intersections have LOS C or better in 2020 existing, and 2040 Build per Final Traffic Report, SR303, Lake Pleasant Parkway to I-17 (completed in 2022).
Source: Initial Traffic Memo provided by Kimley Horn on April 3, 2024.

Table 2B – Intersections LOS in the Project Area (F0562)

Level of Service (LOS)		2023 Existing		2050 No-Build		2050 Build	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
		LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)	LOS (delay)
Overall Intersection LOS	51st Avenue & SB SR 303L	A (0)	A (0)	B (11.9)	B (12.3)	B (14.8)	B (12.1)
	51st Avenue & NB SR 303L	A (0)	A (0)	C (23.5)	A (8.8)	D (42.5)	B (13.7)
	43rd Avenue & SB SR 303L	B (10.1)	A (5.0)	C (20.5)	B (19.7)	C (20.5)	B (19.8)
	43rd Avenue & NB SR 303L	B (11.3)	A (7.7)	B (16.8)	B (13.6)	C (28.2)	C (20.5)
	Dexileta Dr & NB I-17	---	---	A (0)	A (0)	A (0)	A (0)
	Dexileta Dr & SB I-17	---	---	A (0)	A (0)	A (0)	A (0)
	Sonoran Desert Dr & NB I-17	E (63.5)	F (195.8)	F (358.1)	F (329.4)	B (18.0)	B (19.4)
	Sonoran Desert Dr & SB I-17	E (74.6)	F (87.5)	F (375.7)	F (447.9)	B (16.8)	B (15.0)
	Dove Valley Rd & NB I-17	C (33.3)	C (34.7)	C (33.7)	C (27.2)	C (27.1)	C (26.1)
	Dove Valley Rd & SB I-17	D (46.8)	D (38.8)	C (30.9)	D (50.1)	C (26.5)	C (25.4)

Notes:
Source: LOS data provided by Jacobs on April 8 and April 15, 2024.

New Bus and Rail Terminals

Does the project involve construction of a new bus or intermodal terminal that accommodates a significant number of diesel vehicles?

NO – This project does not construct any new bus or rail terminals.

Expanded Bus and Rail Terminals

Does the project involve an existing bus or intermodal terminal that has a large vehicle fleet where the number of diesel buses (or trains) increases by 50% or more, as measured by arrivals?

NO – This project does not expand any bus or rail terminals.

Projects Affecting PM Sites of Violation or Possible Violation

Does the project affect locations, areas or categories of sites that are identified in the PM_{10} or $PM_{2.5}$ applicable plan or implementation plan submissions, as appropriate, as sites of violation or potential violation?

NO – The project location is not listed in MAG's 2012 SIP as a site of violation or potential violation.

POAQC Determination

F0562 and F0561 projects are expanded highway projects that has a significant increase in the number of diesel vehicles on mainline and at intersections. Therefore, ADOT is recommending these two projects for interagency consultation in accordance with 40 CFR93.105 as a Project of Air Quality Concern and thereby will require a PM hot-spot analysis.

For F0562 project, the top three intersections ranked by volume are as follows:

- Sonoran Desert Dr & NB I-17
- 51st Avenue & SB SR 303L
- Sonoran Desert Dr & SB I-17

And, the top three intersections ranked by LOS and delay are as follows:

- 51st Avenue & NB SR 303L (AM Peak Hour)
- 43rd Avenue & NB SR 303L (AM Peak Hour)
- Dove Valley Rd & NB I-17 (AM Peak Hour)

Based on the top intersections ranked by volume and by LOS and delay, the intersection modeling analysis will be performed for the following four TI intersections' peak hours of the days for F0562 project:

- 51st Avenue & SB SR 303L
- 51st Avenue & NB SR 303L
- 43rd Avenue & NB SR 303L
- Sonoran Desert Dr & NB I-17
- Sonoran Desert Dr & SB I-17
- Dove Valley Rd & NB I-17

For F0561 project, the intersection modeling analysis will be performed for two intersections' peak hours of the days including 67th Avenue & SB SR303L and 67th Avenue & NB SR303L.

For PM hotspot analysis, receptors are placed around the concerned TI/intersections and extended along the on and off-ramps to the mainline gore area. Receptors are not placed on freeway mainline between the gore area of two adjacent TIs on SR303. The reason is because high PM concentrations normally occur adjacent to the intersections because of greater traffic volumes, worse LOS, and close proximity to public.

Section 3.3.2 of EPA's PM Hot Spot Guidance indicates the geographic area to be covered by a PM hot-spot analysis is to be determined on a case-by-case basis. The guidance states that it may be appropriate to focus the PM hot-spot analysis only on locations of highest air quality concentrations, and that if conformity requirements are met at such locations, then it can be assumed that conformity is met throughout the project area.

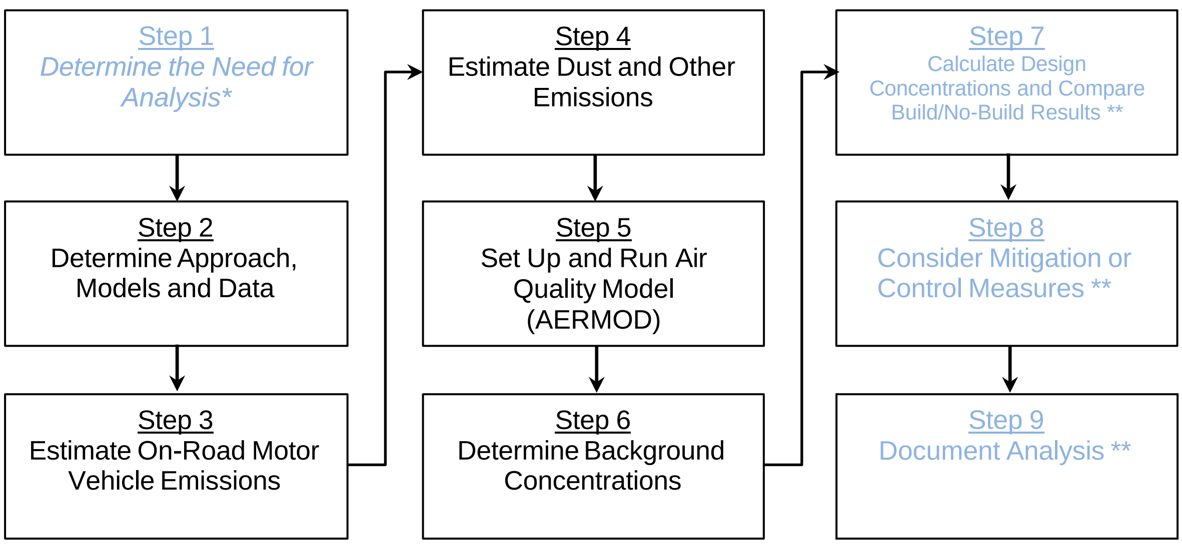
Receptors could not be modeled along SR303L West of Lake Pleasant Parkway NB offramp because it is outside of project limit and no design files/data are available.

Based on the above reasons, we believed the five TIs selected for PM hotspot analysis in the consultation document are the locations that would result in highest air quality concentrations.

Project Level PM Quantitative Hot-Spot Analysis – Consultation Document for Project of Air Quality Concern

Completing a Particulate Matter (PM) Hot-Spot Analysis

The general steps required to complete a quantitative PM hot-spot analysis are outlined below and described in detail in the EPA Office of Transportation and Air Quality guidance document "Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas" EPA-420-B-21-037, October 2021.



* Described in the previous section.

** These Steps will be described and documented in a final air quality analysis report.

Step 2: Determine the Approach, Models, and Data

- Describe the project area (area substantially affected by the project, 58 FR 62212) and emission sources.
- Determine general approach and analysis year(s) – year(s) of peak emissions during the time frame of the transportation plan (69 FR 40056).
- Determine National Ambient Air Quality Standards (NAAQS) and PM types to be evaluated.
- Select emissions and dispersion models and methods to be used.
- Obtain project-specific data (e.g., fleet mix, peak-hour volumes and average speed).

Step 3: Estimate On-Road Motor Vehicle Emissions

a. Estimate on-road motor vehicle emissions using MOVES.

Step 4: Estimate Dust and Other Emissions

- ☐ Estimate road dust emissions using AP-42 Paved Roads.
- ☐ Do emissions from other sources (e.g., locomotives) need to be considered?

Step 5: Set Up and Run Air Quality Model (AERMOD)

- Obtain and input required site data (e.g., meteorological).
- Input MOVES and AP-42 outputs (emission factors).
- Determine number and location of receptors, roadway links, and signal timing.
- Run air quality dispersion model and obtain concentration results.

Step 6: Determine Background Concentrations

a. Determine background concentrations from nearby and other emission sources excluding the emissions from the project itself.

- Nearby TMCS emissions are included
- Atypical Events Report will be needed.

Step 7: Calculate Design Concentrations and Compare Build/No-Build Results

* Add step 5 results to background concentrations to obtain values for the Build scenario.
* Determine if the design values allow the project to conform.

Step 8: Consider Mitigation or Control Measures

a. Consider measures to reduce emissions and redo the analysis. If mitigation measures are required for project conformity, they must be included in the applicable SIP and be enforceable.

b. Determine if the design values from allow the project to conform after implementing mitigation or control measures.

Step 9: Document Analysis

a. Determine if the project conforms or not based on the results of step 7 or step 8.

To support the conclusion that a project meets conformity under 40 CFR 93.116 and 93.123, at a minimum the documentation will include:

- *Description of proposed project, when it is expected to open, and projected travel activity data.*
- *Analysis year(s) examined and factors considering in determining year(s) of peak emissions.*
- *Emissions modeling data, model used with inputs and results, and how characterization of project links.*
- *Model inputs and results for road dust, construction emissions, and emissions from other source if needed.*
- *Air Quality modeling data, included model used, inputs and results and receptors.*
- *How background concentrations were determined.*
- *Any mitigation and control measures implemented, including public involvement or consultation if needed.*
- *How interagency and public participation requirements were met.*
- *Conclusion that the proposed project meets conformity requirements.*
- *Sources of data for modeling.*

Table 1. Proposed Inputs, Parameters and Data Sources

Estimate On-Road Motor Vehicle Emissions (Step 3)		
MOVES3.1	**Input**	**Data Source/Detail**
Scale	*Onroad, Project Scale and Inventory*	*MAG Regional Conformity Data (Spring, 2023)*
Time Spans	*2050, 16 runs* *PM_{10} emission factors were developed for an analysis year of 2050, which represents the year peak emissions from the project are expected. Vehicle emissions of PM10 are a combination of vehicle exhaust, brakewear, tirewear, and road dust. Road dust is the largest contributor to the overall emissions. Because road dust is highly dependent on vehicle volumes, the analysis year of 2050 was selected as the year of peak emissions because it was the year with the greatest vehicle volumes. This has been reflected in the 2021 MAG Conformity Analysis budget test, which resulted in highest PM10 emissions in 2050 due to largest VMT and the most surrounding PM emissions.*	*4 seasons (Jan, Apr, July & Oct) x 4 weekday time periods (6-9AM, 9AM-4PM, 4-7PM & 7PM-6AM)*
Geographic Bounds	*Maricopa County*	*EPA Hot Spot Guidance Section 4.4.4*
Onroad Vehicles	*All Fuels and Source Use Types*	*EPA Hot Spot Guidance Section 4.4.5*
Road Type	*Urban Restricted and Urban Unrestricted access*	*EPA Hot Spot Guidance Section 4.4.6*
Pollutants and Processes	*Primary Exhaust PM10-Total(for Running Exhaust and Crankcase Running Exhaust), Break Wear Particulate, Tire Wear Particulate*	*EPA Hot Spot Guidance Sections 2.5, 4.4.7*
General Output and Output Emissions Detail	*Output Database TBD*	*EPA Hot Spot Guidance Section 4.4.8, 4.4.9 & 4.6*
Create Input Database	*Input database will be created and modified for Project level using required Regional Inputs from latest Regional Conformity Analysis.*	*MAG Regional Conformity Data (Spring, 2023)*
Project Data Manager	*Database will be created and MOVES3.1 templates will be created to include local project data and information provided by MAG, e.g., Fuel, Age Distribution, Meteorology Data, to be consistent with the regional model. Links and Link Source Type will be specific to project as provided by the traffic study, any missing information will use default MOVES3.1 data.*	*EPA Hot Spot Guidance Sections 4.5 &Appendix D*
Meteorology	*Calculated from ADEQ Phoenix AERMET data based on 4 seasons and 4 weekday time periods from year 2017 to 2021.*	*16 meteorology data set, 4 seasons (Jan, Apr, July & Oct) x 4 weekday time periods*
Age Distribution	*MAG local specific data (sourceTypeID: 11 – 62, yearID: 2050, ageID: 0 -30)*	*MAG Regional Conformity Data (Spring, 2023)*
Fuel	*MOVES default*	*EPA Hot Spot Guidance Section 4.5.3*

I/M Programs	*MAG local specific data (countyID: 4013, yearID: 2050)*	*MAG Regional Conformity Data (Spring, 2023)*
Retrofit Data	*Not used*	
Links	*Please see attached the link maps.*	
Link Source Types	*Option 2 in the EPA's PM Hot- spot Guidance Section 4.5.7 will be used.*	*MAG Regional Conformity Data (Spring, 2023)*
Link Drive Schedules, Operating Mode Distribution	*Options 1 in the EPA's PM Hot-spot Guidance Section 4.5.8 will be used. Average speeds and road types through the Links Importer will be used.*	
Off-Network, Hoteling	*Not used*	
Estimate Dust and Other Emissions (Step 4)		
AP-42, Fifth Edition, 2011	**Parameter**	**Data Source/Detail**
Average Weight Vehicles	*Freeways 3.83 tons in 2025, 3.87 tons in 2030, 3.97 tons in 2040, and 4.08 tons in 2050. Arterials 2.48 tons in 2025, 2.49 tons in 2030, 2.48 tons in 2040, and 2.48 tons in 2050*	*Conformity Analysis for the FY 2022-2025 MAG TIP and the Momentum 2050 RTP, dated December, 2021.*
Silt Loading	*Section 13.2.1 Paved Roads from AP 42 will be used, consistent with the Regional analysis from MAG. Emission factors for road and construction dust should be added to the emission factors generated for each link by MOVES. Ex. Silt loading – Freeways .02 g/m^2, Arterials >10,000 ADT .067g/m^2, Low traffic roads <10,000 ADT .23g/m^2.*	*EPA Hot Spot Guidance Section 6, When estimating emissions of re-entrained road dust from paved roads, site-specific silt loading data must be consistent with the data used for the project's county in the regional emissions analysis (40 CFR 93.123(c)(3)).*
Construction Dust	*Construction Emissions will not be addressed because the construction of this project is not expected to last longer than 5 years. There are no other sources (e.g., locomotives) that need to be considered for most projects.*	EPA Hot Spot Guidance Section 6.5
Precipitation	*In 2008-2012 SIP/Regional Conformity used average of 32 days with at least .01 inch of precipitation County.*	*The MAG 2012 Five Percent Plan for PM-10 (used for the Conformity Analysis for the FY 2022-2025 MAG TIP and the Momentum 2050 RTP, dated December, 2021).*
Set Up and Run Air Quality Model (AERMOD) (Step 5)		
AERMOD v.23132	**Parameter**	**Data Source/Detail**
Model Setup (CO Pathway)		*EPA Hot Spot Guidance Section 7.1, 7.2 & Appendix J, AERMOD User's Guide Section 2.3.2 & 3.2*
TITLEONE	*TBD*	
MODELOPT	*CONC FLAT. Initial modeling will be done with all sources and receptors at grade.*	*Modeling Concentrations and Flat Terrain*
AVERTIME	*24*	*Average across each 24-hour period from the available met data*
URBANOPT	*1,645,000*	*Population of Phoenix, AZ* *https://www.census.gov/quickfacts/fact/table/phoenixcityarizona/PST045222*

FLAGPOLE	*Receptor height in meter, 1.8*	
POLLUTID	*PM10*	

Source Types and Characters (SO Pathway)		
LOCATION	*Srcid Srctyp (VOLUME)*	
SRCPARAM	*Srcid Vlemis Relhgt Syinit Szinit*	*VOLUME Source parameters See EPA Hot Spot Guidance Appendix J.3.1*
URBANSRC	*ALL*	*All urban source*
EMISFACT	*Emission rate=1, Use SEASHR (season by hour-of-day)* *As directed by the PM Hot Spot Guidance, emissions were input in a manner to reflect changes in emission factors and vehicle volumes throughout the day. This was represented in AERMOD by specifying an emission rate of 1 g/s/m² with the variable variable emission rate option to specify the emission rate of 96 emission factors (4 seasons/24 hours per day) for each emission source. Excel files that outline this process are included with MOVES and AERMOD modeling files for agency review.*	*Total 16 MOVES run=4 seasons x 4 time periods to 96 factors (4 seasons/24 hours) See PM hot-spot training slides (FHWA, 2022)*
SRCGROUP	*ALL*	
Meteorological Data (ME Pathway)		
SURFFILE	*Phoenix2017-2021.sfc* *ADOT followed up with ADEQ on the AERMET files- the Phoenix Sky Harbor Airport dataset. ADEQ provided a document detailing the AERMET data completeness, their representativeness of meteorology of the project area, and QA/QC.*	*ADEQ Phoenix AERMET files*
PROFFILE	*Phoenix2017-2021.pfl* *ADOT followed up with ADEQ on the AERMET files- the Phoenix Sky Harbor Airport dataset. ADEQ provided a document detailing the AERMET data completeness, their representativeness of meteorology of the project area, and QA/QC.*	*ADEQ Phoenix AERMET files*
SURFDATA	*23183 2017*	*ADEQ Phoenix AERMET files*
UAIRDATA	*23160 2017*	*ADEQ Phoenix AERMET files*
PROFBASE	*0*	*ADEQ Phoenix AERMET files*
Run Met Pre-Processor	*Not used*	

Urban or Rural Sources	*Specifications for URBANSRC (SO Pathway). The emission sources are SR 303L and I-17 mainlines, ramps, frontage roads, and cross streets. No nearby emission sources other than the roadway links included in the model run would be affected by the project.* *All emission sources used URBANOPT to specify urban dispersion coefficients. The PM Hot-spot Guidance recommends "in urban areas, sources should generally be treated as urban." Appendix W recommends multiple procedures to identify an area as urban. Using the Auer land use procedure described in Section 7.2.1.1(b)(i). Based on aerial maps, this project is in the urban fringe of Phoenix that is partially developed. Currently, residential takes 5% of the land use, open space takes 35%, and vacant land takes 31%, other minor land use includes industrial and commercial. Therefore, the use of urban dispersion coefficients is appropriate for the project area.*	*EPA Hot Spot Guidance Section 7.5.5 & Appendix J.4,* *AERMOD Implementation Guide, Section 7.2.3 of Appendix W to 40 CFR Part 51*
Receptors (RE Pathway)	*Please see attached receptor maps on pages 14 to 18. 67th Avenue TI, 51st Avenue TI, 43rd Avenue TI, Sonoran Desert Dr TI, and Dove Valley Rd TI were selected for PM hotspot analysis that were ranked by ADT volumes on mainline and at intersections, and LOS and delay at intersections.* *The receptor placement is consistent with the guidance. Receptors were placed 5m from the edge of the roadway. Receptors were placed at 25 meters spacing. (total 969 receptors for 67th Ave TI, 979 receptors for 51st Ave TI, 977 receptors for 43rd Ave TI, 750 receptors for Sonoran Desert Dr TI, and 966 receptors for Dove Valley Rd TI). the highest PM concentration would normally occur at receptors near the roadway sources. the PM concentrations would decrease further away from the roadway sources, and receptor placements further away from the source would not affect the highest PM concentration design value for the intersection and analysis results.*	*EPA Hot Spot Guidance Section 7.6, AERMOD User's Guide Section 2.3.4 & 3.4,* *Section 7.2.2 of Appendix W to 40 CFR Part 51,* *See PM hot-spot training slides*
DISCCART	*X Y (Z)*	*Z is optional if FLAGPOLE is already defined in CO Pathway.*
GRIDCART	*Not used*	
Output (OU Pathway)		
RECTABLE	*24 6th*	*Since PM should be one or less exceedance per year, with 5 years of met data, the 6th highest concentration at each receptor*

PLOTFILE	*Not used*	
POSTFILE	*Not used*	
Model Runs		
Determine Background Concentrations (Step 6)		
Source Type	**Description**	**Data Source/Detail**
Nearby Sources	*TSMC AZ project has gone through the NEPA process, see link at:* https://www.nist.gov/chips/national-environmental-policy-act-nepa *Below is the excerpt from the AQ section from its Draft Environmental Assessment:* *TSMC AZ has modeled and CPO has reviewed the estimated criteria pollutant emissions from all three phases (assuming emissions from semiconductor manufacturing at the technology nodes noted in Section 2.2.2) using the same air dispersion modeling software (i.e., AERMOD v21112 and AERMAP v18081) that TSMC used to obtain its current permit for Phases 1 and 2. Background pollutant concentrations were determined from the closest ambient air monitors to the Facility. To achieve a conservative estimate of criteria pollutant emissions from all three phases, TSMC factored all anticipated emissions from full use of the SME and tools that would be installed in Phases 1 through 3 into its modeling approach. The resulting Facility-wide impact from the operations of Phases 1, 2, and 3 was added to the ambient air background levels to determine the total impact of the Proposed Project. This modeling showed that emissions under the Proposed Project would not cause an exceedance of NAAQS standards.* *TSMC AZ would have no significant effects with mitigation and BMPs for the air quality. TSMC SZ was modeled in the PM10 hotspot analysis per EPA's correspondence on October 2, 2024. 148-point sources and/or volume sources were exported from original TSMC AERMOD model provided by EPA and imported into SR303 AERMOD model. See materials provided.*	Maricopa Air Quality Permit Application, and email provided by EPA email, October 4, 2024

Other Sources (Ambient Monitoring Data)	*Please see the selected monitor's location map and monitoring data with wind rose information. Zuni Hills (ZH) monitor was selected as PM background monitor.* *The background concentration data of Zuni Hills (ZH) monitor is representative for the project area because:* *1. Similar characteristics between the monitor location and project area including density, mix of emission sources, land use, terrain, etc.* *2. Distance of monitor from the project area. ZH monitor is closer to the project and have concentration most similar to the project area.* *3. Wind patterns between the monitor and the project area. ZH monitor shows significant upwind patterns.* *Atypical Events Report is under preparation. See Atypical Events Report for detailed monitor data, calculations, and resulting recommended background concentrations when ready.* *For the design concentration, the highest sixth-highest value among all receptors should be added to the fourth highest background monitor value (Section 9.3.4 of PM Hot-spot Guidance). The design concentration will then be compared to NAAQS threshold for conformity determination.*	*EPA Hot Spot Guidance Section 8.3, PM hot-spot training slides Module 5 & 6*

References

PM Hot-spot guidance, EPA-420-B-21-037, October 2021.

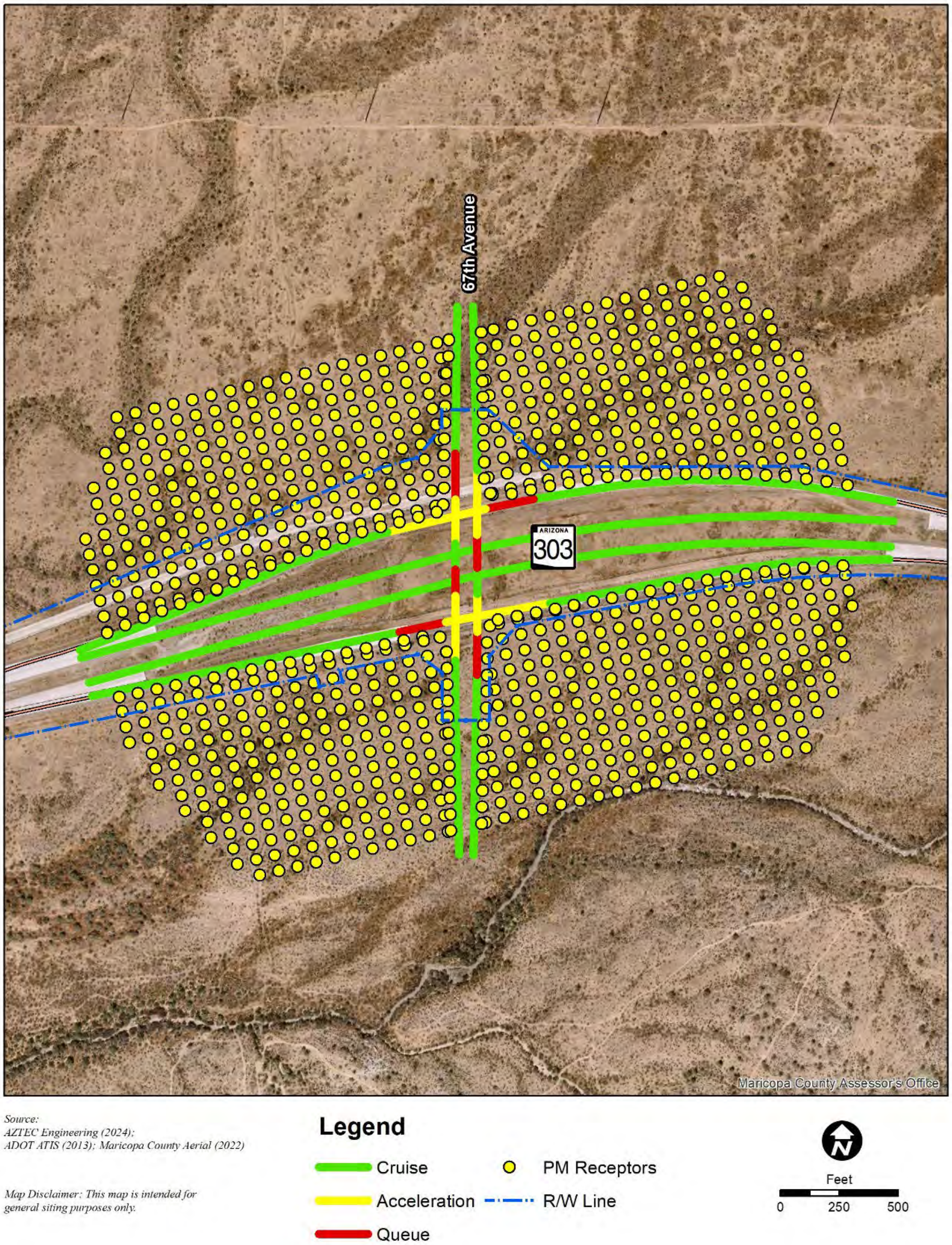
User's Guide for the AMS/EPA Regulatory Model (AERMOD), EPA-454/B-21-001, April 2021.

AERMOD Implementation Guide, EPA-454/B-21-006, July 2021.

User's Guide for the AERMOD Meteorological Preprocessor (AERMET), EPA-454/B-22-006, June 2022.

Completing Quantitative PM Hot-spot Analyses: 3-Day Course, FHWA, October 2022.

Figure 1. PM Links and Receptors Placement for Air Quality Modeling
(67th Avenue & SR303L, F0561)



There are no existing developments or sidewalks beyond the freeway mainline at 67th Avenue. In addition, there will be no planned developments for the next 10 years. Thus, the proposed sidewalks at the TI are for future use as there are currently no connections to the north or south of the TI, the likelihood of the sidewalks being used would be minor. No PM receptors would be placed on the sidewalks as a result.

Figure 2. PM Links and Receptors Placement for Air Quality Modeling
(51st Avenue & SR303L, F0562)

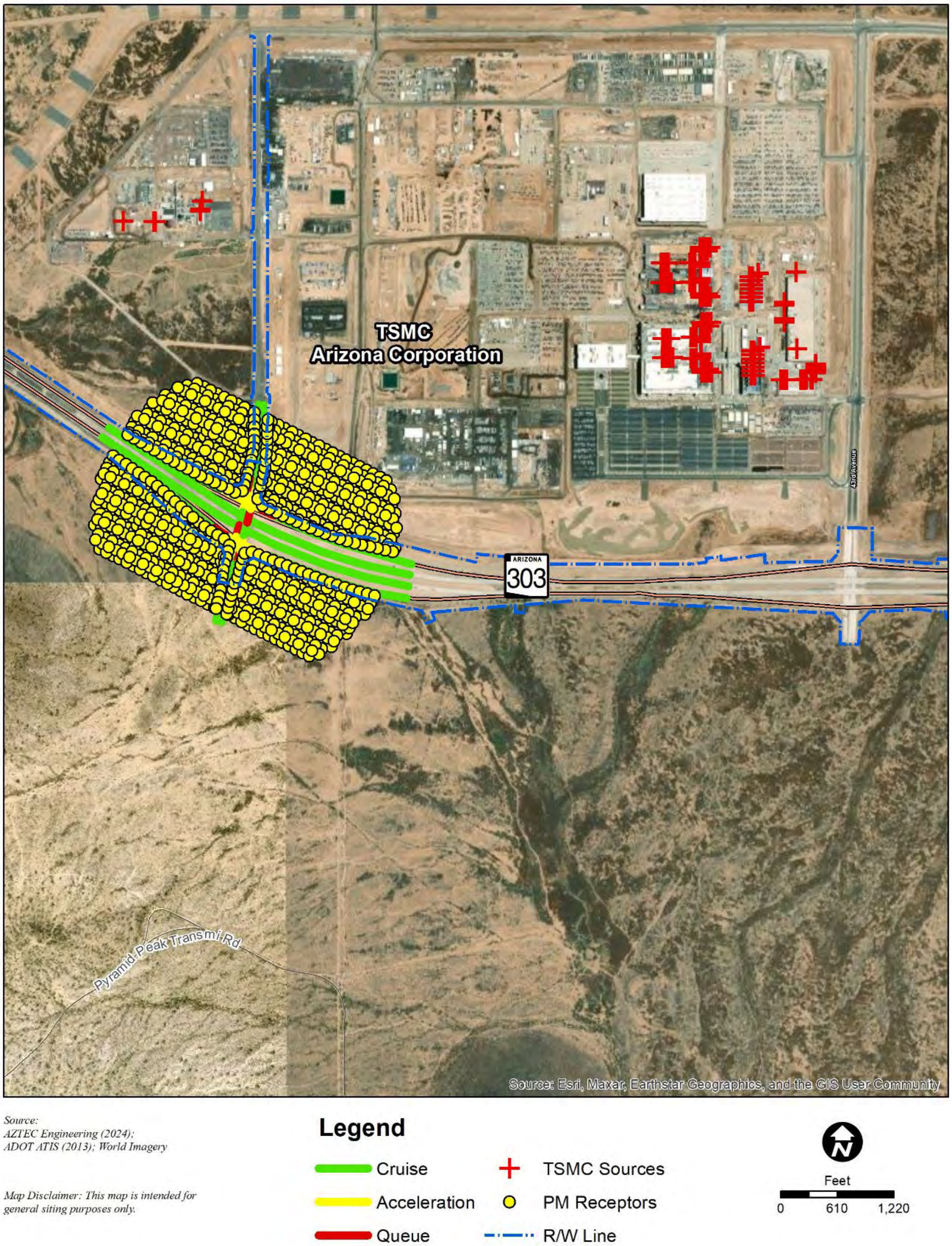


Figure 3. PM Links and Receptors Placement for Air Quality Modeling
(43rd Avenue & SR303L, F0562)

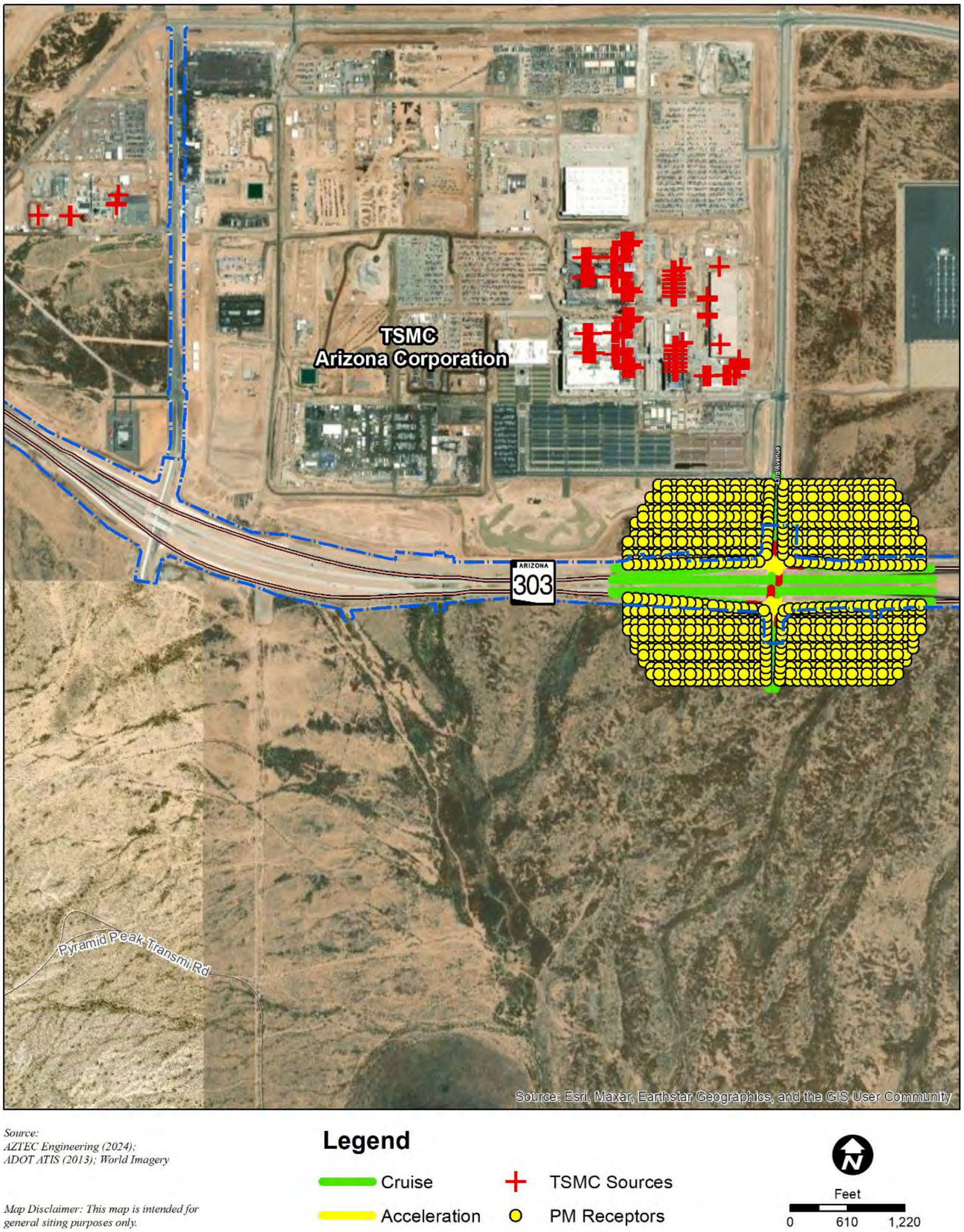


Figure 4. PM Links and Receptors Placement for Air Quality Modeling
(Sonoran Desert Dr & I-17, F0562)

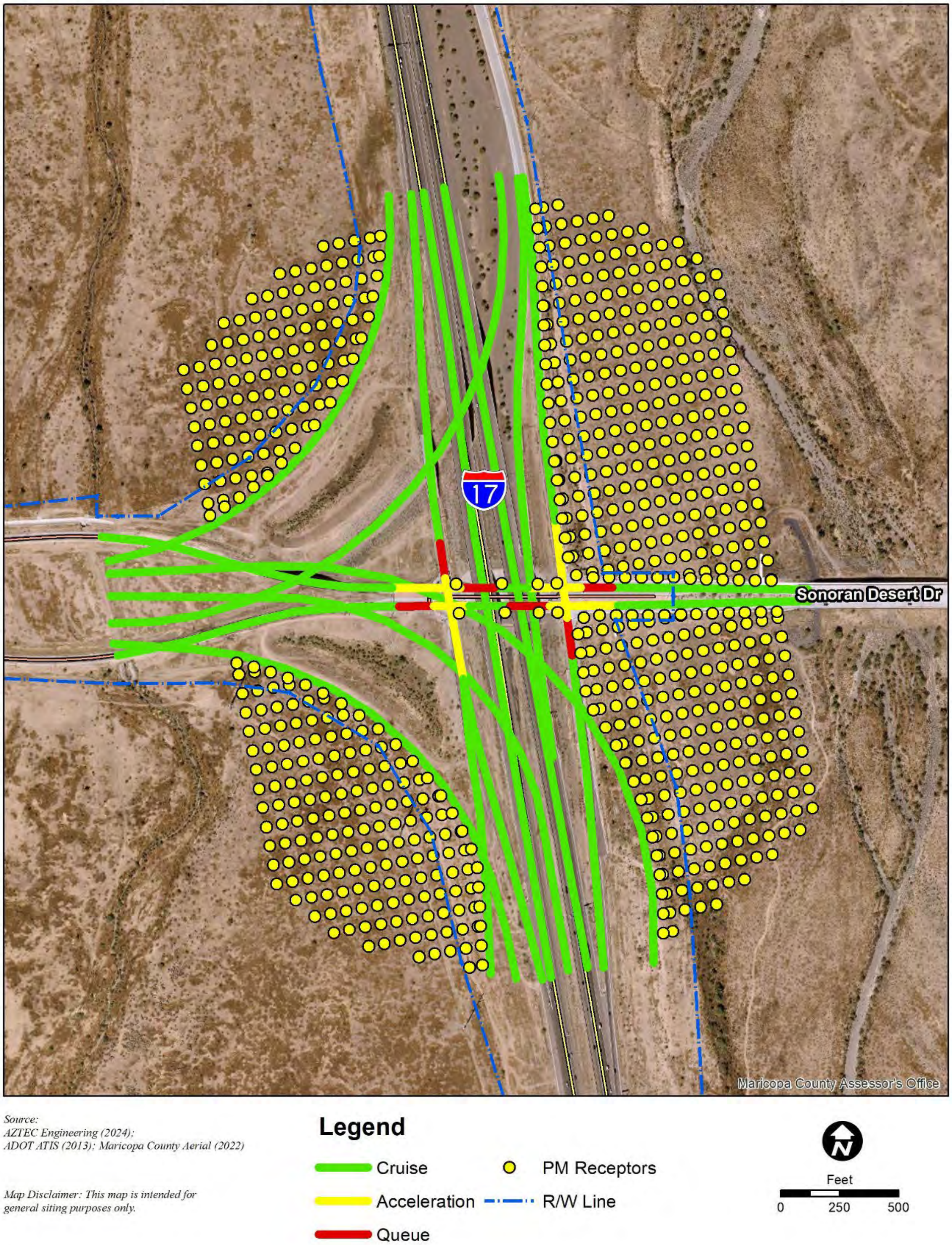
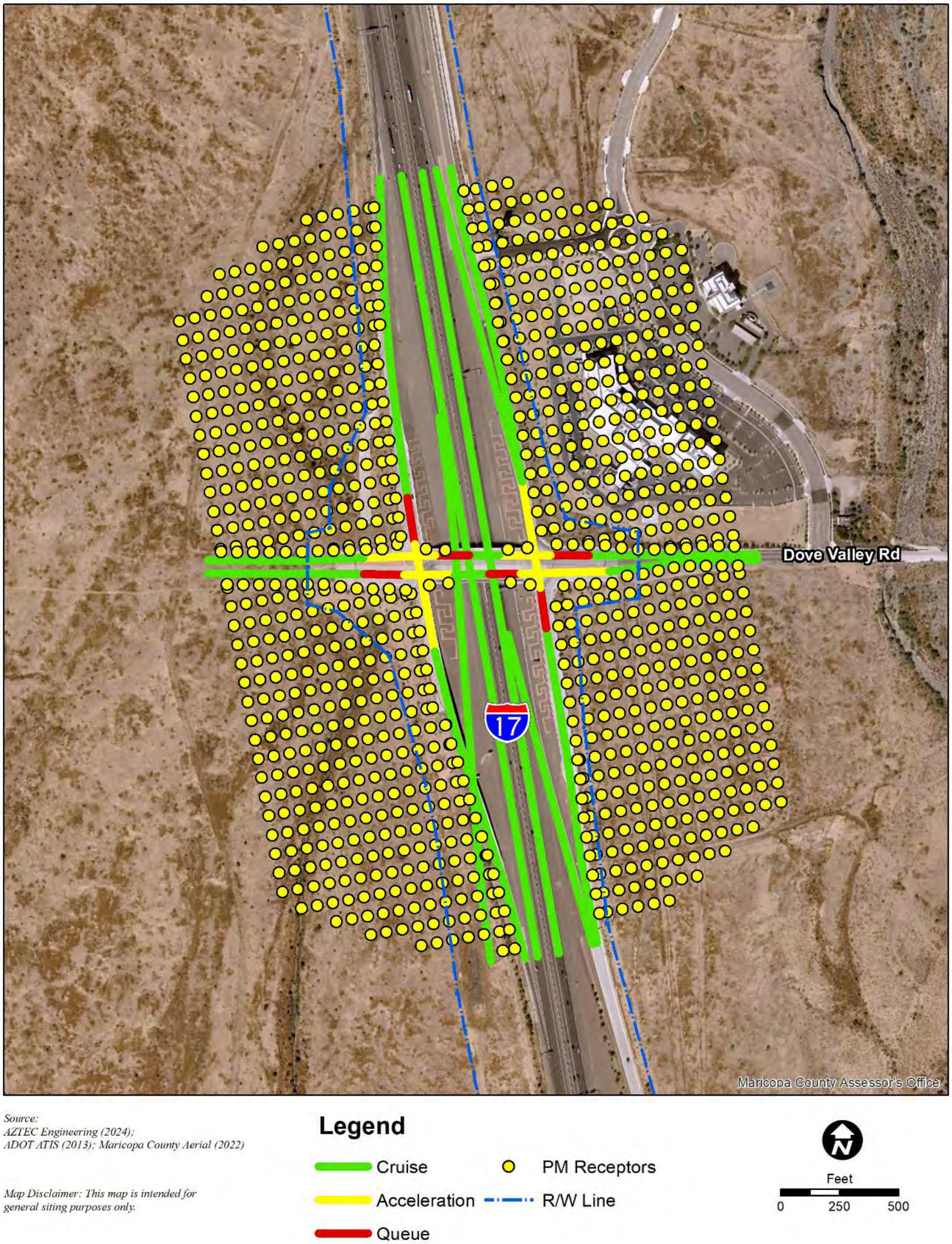


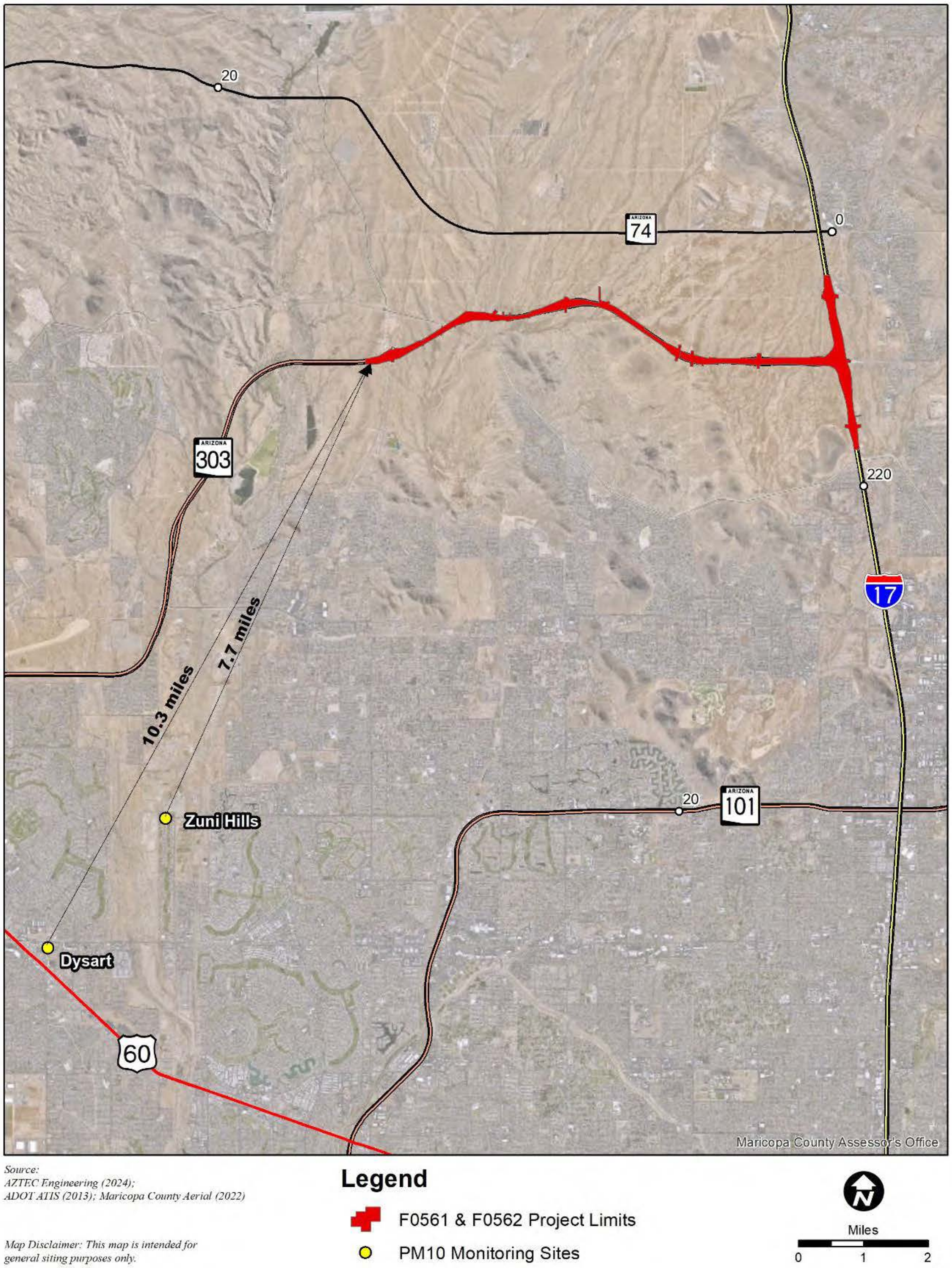
Figure 5. PM Links and Receptors Placement for Air Quality Modeling
(Dove Valley Rd & I-17, F0562)



Source:
AZTEC Engineering (2024);
ADOT ATIS (2013); Maricopa County Aerial (2022)

Map Disclaimer: This map is intended for general siting purposes only.

Figure 6. PM Monitoring Sites adjacent to the Project Area (F0561 & F0562)



Zuni Hills (ZH) (04-013-4016)

Site Location 109th Ave. & Deer Valley Rd., Phoenix

Spatial Scale Neighborhood

Site Type Population Exposure

Site Description: This site began operating in December 2009. This SLAMS location monitors for PM_{10}. Meteorological monitoring includes ambient temperature and wind speed/direction.

The station is located on the campus of the Zuni Hills Elementary School.

Number of complete monitoring days at Zuni Hills:

2019	2020	2021	Total
361	365	365	1091

4th Highest 24-hour readings at Zuni Hills **Without** removing atypical events (in red number):

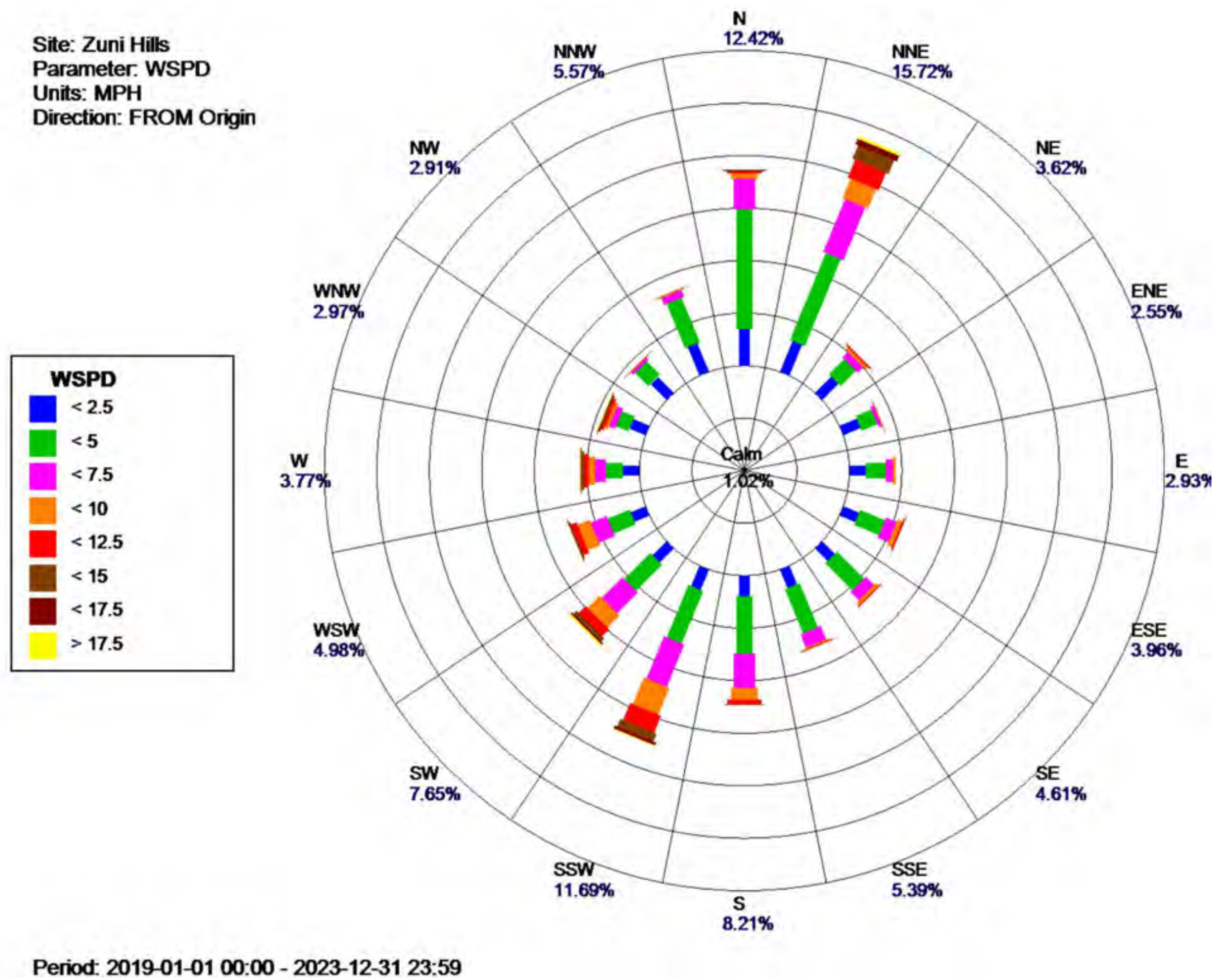
	2021	2022	2023
1	248	167	146
2	**142**	126	129
3	122	116	125
4	110	107	120

Based on the background PM10 concentrations and preliminary modeling results, the potential dates (subject to minor changes based on coordination with EPA) of the atypical events to be removed for Zuni Hills are: 7/9/2021; 7/10/2021; 10/12/2021; 10/11/2021; 9/2/2022; 8/31/2023; 7/21/2023; 7/26/2023; 4/3/2023. These dates have been flagged as atypical events because of PM10 exceedances at varies PM10 monitors per communication between Beverly Chenausky (ADOT) and Ron Pope (AQD) on April 5, 2024. EPA reviewed these days and replied on September 10 and stated that *"The green days show impacts at other monitors as well as sustained WS over 25mph at the airport along with weather type logs of dust or drops in visibility. The yellow days showed spikes at other monitors but sustained WS were not at or over 25mph, there were no notes on adverse weather types, nor noticeable changes in visibility."* For the yellow days, EPA would like to see more evidence to support the weight of evidence for their removal compared to the green days.

4th Highest 24-hour readings at Zuni Hills after removing atypical events (in red number). Pending EPA approval.

	2021	2022	2023
1	**110**	126	146
2	84	116	66
3	72	107	65
4	70	87	62

Source: https://www.epa.gov/outdoor-air-quality-data/download-daily-data



Source: email from Ron Pope (AQD) Friday, April 5, 2024

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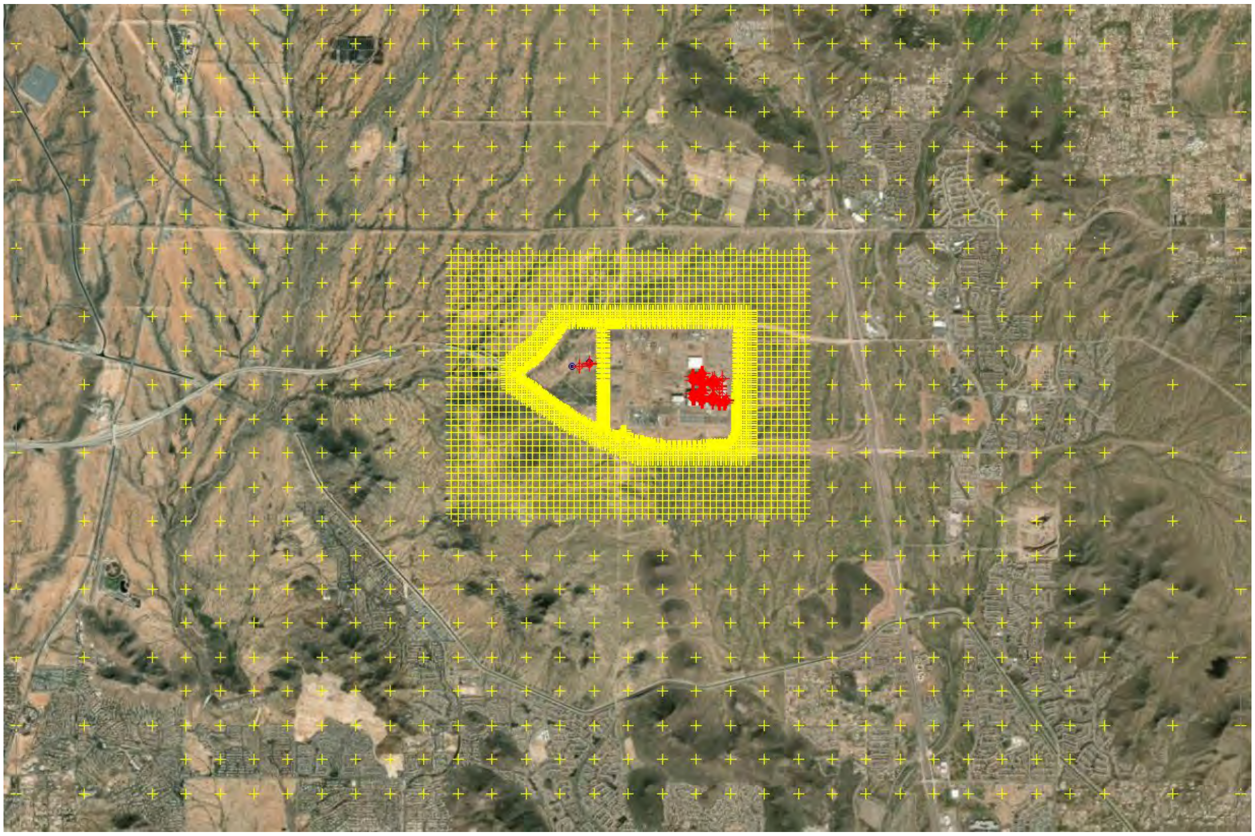
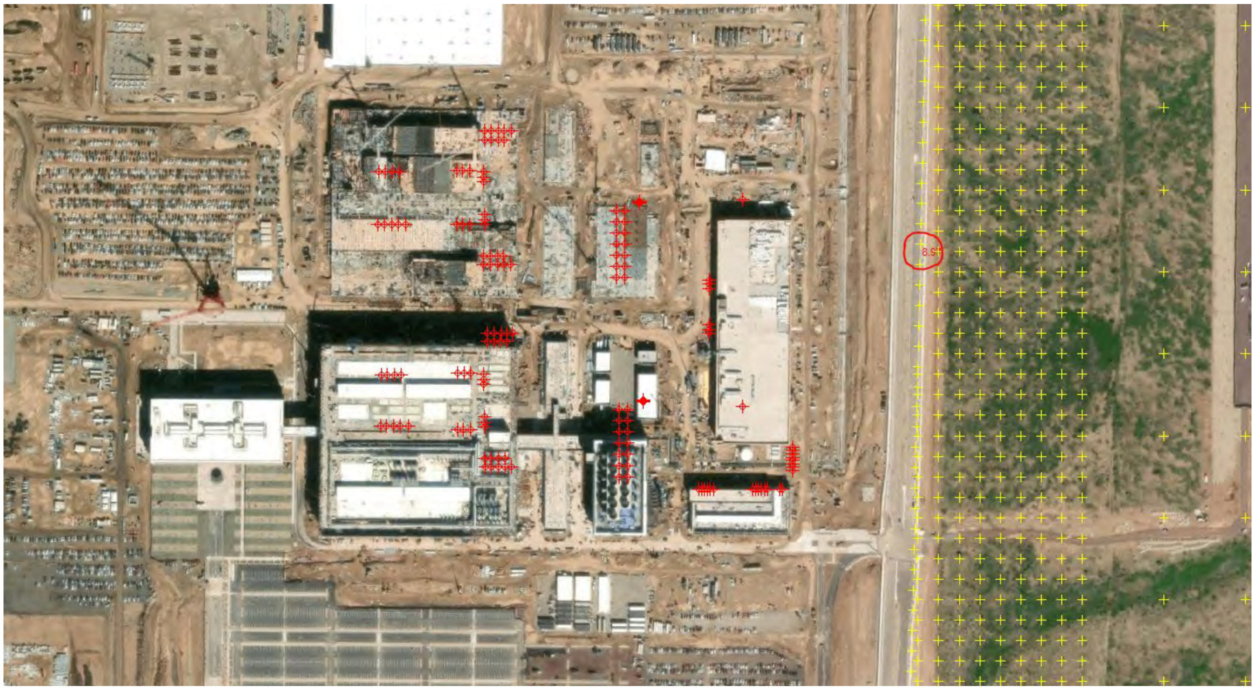
TSMC Facility Modeling Approach and Results

EPA provided the TSMC AERMOD input file for PM10 from the document as *4D2D6C7F.inp on October 4, 2024*, which contains every modeled source information for TSMC facilities. See screenshot below. In all, there were 148 point sources and/or volume sources modeled for the TSMC facilities, and 1000 receptors were modeled around the TSMC facilities.



After running the original TSMC AERMOD file provided by EPA with ADEQ Met file with data between 2017 and 2021, the maximum and 6th high 24-hour PM10 concentration results in the TSMC immediate property line on the east (red circle in figure below) and the 6th highest 24-hour PM10 concentration from TSMC facilities would be **8.2 ug/m3**.



Results Summary

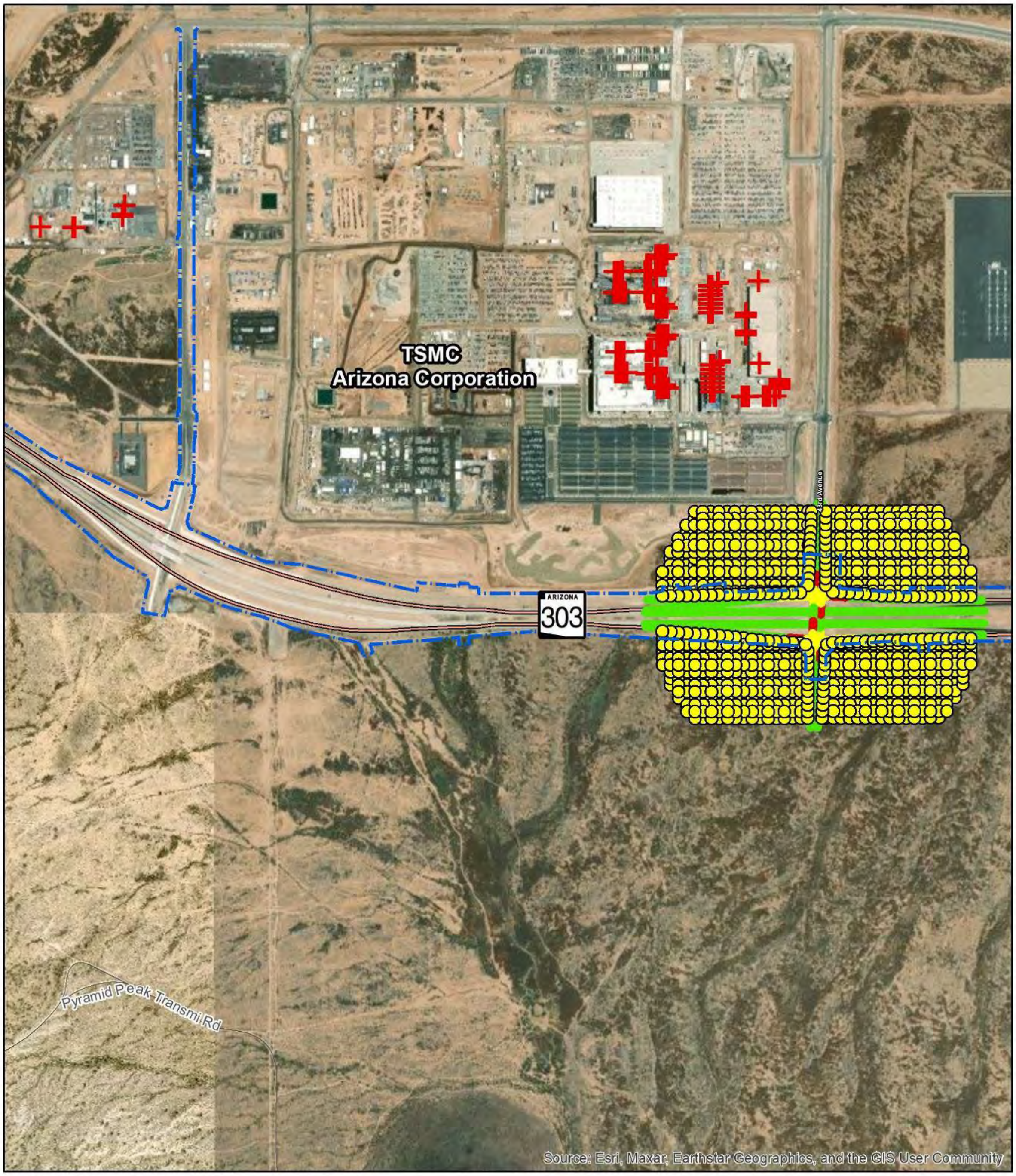
TSMC Arizona

PM-10 NAAQS (Pre 97) - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	8.96902	ug/m^3	393402.92	3738133.70	486.01	0.00	486.01	8/26/2019, 24
24-HR	6TH	8.19158	ug/m^3	393402.92	3738133.70	486.01	0.00	486.01	10/9/2021, 24

Per EPA's suggestion, to be consistent with the source parameters and locations from the TSMC permit, we exported all TSMC sources into excel files and re-imported them into our SR303 AERMOD file for every TI under evaluation, that way the source parameters and locations would be identical, see example figures below for imported TSMC sources in SR303 AERMOD models at nearby 43rd Ave TI and 51st Ave TI.

Because the PM10 concentrations generated by TSMC facilities are far less than those generated by roadway emissions from SR303 project, the PM10 hotspot areas would still be located near at each TI/intersection that our modeled receptors already cover those areas. And there is no need to input the 1000 receptors from TSMC AERMOD file into our SR303 AERMOD model file.



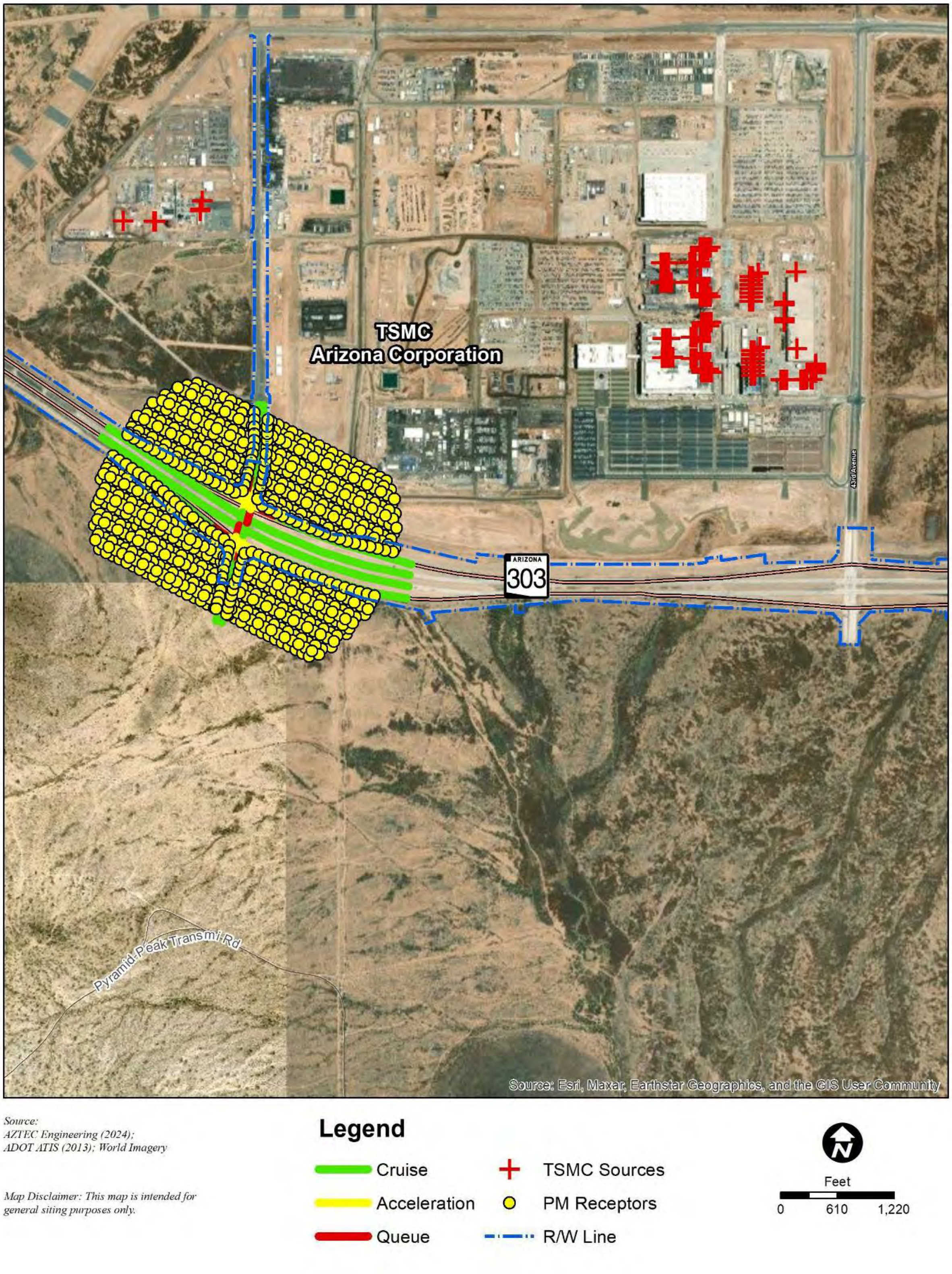
Source:
AZTEC Engineering (2024);
ADOT ATIS (2013); World Imagery

Map Disclaimer: This map is intended for general siting purposes only.

Legend

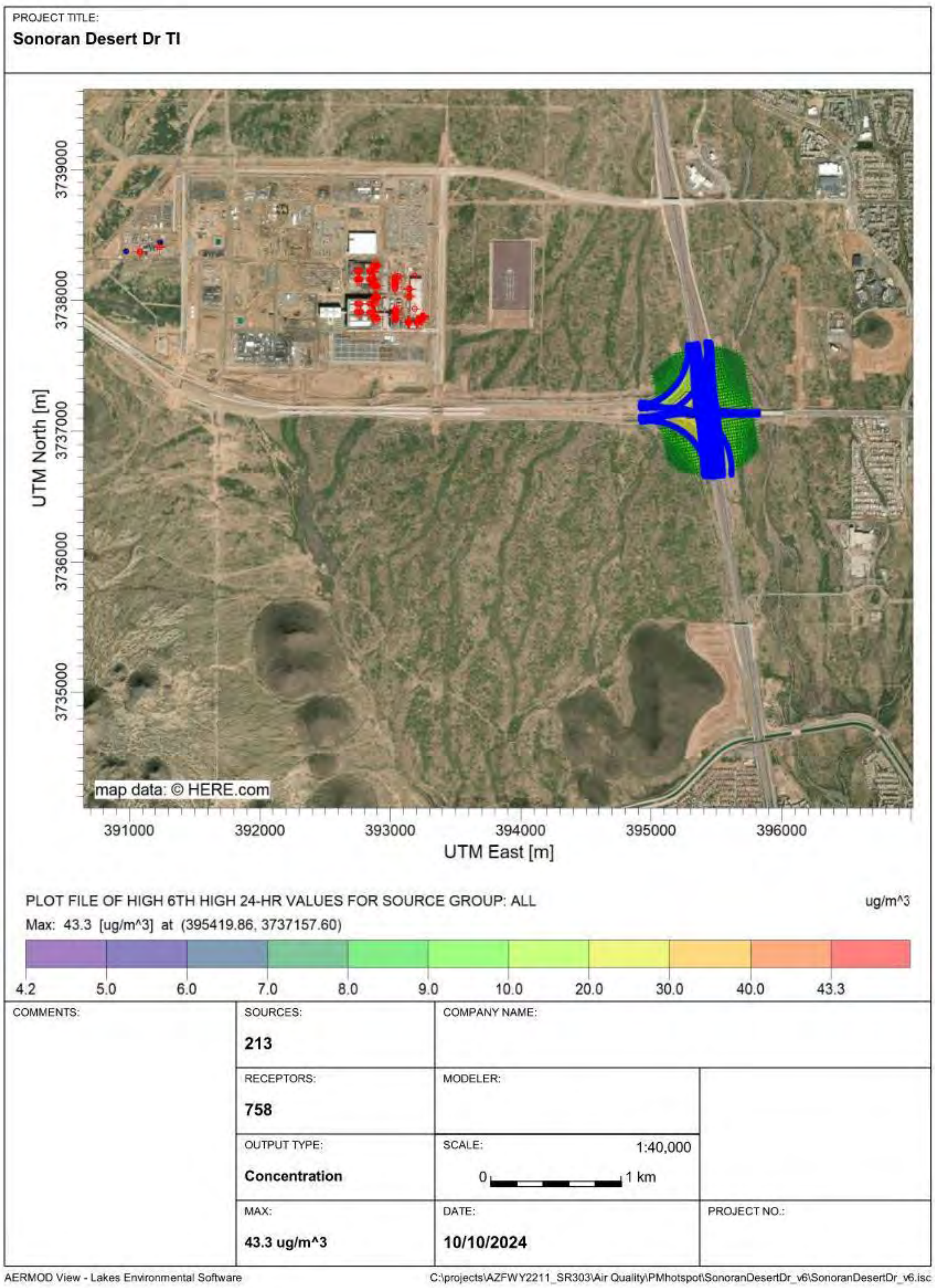
Cruise
Acceleration
Queue
TSMC Sources
PM Receptors
R/W Line

Feet
0 610 1,220



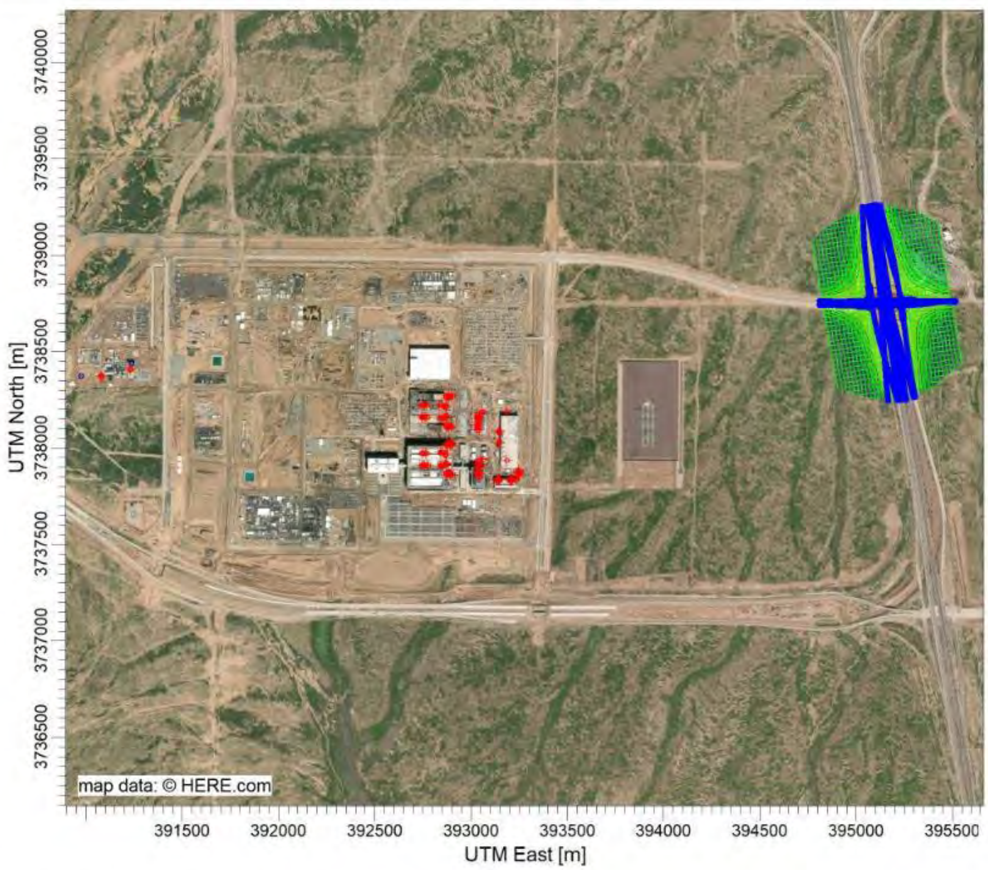
Below are the results with PM10 concentration contours for each analyzed TI/intersections with TSMC facilities sources included. We modeled receptors along sidewalks at Sonoran Desert Dr

TI and Dove Valley Rd TI per EPA's direction.



PROJECT TITLE:

Dove Valley Rd TI



PLOT FILE OF HIGH 6TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 39.4 [ug/m^3] at (395195.82, 3738772.33)

3.2 5.0 6.0 7.0 8.0 9.0 10.0 20.0 30.0 39.4

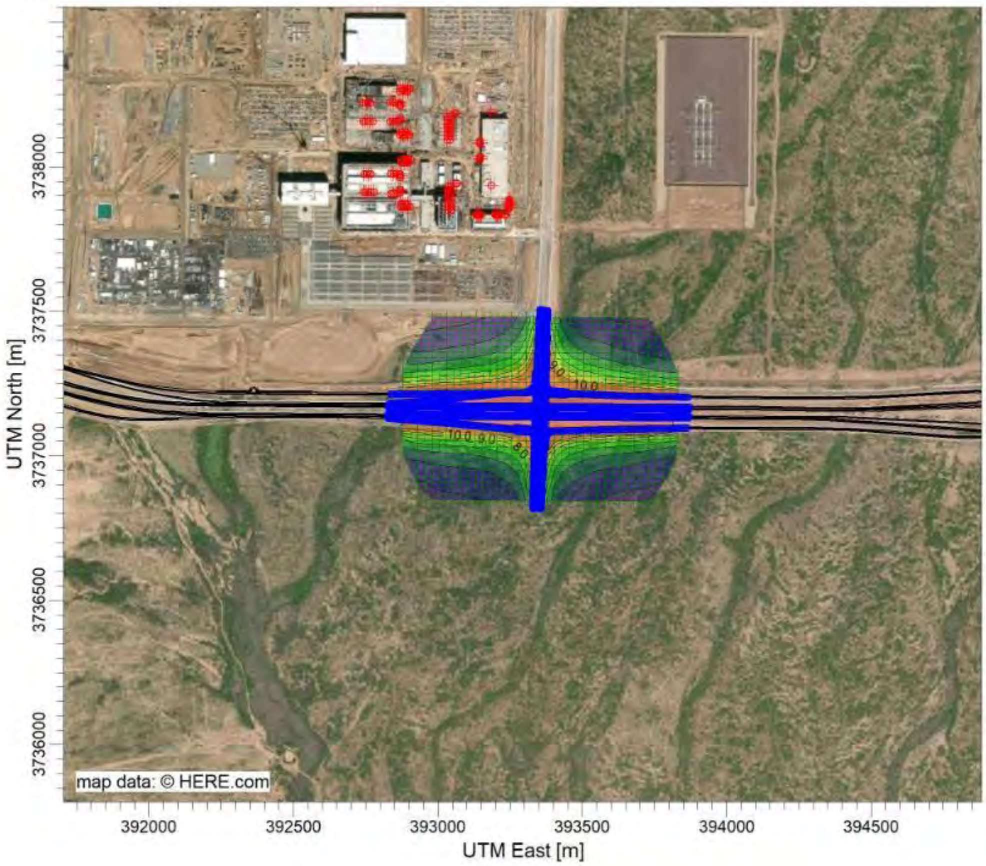
COMMENTS:	SOURCES:	COMPANY NAME:	
	216		
	RECEPTORS: **987**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:30,000 (0 — 1 km)	
	MAX: **39.4 ug/m^3**	DATE: **10/10/2024**	PROJECT NO.:

AERMOD View - Lakes Environmental Software

C:\projects\AZFWY2211_SR303\Air Quality\PMhotspot\DoveValleyRd_v6\DoveValleyRd_v6.isc

PROJECT TITLE:

43rd Ave TI



PLOT FILE OF HIGH 6TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 19.9 [ug/m^3] at (393404.82, 3737231.43)

2.7 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 19.9

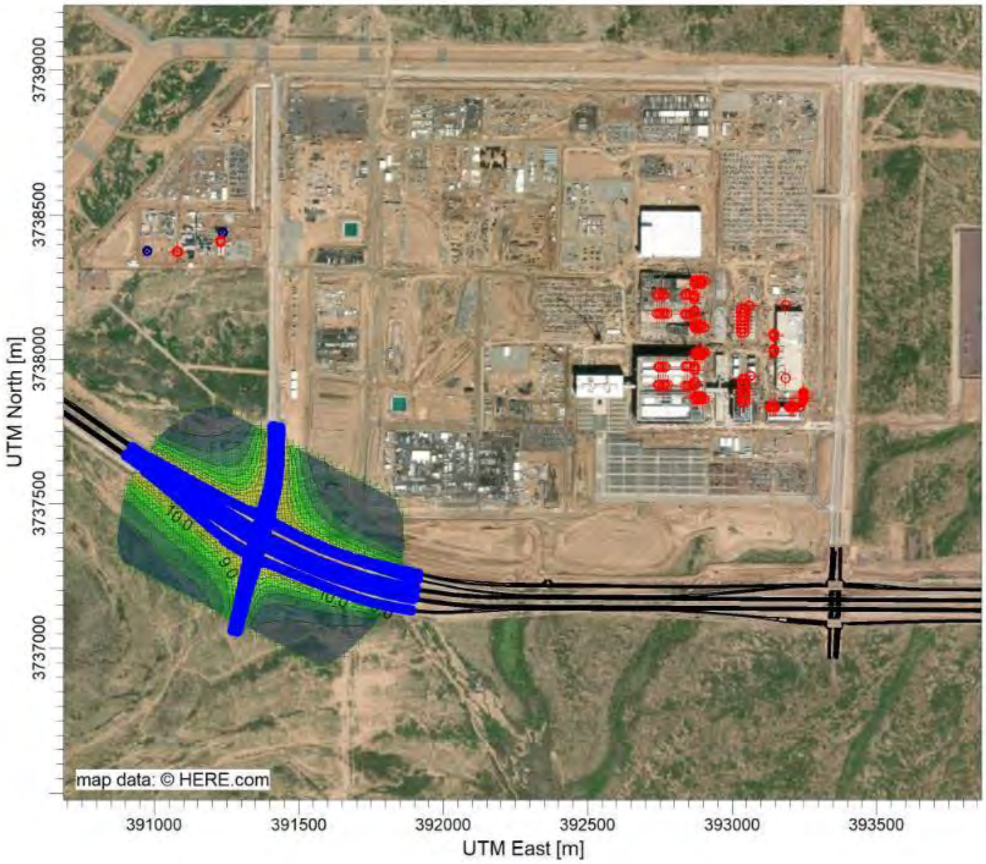
COMMENTS:	SOURCES: **215**	COMPANY NAME:	
	RECEPTORS: **976**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:20,000 0 — 0.5 km	
	MAX: **19.9 ug/m^3**	DATE: **10/10/2024**	PROJECT NO.:

AERMOD View - Lakes Environmental Software

C:\projects\AZFWY2211_SR303\Air Quality\PMhotspot\43rdAve_v6\43rdAve_v6.isc

PROJECT TITLE:

51st Ave TI



PLOT FILE OF HIGH 6TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 23.5 [ug/m^3] at (391410.51, 3737459.94)

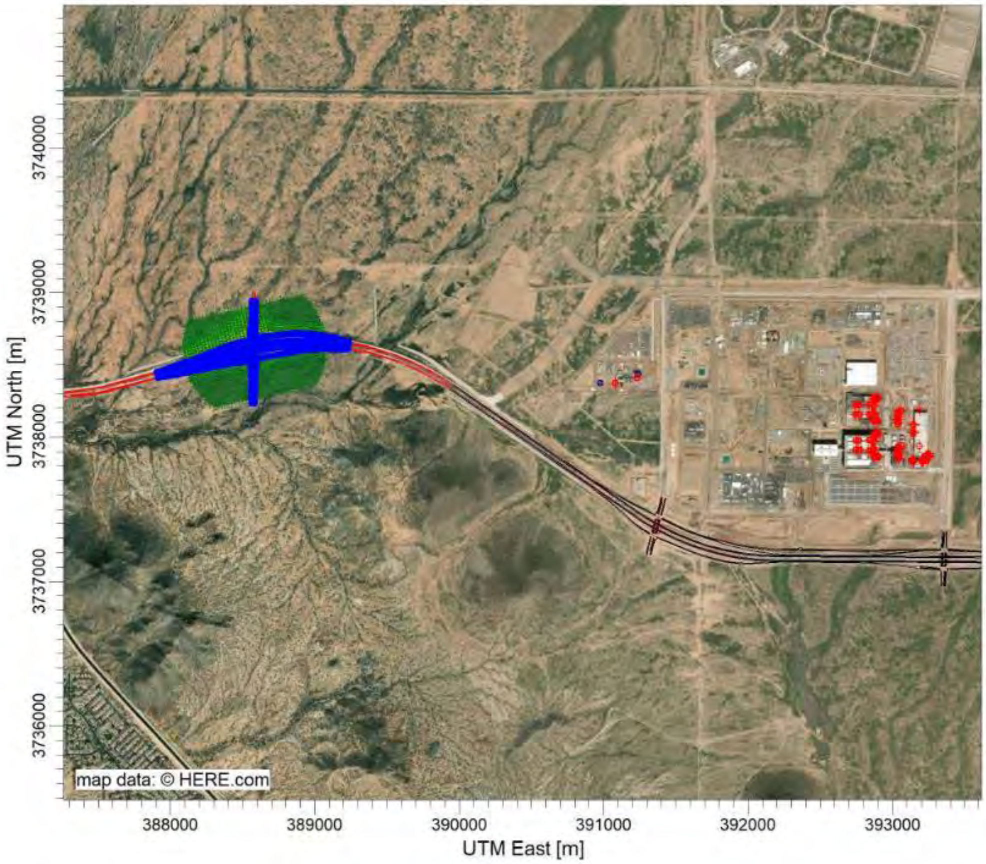
2.3 4.0 5.0 6.0 7.0 8.0 9.0 10.0 20.0 23.5

COMMENTS:	SOURCES:	COMPANY NAME:	
	222		
	RECEPTORS: **979**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:20,000 (0 – 0.5 km)	
	MAX: **23.5 ug/m^3**	DATE: **10/10/2024**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\projects\AZFWY2211_SR303\Air Quality\PMhotspot\51stAve_v6\51stAve_v6.isc

PROJECT TITLE:

67th Ave TI



PLOT FILE OF HIGH 6TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 23.7 [ug/m^3] at (388546.33, 3738687.00)

2.1 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 20.0 | 23.7

COMMENTS:	SOURCES: **214**	COMPANY NAME:	
	RECEPTORS: **969**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:40,000 0 — 1 km	
	MAX: **23.7 ug/m^3**	DATE: **10/10/2024**	PROJECT NO.:

Permit Information other Background

Gmail

Beverly Chenausky <bchenausky@azdot.gov>

RE: Atypical Events Approach for Loop 303, Lake Pleasant Parkway to I-17 Improvements @ Mon, May 13, 2024 10:00am – 12:00pm (GMT-07)

1 message

Tsui, William <Tsui.William@epa.gov> Fri, Oct 4, 2024 at 2:04 PM
To: Beverly Chenausky <bchenausky@azdot.gov>, "Wickersham, Lindsay (she/her/hers)" <wickersham.lindsay@epa.gov>
Cc: ADOTAirNoise - ADOT <adotairnoise@azdot.gov>, "ddunn@aztec.us" <ddunn@aztec.us>, "dshu@aztec.us" <dshu@aztec.us>, Ivan Racic <iracic@azdot.gov>, Joonwon Joo <jjoo@azdot.gov>, Katie Rodriguez <krodriguez@azdot.gov>, "mchase@aztec.us" <mchase@aztec.us>, Morgan Ghods <mghods@azdot.gov>, "Seeds, Amy" <Seeds.Amy@epa.gov>, "ssingh@aztec.us" <ssingh@aztec.us>, Sandy Thoms <sthoms@azdot.gov>

Hello Beverly,

Thanks for taking the time to write up an outline of your approach. While it is a reasonable attempt to characterize the emissions in the absence of additional information, we were recently able to find source parameters and locations from the TSMC permit. Therefore, we recommend using this detailed source information instead. See attached files.

TSMC_application.pdf contains the modeling report associated with the TSMC permit in Appendix E. Also, Appendix A of Appendix E contains a spreadsheet of source parameters and emissions. *TSMC_TSD_initialpermit.docx* contains the initial permit issuance and includes all AERMOD input and output files in the appendix. For your convenience, we have attached the AERMOD input file for PM10 from this document as *4D2D6C7F.inp*, which contains source information for TSMC.

If you have any questions, please let us know.

Thank you,

William

William G. Tsui, Ph.D.

Geographic Strategies and Modeling Section, Air & Radiation Division

U.S. Environmental Protection Agency, Region 9

Email: tsui.william@epa.gov

From: Beverly Chenausky <bchenausky@azdot.gov>
Sent: Wednesday, October 2, 2024 2:22 PM
To: Wickersham, Lindsay (she/her/hers) <wickersham.lindsay@epa.gov>
Cc: ADOTAirNoise - ADOT <adotairnoise@azdot.gov>; ddunn@aztec.us; dshu@aztec.us; Ivan Racic <iracic@azdot.gov>; Joonwon Joo <jjoo@azdot.gov>; Katie Rodriguez <krodriguez@azdot.gov>; mchase@aztec.us; Morgan Ghods <mghods@azdot.gov>; Seeds, Amy <Seeds.Amy@epa.gov>; ssingh@aztec.us; Sandy Thoms <sthoms@azdot.gov>; Tsui, William <Tsui.William@epa.gov>

Subject: Re: Atypical Events Approach for Loop 303, Lake Pleasant Parkway to I-17 Improvements @ Mon, May 13, 2024 10:00am – 12:00pm (GMT-07)

Lindsay - Please find attached a general outline of the approach that should cover the approach, if this is ok with EPA, we will provide the updated modeling files and begin formal consultation. You can see the added additional receptors on Sonoran Desert Drive sidewalks of the SR303/I-17 TI. We also added a TSMC facility into the model per attached approach.

Beverly Chenausky

ASSISTANT ENVIRONMENTAL ADMINISTRATOR

ARIZONA DEPARTMENT OF TRANSPORTATION

MD EM02, 206 S. 17th Ave.

Phoenix, AZ 85007

480.390.3417

Website: azdot.gov

On Wed, Oct 2, 2024 at 2:13 PM Wickersham, Lindsay (she/her/hers) <wickersham.lindsay@epa.gov> wrote:

> Hi Beverly and Team,
>
> I wanted to follow up with you all about our comment regarding modeling the TSMC as a stationary source.
>
> We consulted with OTAQ and determined that the TSMC **should** be modeled as a stationary source in this PM Hot Spot analysis. We are happy to consult with ADOT on how to best model this facility in the hot spot analysis. We have also reached out to Maricopa county to see if we can find more information about the anticipated emissions used for their permit--we will share any materials we receive with you.
>
> In the meantime, we wanted to pass on the advice we got from OTAQ on how to get started: “This facility should be modeled in line with Appendix W, allowable emissions based on Table 8-1 (82 FR 5219) or Table 8-2 (82 FR 5220), GEP Stack heights for any stacks, downwash, etc.”
>
> Please let us know if you would like us to set up a meeting to discuss this further—we are happy to help as we can!
>
> Best,
>
> Lindsay

Lindsay Wickersham (she/hers) | 415-947-4192

Physical Scientist | Planning Section (AIR-2-1) | Air and Radiation Division | US EPA - Region 9

-----Original Appointment-----
From: Beverly Chenausky <bchenausky@azdot.gov>
Sent: Wednesday, September 11, 2024 8:51 AM
To: Beverly Chenausky; ADOTAirNoise - ADOT; ddunn@aztec.us; dshu@aztec.us; Ivan Racic; Joonwon Joo; Katie Rodriguez; mchase@aztec.us; Morgan Ghods; Seeds, Amy; ssingh@aztec.us; Sandy Thoms; Tsui, William; Wickersham, Lindsay (she/her/hers)
Subject: Atypical Events Approach for Loop 303, Lake Pleasant Parkway to I-17 Improvements @ Mon, May 13, 2024 10:00am – 12:00pm (GMT-07)
When: Monday, September 23, 2024 11:00 AM-12:00 PM America/Phoenix.
Where:

azdot.gov/projects/central-district-projects/loop-303-lake-pleasant-parkway-

Discussion on days and data needs for atypical event and monitor selection.

Project Details, Public meeting materials https://azdot.gov/projects/central-district-projects/loop-303-lake-pleasant-parkway-i-17-improvements

Draft Modeling Files - Refer to 9/5 email with documents

https://azdot.my.workfront.adobe.com/document/public/view?publicToken=GwwbpJWS7fbmmc9m3z90_fYpLoJa9tRgPYSDw1pVB8UDOHb9mOKNyy4XIC7cBiCHZDdaYgMMPb6Cv5gJOZSoWQ==&endcap

When

Monday Sep 23, 2024 · 11am – 12pm (Mountain Standard Time - Phoenix)

Guests

Beverly Chenausky - organizer

ADOTAirNoise - ADOT

ddunn@aztec.us

dshu@aztec.us

Ivan Racic

Joonwon Joo

Katie Rodriguez

mchase@aztec.us

Morgan Ghods

seeds.amy@epa.gov

ssingh@aztec.us

Sandy Thoms

tsui.william@epa.gov

Join with Google Meet

Meeting link

meet.google.com/exp-zwjq-ouz

Join by phone

+1 929-282-0937(US)
PIN: 673321219

More phone numbers

Attachments

F0561&F0562_SR303_AQ_C...

5.29.24 EPA Comments o...

wickersham.lindsay@epa.gov

View all guest info

wickersham.lindsay@epa.gov for **Reply**

Maybe | No | Yes

More options

3 attachments

TSMC_application.pdf
5841K

TSMC_TSD_initialpermit.docx
5189K

4D2D6C7F.inp
709K

Gmail

Beverly Chenausky <bchenausky@azdot.gov>

RE: Atypical Events Approach for Loop 303, Lake Pleasant Parkway to I-17 Improvements @ Mon, May 13, 2024 10:00am – 12:00pm (GMT-07)

1 message

Wickersham, Lindsay (she/her/hers) <wickersham.lindsay@epa.gov> Wed, Oct 2, 2024 at 2:13 PM
To: Beverly Chenausky <bchenausky@azdot.gov>, ADOTAirNoise - ADOT <adotairnoise@azdot.gov>, "ddunn@aztec.us" <ddunn@aztec.us>, "dshu@aztec.us" <dshu@aztec.us>, Ivan Racic <iracic@azdot.gov>, Joonwon Joo <jjoo@azdot.gov>, Katie Rodriguez <krodriguez@azdot.gov>, "mchase@aztec.us" <mchase@aztec.us>, Morgan Ghods <mghods@azdot.gov>, "Seeds, Amy" <Seeds.Amy@epa.gov>, "ssingh@aztec.us" <ssingh@aztec.us>, Sandy Thoms <sthoms@azdot.gov>, "Tsui, William" <Tsui.William@epa.gov>

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Please let us know if you would like us to set up a meeting to discuss this further—we are happy to help as we can!

Best,

Lindsay

Lindsay Wickersham (she/hers) | 415-947-4192

Physical Scientist | Planning Section (AIR-2-1) | Air and Radiation Division | US EPA - Region 9

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Subject: Atypical Events Approach for Loop 303, Lake Pleasant Parkway to I-17 Improvements @ Mon, May 13, 2024 10:00am – 12:00pm (GMT-07)
When: Monday, September 23, 2024 11:00 AM-12:00 PM America/Phoenix.
Where:

4747 N. 22nd Street, Suite 200
Phoenix, Arizona 85016
United States
www.ghd.com

Our ref: 11218799-03

March 15, 2022

Mr. Ryan Dalrymple, EIT
Air Quality Engineering Associate
Maricopa County Air Quality Department
3800 North Central, Suite 1400
Phoenix, AZ 85012

New Source Non-Title V Application - Additional Information Submittal
Taiwan Semiconductor Manufacturing Company Arizona Corporation
Facility ID: F041443; Permit Number: P00008497

Dear Mr. Dalrymple:

On behalf of the Taiwan Semiconductor Manufacturing Company Arizona Corporation (TSMC), GHD Services Inc. (GHD) has prepared an additional information submittal for Maricopa County Air Quality Department (MCAQD) review. Since the New Source Non-Title V (NTV) application submittal in August 2021, updated process and equipment information has become available, some of which affects facility potential emissions, as well as the dispersion modeling analysis. However, the emissions remain within the NTV permit thresholds. TSMC has also requested to include both fab facilities (P1 and P2) to the existing application. Application changes and/or updated sources of emissions are summarized below.

Change	Affected Equipment	Affected Application Section
Updated of emissions for P2	All Equipment/Process, except emergency generators	PTE calculations
Updated generator stack height from 15m to 13m (all units); Reduced generator numbers from 38 to 22 for P1	Emergency generators, P1 only. zero in P2	PTE calculations, Dispersion modeling analysis
Updated GOWN building position	None	Dispersion modeling analysis
Updated HAPs identified for scrubbers and RCTO	Acid scrubbers, bench scrubbers, RCTO	PTE calculations; dispersion modeling analysis
Updated VOCs for scrubbers	Bench scrubbers	PTE calculations; dispersion modeling analysis
Updated fugitive VOC emissions included in PTE (wipe cleaning)	Not applicable	PTE calculations
Updated NOx/CO performance guarantees from low NOx-burners	RCTO	PTE calculations; dispersion modeling analysis
Updated NOx/CO emissions	Acid Scrubbers	PTE calculations; dispersion modeling analysis
Updated Total Exhaust Flow for each Phase	RCTO Process	PTE calculations; dispersion modeling analysis
Revised SO_2 emission calculation methodology	RCTO	PTE calculations; dispersion modeling analysis

Notes:
PTE - Potential to Emit
HAP - hazardous air pollutants
RCTO - Rotor Concentrator Thermal Oxidizers
VOCs - volatile organic compounds
NOx - nitrogen oxides
CO - carbon monoxide
SO_2 - sulphur dioxide

The aforementioned changes do not trigger any new applicable requirements or affect the revised confidentiality request, which was approved by MCAQD on January 28, 2022. The following documents have been attached:

- Updated NTV permit application that includes:
  - Updated main permit application document and MCAQD forms
  - Updated PTE calculations
  - Updated Modeling Report
- Updated modeling files

If requested, the documents will be uploaded to the IMPACT system.

Sincerely,

Xinze Peng, Ph.D.
Air Compliance Engineer

+1 949 585-5246
xinze.peng@ghd.com

Encl.

XP/trc/Dalr-001

Non-Title V Air Permit Application

TSMC Phoenix Project

Phoenix, Maricopa County, Arizona

TSMC Arizona Corporation

March 15, 2022

Acronyms List

AsH_3	Arsine
AP-42	EPA Compilation of Air Pollutant Emission Factors
BAAQMD	Bay Area Air Quality Management District
BACT	Best Available Control Technology
bhp	brake horsepower
BTU	British Thermal Unit
C_2H_3N	acetonitrile
CARB	California Air Resources Board
CFR	Code of Federal Regulations
Cl_2	chlorine
CMP	Chemical Mechanical Planarization Polishing
CO	carbon monoxide
COS	carbonyl sulfide
CVD	Chemical Vapor Deposition
EC	Exhaust Conditioner
ECS	Emission Control System
EPA	Environmental Protection Agency
Fab	Semiconductor Manufacturing (Fabrication) Plant
g	grams
H_2SO_4	sulfuric acid
HAP	hazardous air pollutant
HCl	hydrogen chloride
HF	hydrogen fluoride
HNO_3	nitric acid
HP	horsepower
hr	hour
kW	kilowatt
lb/hr	pound per hour

MCAPCR	Maricopa County Air Pollution Control Regulations
MCAQD	Maricopa County Air Quality Department
mg	milligrams
MMBTU	Million British Thermal Units
NH_3	ammonia
NMHC	non-methane hydrocarbon
NOx	nitrogen oxides
NSR	New Source Review
O&M	Operation and Maintenance
$PM_{2.5}$	Particulate Matter less than 2.5 micron aerodynamic diameter
PM_{10}	Particulate Matter less than 10 micron aerodynamic diameter
ppm	parts per million
ppmv	parts per million by volume
PH_3	Phosphine
POU	Point of Use
PTE	potential to emit
PVD	Physical Vapor Disposition
RACT	Reasonably Available Control Technology
RCTO	Rotor Concentrator Thermal Oxidizers
SCAQMD	South Coast Air Quality Management District
SJVAPCD	San Joaquin Valley Air Pollution Control District
sfc	standard cubic foot
SO_2	sulfur dioxide
$TiCL_4$	titanium tetrachloride
Title V	Title V of the Clean Air Act Amendments of 1990
TPY	tons per year
TSMC	Taiwan Semiconductor Manufacturing Co., Ltd.
VOC	volatile organic compounds
WWTP	Wastewater Treatment Plant
yr	year

Contents

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Appendices

1. Project Description

TSMC Arizona Corporation (TSMC) proposes to construct an advanced semiconductor facility on an approximate 1,000-acre parcel near the City of Phoenix, Maricopa County, Arizona. The proposed facility will utilize TSMC's 5 nanometer technology for semiconductor wafer fabrication. Construction is proposed to commence in 2021, with production targeted to start in 2024.

The facility will be located at Parcel #204 09 001, which is bounded by 51st Avenue, Dove Valley Road, State Route 303, and 43rd Avenue. The site location, emission sources, and building information are depicted in attached **Figures 1, 2A**, and **2B**. The facility will consist of two semiconductor fabrication (Fab) plant buildings (P1 and P2) where semiconductor chips will be manufactured in buildings containing the air pollution control and support equipment for the Fab, including natural gas fired boilers, diesel fired emergency generators, fire pump engines, and cooling towers. Based on the projected emissions, this project qualifies for a Non-Title V permit.

The enclosed application demonstrates that the proposed project meets the applicable requirements of Maricopa County Air Quality Department (MCAQD) Rules 220 and 241. The Non-Title V (NTV) Air Permit Application form is included as **Appendix A**.

2. Process Description

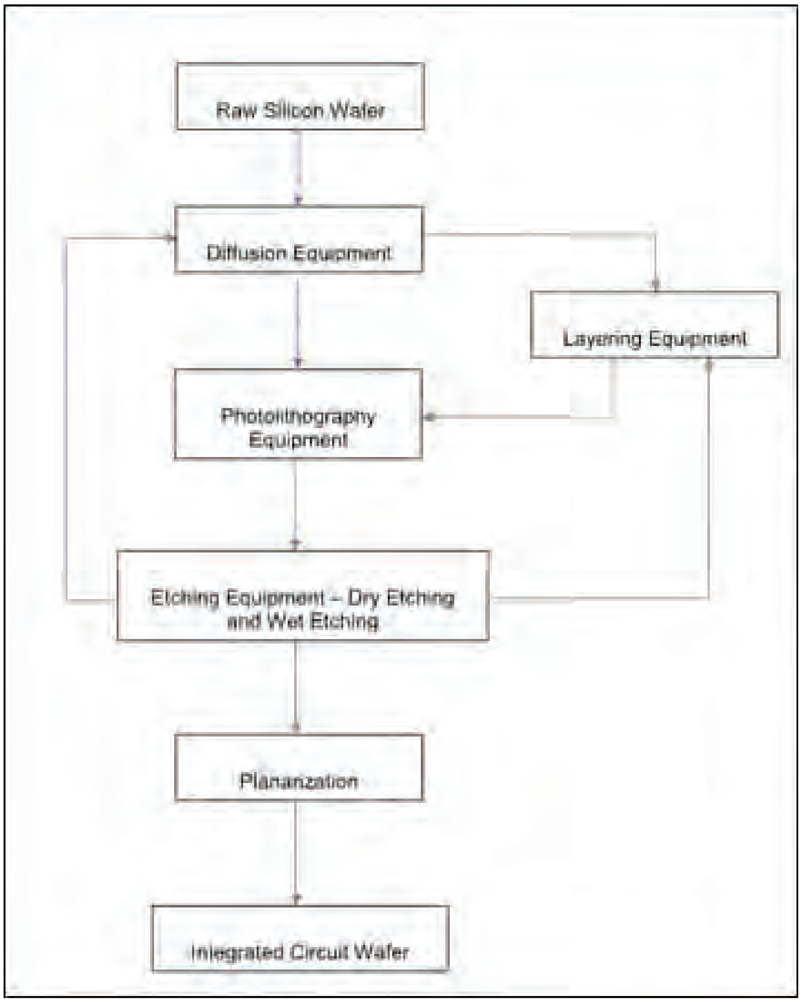
The proposed project includes two Fab buildings where semiconductor chips will be manufactured in buildings containing air pollution control and support equipment, as further outlined herein. Supporting equipment will reside in the Wastewater Treatment Plant (WWTP), Chemical Storage, Bulk Specialty Gas System, and Central Utility Plant buildings. A general process flow diagram is included in attached **Figure 3A**, a Fab building process flow diagram is included in attached **Figure 3B**, and a process flow diagram for the supporting equipment is included in attached **Figure 3C**.

Manufacturing operations will occur 24 hours per day, 7 days per week, 365 days per year.

2.1 Manufacturing Process Description

The semiconductor manufacturing process starts with thin disks of high purity silicon called wafers, which undergo various processes, including diffusion, ion implantation, photolithography, etching, layering, and oxidizing. These are cyclical processes; the sequence and the number of cycles will vary depending on the requirements of the integrated circuit design. The simplified process flow diagram is shown in Figure 1 below.

Figure 1 Simplified Process Flow Diagram



The manufacturing process of integrated circuits utilizes silicon wafers as the base material. The silicon wafers are exposed to oxygen at high temperatures to form a layer of silicon dioxide on the wafer surface. After the surface oxide film is formed, the photosensitive agent is coated to the wafers. After a wafer has been coated with photoresist and the photoresist has cured, the wafer is exposed to a light source and developed in combination with a photomask to form various types of circuits on the wafer. After etching, removing photoresist liquids, and doping, the wafer is deposited to form the circuits and electrodes for final testing.

The typical processes of semiconductor manufacturing are described below.

2.1.1 Doping

A semiconductor is a material whose conductivity is between that of a conductor and a non-conductor. Its ability to conduct electricity depends not only on the energy gap characteristics of its own material, but also is affected by foreign impurities. The energy levels generated by the donor and the acceptor increase the original conductivity of silicon. This action of adding a small amount of specific impurities to the semiconductor is called doping. Doping methods include ion implantation and diffusion.

2.1.1.1 Ion Implantation

The ion implantation method first ionizes the dopants (e.g., Arsine [AsH3]), and then with the use of an accelerator, the ionized dopants are directly injected into the silicon wafer to pre-set the dopants to form various N type or P type semiconductor regions. This method can accurately adjust the content (concentration) and distribution of the dopants in the wafer.

2.1.1.2 Diffusion

The diffusion method utilizes the dopants' mobility along its own concentration gradient at high temperatures (above about 800 degrees Celsius) to realize the doping of silicon wafers. Because it is not easy to control the concentration distribution of dopants by heat diffusion in hot furnace tubes, this method is mainly used to perform the distribution correction of dopants after implantation and restore the single crystal structure of the surface atoms at the silicon wafer.

2.1.2 Layering (Thin Film)

The formation of a thin film of material on the wafer is due to the gas molecules or other particles spread on the surface of the wafer. These particles may be solidified due to the chemical reactions and deposit on the surface of the wafer, or they may lose part of their kinetic energy after undergoing surface diffusion and be adsorbed on the surface of the wafer and then deposited. Therefore, layering methods include physical and chemical vapor deposition.

2.1.2.1 Physical Vapor Deposition (PVD)

PVD is a technology that forms a thin film through physical processes, including evaporation and sputtering. In the evaporation process, the deposition material is evaporated by heating. Once the deposition material saturates in the vapor phase, it is then condensed and deposited to form a thin film on the wafer surface. The sputtering process uses the ions generated by the plasma to bombard the electrode of the deposition material, emitting particles of the deposition material to the vapor phase, and then depositing a thin film on the wafer surface.

2.1.2.2 Chemical Vapor Deposition (CVD)

CVD is a thin film deposition technology that uses chemical reactions to generate solid products from gaseous reactants in the reactor that deposit on the surface of the wafer. Because it involves chemical reactions, it is called CVD. At present, it is the most important and the main thin film deposition technology in the semiconductor manufacturing process. It can deposit materials with precise composition and has better step coverage. Main CVD technologies include atmospheric pressure CVD, low pressure CVD, and plasma CVD.

2.1.3 Photolithography

Photolithography is the most important step in the entire semiconductor manufacturing process. Anything related to the metal oxide semiconductor device structure, such as the pattern of each layer of film and the area of impurities, are determined by this step. The basic procedure consists of three steps: photoresist coating, exposure, and development.

2.1.3.1 Photoresist Coating

Photoresist is mainly composed of resin, photosensitizer, solvent, and several other different compositions. Negative photoresists produce chains when exposed to light and cannot dissolve in the developer, while positive photoresists themselves are difficult to dissolve in the developer but dissociate into the developer solution when exposed to light.

2.1.3.2 Exposure and Development

Parallel light from the light source passes through the glass body photomask with a desired pattern and reaches the photoresist coated wafer. The projected light inherits the same pattern from the photomask, and therefore, exposes the photosensitive materials on the wafer surface. The exact same pattern on the photomask is transferred onto the wafer surface in this manner. During the development process, the exposed photoresist on the wafer surface is removed via a neutralization reaction, and then the desired pattern is retained on the wafer.

2.1.4 Etching

The etching process removes the deposited film material not coated and protected by the photoresist during the photolithography process. This is done via chemical reactions or physical processes to complete the final goal of transferring the mask pattern onto the film. The film developed and etched by photolithography will become a part of the semiconductor. Etching techniques including wet etching and dry etching.

2.1.4.1 Wet Etching

Wet etching uses a chemical reaction between the film and a specific solution to remove the film not coated by the photoresist. The process occurs at the acid tanks and is simple and fast.

2.1.4.2 Dry Etching

Dry etching uses plasma to etch the films. As the process does not involve any solution, it is called dry etching.

2.1.5 Planarization (Polishing)

Chemical Mechanical Planarization (or Polishing, CMP) is the process of injecting abrasive particles into the polishing pad of the polishing machine to remove varying types of materials from the wafer. The purpose is to smooth the dielectric layer and the metal layer on the integrated circuit wafer to flatten it and achieve three-dimensional wiring or multilayer wiring, increasing the wiring density while reducing defects.

2.1.6 Cleaning Operations

Various organic and inorganic cleaners are used in enclosed hoods to clean equipment parts and quartz reaction chambers. Organic cleaners can include isopropanol which is a source of volatile organic compounds (VOC) emissions. Inorganic cleaners include acids such as hydrogen chloride (HCl), and bases such as ammonium hydroxide solution. The enclosed hoods will have a positive pressure and each collection system will have a negative pressure so that the emissions can be collected and sent to an abatement device (i.e., Rotor Concentrator Thermal Oxidizers [RCTO]).

2.2 Air Pollution Control Equipment

In general, acid gas will be routed to an acid abatement system (Acid or Bench Scrubbers), ammonia gas will be routed to an alkaline abatement system (Ammonia Scrubbers), and VOCs will be routed to a VOC abatement system (RCTO).

2.2.1 Acid Scrubbers

Each of the two Fabs will have acid scrubber systems, bench scrubber systems, and wastewater acid scrubber systems. Each acid scrubber will have a single scrubber whereas the bench scrubber systems have a design with two scrubbers in series, initially installed with a single scrubber with space for future addition. The bench scrubber system will be used to control emissions from processes with high acid concentration that require a secondary scrubber to achieve the desired removal efficiency.

The Fab process exhaust airstreams routed to these scrubbers will contain primarily inorganic acids hydrogen fluoride (HF), nitric acid (HNO_3), HCl, and sulfuric acid (H_2SO_4), as well as other compounds such as chlorine (Cl_2), acetonitrile (C_2H_3N), carbonyl sulfide (COS), titanium tetrachloride ($TiCl_4$), Ethylene Glycol, Triethylamine, Phosphine (PH_3) and Cobalt. The acid laden exhaust stream enters at the bottom of the packed tower and rise upwards with water draining through the packed column. Most of the acid gases will be transferred out of the air stream into the water stream and the treated exhaust streams will be vented to the atmosphere.

The WWTP buildings will also be equipped with wastewater acid scrubber systems that will vent to the atmosphere.

2.2.2 Ammonia Scrubbers

Each Fab will have ammonia (NH_3) scrubbers to control NH_3 in the exhaust stream before being vented to the atmosphere.

2.2.3 RCTOs

Each Fab will have RCTOs to control the VOCs emitted throughout the photolithography and etching processes. The airstream from these sources will first enter a zeolite rotor concentrator wheel where the VOCs will be absorbed onto the zeolite wheel before being vented to the atmosphere. A small portion of the clean exhaust stream will be heated and passed over the concentrator wheel after it passes from the adsorption section to the desorption section. The VOC concentration of the airstream will be increased while the overall airflow will be reduced. The resulting airflow will then be routed to the thermal oxidizer where most of the VOCs will be removed from the airstream before being vented to the atmosphere.

2.3 Support Equipment

2.3.1 Hot Water Boilers

Each Fab will have natural gas fired boilers to supply heating to the site. To allow for operational flexibility, all boilers are being permitted. These hot water boilers are expected to be used for a maximum of 300 hours per year per boiler. Loading requirements will vary based on outdoor temperatures with colder temperatures requiring more load.

2.3.2 Cooling Towers

Each Fab will be supported by mechanically induced (i.e., fan driven) cooling towers that are open to the atmosphere. Initially, cooling towers will be installed for the Fabs and based on need, a few more may be added in the future. The cooling towers will be used to dissipate large heat loads generated by the Fab and to condition the incoming air. The heat generated will be removed by air handlers whose heat is ultimately rejected to the atmosphere from the cooling towers. Cooling tower demand is expected to be higher during the warmer months and decrease during the cooler months.

2.3.3 Emergency Generators and Fire Pumps

P1 will have emergency power provided by 22 emergency diesel generators. There will also be one diesel fire pump for each Fab. The emergency engines will provide backup power in case of power disruptions during emergency conditions. The generators and fire pumps will combust ultra-low sulfur diesel fuel (15 parts per million [ppm] of Sulfur) and will be tested monthly for reliability and quarterly for load testing to ensure proper operation. Currently, no emergency generators are proposed for P2.

2.4 Utilities

2.4.1 Tanks

Liquid waste for disposal will be collected in aboveground storage tanks. The chemicals for acid waste neutralization and water purification will also be stored in tanks. Tanks containing primarily inorganic wastes will have breathing vents ducted to the scrubbers. Solvent tanks will be equipped with a pressure/vacuum relief valve and a flame arrestor to maintain the tanks' internal pressures and prevent explosions caused by potential external ignition sources.

There will be four vertical fixed tanks for each of the following materials: IPA, Thinner-1, Thinner-3, and DP001. These tanks will store the following chemical components: Isopropyl Alcohol, Propylene Glycol Monomethyl Ether, Propylene

Glycol 1-Monomethyl Ether Acetate, and Butyl Acetate. Tank emissions will be captured with 100 percent efficiency and controlled with 95 percent efficiency.

2.4.2 Wastewater Treatment Systems

Each Fab will have an ancillary WWTP to receive feed streams from Wastewater Reclaim Systems, Scrubbers, Cooling Towers, Process Tools, and General Facility/Public Uses (**Figure 3A**).

3. Emission Information

This project may generate emissions of the following criteria pollutants:

- Nitrogen oxides (NOx)
- Carbon Monoxide (CO)
- Sulfur Dioxide (SO_2)
- VOC
- Particulate matter with a diameter less than 10 microns (PM_{10})
- Particulate matter with a diameter less than 2.5 microns ($PM_{2.5}$)

Emissions from each of the process units in the wastewater reclaim system and in the wastewater treatment system will be routed to an abatement device resulting in insignificant emissions from wastewater treatment and reclaim systems.

The following sections describe the methodology used to calculate emissions for the project. Detailed emissions calculations are provided in **Appendix B** of this application.

3.1 Rotor Concentrator Thermal Oxidizers

The VOC emissions from the Fab operation will be controlled by the RCTOs. The emission factors for estimating combustion emissions from RCTO was based on emission factors in Tables 1.4 1, 1.4 2, and 1.4 3 for natural gas combustion in AP-42 (From EPA Compilation of Air Pollutant Emission Factors), assuming a fuel heat value of 1,020 British Thermal Unit (BTU)/standard cubic foot (scf), a flow rate of 3,390 scf/hour (hr), and 8,760 hrs/year (yr) of operation.

The proposed RCTOs will be subject to Maricopa County Air Pollution Control Regulations (MCAPCR) Rule 338- Semiconductor Manufacturing. Section 301 specifies that the RCTOs will need to achieve the requirements of subsections 301.1 or 301.2 of this rule. Specifically, achieve at least 80 percent overall VOC-control of aggregated cleaning plus photoresist VOC, including capture and processing of photoresist VOC or capture at least 90 percent of all aggregated cleaning plus photoresist VOC and achieve an hourly average stack concentration not exceeding 20 milligrams (mg) VOC/standard cubic meter.

3.2 Hot Water Boilers

The combustion emissions from the natural gas fired hot water boilers are based on emission factors from Tables 1.4.1, 1.4 2, and 1.4 3 for natural gas combustion in AP-42 assuming a fuel heat value of 1,020 BTU/scf, a boiler rating of 5.12 million BTU (MMBTU)/hr, and 300 hrs/yr per boiler of operation.

3.3 Cooling Towers

Cooling tower emissions are based on a conservative maximum total dissolved solids of 2,000 mg per liter. The emissions are based on a cooling water flow rate of 16,120 gallons per minute, a drift rate of 0.0005 percent, and 8,760 hrs/yr of operation. PM emissions assume 31.5 percent of total PM as PM_{10}, and 60 percent of PM_{10} as $PM_{2.5}$.

3.4 Scrubbers

There will be three types of scrubbers at the Fab, including acid scrubbers, bench scrubbers, and ammonia scrubbers. The acid scrubbers will control emissions of HF, HCl, H_2SO_4, HNO_3, NH_3, and Cl_2. The calculations for these sources are based on stack test data from acid scrubbers at a comparable Taiwan Fab plus a 15 percent safety factor to account for differences in emissions between facilities as operated. PM emissions are also based on stack test data for a comparable Taiwan Fab plus a 15 percent safety factor. Adjustments were made to HF and HNO_3 based on an expected increased material usage for these chemicals.

For the acid scrubbers, there will also be NOx and CO emissions resulting from Point of Use (POU) abatement unit combustion at the tool level. Emission rates used in this application are based on stack test data from the same scrubbers at a comparable Fab in Taiwan.

AsH_3, C_2H_3N, COS, and $TiCl_4$[1] emissions were calculated conservatively assuming that 100 percent of these compounds are emitted and routed to a destruction device. For AsH_3, it is assumed that over 99.5 percent of the emissions are controlled by the absorption bed and then routed to the acid scrubber. This is based on a test report from a similar facility showing that at an inlet concentration of 192 ppm of AsH_3, the outlet concentration was a non-detect. For the C_2H_3N, COS, and $TiCl_4$, a conservative control efficiency of 95 percent is assumed. The emissions from the ammonia scrubbers are also based on stack test data from the same scrubbers at a comparable Fab in Taiwan and a 15 percent safety factor was also added to these emissions.

Ethylene Glycol, PH_3, and Triethylamine emissions were calculated based on facility chemical usage, conservatively assuming that 100 percent of the compounds are emitted, and a 15 percent safety factor was also added to these emissions. Cobalt emissions were based on stack test data at a comparable Fab in Taiwan with an added 15 percent safety factor.

3.5 Emergency Generators and Fire Pumps

The emergency generators and fire pumps will be fueled by diesel with a sulfur content of 15 ppm and emissions are based on available manufacturer specifications and AP-42 factors for diesel engines. The manufacturer specifications are included in **Appendix C**. The generators have an engine rating of 2,923 horsepower (HP) and the fire pumps are rated at 360 HP. As these are emergency engines, their operation hours are limited to 18 hrs/yr.

3.6 Fugitive VOC

Fugitive VOC emissions come from the chemical usage of wipe cleaning process.

[1] It is not expected to actually have measurable $TiCl_4$ emissions due to the highly reactive nature of the compound.

3.7 Summary Emissions

The PTE summary for this project is presented below. Criteria pollutants emissions are shown in **Table 1** and HAP emissions are shown in **Appendix B** of this application.

Table 1 PTE Summary of Criteria Pollutant Emissions

Emission Source	VOC		PM_{10}		$PM_{2.5}$		SO_2		NO_x		CO	
Description	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Boilers	0.17	0.02	0.23	0.03	0.23	0.03	0.07	0.010	3.01	0.45	2.53	0.38
Emergency Engines	59.21	0.53	17.97	0.16	17.97	0.16	0.78	0.01	566.74	5.10	63.44	0.57
Cooling Towers	-	-	0.71	3.12	0.43	1.87	-	-	-	-	-	-
Fire Pump Engines	0.51	4.57E-03	0.24	2.14E-03	0.24	2.14E-03	8.74E-03	7.86E-05	4.76	0.04	4.13	0.04
Tanks	0.04	0.2	-	-	-	-	-	-	-	-	-	-
RCTOs - Combustion	1.81	7.93	3.8	16.8	3.8	16.8	0.3	1.2	3.9	17.0	2.7	11.8
Acid Scrubbers	0.09	0.39	7.7	33.6	7.7	33.6	-	-	14.6	64.2	12.0	52.8
Bench Scrubbers	1.84	8.08	3.9	17.3	3.9	17.3	-	-	-	-	-	-
Ammonia Scrubbers	0.77	3.35	0.1	0.4	0.1	0.4	-	-	-	-	-	-
Fugitive VOC	0.26	1.13	-	-	-	-	-	-	-	-	-	-
Total Emissions	**64.7**	**21.6**	**34.7**	**71.4**	**34.4**	**70.2**	**1.1**	**1.2**	**593.0**	**86.8**	**84.8**	**65.6**

4. Regulatory Applicability

4.1 Applicable Federal Standards

4.1.1 40 CFR Part 60, Subpart IIII – Stationary Compression Ignition Internal Combustion Engines

The emergency generators and fire pump engines proposed in this permit application will be manufactured after April 1, 2006, and thereby subject to requirements under 40 Code of Federal Regulations (CFR) Part 60, Subpart IIII.

TSMC proposes to purchase the emergency engines that is certified by the manufacturer to the emissions standard specified in 40 CFR 60.4202(d)(2)(ii) to meet the compliance requirement of this regulation in accordance with 40 CFR 4205(b).

TSMC will meet the emission standards specified in Table 4 to 40 CFR Part 60, Subpart IIII per §60.4205(c) to comply with this regulation.

TSMC shall demonstrate compliance with this standard by keeping a copy of the manufacturer's certification onsite for the life of each of the emergency generators. TSMC will not modify these engines in any way and will operate and maintain the emergency generators and fire pumps at the Facility in accordance with the manufacturer's specifications. Therefore, TSMC will comply with all necessary regulations under New Source Performance Standards Subpart IIII. In complying with this subpart, the emergency generators and fire pumps will satisfy the associated National Emission Standards of Hazardous Air Pollutant, Subpart ZZZZ regulations.

4.2 Applicable MCAQD Standards

4.2.1 Rule 324 – Stationary Internal Combustion Engines

Per MCAQD Rule 324 §102, the proposed emergency generator and fire pump engines are subject to Rule 324, as the rating for each engine is greater than 250 brake hp (bhp). In addition to the 40 CFR Part 60, Subpart IIII requirements incorporated into Rule 324, TSMC will use fuel that contains no more than 15 ppm sulfur by weight, alone or in combination with other fuels, as required by MCAQD Rule 324 §301.1.

4.2.2 Rule 338 – Semiconductor Manufacturing

TSMC will meet the following conditions per MCAQD Rule 338 §502.4, for the RCTOs and scrubbers the associated Operation and Maintenance (O&M) plan:

1. Maintain continuous record of the times an Emission Control System (ECS) is used to comply with this rule.
2. Maintain records of the O&M Plan's key system operating parameters with the frequency required by the Plan.
3. Maintain records of all maintenance performed according to the O&M Plan.
4. TSMC will also document the reason for scheduled maintenance that is not performed during the period designated in the O&M Plan.

The O&M plan will be submitted as supplement to this application at a later time, within the required timeframe of MCAQD.

Per MCAQD Rule 338 §502, records shall be retained for 5 years and shall be made available to the Control Officer upon request.

4.3 Performance Test and Optional Compliance Demonstration

Semiconductor fabrication facilities commonly produce very dilute emission streams, which typically result from the high ventilation airflow used in a clean room environment. Because of the very dilute pollutant concentrations, it is often difficult, sometimes impractical, to demonstrate compliance by conducting a traditional performance test. According to the MCAQD Permitting Handbook (December 2021), TSMC proposes to use the following three alternative methods to demonstrate compliance:

- Acid/Base Emissions and the Wet Scrubber Performance Test
- Procedures to Determine Requirement for O&M Plan POU / Exhaust Conditioner (EC) Units
- VOC Abatement Performance Test

4.3.1 Acid/Base Emissions and the Wet Scrubber Performance Test

For process emissions emitting through the acid scrubbers and bench scrubbers, TSMC will follow the general procedure and conduct performance tests for regulated pollutants according to standard permit conditions. After the completion of the performance tests, should the results be inadequate to demonstrate compliance, TSMC will use one of the following optional compliance demonstrations (OCDs):

- Vendor performance curve
- Mass Emissions
- Non-detect

It should be noted that POU control devices will not be subject to performance tests due to the size and configuration of relatively small piping to the unit. Traditional stack testing methods are neither feasible nor applicable to these types of devices due to the size constraint.

4.3.2 Procedures to Determine Requirement for O&M Plan for POU/EC Units

Based on the MCAQD Permitting Handbook, an O&M plan is not required for POU control devices that are interlocked (shutdown) to the appropriate process equipment. In TSMC’s cases, all local POUs are operated as follows:

- Primary failure of device => switch to secondary unit
- If secondary unit fails => interlock forces tool shutdown

Therefore, an O&M plan is not required to be submitted with the permit application.

4.3.3 VOC Abatement Performance Test

For process emissions controlled by the RCTOs, TSMC will follow the general procedure and conduct performance tests for regulated pollutants according to standard permit conditions. After the completion of the performance tests, should the results be inadequate to demonstrate compliance, TSMC will use the following OCD:

- Non-detect

It should be noted that POU control devices will not be subject to performance tests due to the size and configuration of relatively small piping to the unit. Traditional stack testing methods are neither feasible nor applicable to these types of devices due to the size constraint.

4.4 MCAQD Permit Application Requirements

MCAQD Rule 220 §301, Permit Application Processing Procedures, describes the requirements for a complete permit application. **Table 2** below illustrates how this application complies with this rule. The completed MCAQD Non-Title V Permit Application Form is contained in **Appendix A**.

Table 2 MCAQD Non-Title V Permit Application Requirements

Rule 220 Section	Description	Compliance in this application
301.1	Standard Application Form and Required Information: To apply for a permit or permit revision under this rule, applicants shall complete a permit application filed in the manner and form prescribed by the Control Officer. The Control Officer, either upon the Control Officer's own initiative or upon the request of a permit applicant, may waive the requirement that specific information or data for a particular source or category of sources be submitted in the permit application.	To be determined by MCAQD Control Officer.
301.4.b	An application for a new permit or a permit revision shall contain an assessment of the applicability of Rule 241-Minor New Source Review (NSR) of these rules. If the applicant determines that the proposed new source is subject to Rule 241 of these rules, or the proposed permit revision constitutes a minor NSR modification, then the applicant shall demonstrate compliance with all applicable requirements of Rule 241 of these rules.	Compliance with Rule 241 is in Section 4.4 of this application.
301.4.c	An application for a new permit, permit revision, or renewal shall be deemed complete unless the Control Officer notifies the applicant by certified mail within 60 days of receipt of the application that the application is not complete and specifies what additional information is necessary for the application to be deemed complete.	To be determined by MCAQD within 60 days of receipt.

4.5 MCAQD Minor NSR

MCAQD Rule 241 §300 - Standards, describes the requirements for a Minor NSR permit application. **Table 3** below illustrates how this application complies with this rule.

Table 3 MCAQD Minor NSR Requirements

Rule 241 Section	Description	Compliance in this application
102.1	APPLICABILITY: the provisions of this rule shall apply to the construction of any new or modified stationary source, when a new source has the potential to emit a regulated minor NSR pollutant in an amount equal to or greater than any of the permitting thresholds specified in Rule 100 of these rules.	The PTE emissions are below major source thresholds so Rule 241 applies.
301	PERMIT REQUIRED: An owner or operator of a source shall not begin actual construction of a new stationary source without first obtaining a permit or a proposed final permit from the Control Officer in accordance with the requirements of Rule 210 or Rule 220 of these rules.	This permit application seeks to obtain a permit before construction of source.

Rule 241 Section	Description	Compliance in this application
302, 304, 305, 306, 307	CONTROL TECHNOLOGY REQUIREMENTS: The Control Officer shall not issue a permit or permit revision to an owner or operator of a source proposing to construct a new source or make a modification unless such owner or operator implements Best Available Control Technology (BACT) or Reasonably Available Control Technology (RACT), as required by Sections 304 or 305 of this rule.	BACT analysis and determinations are provided in Section 5. BACT is triggered by PM and NOx emissions.
303, 308, 312	AMBIENT AIR QUALITY IMPACT ASSESSMENTS: An ambient air quality impact assessment, if required by Section 303 of this rule, must demonstrate that emissions from the new or modified source will not interfere with attainment or maintenance of any national ambient air quality standard. MODELING REQUIRED: All modeling required pursuant to this rule shall be conducted in accordance with 40 CFR 51, Appendix W as of July 1, 2019 (and no future amendments or additions).	Ambient air quality impact assessment is provided in the Modeling Report included in this application. Modeling is conducted in accordance with 40 CFR 51, Appendix W.
310	PUBLIC NOTICE: Public notice requirements pursuant to Rules 210 or 220 of these rules shall be required for a permit or permit revision if the emissions of any one pollutant is equal to or greater than the public notice threshold as defined in Rule 100-General Provisions and Definitions of these rules.	TSMC will comply with the public notice requirements in accordance with Rule 220
311	NOTICE TO OTHER AGENCIES: A copy of the notice required by Rule 210, Section 408 for permits or significant permit revisions or Rule 220, Section 304.4 of these rules for permits or non-minor permit revisions subject to this rule must also be sent to the Administrator through the appropriate regional office. The notice also must be sent to any other agency in the region having responsibility for implementing the procedures required under this rule.	A copy of the notice will be sent to appropriate agencies.

5. BACT and RACT Analyses

As per MCAQD Standard Operating Procedure (SOP 2020 06), for Selecting BACT and RACT, Issued June 2020:

1. BACT is defined as "an emissions limitation, based on the maximum degree of reduction for each pollutant, subject to regulation under the Clean Air Act, which would be emitted from any proposed stationary source or modification, which the Control Officer, on a case by case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combination techniques for control of such pollutant."
2. RACT is listed as emission limitations for applicable facilities per MCAPCR, Regulation III (Control of Air Contaminants). For facilities subject to MCAPR, Regulation II, RACT is the lowest emission limitation that a particular source is capable of achieving by the application of control technology that is reasonably available considering technological and economic feasibility. Such technology may have been applied to a similar, but not necessarily identical source category. RACT for a particular facility, other than a facility subject to MCAPCR Regulation III, is determined on a case-by-case basis, considering the technological feasibility and cost effectiveness of the application of the control technology to the source category.

5.1 Applicability Determination

In accordance with MCAPCR Rule 241, Section 304.1, BACT must be implemented for each pollutant emitted from every new stationary source that meets or exceeds the following PTE thresholds:

- 40 TPY of VOCs
- 40 TPY of NOx
- 40 TPY of SO_2
- 15 TPY of PM_{10}
- 100 TPY of CO
- 10 TPY of $PM_{2.5}$
- 0.3 TPY of lead

Per MCAPCR Rule 341, Section 305, RACT is required to be implemented for pollutants for which the increase in emissions is less than the BACT thresholds specified above (MCAPCR Rule 241, Section 304.1)

Based on emission calculations provided in Appendix B:

- BACT is required for PM_{10}, $PM_{2.5}$ and NOx
- RACT is required for VOC, SO_2, and CO

As per MCAQD SOP 2020 06, Section VII (Procedures), Part D, TSMC is opting to conduct an "Alternative to Top Down BACT Analysis" for the proposed sources as discussed below.

5.1.1 Hot Water Boilers

TSMC proposes to install and operate three natural gas fired hot water boilers (5.12 MMBTU/hr each). The hot water boilers are expected to operate for a maximum of 300 hr/yr per boiler and are used to supply hot water and heating to the site. Due to the limited hours of operation, boiler PTE is negligible, and installation of additional emission controls is not cost effective. TSMC proposes to use pipeline quality natural gas and good combustion practices as BACT/RACT for the proposed hot water boilers.

5.1.2 Emergency Engines

TSMC proposes to install and operate 22 emergency generators and one emergency fire pump in P1. The emergency generators will be powered by diesel fired compression ignition engines with a horsepower rating greater than 750 hp (600 [kilowatt] kW). MCAQD follows the BACT requirements from California air quality agencies, such as the South Coast Air Quality Management District (SCAQMD) and the Bay Area Air Quality Management District (BAAQMD). On September 22, 2021, GHD was informed by MCAQD that the BACT determination for NOx emissions from stationary emergency engines at the proposed TSMC facility (F041443) has been reached. The SCAQMD BACT requirement for NOx, PM_{10}, and $PM_{2.5}$ emissions from diesel fired engines of this size and service is[2]:

1. The use of United Stated Environmental Protection Agency (EPA) or California Air Resources Board (CARB) certified Tier 2 engines with NOx+ Non-methane hydrocarbon (NMHC) emission limitations of 6.4 grams (g)/kW hr (4.8 g/bhp hr) and filterable PM emission limitations of 0.20 g/kW hr (0.15 g/bhp hr). If there are no available engines that meet the above standards, then the engine must meet the family emission limits established by the manufacturer and approved by EPA.
2. Restrict operation of emergency compression ignition engines to 50 hrs/yr for maintenance and testing and a maximum of 200 hrs/yr total operation. For engines used to drive standby generators, operation beyond 50 hrs/yr for maintenance and testing is allowed only in the event of a loss of grid power or up to 30 minutes prior to a rotating outage provided that the electrical grid operator or electric utility has ordered rotating outages in the

[2] South Coast Air Quality Management District, *Best Available Control Technology (BACT) Guidelines, Part D: BACT Guidelines for Non-Major Polluting Facilities*, February 1, 2019, pp. 75 79, I.C. Engine, Stationary, Emergency, 2 1 2019 Rev. 6.

control area where the engine is located or has indicated that it expects to issue such an order at a certain time, and the engine is located in a control area that is subject to the rotating outage.

BAAQMD recently issued new BACT guidance for stationary emergency engines, which requires that new engines greater than or equal to 1,000 hp meet the “demonstrated in practice” BACT of Tier 4 emissions standards.

TSMC proposes to follow BACT as outlined by SCAQMD for the emergency generators. TSMC has proposed extremely limited use restrictions for all emergency engines; they will be limited to only 18 hours per year per engine. Due to the limited operation, total annual PTE associated with the emergency generators is minor, as shown in **Table 4** below.

Table 4 Total Annual PTE Associated with Emergency Generators

Pollutant (TPY)	VOC	PM10	PM2.5	SO2	NOx	CO
Gensets	0.53	0.16	0.16	0.01	5.10	0.57

A cost analysis was performed to determine the cost effectiveness of implementing Tier 4 engines vs. Tier 2 engines for the project. The additional capital cost associated with purchasing 22 Tier 4 engines vs. 22 Tier 2 engines is $9.25 million per a quote from Kohler Power Generation and $1.39 million in additional tax, transport, and installation fees. Also, the extra operations and maintenance costs would run approximately $1,000 per engine or $22,000 per year. This results in an annualized control cost of approximately $950,000 per year and a corresponding NOx reduction cost of approximately $207,000 per ton of emissions. Please refer to **Appendix D** for supporting calculations.

It is requested that each engine be allowed to operate up to 18 hours per year. This reduces proposed NOx emissions by more than half and increases the per ton reduction cost to nearly $400,000. The benefits of moving from Tier 2 to Tier 4 emissions controls are significantly outweighed by the cost. As such, Tier 4 generators are considered economically infeasible for this project.

In accordance with MCAPCR Regulation III, Rule 324 (Stationary Reciprocating Internal Combustion Engines), Section 301.1, RACT for SO_2, is the use of diesel fuel with a sulfur content no greater than 15 ppm by weight. There is no defined RACT limit in Rule 324 specific to VOC or CO that is applicable to emergency engines of this size/use.

TSMC will utilize ultra-low sulfur diesel fuel as required by this rule.

5.1.3 Fire Pumps

TSMC proposes to install and operate one fire pump (360 hp) per Fab. The fire pump will be powered by diesel fired compression ignition engines with an hp rating greater than 175 hp but less than 750 hp (600 kW). MCAQD allows facilities to utilize the BACT requirements of California air quality agencies. SCAQMD BACT for NOx, PM10, and PM2.5 emissions from diesel fired engines of this size and service is1[3].

1. The use of EPA or CARB certified Tier 3 engines with NOx+NMHC emission limitations of 4 g/kW hr (3.0 g/bhp hr) and filterable PM emission limitations of 0.20 g/kW hr (0.15 g/bhp hr). If, because of the averaging, banking, and trading program, there is no new engine from any manufacturer that meets the above standards, then the engine must meet the family emission limits established by the manufacturer and approved by EPA.
2. Restrict operation of emergency compression ignition engines to 50 hrs/yr for maintenance and testing and a maximum of 200 hrs/yr total operation. For engines used to drive standby generators, operation beyond 50 hrs/yr for maintenance and testing is allowed only in the event of a loss of grid power or up to 30 minutes prior to a rotating outage provided that the electrical grid operator or electric utility has ordered rotating outages in the control area where the engine is located or has indicated that it expects to issue such an order at a certain time, and the engine is located in a control area that is subject to the rotating outage.

[3] South Coast Air Quality Management District, *Best Available Control Technology (BACT) Guidelines, Part D: BACT Guidelines for Non-Major Polluting Facilities*, February 1, 2019, pp. 75 79, I.C. Engine, Stationary, Emergency, 2 1 2019 Rev. 6.

TSMC proposes to follow BACT outlined by SCAQMD for the fire pump.

In accordance with MCAPCR Regulation III, Rule 324 (Stationary Reciprocating Internal Combustion Engines), Section 301.1, RACT for SO2, is the use of diesel fuel with a sulfur content no greater than 15 ppm by weight. There is no defined RACT limit in Rule 324 specific to VOC or CO that is applicable to fire pump engines of this size/use. TSMC will utilize low sulfur diesel fuel as required by this rule.

5.1.4 Cooling Towers

TSMC proposes to install and operate 14 cooling towers in each fab to support facility operations.

San Joaquin Valley Air Pollution Control District (SJVAPCD) documents the BACT for PM_{10} control from cooling towers in SJVAPCD BACT Guideline 8.3.10 as the use of cellular type drift eliminators. No specific drift rate was stipulated by SJVAPCD.

BAAQMD determinations for BACT for cooling towers were reviewed. The BAAQMD's permit evaluation document[4] for Metcalf Energy Center, LLC, indicates that BACT for cooling towers is high efficiency mist eliminators with a maximum guaranteed drift rate of 0.0005 percent.

Further review of EPAs RACT/BACT/Lowest Achievable Emission Rate Clearinghouse database shows BACT for cooling towers is high efficiency drift eliminators with drift rate of 0.0005 percent.

Based on Maricopa County's streamlined Alternative to Top Down BACT Analysis, BACT for cooling towers is a design capable of achieving a drift rate of 0.0005 percent.

TSMC will install and operate cooling towers capable of achieving a drift rate of 0.0005 percent to meet BACT requirements.

5.1.5 Semiconductor Manufacturing (Photolithography and Etching)

5.1.5.1 VOC Emissions

Organic emissions from etching and photolithography are captured by the fab ventilation systems and directed to the RCTO for thermal destruction resulting in products of combustion (VOC, NOx, CO, SO_2, PM_{10}, and $PM_{2.5}$). TSMC proposes to install and operate six RCTO units per fab to capture and destroy VOC emissions.

RACT for VOC emission shall be the installation, operation, and maintenance of ECS that meets BAAQMD standards for BACT (BACT guidelines for Semiconductor Fabrication Photoresist operations):

The RCTO shall:

1. Achieve at least 98.5 percent VOC control when the inlet VOC concentration >2,000 ppm by volume (ppmv) measured as methane
2. Achieve at least 97 percent VOC control when the inlet VOC concentration >200 to <2,000 ppmv measured as methane
3. Achieve at least 90 percent VOC control when the inlet VOC concentration <200 ppmv measured as methane
4. Achieve an outlet concentration of less than or equal to 10 ppmv measured as methane

TSMC proposes to follow BACT outlined by BAAQMD (as detailed above) as BACT for RCTOs proposed at the Site.

5.1.5.2 Acid and Ammonia Emissions

Acid and ammonia emissions from the etching areas include NH_3, HF, HNO_3, HCl, H_2SO_4, phosphoric acid, Cl_2, and AsH_3. These vent streams are collected and routed to acid, bench, and ammonia scrubbers, as appropriate, for control of emissions prior to release to the atmosphere.

[4] Permit Evaluation and Statement of Basis for the Major Facility Review Permit (for Metcalf Energy Center, LLC) April 2011

TSMC proposes install and operate 18 acid scrubbers, 9 bench scrubbers, and 6 ammonia scrubbers for each fab to capture and control acid emissions from these processes.

There is no required BACT determination for scrubbers since acids, bases, and HAPs are not specifically subject to BACT under the Maricopa County rules as they are not criteria pollutants (MCAPCR Rule 241, Section 304.1).

Based on Maricopa County Environmental Services Department, Optional Compliance Demonstrations Procedure, "A Guideline for Semiconductor Industry/Part I, Acid/Base Emissions & Wet Scrubber Performance Test (May 4, 2001)", each wet scrubber system will have removal efficiency for the acid gas constituent of at least 90 percent by weight or less than a 1 ppmv outlet concentration for that pollutant.

The proposed scrubbers at the facility are expected to attain removal efficiencies equal to or greater than 90 percent for acid and caustic exhausts from the facility.

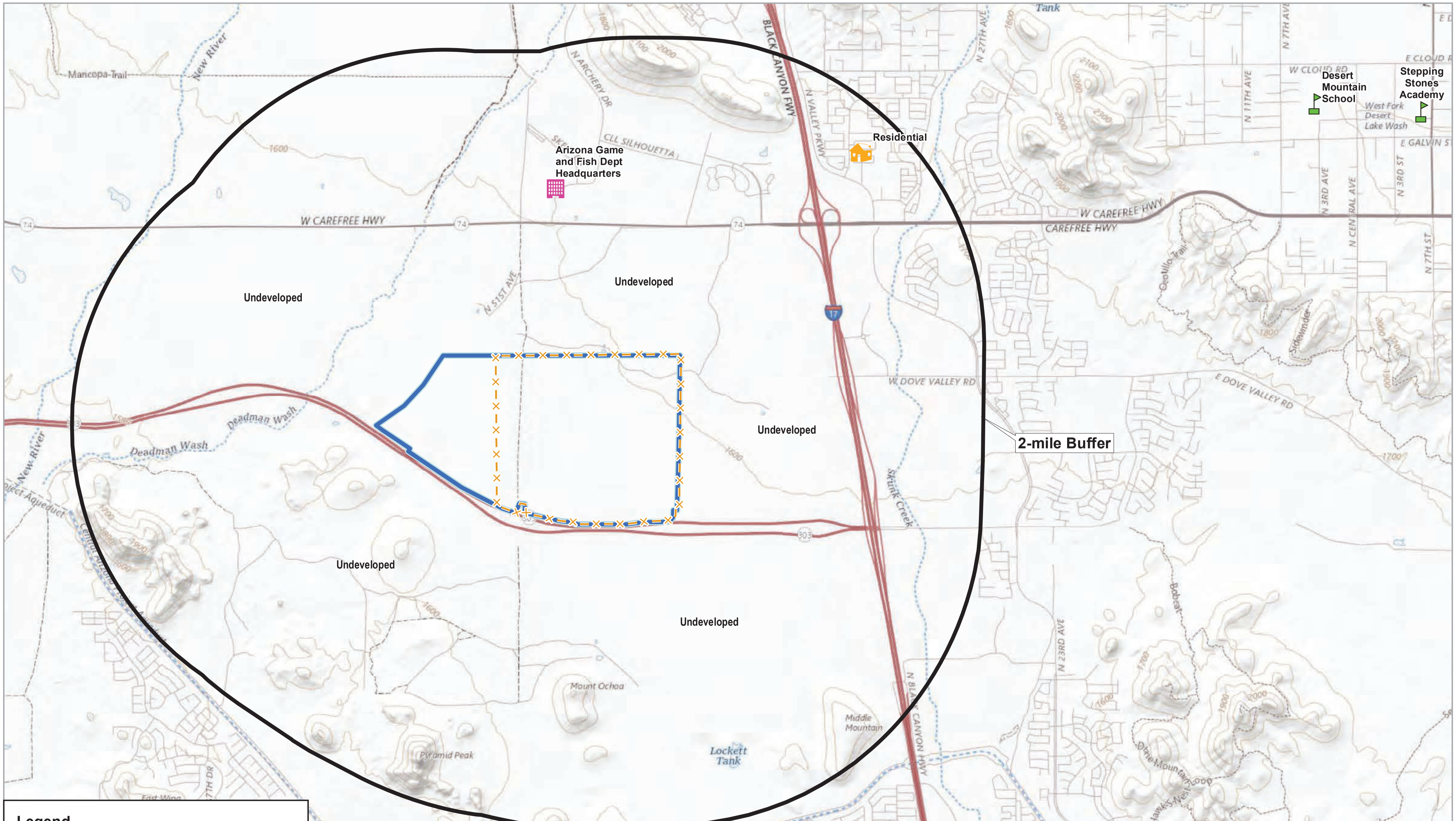
6. Dust Control Plan

A dust control plan has been filed for the construction phase of the project. Once constructed, there will be no "routine" dust generating operations with a disturbed surface area that equals or exceeds 0.10 acres (4,356 square feet). All undeveloped areas will be graded and stabilized until development is necessary. The roads and parking lots on Site will be paved and landscaping will be added to exposed areas. Therefore, a Dust Control Plan is not included with this application.

7. O&M Plans

The RCTOs and Scrubbers are emission controls subject to this requirement. O&M plans for this equipment is being developed and will be provided to MCAQD for approval shortly after permit issuance.

Figures



Legend

Residential	Approximate Fence Line
Office	Site Boundary
School	2-mile Buffer

NOTE:

NO SCHOOLS WERE IDENTIFIED WITHIN 2 MILES OF THE SITE BOUNDARY.

Paper Size ANSI B

0 0.2 0.4 0.6

Miles

N

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Arizona Central FIPS 0202 Feet

GHD

TSMC PHOENIX PROJECT
PHOENIX, ARIZONA

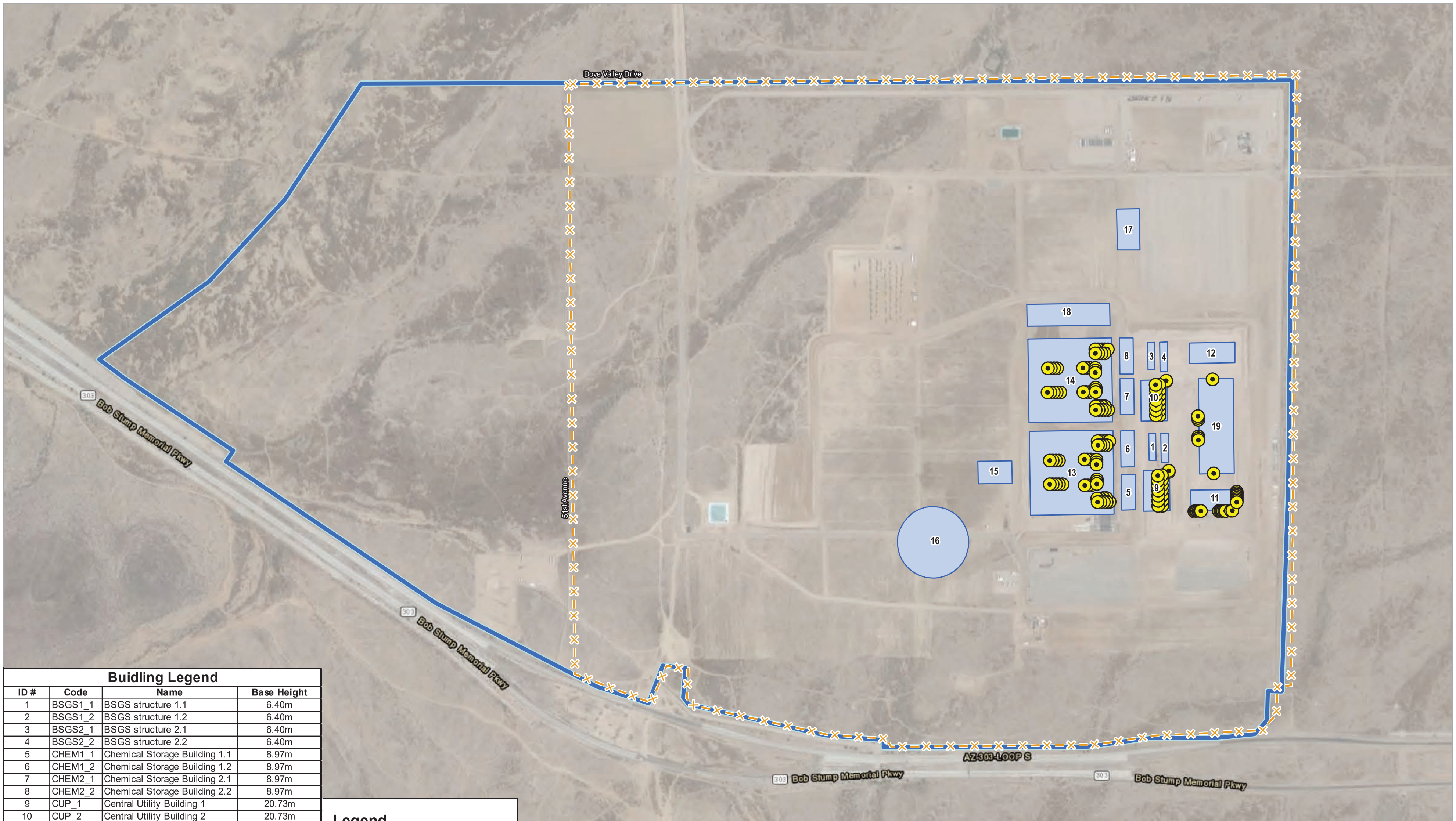
SITE PLAN

Project No. 11218799-03
Report No. NSR
Date 5/25/2021

FIGURE 1

G:\562\11218799\GIS\Maps\Deliverables\NSR\11218799-03(NSR)GIS-DL001_Site Map.mxd
Print date: 25 May 2021 - 12:20

Data source: USGS 7.5-minute Quadrangle Maps. Created by: cgerdts



Buidling Legend

ID #	Code	Name	Base Height
1	BSGS1_1	BSGS structure 1.1	6.40m
2	BSGS1_2	BSGS structure 1.2	6.40m
3	BSGS2_1	BSGS structure 2.1	6.40m
4	BSGS2_2	BSGS structure 2.2	6.40m
5	CHEM1_1	Chemical Storage Building 1.1	8.97m
6	CHEM1_2	Chemical Storage Building 1.2	8.97m
7	CHEM2_1	Chemical Storage Building 2.1	8.97m
8	CHEM2_2	Chemical Storage Building 2.2	8.97m
9	CUP_1	Central Utility Building 1	20.73m
10	CUP_2	Central Utility Building 2	20.73m
11	ELE_1	Electrical Building 1	11.23m
12	ELE_2	Electrical Building 2	11.23m
13	FAB_1	Fabrication Building 1	30.25m
14	FAB_2	Fabrication Building 2	30.25m
15	GOWN	GOWN	29.41m
16	OFFBLD	Office Building	25.30m
17	VEND	Vendor Building	10.06m
18	WH	Warehouse	23.93m
19	WWT	Wastewater Treatment Unit	15.27m

Legend

- Point Source
- Approximate Fence Line
- Site Boundary
- Buildings

Notes:
m - Values denote building heights in meters.
* see Figure 2B for Point source identification information.

Paper Size ANSI B
0 480 960
Feet
Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

N

GHD

TSCM PHOENIX PROJECT
PHOENIX, ARIZONA

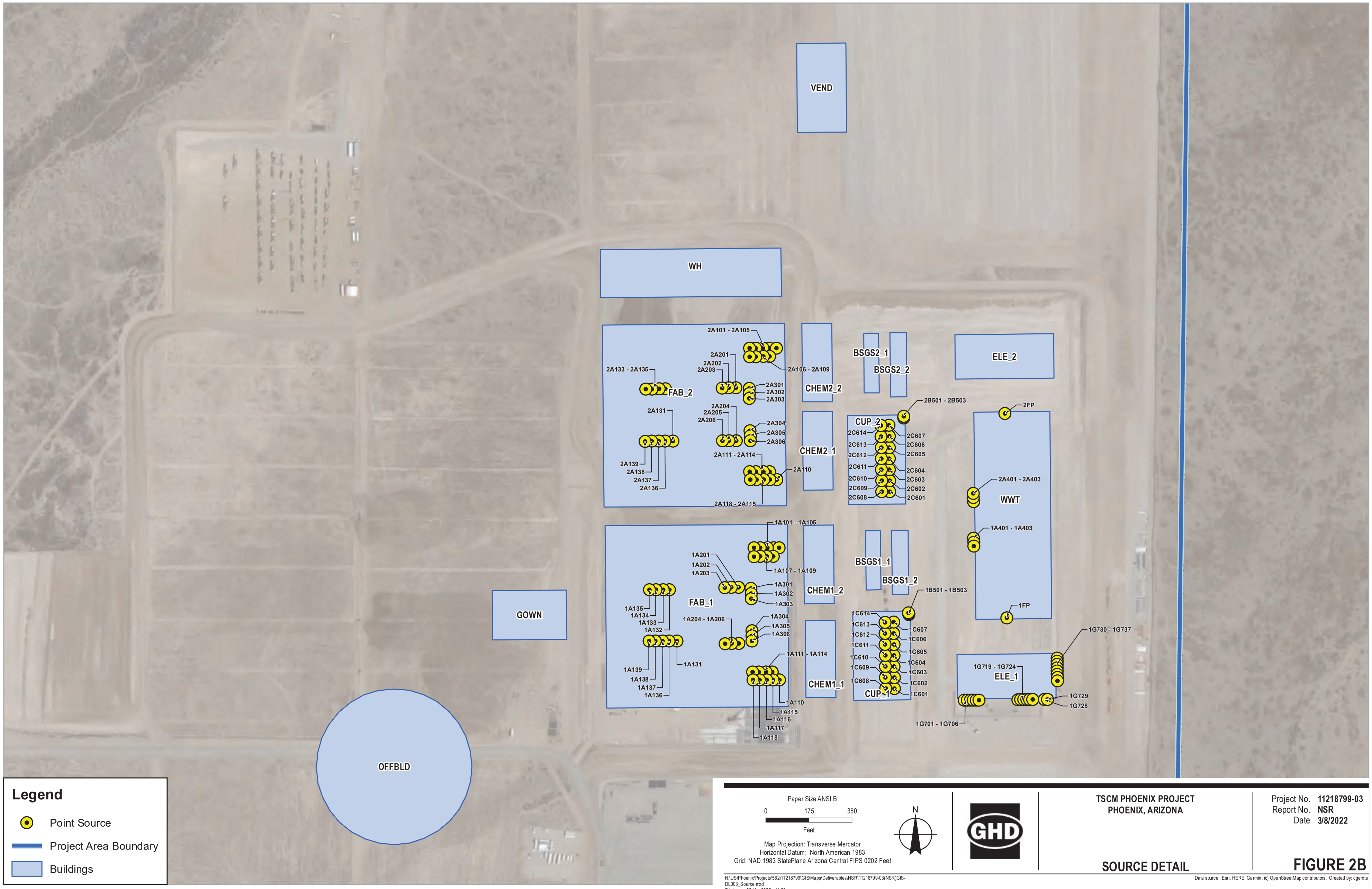
FACILITY PLOT PLAN

Project No. 11218799-03
Report No. NSR
Date 3/8/2022

FIGURE 2A

C:\Users\cgerdts\OneDrive - GHD\Desktop\11218799-03(NSR)GIS-DL002_Fac.mxd
Print date: 08 Mar 2022 - 11:58

Data source: Esri, HERE, Garmin, (c) OpenStreetMap contributors. Created by: cgerdts



Paper Size ANSI B

0 175 350

Feet

N

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Arizona Central FIPS 0202 Feet

GHD

TSCM PHOENIX PROJECT
PHOENIX, ARIZONA

SOURCE DETAIL

Project No. 11218799-03
Report No. NSR
Date 3/8/2022

FIGURE 2B

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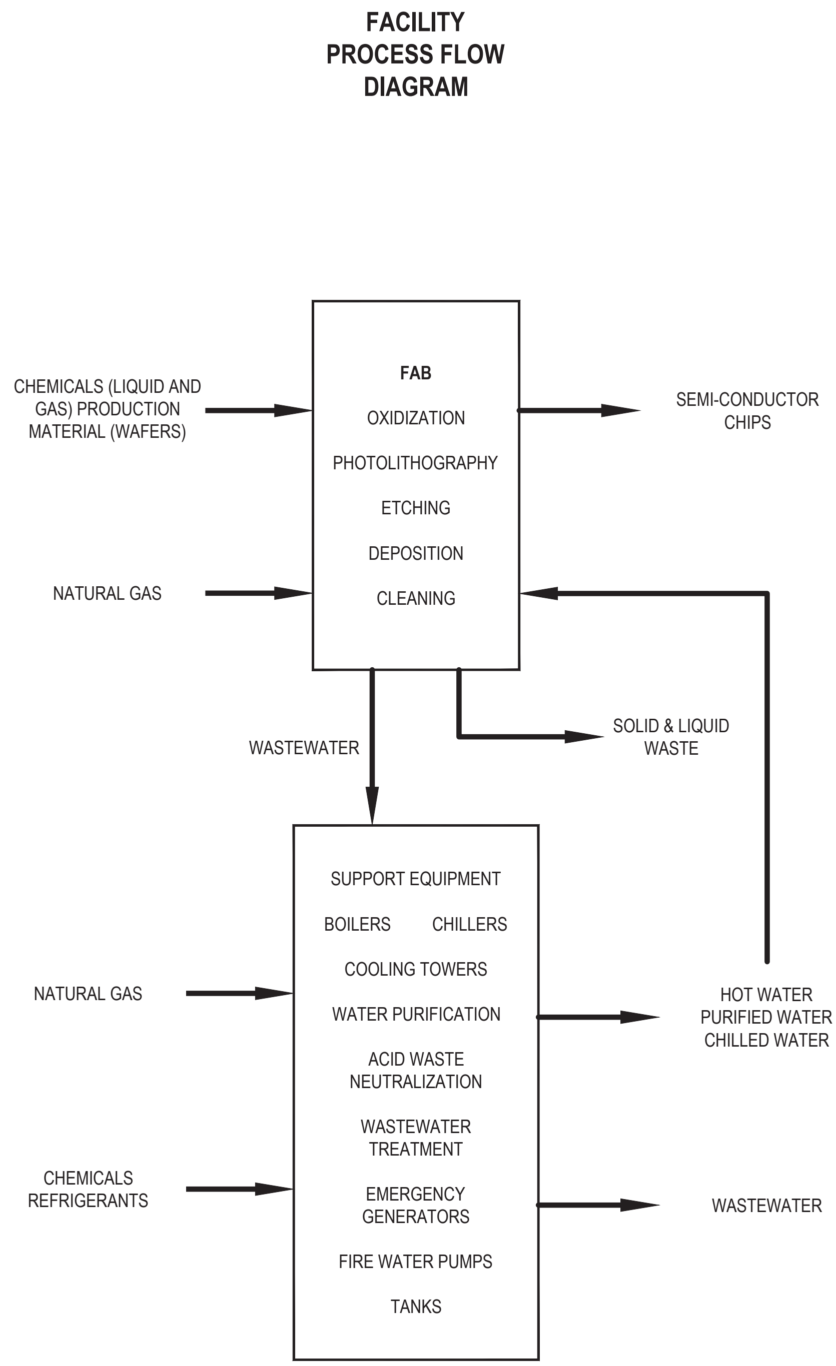


NOT TO SCALE

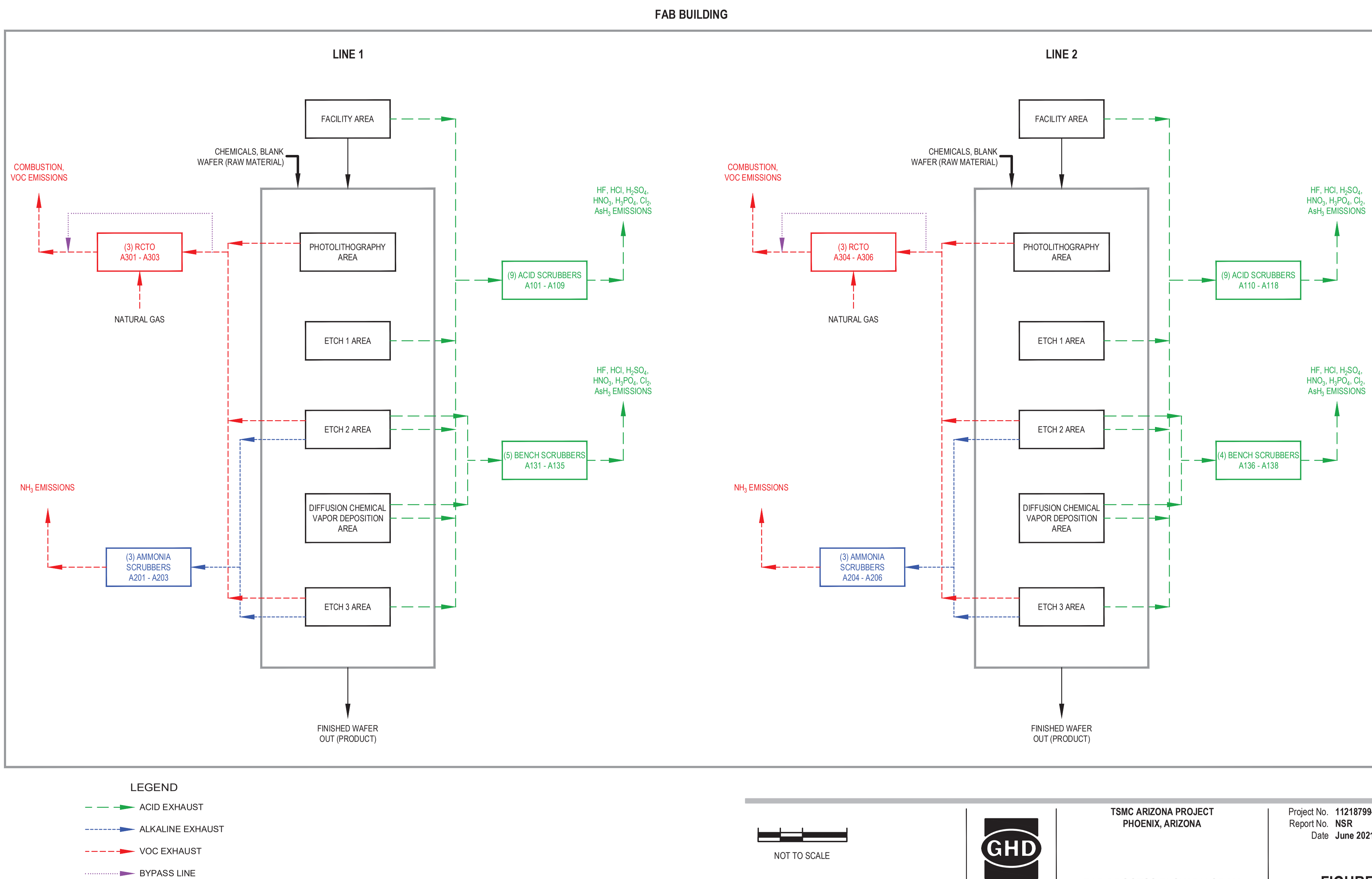
TSMC ARIZONA PROJECT
PHOENIX, ARIZONA

Project No. **11218799-03**
Report No. **NSR**
Date **June 2021**

FACILITY PROCESS FLOW DIAGRAM

FIGURE 3A

Filename: \\ghdnet\ghd\US\Phoenix\Projects\562\11218799\Digital_Design\ACAD 2017\Figures\NSR\11218799-03(NSR)GN-DL001.dwg
Plot Date: 09 June 2021 8:20 PM



NOT TO SCALE

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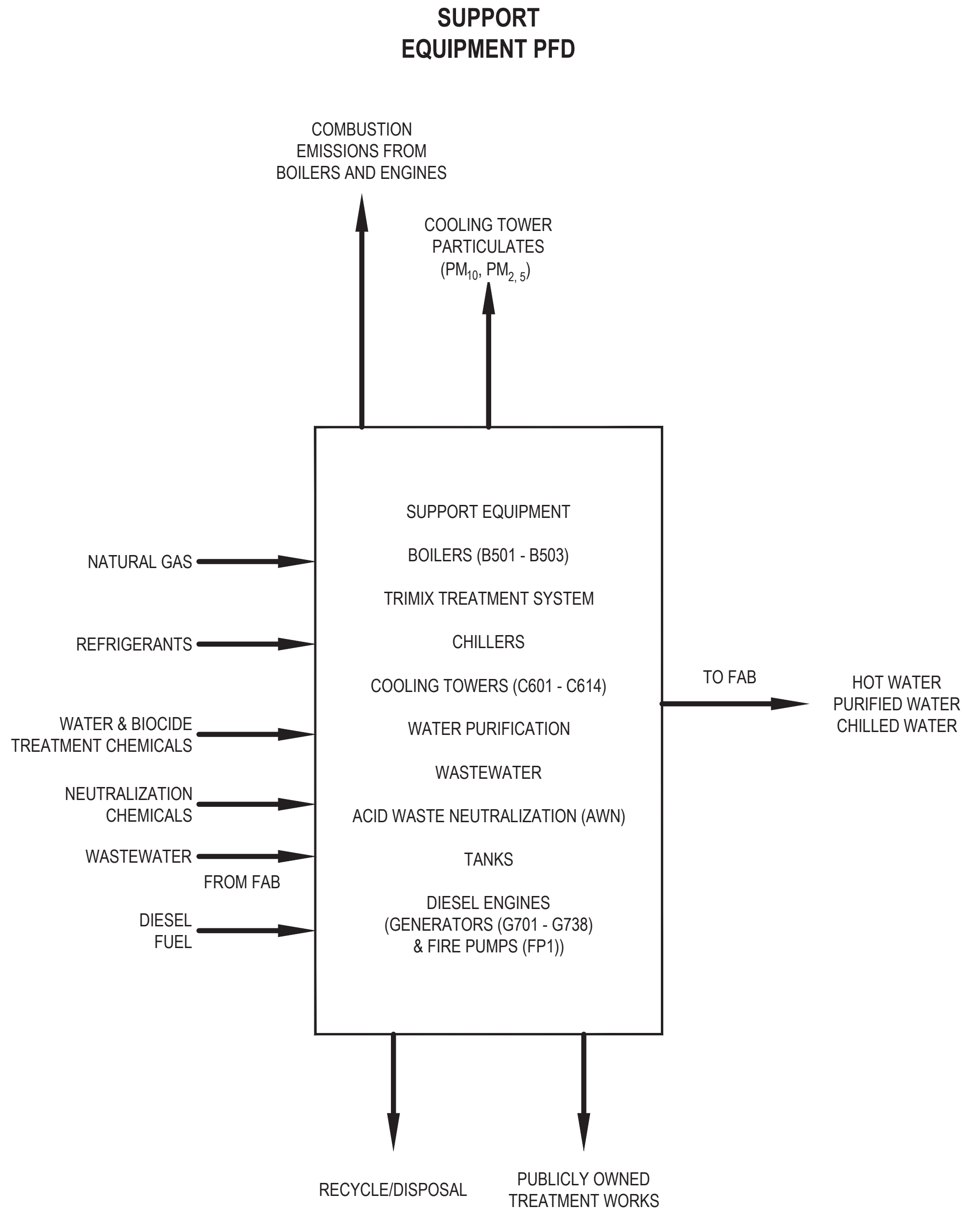
TSMC ARIZONA PROJECT
PHOENIX, ARIZONA

Project No. 11218799-03
Report No. NSR
Date June 2021

FAB PROCESS FLOW DIAGRAM

FIGURE 3B

Filename: \\ghdnet\ghd\US\Phoenix\Projects\562\11218799\Digital_Design\ACAD 2017\Figures\NSR\11218799-03(NSR)GN-DL001.dwg
Plot Date: 09 June 2021 8:19 PM



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TSMC ARIZONA PROJECT
PHOENIX, ARIZONA

Project No. **11218799-03**
Report No. **NSR**
Date **June 2021**

SUPPORT EQUIPMENT
PROCESS FLOW DIAGRAM

FIGURE 3C

Filename: \\ghdnet\ghd\US\Phoenix\Projects\562\11218799\Digital_Design\ACAD 2017\Figures\NSR\11218799-03(NSR)GN-DL001.dwg
Plot Date: 09 June 2021 8:21 PM

Appendices

Appendix A

Application for Non-Title V Air Quality Permit

Maricopa County Air Quality Department
3800 N. Central Ave, Suite 1400, Phoenix, AZ 85012
Phone: 602.506.6010 Fax: 602.372.0587
AQPermits@maricopa.gov

APPLICATION FOR A NON-TITLE V AIR QUALITY PERMIT

Applications should be submitted through the AQD Online Portal. Please see our instructions for creating an account. Additional information is available on the AQD Online Portal (IMPACT) page.

Is this the right application for your needs?

Use this form to apply for a Non-Title V air quality permit. Do not use this form to renew a Non-Title V permit, amend prior applications, add additional pieces of equipment to an existing permitted facility, transfer a current air quality permit from one person to another, or apply for a Title V air quality permit. Separate application forms are available for these purposes.

Your facility may be eligible for an Authority to Operate (ATO) under a General Permit. The General Permit program offers an alternative to regular permits and simplifies the process for authorizing operation. To see if your facility qualifies for an ATO under a General Permit or for more information, please visit our General Permit Information page or call (602) 506-6010. Do not use this application to apply for an ATO under a General Permit.

How to complete this application

Complete the application by typing or printing legibly. Complete items 1-18 and any additional sections that are applicable to your facility. Submit manufacturers' drawings and specifications when required by the permit application. If necessary, attach additional sheets to the application to provide all required information. Submit the application by completing the attached original forms. **All applicants must complete items 1 through 18 or the application will be deemed incomplete.** If supporting calculations to verify the facility's emissions are not included for Section Z of the application, all emission estimates will be performed by an MCAQD permit engineer. The applicant will be charged for this activity as a billable permit action at the current hourly permit processing rate.

Public Records

The submitted application and documents become the property of the Maricopa County Air Quality Department (hereafter referred to as the Department) and will not be returned. All submitted documents will be available to the public unless a notice of confidentiality has been submitted by the applicant in accordance with Arizona Revised Statutes (ARS) §49-487 and accepted by the Department in accordance with Maricopa County Air Pollution Control Regulations, Rules 100 and 200. If confidentiality is claimed pursuant to ARS §49-487, a fully completed application with confidential information clearly identified along with a separate copy of the application for public review without the confidential information and a written justification for the confidentiality claimed must be submitted.

Fees

A **$200.00** application fee is due at the time of submittal. Before the permit is issued, the applicant will be billed for all permit processing time required for a billable permit action. If the application is submitted as a result of receiving a notice of violation (NOV), an additional **$100.00** late fee must accompany the application. Before the permit is issued, the Permittee will be billed for all permit processing time required for a billable permit action at a rate of $158.80 per hour, adjusted annually under Department Rule 280 (Fees), §304. An annual administrative fee will also be charged per Rule 280, §302.2. For questions regarding billing, call (602) 506-6010.

Assistance and Resources

If you would like to schedule a pre-application meeting with permitting staff, please contact the Non-Title V Permitting Supervisor at 602-506-7248. If you need assistance completing the application package, please contact our Business Assistance Office at 602-506-5102.

Maricopa County Air Pollution Control Regulations are available at the above address or may be viewed and/or downloaded from the Adopted Rules page of our web site.

Notice of Regulatory Reform

In accordance with A.R.S. §11-1604:
A. A county shall not base a licensing decision in whole or in part on a licensing requirement or condition that is not specifically authorized by statute, rule, ordinance or delegation agreement. A general grant of authority does not constitute a basis for imposing a licensing requirement or condition unless the authority specifically authorizes the requirement or condition.
B. Unless specifically authorized, a county shall avoid duplication of other laws that do not enhance regulatory clarity and shall avoid dual permitting to the maximum extent practicable.
C. This section does not prohibit county flexibility to issue licenses or adopt ordinances or codes.
D. A county shall not request or initiate discussions with a person about waiving that person's rights.
E. This section may be enforced in a private civil action and relief may be awarded against a county. The court may award reasonable attorney fees, damages and all fees associated with the license application to a party that prevails in an action against a county for a violation of this section.
F. A county employee may not intentionally or knowingly violate this section. A violation of this section is cause for disciplinary action or dismissal pursuant to the county's adopted personnel policy.
G. This section does not abrogate the immunity provided by section 12-820.01 or 12-820.02.

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For Office Use Only	Date Received:	Log Number:

APPLICATION FOR A NON-TITLE V AIR QUALITY PERMIT

As required by A.R.S. §49-480 and Maricopa County Air Pollution Control Regulations, Rule 200

ALL APPLICANTS MUST COMPLETE THE ENTIRE APPLICATION

Important: Please note that email will be our primary means for routine communication with you, unless you do not have an email account. Please be sure that your email address is entered correctly.

1. Business Name (as filed with the Arizona Corporation Commission): TSMC Arizona Corporation

2. Is this a portable source? ☐ Yes (If yes, provide the current site info in items 2a, 2b & 3) ☒ No (Complete items 2a, 2b & 3)

2a. Address of site: 32200 N 43rd Street

City: Phoenix State: AZ Zip Code: 85083

2b. Parcel # 204-09-001 Look up using the Maricopa County Assessor parcel lookup search

3. Contact at Site: Robert Sandoval Phone: 602-558-5670 Email: sandoval@tsmc.com

4. Type of Ownership: ☒ Corporation ☐ Sole Owner ☐ Partnership ☐ Government ☐ Other - Specify:

5. Name of Ownership or Legal Entity: TSMC Arizona Corporation

Address: 2510 W Dunlap Avenue Suite 600

City: Phoenix State: AZ Zip Code: 85021

6. Ownership Contact: Brian Harrison 6a. Phone: 602-567-1688 6b. Fax:

7. Send All Correspondence Including Invoice And Permit To: Company Name: TSMC Arizona Corporation Attn: Brian Harrison

Address: 2510 W Dunlap Avenue Suite 600

City: Phoenix State: AZ Zip Code: 85021

8. SIC (Standard Industrial Classification) or NAICS (North American Industry Classification) Code(s): 3674

9. Brief Description of Business or Process at Site: semiconductor manufacturing

10. Operating Schedule Hours Per Day: 24 Days Per Week: 7 Weeks Per Year: 52

11. Projected Start-Up Date (New Facilities): January 2024

12. The authorized contact person regarding this application is:

Name: Xinze Peng Title: Air Compliance Engineer

Company: GHD Services Inc. Email: xinze.peng@ghd.com

Phone: +1 949 585-5246 Fax:

13. I certify that I am familiar with the operations and equipment represented on this application, and the corresponding attachments, and the information provided herein is true and complete to the best of my knowledge.

Signature of owner or responsible official of business: Date:

Type or Print Name and Title: Sr. Vice President

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14. SITE DIAGRAM: Attach a site layout showing distances to property lines, equipment, controls, ducts, stacks and emission points. Also show storage areas for fuels, raw materials, chemicals, finished products, waste materials, etc. Attach additional sheets if necessary.

Please see figures 1, 2A, and 2B of the Application Report.

N
W E
S

15. PROCESS FLOW DIAGRAM: Attach a flow diagram which indicates how processes/activities are conducted at the facility. Begin with raw materials and show each step in the production process. Indicate emissions control devices and all emission points. Attach additional sheets if necessary.
Please see figures 3A, 3B, and 3C of the Application Report.

16. OPERATION & MAINTENANCE (O&M) PLAN(S): O&M Plans are required for any process that vents emissions through a control device and includes both add-on control type equipment or processes whose controls are integrated into the design of the process equipment. Indicate if your facility has such control devices. (The list below is not an all-inclusive list of control devices.)

Equipment	No	Yes	How Many?
Baghouse	(X)	( )	
Dust Collector/Filter	(X)	( )	
Incineration System (e.g., catalytic or thermal oxidizer, afterburner, boiler, process heater, flare) Specify: RCTOs	( )	(X)	12
Adsorption Unit (e.g., resin, carbon filter, other) Specify:	( )	( )	
Absorption Unit (e.g., scrubber) Specify: scrubbers	( )	(X)	72

If you checked YES to any of these boxes, submit a separate O&M Plan for each control device. The O&M Plan should specify key system operating parameters and limits, maintenance procedures and schedules, and documentation methods necessary to demonstrate proper operation and maintenance for the control device. For new equipment or processes, provide an educated estimate of the ranges of any parameters to be monitored. These ranges should be supported with manufacturer's test data or other manufacturer's data from engineering calculations and/or experience with the equipment. In addition, O&M Plans should be prepared in accordance with Maricopa County Air Quality Department O&M Plan Guidelines. These guidelines can be obtained on the Forms and Applications web page, on the Operations & Maintenance tab. Multiple control devices can be combined in a single O&M Plan providing they are identical in type, capacity, and use. A separate O&M Plan is required for each device that is unique in type, capacity, or use.

17. DUST CONTROL PLAN: Facilities that conduct "routine" dust-generating operations with a disturbed surface area that equals or exceeds 0.10 acre (4,356 square feet) are required to submit a Dust Control Plan. "Routine" is defined as any dust-generating operation which occurs more than 4 times per year or lasts 30 cumulative days or more per year. Dust-generating operations involve any activity capable of generating fugitive dust including, but not limited to, land clearing, earthmoving, weed abatement by discing or blading, excavating, vehicle use and movement on unpaved parking lots, the operation of any outdoor equipment, or bulk material handling, storing and/or transporting. Bulk materials include, but are not limited to, non-metallic minerals, soil, demolition debris, cotton, trash, saw dust, feed, grain, fertilizers, fluff from shredders, dry concrete, or any other material that is capable of producing fugitive dust.

A. Indicate if your facility has or conducts any of the following:

	No	Yes
Unpaved parking lots	(X)	( )
Unpaved staging/material storage areas	(X)	( )
Unpaved haul/access roads	(X)	( )
Open storage piles	(X)	( )
Bulk material hauling, storing and/or transporting	(X)	( )
Weed abatement by discing or blading	(X)	( )
Blasting operations	( )	( )
Other routine dust-generating activity	(X)	( )

B. How many acres of disturbed surface area does the facility have? 700

C. If you checked YES to any of the items in Question 17(A) and have more than 0.10 acre (4,356 square feet) of disturbed surface area, you must submit a Dust Control Plan with this application. The appropriate dust control plan forms are available on our website.

Rule 316 Dust Control Plan (Non-metallic mineral processing facilities subject to Rule 316)

Rule 310 Dust Control Plan (All other facilities not subject to Rule 316)

18. APPLICABLE SECTIONS. Review each section of the application and mark below the sections that apply to this facility. Submit only those sections that apply to this facility. Note that Section Z must be completed by all applicants.

- ☑ A Fuel Burning Equipment
- ☑ B Internal Combustion Engines & Turbines
- ☑ C Petroleum Storage Tanks
- ☐ D Water & Soil Remediation
- ☐ E Surface Coating
- ☐ F Woodworking Operations
- ☐ G Solvent Cleaning
- ☐ H Metal Finishing Processes
- ☐ I Dry Cleaning Equipment
- ☐ J Graphic Arts
- ☐ K-1 Concrete Batch Plants
- ☐ K-2 Non-Metallic Mineral Mining and/or Processing
- ☐ K-3 Asphalt Production
- ☐ K-4 Non-Metallic Mineral Storage and Processing (continued)
- ☑ L Abrasive Blasting
- ☑ X Emissions Sources for Hazardous Air Pollutants
- ☐ Y Other Sources
- ☑ Z Air Pollution Emissions

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SECTION A. EXTERNAL FUEL BURNING EQUIPMENT

Your facility may not require a Non-Title V permit if the facility is eligible to obtain an authority to operate (ATO) under a general permit. (Refer to the Fuel Burning General Permit Application to determine eligibility)

Complete this section if you burn natural gas, propane, butane, waste derived fuel, fuel oils, used oil, diesel, kerosene, gasoline, coal, charcoal, wood, or any other fossil fuel. Provide complete specifications for non-commercial and special fuels. Describe equipment such as boilers, furnaces, space heaters, water heaters, dryers, pool and spa heaters, kilns, ovens, burners, stoves, steam cleaners, hot water pressure washers, etc, with an input rating of 300,000 Btu/hr or more. Do not include vehicles, forklifts, lawn mowers, weed eaters and hand-held equipment operating on fossil fuels. Use Section Y to describe items such as asphalt kettles, incinerators, crematories, and emission control devices burning fuel. List internal combustion engines and gas turbines in Section B.

Fuel Type	Make / Model / Identification #	Date of Installation	Number of Hours in Operation Annually	Equipment Rating (Btu/hr)*
natural gas	Danstoker / GLOBAL No. 3 Boilers (6)	TBD	300	5,120,000
natural gas	RCTO - D-Tech Group (12)	TBD	8760	3,458,000

*Equipment rating is the heat input capacity for each external combustion unit (boiler, heater, etc.) in Btu/hr.

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SECTION B. INTERNAL COMBUSTION ENGINES & TURBINES

Your facility may not require a Non-Title V permit if the facility is eligible to obtain an authority to operate (ATO) under a general permit. (Refer to the Emergency Internal Combustion Engine General Permit Application to determine eligibility.)

This section applies to stationary fuel-fired equipment such as generators, fire pumps, air conditioning compressor engines, co-generation units, etc. Do not include vehicles, forklifts, lawnmowers, and hand-held equipment.

Portable engines that remain in one location for no more than 12-consecutive months are exempt from permitting requirements. If you believe your engine may qualify, please fill out a Non-Road Engine Determination Form.

Submit the manufacturer's specification sheets for each engine listed, specifying the engine make, model, manufactured date, emission data, and maximum engine power rating.

Fuel Type	Make / Model / Identification # *	Emergency or Non-emergency	Date Manufactured	Number of Hours in Operation Annually	Engine Rating (bhp) **	Genset Output (hp, kW)
Diesel	KOHLER / Mitsubishi - S16R R2PTAW2-1 Engines (22)	Emergency	TBD	18	2,293	2,180
Diesel	CLARKE / DQ6H-UFAA88 - Fire Pump Engine (2)	Emergency	TBD	18	360	268

* Describe air pollution abatement/controls, if any.

** Enter the brake horsepower (bhp) rating of the engine. This information may be found on the engine faceplate or obtained from the engine manufacturer. The engine bhp rating should not be confused with the output power rating of the generator.

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SECTION C. PETROLEUM STORAGE TANKS

Your facility may not require a Non-Title V permit if the facility is eligible to obtain an authority to operate (ATO) under a general permit. (Refer to the Gasoline Dispensing General Permit Application to determine eligibility.)

This section applies to storage of gasoline and other organic liquids which have a true vapor pressure of 0.5 psia or greater under actual loading conditions. Petroleum terminals and bulk plants must use Section Y instead of this section. Also use Section Y to list storage tanks containing liquids with a vapor pressure less than 0.5 psia, non-petroleum organic liquids, caustic solutions, acids, etc.

1. Describe Tanks and Products Stored

Product Stored	Capacity of Each Tank (gallons)	Above Ground or Underground?	Date of Installation	Submerged Fill Pipe? (Yes/No)*	Stage I Vapor Recovery System? (Yes/No)**
Diesel Fuel	27,738	Aboveground	TBD	Yes	No

*A fill pipe is considered submerged if the discharge opening is completely submerged when the liquid level is six inches above the tank bottom. All gasoline storage tanks with a capacity of more than 250 gallons must be equipped with a submerged fill pipe.

**A Stage I Vapor Recovery System returns displaced vapors from the storage tank into the tank truck from where the liquid is loaded.

2. Estimate total annual throughput for each product stored in these tanks.

Product: Diesel Fuel Gallons/year: 86,214

Product: ______ Gallons/year: ______

Product: ______ Gallons/year: ______

Product: ______ Gallons/year: ______

Product: ______ Gallons/year: ______

Product: ______ Gallons/year: ______

Product: ______ Gallons/year: ______

3. Is any gasoline stored at this facility resold? ☐ Yes ☒ No

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SECTION G. SOLVENT CLEANING

This section applies to solvent operations such as, but not limited to, dip tanks for parts cleaning, wipe cleaning, vapor degreasers, and in-line cleaning machines.

1. List all solvent cleaning devices and cleaning solvents used. Provide the manufacturer's specifications to each piece of equipment. Submit a Safety Data Sheet (SDS) for each material listed and number it to correspond to the table below. Each SDS must state the name, manufacturer, VOC content, hazardous component concentrations, density/specific gravity, and vapor pressure of the material. Provide any additional equipment information, usage rate and/or operating parameters for solvent cleaning devices utilizing any of the following halogenated solvents: **methylene chloride, perchloroethylene, trichloroethylene, 1, 1, 1–trichloroethane, carbon tetrachloride, and/or chloroform**.

Equipment Type* (See list below)	Make/Model/Identification #	Internal Volume (gallons)	Solvent Interface Area (sq ft)	Solvent Used	SDS #	Annual Solvent Usage (gallons)	Disposal Quantity (gallons)	Exhausted to Control?

*Solvent cleaning equipment types:

A. Non-vapor batch cleaning machine with remote reservoir
B. Non-vapor batch cleaning machine with internal reservoir
C. Non-vapor in-line cleaning machine
D. Special non-vapor machine using blasting, misting or high pressure flushings
E. Non-vapor batch cleaning machine using solvent that is heated, agitated, or has a VOC vapor pressure exceeding 1 mm Hg at 68° F
F. Batch loaded vapor cleaning machine
G. In-line vapor cleaning machine
H. Other (specify) : ____________________

2. Describe how the cleaning solvents are disposed. Disposal of solvent by evaporation is not permitted. If waste solvent is redistilled on site, provide information on the still, including manufacturer's specifications.

3. Describe air pollution control devices. Submit an Operation and Maintenance (O&M) Plan for each control device listed and provide documentation of control efficiency (e.g., manufacturer's data or actual test data).

Type of Control Device	Make/Model/Identification #	Maximum Design Air Flow Rate (CFM)	Control Efficiency (% Weight)

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SECTION L. ABRASIVE BLASTING

This section is intended for all processes, equipment, and related emission controls associated with abrasive blasting operations (e.g. surface preparation using an abrasive media propelled by pressurized liquid, compressed air, or other method against a substrate's surface). Your facility may not require a Non-Title V permit if the facility is eligible to obtain an authority to operate (ATO) under a General Permit for Surface Coating and Abrasive Blasting.

1. Is abrasive blasting performed daily or is it part of the facility's primary work activities? ☒ Yes ☐ No

2. Describe substrate being blasted (e.g., metal, stone, concrete, etc.): metal parts

3. Describe substrate being removed (e.g., non-leaded paint, leaded paint, rust, etc.): residual chemical

If leaded paint was indicated on item 3, indicate the percent concentration of lead in the paint: ______ %

4. Blast Media: Indicate the type and quantity of each blast media used and submit a safety data sheet (SDS).

Type of Blast Media	Maximum Annual Usage (tons/yr)	Are Blast Media CARB Certified? (Yes/No) *	How many times are Blast Media reclaimed for reuse?
soda lime glass	0.55	No	

*Certified by California Air Resources Board (CARB) pursuant to Section 92530 of Subchapter 6, Title 17, California Code of Regulations. See the CARB list of certified abrasives.

5. List all abrasive blasting equipment.

Equipment Type (see list below)**	Make / Model / Identification #	Blasting Method (see list below)***	Internal Volume (ft^3)	Confined or Unconfined?	Equipment Exhaust Vents
B	NORMFINISH DI-12 P	C	23	Confined	to SEX scrubber

**Equipment Types: A. Booth B. Enclosure C. Room D. Cabinet E. Other (Specify): ______

***Blasting Methods: A. Hydroblasting B. Wet Abrasive Blasting C. Dry Abrasive Blasting D. Vacuum Blasting

E. Other (Specify): ______

6. Describe air pollution control devices. Submit an Operation and Maintenance (O&M) Plan for each control device listed and provide written documentation of control efficiency (e.g., manufacturer's data or actual test data).

Type of Control Device	Make / Model / Identification #	Maximum Design Air Flow Rate (CFM)	Control Efficiency (% Weight)	Control Exhaust Vents: (indoors / outdoors)
scrubber				

SECTION X. EMISSIONS SOURCES FOR HAZARDOUS AIR POLLUTANTS

This section is for all facilities which will have hazardous air pollutant (HAP) emissions of any single federal HAP listed on the last page of the application.

Please see the modeling report in Appendix F of the Application Report for HAPs emission sources information.

Identify each HAP emission source and each HAP associated with that emission source for the entire facility. Use as many lines as necessary for each HAP source.

Source or Equipment Name	HAP and/or CAS #	HAP Emission Rate		Stack or Point Discharge Parameters (3)					Building or Release Source Dimensions (4)			Distance from Source to Nearest Property Line (ft) (5)
		(lb/hr) (1)	(tons/yr) (2)	Stack ID	Stack Height Above Ground (ft)	Exit Velocity (fps)	Flow Rate (ACFM)	Temp (°F)	Length (ft)	Width (ft)	Height (ft)	

(1) Pounds per hour (lb/hr) is actual emission rate estimated or measured by applicant to be released from the emissions source.

(2) Tons per year is actual annual emission rate estimated or measured by applicant to be released from the emissions source. This value should take into account process operating schedules.

(3) If the emission source is a point source, provide information about the stack or point of discharge.

(4) If the emission source is a non-point (area) source located inside a building, provide the dimensions of the building. Otherwise, provide the dimension of the release source.

(5) Enter the closest distance between the emission source and the nearest property boundary.

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SECTION Y. OTHER SOURCES

This section is intended for all emissions related activities, equipment and applicable emission controls which are not covered in previous sections. Use a separate sheet for each process line. **If you need additional sheets, print multiple copies of this page.**

Provide a simple process (block flow) diagram with emission points and/or emission areas and control equipment identified. In response to item 2, provide a detailed step-by-step narrative, including how raw materials are handled, stored, processed, mixed, treated, and converted to finished products. Provide flow rates, temperatures, pressures, and other appropriate details concerning each process. Whenever available, provide manufacturer's data sheets and literature. Describe in detail how waste materials are generated, handled, stored, processed, mixed, treated and disposed of. List each material that is partially recovered, salvaged or otherwise reclaimed. Provide estimates of the quantities of such material recoveries on an annual basis. Describe how the annual quantity figures were developed.

1. Name of Process, Equipment Grouping or Activity: ______________________________

2. Narrative description:

3. Equipment List. Include machinery, storage silos, tanks, etc.

Assigned Equipment #	Make / Model / Identification #	Date of Installation	Rated Capacity (specify units)	Exhausted to Control? (Yes/No)

4. Material List. List all materials handled, stored, processed, used, mixed, treated, or emitted from the facility, including but not limited to chemicals, mixtures, resins, cleaning compounds, etc. Submit a copy of the Safety Data Sheet (SDS) for each material and number the SDS to correspond to the table below.

SDS #	Material	Chemical Composition (% weight)	Annual Usage or Throughput (gal/lbs/tons)	Amount Shipped as Waste (gal/lbs/tons)	Equipment Number in which used**

**Specify the assigned equipment number from item 3, column 1 for the piece of equipment in which the material is used.

5. Describe air pollution control devices. Submit an Operation and Maintenance (O&M) Plan for each control device listed and provide written documentation of control efficiency (e.g., manufacturer's data or actual test data).

Type of Control Device	Make / Model / Identification #	Maximum Design Air Flow Rate (CFM)	Control Efficiency (% Weight)	Equipment Controlled ***

***Specify the assigned equipment number from item 3, column 1 for the piece of equipment whose emissions are being controlled by the control device.

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SECTION Z. AIR POLLUTANT EMISSIONS

Provide a summary of the projected actual air emissions on an annual basis for the entire site in the following summary tables. Submit detailed calculations to support the figures.

Pollutant	Emissions (lbs/yr)
Carbon monoxide (CO)	131,223
Oxides of nitrogen (NOx)	173,572
Oxides of sulfur (SOx)	2,387
Particulates of 2.5 microns or smaller ($PM_{2.5}$)	140,326
Particulates of 10 microns or smaller (PM_{10})	142,819
Total suspended particulates (TSP), including PM_{10}	142,819
Volatile organic compounds (VOCs)[1]	43,254
Lead	0
Federal hazardous air pollutants (list each one separately):	
Benzene	3
Toluene	2
Xylenes	1
Formaldehyde	28
HF	7,874
HCl	13,326
Cl2	13,326
Acetonitrile	501
COS	2,555
TiCl4	1,539
Arsine	15
H2SO4	9,208
Ethylene Glycol	6,725
Phosphine	34
Triethylamine	433
Cobalt	3

[1] VOCs are defined by EPA in their Technical Overview of Volatile Organic Compounds web page.

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Do not include the emissions from motor vehicles. Include the emissions from stationary sources, portable sources, test areas, experimental facilities, evaporative losses, storage and handling losses, fuel loading and unloading losses, etc. Specifically identify the following in detailed calculations:

1. Emissions From Each Point Source And Each Stack
2. Capture Efficiencies
3. Control Efficiencies
4. Overall Efficiencies
5. Fugitive Emissions
6. Non-point (area) Emissions

For particulate (dust) emissions, describe the types of particulates being emitted and the quantities of emissions for each type. Whenever a material is identified by a trade name, also provide its generic name and its chemical abstract service (CAS) number.

Facilities with emissions greater than or equal to the thresholds shown below may be subject to additional permitting requirements, such as minor New Source Review (NSR) and/or Best Available Control Technology (BACT) per MCAQD Rule 241.

Pollutant	**Potential to Emit Threshold (tpy)**	
	Minor NSR	BACT
Fine Particulate Matter ($PM_{2.5}$)	5.0	10
Respirable Particulate Matter (PM_{10})	7.5	15
Sulfur Dioxide (SO_2)	20	40
Nitrogen Oxides (NO_x)	20	40
Volatile Organic Compounds	20	40
Carbon Monoxide (CO)	50	100
Lead (Pb)	0.3	0.3

For sources subject to minor NSR and required to conduct an ambient air quality impact assessment, see the Minor New Source Review Air Dispersion Modeling Guideline.

See Requirements, Procedures and Guidance in Selecting BACT and RACT for information about BACT.

Emission Factors for calculating emissions from specific industries or processes can be obtained at the EPA Compilation of Air Pollutant Emission Factors (AP-42). Industry-specific help sheets and other reference materials may be found at: Emissions Inventory Instructions & Help Sheets.

If you need help completing the application package, please contact our Business Assistance Office at 602-506-5102.

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FEDERAL HAZARDOUS AIR POLLUTANTS LIST

(Federal Clean Air Act, Title I, Section 112(b))

CAS No.	Chemical name
75070	Acetaldehyde
60355	Acetamide
75058	Acetonitrile
98862	Acetophenone
53963	2-Acetylaminofluorene
107028	Acrolein
79061	Acrylamide
79107	Acrylic acid
107131	Acrylonitrile
107051	Allyl chloride
92671	4-Aminobiphenyl
62533	Aniline
90040	o-Anisidine
1332214	Asbestos
71432	Benzene (including benzene from gasoline)
92875	Benzidine
98077	Benzotrichloride
100447	Benzyl chlo ride
92524	Biphenyl
117817	Bis(2-ethylhexyl)phthalate (DEHP)
542881	Bis(chloromethyl)ether
75252	Bromoform
106990	1,3-Butadiene
156627	Calcium cyanamide
133062	Captan
63252	Carbaryl
75150	Carbon disulfide
56235	Carbon tetrachloride
463581	Carbonyl sulfide
120809	Catechol
33904	Chloramben
57749	Chlordane
7782505	Chlorine
79118	Chloroacetic acid
532274	2-Chloroacetophenone
108907	Chlorobenzene
510156	Chlorobenzilate
67663	Chloroform
107302	Chloromethyl methyl ether
126998	Chloroprene
1319773	Cresols/Cresylic acid (isomers and mixture)
95487	o-Cresol
108394	m-Cresol
106445	p-Cresol
98828	Cumene
94757	2,4-D, salts and esters
3547044	DDE
334883	Diazomethane
132649	Dibenzofurans
96128	1,2-Dibromo-3-chloropropane
84742	Dibutylphthalate
106467	1,4-Dichlorobenzene(p)
91941	3,3-Dichlorobenzidene
111444	Dichloroethyl ether (Bis(2-chloroethyl)ether)
542756	1,3-Dichloropropene
62737	Dichlorvos
111422	Diethanolamine

CAS No.	Chemical name
121697	N,N-Diethyl aniline (N,N-Dimethylaniline)
64675	Diethyl sulfate
119904	3,3-Dimethoxybenzidine
60117	Dimethyl aminoazobenzene
119937	3,3′-Dimethyl benzidine
79447	Dimethyl carbamoyl chloride
68122	Dimethyl formamide
57147	1,1-Dimethyl hydrazine
131113	Dimethyl phthalate
77781	Dimethyl sulfate
534521	4,6-Dinitro-o-cresol, and salts
51285	2,4-Dinitrophenol
121142	2,4-Dinitrotoluene
123911	1,4-Dioxane (1,4-Diethyleneoxide)
122667	1,2-Diphenylhydrazine
106898	Epichlorohydrin (1-Chloro-2,3-epoxypropane)
106887	1,2-Epoxybutane
140885	Ethyl acrylate
100414	Ethyl benzene
51796	Ethyl carbamate (Urethane)
75003	Ethyl chloride (Chloroethane)
106934	Ethylene dibromide (Dibromoethane)
107062	Ethylene dichloride (1,2-Dichloroethane)
107211	Ethylene glycol
151564	Ethylene imine (Aziridine)
75218	Ethylene oxide
96457	Ethylene thiourea
75343	Ethylidene dichloride (1,1-Dichloroethane)
50000	Formaldehyde
76448	Heptachlor
118741	Hexachlorobenzene
87683	Hexachlorobutadiene
77474	Hexachlorocyclopentadiene
67721	Hexachloroethane
822060	Hexamethylene-1,6-diisocyanate
680319	Hexamethylphosphoramide
110543	Hexane
302012	Hydrazine
7647010	Hydrochloric acid
7664393	Hydrogen fluoride (Hydrofluoric acid)
123319	Hydroquinone
78591	Isophorone
58899	Lindane (all isomers)
108316	Maleic anhydride
67561	Methanol
72435	Methoxychlor
74839	Methyl bromide (Bromomethane)
74873	Methyl chloride (Chloromethane)
71556	Methyl chloroform (1,1,1-Trichloroethane)
60344	Methyl hydrazine
74884	Methyl iodide (Iodomethane)
108101	Methyl isobutyl ketone (Hexone)
624839	Methyl isocyanate
80626	Methyl methacrylate
1634044	Methyl tert butyl ether
101144	4,4-Methylene bis(2-chloroaniline)
75092	Methylene chloride (Dichloromethane)

CAS No.	Chemical name
101688	Methylene diphenyl diisocyanate (MDI)
101779	4,4′-Methylenedianiline
91203	Naphthalene
98953	Nitrobenzene
92933	4-Nitrobiphenyl
100027	4-Nitrophenol
79469	2-Nitropropane
684935	N-Nitroso-N-methylurea
62759	N-Nitrosodimethylamine
59892	N-Nitrosomorpholine
56382	Parathion
82688	Pentachloronitrobenzene (Quintobenzene)
87865	Pentachlorophenol
108952	Phenol
106503	p-Phenylenediamine
75445	Phosgene
7803512	Phosphine
7723140	Phosphorus
85449	Phthalic anhydride
1336363	Polychlorinated biphenyls (Aroclors)
1120714	1,3-Propane sultone
57578	beta-Propiolactone
123386	Propionaldehyde
114261	Propoxur (Baygon)
78875	Propylene dichloride (1,2-Dichloropropane)
75569	Propylene oxide
75558	1,2-Propylenimine(2-Methyl aziridine)
91225	Quinoline
106514	Quinone
100425	Styrene
96093	Styrene oxide
1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin
79345	1,1,2,2-Tetrachloroethane
127184	Tetrachloroethylene (Perchloroethylene)
7550450	Titanium tetrachloride
108883	Toluene
95807	2,4-Toluene diamine
584849	2,4-Toluene diisocyanate
95534	o-Toluidine
8001352	Toxaphene (chlorinated camphene)
120821	1,2,4-Trichlorobenzene
79005	1,1,2-Trichloroethane
79016	Trichloroethyleneprocessing
95954	2,4,5-Trichlorophenol
88062	2,4,6-Trichlorophenol
121448	Triethylamine
1582098	Trifluralin
540841	2,2,4-Trimethylpentane
108054	Vinyl acetate
593602	Vinyl bromide
75014	Vinyl chloride
75354	Vinylidene chloride (1,1-Dichloroethylene)
1330207	Xylenes (isomers and mixture)
95476	o-Xylenes
108383	m-Xylenes
106423	p-Xylenes

Chemical name
Antimony Compounds
Arsenic Compounds (inorganic including arsine)
Beryllium Compounds
Cadmium Compounds
Chromium Compounds
Cobalt Compounds
Coke Oven Emissions
Cyanide Compounds[1]
Glycol ethers[2]
Lead Compounds
Manganese Compounds
Mercury Compounds
Fine mineral fibers[3]
Nickel Compounds
Polycylic Organic Matter[4]
Radionuclides (including radon)[5]
Selenium Compounds

For all listings above which contain the word "compounds" and for glycol ethers, unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical as part of that chemical's infrastructure.

[1] X′CN where X = H′ or any other group where a formal dissociation may occur. For example KCN or Ca(CN)2.

[2] Includes mono- and di- ethers of ethylene glycol, diethylene glycol and triethylene glycol R(OCH2CH2)n-OR' where:

n = 1, 2 or 3

R = alkyl C7 or less, or phenyl or alkyl substituted phenyl

R′ = H, or alkyl C7 or less, or carboxylic acid ester, sulfate, phosphate, nitrate, or sulfonate.

[3] Includes mineral fiber emissions from facilities manufacturing or glass, rock or slag fibers or other mineral derived fibers of average diameter one (1) micrometer or less.

[4] Includes organic compounds with more than one (1) benzene ring and which have a boiling point greater than or equal to 100°C.

[5] A type of atom which spontaneously undergoes radioactive decay

Appendix B

Detailed Emission Calculations

Appendix B

Facility Emissions Summary
TSMC Phoenix Project
Maricopa County, Arizona

	VOC		PM_{10}		$PM_{2.5}$		SO_2		NO_x		CO	
Emission Source Description	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**
Boilers	0.17	0.02	0.23	0.03	0.23	0.03	0.07	0.010	3.01	0.45	2.53	0.38
Emergency Engines	59.21	0.53	17.97	0.16	17.97	0.16	0.78	0.01	566.74	5.10	63.44	0.57
Cooling Towers	-	-	0.71	3.12	0.43	1.87	-	-	-	-	-	-
Fire Pump Engine	0.51	4.57E-03	0.24	2.14E-03	0.24	2.14E-03	8.74E-03	7.86E-05	4.76	0.04	4.13	0.04
Tanks	0.04	0.2	-	-	-	-	-	-	-	-	-	-
RCTOs	1.81	7.93	3.8	16.8	3.8	16.8	0.3	1.2	3.9	17.0	2.7	11.8
Acid Scrubbers	0.09	0.39	7.7	33.6	7.7	33.6	-	-	14.6	64.2	12.0	52.8
Bench Scrubbers	1.84	8.08	3.9	17.3	3.9	17.3	-	-	-	-	-	-
Ammonia Scrubbers	0.77	3.35	0.1	0.4	0.1	0.4	-	-	-	-	-	-
Fugitive VOC	0.26	1.13	-	-	-	-	-	-	-	-	-	-
Total Emissions for 2 FABs	**64.7**	**21.6**	**34.7**	**71.4**	**34.4**	**70.2**	**1.1**	**1.2**	**593.0**	**86.8**	**84.8**	**65.6**

Notes:

TSMC -Taiwan Semiconductor Manufacturing Co., Ltd.
VOC - volatile organic compounds
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter
SO_2 - sulfur dioxide
NO_x - nitrogen oxides
CO - carbon monoxide
lb/hr - pound per hour
tons/yr - tons per year
TO - Thermal Oxidizers
RCTO - Rotor Concentrator Thermal Oxidizers

Appendix B

Hazardous Air Pollutants Emissions Summary
TSMC Phoenix Project
Maricopa County, Arizona

EPN	Benzene		Toluene		Xylenes		Formaldehyde		HF		HCl		Cl_2		Acetonitrile	
CAS #	71-43-2		108-88-3		1330-20-7		50-00-0		7664-39-3		7647-01-0		7782-50-5		75-05-8	
Description	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year
Emergency Engines	0.13	0.001	0.05	4.14E-04	0.03	2.84E-04	0.01	1.16E-04	-	-	-	-	-	-	-	-
Fire Pump Engines	1.42E-03	1.28E-05	5.15E-04	4.63E-06	3.54E-04	3.18E-06	1.45E-04	1.30E-06	-	-	-	-	-	-	-	-
Hot Water Boilers	6.32E-05	9.48E-06	1.02E-04	1.54E-05	-	-	2.26E-03	3.39E-04	-	-	-	-	-	-	-	-
RCTOs	8.54E-05	3.74E-04	1.38E-04	6.06E-04	-	-	3.05E-03	1.34E-02	0.11	0.50	-	-	-	-	-	-
Acid Scrubbers	-	-	-	-	-	-	-	-	0.60	2.64	0.91	4.00	0.91	4.00	0.04	0.17
Bench Scrubbers	-	-	-	-	-	-	-	-	0.08	0.36	0.46	2.00	0.46	2.00	0.02	0.08
Ammonia Scrubbers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WWT Srubbers	-	-	-	-	-	-	-	-	0.10	0.44	0.15	0.67	0.15	0.67	-	-
Total Emissions	**0.13**	**0.00**	**0.05**	**0.00**	**0.03**	**0.00**	**0.02**	**0.01**	**0.90**	**3.94**	**1.52**	**6.66**	**1.52**	**6.66**	**0.06**	**0.25**

EPN	COS		$TiCl_4$		Arsine		Ethylene Glycol		PH3		Triethylamine		Cobalt		Total HAPS		EPN
CAS #	463-58-1		7550-45-0		7784-42-1		107-21-1		7803-51-2		121-44-8		56792-69-9		*Equipment Total*		
Description	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	lb/hr	tons/year	
Emergency Engines	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.22	0.00	Emergency Engines
Fire Pump Engines	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	Fire Pump Engines
Hot Water Boilers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	Hot Water Boilers
RCTOs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12	0.51	RCTOs
Acid Scrubbers	0.19	0.85	0.12	0.51	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.22	0.00	0.00	2.81	12.42	Acid Scrubbers
Bench Scrubbers	0.10	0.43	0.06	0.26	0.00	0.00	-	-	-	-	-	-	-	-	1.17	5.12	Bench Scrubbers
Ammonia Scrubbers	-	-	-	-	-	-	0.77	3.35	-	-	-	-	-	-	0.77	3.35	Ammonia Scrubbers
WWT Srubbers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.40	1.77	WWT Srubbers
Total Emissions	**0.29**	**1.28**	**0.18**	**0.77**	**0.00**	**0.01**	**0.77**	**3.36**	**0.00**	**0.02**	**0.02**	**0.22**	**0.00**	**0.00**	**5.49**	**23.18**	**Total Emissions**

Other Regulated Air Pollutants Emissions Summary

EPN	H_2SO_4	
CAS #	7664-93-9	
Description	lb/hr	tons/year
Acid Scrubbers	0.13	0.56
Bench Scrubbers	0.91	4.00
Ammonia Scrubbers	-	-
WWT Srubbers	0.01	0.05
Total Emissions	**1.05**	**4.60**
		9208

Project Total per Fab Building

Air Contaminant	Hourly Emission Rate lb/hr	Hourly HAP De Minimis Threshold lb/hr	Annual Emission Rate tons/year	Annual Emission Rate lb/year	Annual HAP De Minimis Threshold lb/year
Benzene	0.129	N/A	0.002	3	1.5
Toluene	0.047	109	0.001	2	146,766
Xylenes	0.032	98	0.000	1	644
Formaldehyde	0.018	N/A	0.014	28	0.90
HF	0.90	0.56	3.94	7,874	90
HCl	1.52	0.93	6.66	13,326	129
Cl_2	1.52	-	6.66	13,326	-
Acetonitrile	0.06	-	0.25	501	-
COS	0.29	1.7	1.28	2,555	-
$TiCl_4$	0.18	-	0.77	1,539	-
AsH_3	1.70E-03	-	7.46E-03	15	0.0027
Ethylene Glycol	0.77	2.8	3.36	6,725	2,583
PH3	0.00	-	0.02	34	-
Triethylamine	0.02	-	0.22	433	-
Cobalt	0.00	-	0.00	3	0.0042
H_2SO_4	1.05	-	4.60	9,208	-

Notes:

EPN - Emission Point Number
HF - hydrogen fluoride
HCl - hydrogen chloride
Cl_2 - chlorine
COS - carbonyl sulfide

$TiCl_4$ - titanium tetrachloride
AsH_3 - Arsine
HAP - hazardous air pollutant
CAS - Chemical Abstracts Service
lb/hr - pounds per hour

tons/year - tons per year
RCTO - Rotor Concentrator Thermal Oxidizer
EUV - Extreme Ultraviolet Lithography
H_2SO_4 - sulfuric acid
Fab - Semiconductor Manufacturing (Fabrication) Plant

Appendix B

Scrubber Emissions
TSMC Phoenix Project
Maricopa County, Arizona

lb/hr

S. No	EPN	Name	HF [1,3]	HCl [1]	H_2SO_4 [1]	Cl_2 [1]	C_2H_3N [4]	COS [4]	$TiCl_4$ [4]	AsH_3 [2]	PM	NOx	CO	Ethylene Glycol	PH3	Triethylamine	Cobalt	VOC
10A	1-A101	AAS_SEX (Acid) Scrubber 1	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
11A	1-A102	AAS_SEX (Acid) Scrubber 2	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
12A	1-A103	AAS_SEX (Acid) Scrubber 3	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
13A	1-A104	AAS_SEX (Acid) Scrubber 4	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
14A	1-A105	AAS_SEX (Acid) Scrubber 5	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
15A	1-A106	AAS_SEX (Acid) Scrubber 6	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
16A	1-A107	AAS_SEX (Acid) Scrubber 7	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
17A	1-A108	AAS_SEX (Acid) Scrubber 8	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
18A	1-A109	AAS_SEX (Acid) Scrubber 9	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
19A	1-A110	AAS_SEX (Acid) Scrubber 10	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
20A	1-A111	AAS_SEX (Acid) Scrubber 11	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
21A	1-A112	AAS_SEX (Acid) Scrubber 12	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
22A	1-A113	AAS_SEX (Acid) Scrubber 13	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
23A	1-A114	AAS_SEX (Acid) Scrubber 14	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
24A	1-A115	AAS_SEX (Acid) Scrubber 15	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
25A	1-A116	AAS_SEX (Acid) Scrubber 16	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
26A	1-A117	AAS_SEX (Acid) Scrubber 17	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
27A	1-A118	AAS_SEX (Acid) Scrubber 18	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
28A	1-A131	AAS_SEX-Bench Scrubber 1	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
29A	1-A132	AAS_SEX-Bench Scrubber 2	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
30A	1-A133	AAS_SEX-Bench Scrubber 3	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
31A	1-A134	AAS_SEX-Bench Scrubber 4	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
32A	1-A135	AAS_SEX-Bench Scrubber 5	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
33A	1-A136	AAS_SEX-Bench Scrubber 6	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
34A	1-A137	AAS_SEX-Bench Scrubber 7	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
35A	1-A138	AAS_SEX-Bench Scrubber 8	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
36A	1-A139	AAS_SEX-Bench Scrubber 9	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
37A	1-A201	AAS_AEX (Ammonia) Scrubber 1	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
38A	1-A202	AAS_AEX (Ammonia) Scrubber 2	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
39A	1-A203	AAS_AEX (Ammonia) Scrubber 3	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
40A	1-A204	AAS_AEX (Ammonia) Scrubber 4	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
41A	1-A205	AAS_AEX (Ammonia) Scrubber 5	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
42A	1-A206	AAS_AEX (Ammonia) Scrubber 6	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
43A	1-A401	WWT_SEX (Acid) Scrubber 1	1.67E-02	2.54E-02	3.55E-03	2.54E-02	-	-	-	-	1.83E-01	-	-	-	-	-	-	-
44A	1-A402	WWT_SEX (Acid) Scrubber 2	1.67E-02	2.54E-02	3.55E-03	2.54E-02	-	-	-	-	1.83E-01	-	-	-	-	-	-	-
45A	1-A403	WWT_SEX (Acid) Scrubber 3	1.67E-02	2.54E-02	3.55E-03	2.54E-02	-	-	-	-	1.83E-01	-	-	-	-	-	-	-
10B	2-A101	AAS_SEX (Acid) Scrubber 1	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
11B	2-A102	AAS_SEX (Acid) Scrubber 2	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
12B	2-A103	AAS_SEX (Acid) Scrubber 3	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
13B	2-A104	AAS_SEX (Acid) Scrubber 4	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
14B	2-A105	AAS_SEX (Acid) Scrubber 5	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
15B	2-A106	AAS_SEX (Acid) Scrubber 6	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
16B	2-A107	AAS_SEX (Acid) Scrubber 7	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
17B	2-A108	AAS_SEX (Acid) Scrubber 8	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
18B	2-A109	AAS_SEX (Acid) Scrubber 9	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
19B	2-A110	AAS_SEX (Acid) Scrubber 10	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
20B	2-A111	AAS_SEX (Acid) Scrubber 11	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
21B	2-A112	AAS_SEX (Acid) Scrubber 12	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
22B	2-A113	AAS_SEX (Acid) Scrubber 13	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
23B	2-A114	AAS_SEX (Acid) Scrubber 14	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
24B	2-A115	AAS_SEX (Acid) Scrubber 15	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
25B	2-A116	AAS_SEX (Acid) Scrubber 16	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
26B	2-A117	AAS_SEX (Acid) Scrubber 17	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
27B	2-A118	AAS_SEX (Acid) Scrubber 18	1.67E-02	2.54E-02	3.55E-03	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	1.83E-01	4.07E-01	3.35E-01	5.54E-05	1.07E-04	1.37E-03	1.01E-05	-
28B	2-A131	AAS_SEX-Bench Scrubber 1	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
29B	2-A132	AAS_SEX-Bench Scrubber 2	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
30B	2-A133	AAS_SEX-Bench Scrubber 3	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
31B	2-A134	AAS_SEX-Bench Scrubber 4	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
32B	2-A135	AAS_SEX-Bench Scrubber 5	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
33B	2-A136	AAS_SEX-Bench Scrubber 6	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
34B	2-A137	AAS_SEX-Bench Scrubber 7	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
35B	2-A138	AAS_SEX-Bench Scrubber 8	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
36B	2-A139	AAS_SEX-Bench Scrubber 9	4.54E-03	2.54E-02	5.07E-02	2.54E-02	1.06E-03	5.40E-03	3.25E-03	3.15E-05	2.19E-01	-	-	-	-	-	-	1.01E-01
37B	2-A201	AAS_AEX (Ammonia) Scrubber 1	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
38B	2-A202	AAS_AEX (Ammonia) Scrubber 2	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
39B	2-A203	AAS_AEX (Ammonia) Scrubber 3	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
40B	2-A204	AAS_AEX (Ammonia) Scrubber 4	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
41B	2-A205	AAS_AEX (Ammonia) Scrubber 5	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
42B	2-A206	AAS_AEX (Ammonia) Scrubber 6	-	-	-	-	-	-	-	-	8.37E-03	-	-	6.38E-02	-	-	-	-
43B	1-A401	WWT_SEX (Acid) Scrubber 1	1.67E-02	2.54E-02	3.55E-03	2.54E-02	-	-	-	-	1.83E-01	-	-	-	-	-	-	-
44B	1-A402	WWT_SEX (Acid) Scrubber 2	1.67E-02	2.54E-02	3.55E-03	2.54E-02	-	-	-	-	1.83E-01	-	-	-	-	-	-	-
45B	1-A403	WWT_SEX (Acid) Scrubber 3	1.67E-02	2.54E-02	3.55E-03	2.54E-02	-	-	-	-	1.83E-01	-	-	-	-	-	-	-
		Total Emissions:	**0.79**	**1.52**	**1.06**	**1.52**	**0.06**	**0.29**	**0.18**	**0.00**	**11.71**	**14.65**	**12.05**	**0.77**	**0.00**	**0.05**	**0.00**	**1.83**
		Emission Safety Factor:	**15 %**															

tons/year

S. No	EPN	Name	HF [1]	HCl [1]	H_2SO_4 [1]	Cl_2 [1]	C_2H_3N [4]	COS [4]	$TiCl_4$ [4]	AsH_3 [2]	PM	NOx	CO	Ethylene Glycol	PH3	Triethylamine	Cobalt	VOC
10A	1-A101	AAS_SEX (Acid) Scrubber 1	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
11A	1-A102	AAS_SEX (Acid) Scrubber 2	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
12A	1-A103	AAS_SEX (Acid) Scrubber 3	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
13A	1-A104	AAS_SEX (Acid) Scrubber 4	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
14A	1-A105	AAS_SEX (Acid) Scrubber 5	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
15A	1-A106	AAS_SEX (Acid) Scrubber 6	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
16A	1-A107	AAS_SEX (Acid) Scrubber 7	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
17A	1-A108	AAS_SEX (Acid) Scrubber 8	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
18A	1-A109	AAS_SEX (Acid) Scrubber 9	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
19A	1-A110	AAS_SEX (Acid) Scrubber 10	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
20A	1-A111	AAS_SEX (Acid) Scrubber 11	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
21A	1-A112	AAS_SEX (Acid) Scrubber 12	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
22A	1-A113	AAS_SEX (Acid) Scrubber 13	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
23A	1-A114	AAS_SEX (Acid) Scrubber 14	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
24A	1-A115	AAS_SEX (Acid) Scrubber 15	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
25A	1-A116	AAS_SEX (Acid) Scrubber 16	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
26A	1-A117	AAS_SEX (Acid) Scrubber 17	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
27A	1-A118	AAS_SEX (Acid) Scrubber 18	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
28A	1-A131	AAS_SEX-Bench Scrubber 1	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
29A	1-A132	AAS_SEX-Bench Scrubber 2	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
30A	1-A133	AAS_SEX-Bench Scrubber 3	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
31A	1-A134	AAS_SEX-Bench Scrubber 4	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
32A	1-A135	AAS_SEX-Bench Scrubber 5	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
33A	1-A136	AAS_SEX-Bench Scrubber 6	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
34A	1-A137	AAS_SEX-Bench Scrubber 7	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
35A	1-A138	AAS_SEX-Bench Scrubber 8	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
36A	1-A139	AAS_SEX-Bench Scrubber 9	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
37A	1-A201	AAS_AEX (Ammonia) Scrubber 1	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
38A	1-A202	AAS_AEX (Ammonia) Scrubber 2	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
39A	1-A203	AAS_AEX (Ammonia) Scrubber 3	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
40A	1-A204	AAS_AEX (Ammonia) Scrubber 4	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
41A	1-A205	AAS_AEX (Ammonia) Scrubber 5	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
42A	1-A206	AAS_AEX (Ammonia) Scrubber 6	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
43A	1-A401	WWT_SEX (Acid) Scrubber 1	0.0734	0.1110	0.0155	0.1110	-	-	-	-	0.7995	-	-	-	-	-	-	-
44A	1-A402	WWT_SEX (Acid) Scrubber 2	0.0734	0.1110	0.0155	0.1110	-	-	-	-	0.7995	-	-	-	-	-	-	-
45A	1-A403	WWT_SEX (Acid) Scrubber 3	0.0734	0.1110	0.0155	0.1110	-	-	-	-	0.7995	-	-	-	-	-	-	-
10B	2-A101	AAS_SEX (Acid) Scrubber 1	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
11B	2-A102	AAS_SEX (Acid) Scrubber 2	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
12B	2-A103	AAS_SEX (Acid) Scrubber 3	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
13B	2-A104	AAS_SEX (Acid) Scrubber 4	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
14B	2-A105	AAS_SEX (Acid) Scrubber 5	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
15B	2-A106	AAS_SEX (Acid) Scrubber 6	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
16B	2-A107	AAS_SEX (Acid) Scrubber 7	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
17B	2-A108	AAS_SEX (Acid) Scrubber 8	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
18B	2-A109	AAS_SEX (Acid) Scrubber 9	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
19B	2-A110	AAS_SEX (Acid) Scrubber 10	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
20B	2-A111	AAS_SEX (Acid) Scrubber 11	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
21B	2-A112	AAS_SEX (Acid) Scrubber 12	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
22B	2-A113	AAS_SEX (Acid) Scrubber 13	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
23B	2-A114	AAS_SEX (Acid) Scrubber 14	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
24B	2-A115	AAS_SEX (Acid) Scrubber 15	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
25B	2-A116	AAS_SEX (Acid) Scrubber 16	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
26B	2-A117	AAS_SEX (Acid) Scrubber 17	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
27B	2-A118	AAS_SEX (Acid) Scrubber 18	0.0734	0.1110	0.0155	0.1110	0.0046	0.0237	0.0142	0.0001	0.7995	1.7833	1.4667	0.0002	0.0005	0.0060	0.0000	-
28B	2-A131	AAS_SEX-Bench Scrubber 1	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
29B	2-A132	AAS_SEX-Bench Scrubber 2	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
30B	2-A133	AAS_SEX-Bench Scrubber 3	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
31B	2-A134	AAS_SEX-Bench Scrubber 4	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
32B	2-A135	AAS_SEX-Bench Scrubber 5	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
33B	2-A136	AAS_SEX-Bench Scrubber 6	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
34B	2-A137	AAS_SEX-Bench Scrubber 7	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
35B	2-A138	AAS_SEX-Bench Scrubber 8	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
36B	2-A139	AAS_SEX-Bench Scrubber 9	0.0199	0.1110	0.2221	0.1110	0.0046	0.0237	0.0142	0.0001	0.9594	-	-	-	-	-	-	0.4442
37B	2-A201	AAS_AEX (Ammonia) Scrubber 1	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
38B	2-A202	AAS_AEX (Ammonia) Scrubber 2	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
39B	2-A203	AAS_AEX (Ammonia) Scrubber 3	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
40B	2-A204	AAS_AEX (Ammonia) Scrubber 4	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
41B	2-A205	AAS_AEX (Ammonia) Scrubber 5	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
42B	2-A206	AAS_AEX (Ammonia) Scrubber 6	-	-	-	-	-	-	-	-	0.0366	-	-	0.2795	-	-	-	-
43B	1-A401	WWT_SEX (Acid) Scrubber 1	0.0734	0.1110	0.0155	0.1110	-	-	-	-	0.7995	-	-	-	-	-	-	-
44B	1-A402	WWT_SEX (Acid) Scrubber 2	0.0734	0.1110	0.0155	0.1110	-	-	-	-	0.7995	-	-	-	-	-	-	-
45B	1-A403	WWT_SEX (Acid) Scrubber 3	0.0734	0.1110	0.0155	0.1110	-	-	-	-	0.7995	-	-	-	-	-	-	-
		Total Emissions:	**3.44**	**6.66**	**4.65**	**6.66**	**0.25**	**1.28**	**0.77**	**0.01**	**51.29**	**64.20**	**52.80**	**3.36E+00**	**0.02**	**0.22**	**0.00**	**8.00**

Notes:

AAS_SEX (Acid) Scrubber 120,000 cubic meters per hour (CMH) maximum rated capacity
AAS_SEX-Bench Scrubber 120,000 CMH maximum rated capacity
AAS_AEX (Ammonia) Scrubber 60,000 CMH maximum rated capacity
lb/hr - pounds per hour
tons/year - tons per year
EPN - Emission Point Number
HF - hydrogen fluoride
HCl - hydrogen chloride
H_2SO_4 - sulfuric acid
Cl_2 - chlorine

C_2H_3N - acetonitrile
COS - carbonyl sulfide
$TiCl_4$ - titanium tertachloride
AsH_3 - Arsine
Fab - Semiconductor Manufacturing (Fabrication) Plant
[1] Emissions from highest emission rate found in Taiwan MO1/MO2 permits or stack tests.
[2] AsH_3 throughput for each Fab buildings is 0.72 scf/hr and emission control efficiency is assumed to be at least 99.5%.
[3] HF emission rates were scaled up based on the expected increase in material usage for these chemicals.
[4] C_2H_3N, COS, and $TiCl_4$ emissions were calculated based on the material usage at the Fabs.

Appendix B

Rotor Concentrator Thermal Oxidizer Emissions
TSMC Phoenix Project
Maricopa County, Arizona

	VOC		PM_{10}		$PM_{2.5}$		SO_2		NO_x		CO	
Emission Source Description	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**
RCTOs - Combustion	0.22	0.98	0.31	1.35	0.31	1.35	2.44E-02	0.107	3.88	16.99	2.70	11.82
RCTOs - Process Chemical	1.59	6.95	3.53	15.45	3.53	15.45	0.24	1.07	*	*	*	*
RCTO Total	**1.81**	**7.93**	**3.84**	**16.80**	**3.84**	**16.80**	**0.27**	**1.18**	**3.88**	**16.99**	**2.70**	**11.82**
Per RCTO	0.30		0.64		0.64		0.04		0.65		0.45	

*NOx and CO process emission already accounted in the combustion emission calculations

Appendix B

Rotor Concentrator Thermal Oxidizer Combustion Emissions
TSMC Phoenix Project
Maricopa County, Arizona

Number of RCTOs per FAB building:	6
Number of FAB buildings per project:	2
Number of RCTOs per project:	12
Fuel Usage (m^3/hr):	576
Hourly Fuel Usage for all units (MMscf/hr):	0.04
Annual Fuel Usage for all units (MMscf/yr):	356.38
RCTO Heat Rate (MMBTU/hr):	3.458
Hours of Operation (hr/yr):	8,760
Fuel Heat Value (BTU/scf):	1,020

CO Emissions Calculation

Total Exhaust Flow (m^3/hr) for one FAB:	800,000
Total Exhaust Flow (m^3/hr) for two FABs:	1,600,000
CO Exhaust Concentration (ppm):	0.8
Exhaust Temperature (°C):	83.90
Hours of Operation (hr/yr):	8,760
Standard Molecular Volume (L/mol at 0°C):	22.4
Molecular Weight of CO (g/mol):	28.01
All RCTOs Actual Flow Rate of CO in Exhaust (L/hr):	1280.00
All RCTOs Standard Flow Rate of CO in Exhaust (L/hr):	979.22
All RCTOs CO Molar Flow Rate (mol/hr):	43.72
All RCTOs CO Molar Flow Rate (lb/hr):	2.70

NOx Emissions Calculation

Total Exhaust Flow (m^3/hr) for one FAB:	800,000
Total Exhaust Flow (m^3/hr) for two FABs:	1,600,000
NOx Exhaust Concentration (ppm):	0.7
Exhaust Temperature (°C):	83.90
Hours of Operation (hr/yr):	8,760
Standard Molecular Volume (L/mol at 0°C):	22.4
Molecular Weight of NOx (g/mol):	46.00
All RCTOs Actual Flow Rate of NOx in Exhaust (L/hr):	1120.00
All RCTOs Standard Flow Rate of NOx in Exhaust (L/hr)	856.82
All RCTOs NOx Molar Flow Rate (mol/hr):	38.25
All RCTOs NOx Molar Flow Rate (lb/hr):	3.88

	Emission	**Combustion**		**All RCTOs**	
Pollutant	**lb/MMscf**	**lb/hr**	**tons/year**	**lb/hr**	**tons/year**
PM_{10}	7.6	0.03	0.11	0.31	1.35
$PM_{2.5}$	7.6	0.03	0.11	0.31	1.35
Benzene[1]	0.0021	7.12E-06	3.12E-05	8.54E-05	3.74E-04
Toluene[1]	0.0034	1.15E-05	5.05E-05	1.38E-04	6.06E-04
Formaldehyde[1]	0.075	2.54E-04	1.11E-03	3.05E-03	1.34E-02
SO_2 [2]	0.6	2.03E-03	8.91E-03	2.44E-02	1.07E-01
NOx[3]	-	-	-	3.88	16.99
CO[3]	-	-	-	2.70	11.82
VOC[4]	5.5	0.02	0.08	0.22	0.98

Notes:

RCTO - Rotor Concentrator Thermal Oxidizer
Fab - Semiconductor Manufacturing (Fabrication) Plant
m^3/hr - cubic meters per hour
MMscf/hr - million standard cubic feet per hour
MMscf/yr - million standard cubic feet per year
MMBTU/hr - One Million British Thermal Units per hour
hr/yr - hours per year
BTU/scf - British Thermal Units per standard cubic foot
lb/MMscf - pounds per million standard cubic feet
lb/hr - pounds per hour
tons/year - tons per year
VOC - volatile organic compounds
NO_x - nitrogen oxides
CO - carbon monoxide
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter
SO_2 - sulfur dioxide

[1] Emission factors from AP-42, Chapter 1, Tables 1.4-1, 1.4-2, and 1.4-3, Natural Gas Combustion.
Units are in lb/MMscf: Benzene = 0.0021, Toluene = 0.0034, Formaldehyde = 0.075.
[2] Sulfur Factor from AP-42, Table 1.4-2
[3] NOx and CO include both combustion and process emissions
[4] VOC from combustion using emission factors from AP-42

Appendix B

Rotor Concentrator Thermal Oxidizer PM and SO_2 Emissions from Process Chemicals
TSMC Phoenix Project
Maricopa County, Arizona

General Calculation Parameters

Number of RCTOs per FAB building:	6
Number of FAB buildings per project:	2
Number of RCTOs per project:	12
Total Exhaust Flow (m^3/hr) for one FAB:	800,000
Total Exhaust Flow (m^3/hr) for two FABs:	1,600,000
PM Exhaust Concentration (μg/m^3)	1,000
Exhaust Temperature (°C):	83.90
Hours of Operation (hr/yr):	8,760
Standard Molecular Volume (L/mol at 0°C):	22.4

Final Calculation Summary

	Per RCTO - Process		All RCTOs	
Pollutant	**lb/hr**	**tons/year**	**lb/hr**	**tons/year**
PM_{10}	0.29	1.29	3.53	15.45
$PM_{2.5}$	0.29	1.29	3.53	15.45
SO_2[1]	0.02	0.09	0.24	1.07
VOC[2]	0.13	0.58	1.59	6.95
HF[3]	0.02	0.08	0.23	1.00

Notes:

RCTO - Rotor Concentrator Thermal Oxidizer
FAB - Semiconductor Manufacturing (Fabrication) Plant
m^3/hr - cubic meters per hour
ppm - parts per million
°C - degrees Celsius
L/mol - liters per mole
g/mol - grams per mole
L/hr - liters per hour
mol/hr - moles per hour
lb/hr - pounds per hour
tons/year - tons per year
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter
SO_2 - sulfur dioxide
VOC - Volatile Organic Compounds

[1] SO_2 emission based on RCTO-Combustion emission multiply by a factor of 10
[2] VOC emission based on stack test results, including both combustion and process emission for a conversative estimate
[3] HF emission based on facility chemical usage

Appendix B

Hot Water Boiler Emissions Calculations
TSMC Phoenix Project
Maricopa County, Arizona

Number of Boilers per FAB building:	3
Number of FAB buildings per project:	2
Number of Boilers per project:	6
Hot Water Boiler Rating (kW):	1,500
Boiler Rating (MMBTU/hr):	5.12
Maximum Expected Hours of Operation (hr/yr):	300
Hourly Natural Gas Consumption for All Units (MMscf/hr):	0.03
Annual Natural Gas Consumption for All Units (MMscf/yr):	9.03
Fuel Type:	Natural Gas
Fuel Heat Value (BTU/scf):	1,020

	AP-42 Emission Factor [1]	**All Boilers**	
Pollutant	**lb/MMscf**	**lb/hr**	**tons/year**
VOC	5.5	0.166	0.025
NO_x	100	3.011	0.452
CO	84	2.529	0.379
PM_{10}	7.6	0.229	0.034
$PM_{2.5}$	7.6	0.229	0.034
Benzene	0.0021	6.32E-05	9.48E-06
Toluene	0.0034	1.02E-04	1.54E-05
Formaldehyde	0.075	2.26E-03	3.39E-04
SO_2 [2]	2.25	0.068	0.010

Notes:

Fab - Semiconductor Manufacturing (Fabrication) Plant
kW - killowatt
MMBTU/hr - One Million British Thermal Units per hour
hr/yr - hours per year
BTU/scf - British thermal units per standard cubic foot
lb/MMscf - pounds per million standard cubic feet
lb/hr - pounds per hour
tons/year - tons per year
VOC - volatile organic compounds
NO_x - nitrogen oxides
CO - carbon monoxide
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter
SO_2 - sulfur dioxide

[1] Emission Factors from AP-42, Chapter 1, Tables 1.4-1, 1.4-2, and 1.4-3, Natural Gas Combustion.

[2] Sulfur Factor from AP-42, Table 1.4-2 adjusted from 0.2 gr/100scf to 0.75 gr/100scf (expected Sulfur content in fuel gas).

Appendix B

Emergency Engine Emissions Calculations
TSMC Phoenix Project
Maricopa County, Arizona

Proposed Engines in P1	22
Proposed Engines in P2	0
Number of EnginesTotal:	22
Engine Manufacturer / Model:	KOHLER / Mitsubishi, S16R-T2PTAW2-1
Engine Type:	4-Cycle, 16-V Cylinder
Emission Control Device:	Turbocharger and after cooler
Fuel Type :	No. 2 Diesel
Fuel Sulfur Content:	15 ppm
Engine Rating (kW):	2,180
Engine Rating (hp):	2,923
Engine Rating (MMBTU/hr):	7.44
Hours of Operation (hr/yr):	18

	Manufacturer Emission Factor [1]	**AP-42 Emission Factor [2]**	**AP-42 Emission Factor [3]**	**Per Engine**		**All Engines**	
Pollutant	**g/kWh**	**lb/hp-hr**	**lb/MMBTU**	**lb/hr**	**tons/year**	**lb/hr**	**tons/year**
VOC	0.560	-	-	2.69	0.02	59.21	0.53
NOx	5.36	-	-	25.76	0.23	566.74	5.10
CO	0.6	-	-	2.88	0.03	63.44	0.57
PM_{10}	0.17	-	-	0.82	0.01	17.97	0.16
$PM_{2.5}$	0.17	-	-	0.82	0.01	17.97	0.16
SO_2	-	1.2135E-05	-	0.035	0.00032	0.78	0.007
Formaldehyde	-	-	7.89E-05	0.0006	5.28E-06	0.01	0.000
Benzene	-	-	7.76E-04	0.0058	5.19E-05	0.13	0.001
Toluene	-	-	2.81E-04	0.0021	1.88E-05	0.05	0.000
Xylenes	-	-	1.93E-04	0.0014	1.29E-05	0.03	0.000

Notes:

Fab - Semiconductor Manufacturing (Fabrication) Plant
ppm - parts per million
kW - killowatt
hp - horsepower
MMBTU/hr - One Million British Thermal Units per hour
hr/yr - hours per year
g/kWh - grams per kilowatt-hour
lb/hp-hr - pounds per hporsepower-hour
lb/MMBTU - pounds per Million British Thermal Units
lb/hr - pounds per hour
tons/year - tons per year
VOC - volatile organic compounds
NO_x - nitrogen oxides
CO - carbon monoxide
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter
SO_2 - sulfur dioxide

[1] Emission factor of Interim Tier 4 Engines, 40 CFR 1039.102 Table 7 (g/kWh)
[2] Emission factor from AP-42 Table 3.4-1 (lb/hp-hr)
[3] Emission factor from AP-42 Table 3.4-3 (lb/MMBtu)

Appendix B

Fire Pump Engine Emissions Calculations
TSMC Phoenix Project
Maricopa County, Arizona

Number of Engines per FAB building:	1
Number of FAB buildings per project:	2
Number of Engines per project:	2
Engine Manufacturer / Model:	CLARKE, Model DQ6H-UFAA88
Engine Type :	4-Cycle, 6 Cylinder, 2 Valves per Cylinder, In-Line
Fuel Type :	No. 2 Diesel
Fuel Sulfur Content:	15 ppm
Engine Rating (kW):	268
Engine Rating (HP):	360
Engine Rating (MMBTU/hr):	0.92
Hours of Operation (hr/yr):	18

	NSPS IIII Emission Factor[1]	**AP-42 Emission Factor [2]**	**AP-42 Emission Factor [3]**	**Per Engine**		**All Engines**	
Pollutant	**g/hp-hr**	**lb/hp-hr**	**lb/MMBTU**	**lb/hr**	**tons/year**	**lb/hr**	**tons/year**
VOC		7.05E-04	-	0.254	0.00	0.51	0.00
NO_x	**3**	0.24	-	2.381	0.02	4.76	0.04
CO	**2.6**	1.16	-	2.064	0.02	4.13	0.04
PM_{10}	**0.15**	0.0007	-	0.119	0.001	0.24	0.00
$PM_{2.5}$	**0.15**	0.0007	-	0.119	0.001	0.24	0.00
SO_2		1.21E-05	-	0.004	0.000039	0.01	0.000
Formaldehyde		-	7.89E-05	0.0001	6.50E-07	0.00	0.000
Benzene		-	7.76E-04	0.0007	6.40E-06	0.00	0.000
Toluene		-	2.81E-04	0.0003	2.32E-06	0.00	0.000
Xylenes		-	1.93E-04	0.0002	1.59E-06	0.00	0.000

Notes:

Fab - Semiconductor Manufacturing (Fabrication) Plant
ppm - parts per million
kW - killowatt
hp - horsepower
MMBTU/hr - One Million British Thermal Units per hour
hr/yr - hours per year
g/kWh - grams per kilowatt-hour
lb/hp-hr - pounds per hporsepower-hour
lb/MMBTU - pounds per Million British Thermal Units
lb/hr - pounds per hour
[1] Emission factor from manufacturer specifications (g/kWh)
[2] Emission factor from AP-42 Table 3.4-1 (lb/hp-hr)
[3] Emission factor from AP-42 Table 3.4-3 (lb/MMBtu)

tons/year - tons per year
VOC - volatile organic compounds
NO_x - nitrogen oxides
CO - carbon monoxide
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter
SO_2 - sulfur dioxide

Appendix B

Cooling Tower Emissions Calculations
TSMC Phoenix Project
Maricopa County, Arizona

Cooling Water Flow Rate[1]	16,120	gpm
Design Drift Rate[1]	0.0005%	of circulating water flow rate
Total dissolved solids in Circulating Water (TDS)[1]	2,000	mg/L
Number of Cooling Towers per Fab	14	
Number of Fab buildings per project	2	
Number of Cooling Towers	28	
Percentage of Total PM that is PM_{10}[2]	31.5%	Percentage of Total PM that is PM_{10}
Percentage of PM_{10} that is $PM_{2.5}$[3]	60.0%	Percentage of PM_{10} that is $PM_{2.5}$
Operating hours	8,760	hr/year

Emissions Calculations[3]:

Hourly PM_{10} emissions (lb/hr)

Flowrate (gpm) * TDS/10^6 * 8.34 (lb/gal) * Drift Rate (%) * 60 (min/hr) * PM_{10}% * #Coolingtower Pumps

= **2.26** lb PM/hr

= **0.71** lb PM_{10}/hr

= **0.43** lb $PM_{2.5}$/hr

Annual PM_{10} emissions (ton/yr)

Hourly PM_{10} emissions (lb/hr) * Operating Hours (hr/yr) / 2000 (lb/ton)

= **3.12** tons PM_{10}/yr

= **1.87** tons $PM_{2.5}$/yr

Notes:

[1] Maximum TDSs based on a conservative maximum TDS value of 2,000 parts per million

[2] Per correspondence with Maricopa County Air Quality Department for previous permitting actions

[3] Per South Coast Air Quality Management District guidance document, Appendix A - Updated CEIDARS Table with PM2.5 Fraction

gpm - gallons per minute

mg/L - milligrams per liter

Fab - Semiconductor Manufacturing (Fabrication) Plant

PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter

$PM_{2.5}$ Particulate Matter less than 2.5 micron aerodynamic diameter

hr/yr - hours per year

lb/hr - pounds per hour

min/hr - minutes per hour

PM - Particulate Matter per hour

tons/year - tons per year

Appendix B

Fugitive VOC Emissions Calculations
TSMC Phoenix Project
Maricopa County, Arizona

Total of Fabs: 2

Wipe Cleaning			
Components	**Evaporation Losses per fab (g/quarter)**	**Evaporation Losses per fab (ton/yr)**	**Mass Fraction (%)**
Isopropyl Alcohol	21902.4	0.10	100%
Isopropyl Alcohol (10%)	8938.6	0.00	10%
Ethanol	104083.8	0.46	100%
Ethanol (10%)	6526.2	0.00	10%
VOC Total for 1 Fab	--	**0.57**	--
VOC Total for 2 Fabs	--	**1.13**	--

Appendix B
TSMC Phoenix Project
Tank Emissions Calculations
Maricopa County, Arizona

Promax Tank Loss Stencil Input[1]					
Number of Tanks per Fab		4	4	4	4
Tank Contents		IPA	Thinner-1	Thinner-3	DP001
Size	Gallons	7,925	7,925	7,925	7,925
Tank Color		Tan	Tan	Tan	Tan
Location		Phoenix, AZ			
Shell Height	ft	15.5	15.5	15.5	15.5
Shell Diameter	ft	10	10	10	10
Breather Vent Pressure	psig	0.03	0.03	0.03	0.03
Breather Vac Pressure	psig	-0.03	-0.03	-0.03	-0.03
Operating Pressure	psig	0	0	0	0
Avg. Percent Liquid	%	50	50	50	50
Max Percent Liquid	%	90	90	90	90
Operating Hours	Hours	8760	8760	8760	8760
Net Throughput	tons/day	13	15	1.3	1.1
Atmospheric Pressure	psia	14.70	14.70	14.70	14.70
Max Liq Surface Temperature	°F	95.00	95.00	95.00	95.00
Capture Efficiency	%	100%	100%	100%	100%
Captured Emissions Control Efficiency	%	95%	95%	95%	95%

	IPA Tanks					Thinner-1 Tanks				
Components	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (lb/hr)	Total Losses (ton/yr)	Mass Fraction (%)	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (lb/hr)	Total Losses (ton/yr)	Mass Fraction (%)
Isopropyl Alcohol	0.694	0.363	0.24	1.057	100%	-	-	-	-	-
Propylene Glycol Monomethyl Ether	-	-	-	-	-	0.210	0.102	0.07	0.312	83%
Propylene Glycol 1-Monomethyl Ether Acetate	-	-	-	-	-	0.042	0.021	0.01	0.063	17%
Butyl Acetate	-	-	-	-	-	-	-	-	-	-
TOTAL UNCONTROLLED LOSSES FOR 1 FAB:	**0.69**	**0.36**	**0.24**	**1.06**	**-**	**0.25**	**0.12**	**0.09**	**0.37**	**-**
TOTAL UNCONTROLLED VOC LOSSES FOR 1 FAB:					**-**					**-**
TOTAL CONTROLLED VOC LOSSES FOR 1 FAB:	**0.03**	**0.02**	**0.01**	**0.05**		**0.01**	**<0.01**	**<0.01**	**0.02**	**-**
TOTAL CONTROLLED VOC LOSSES FOR 2 FABS:	**0.07**	**0.04**	**0.02**	**0.11**	**-**	**0.03**	**0.01**	**<0.01**	**0.04**	**-**

	Thinner-3 Tanks					DP001 Tanks				
Components	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (lb/hr)	Total Losses (ton/yr)	Mass Fraction (%)	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (lb/hr)	Total Losses (ton/yr)	Mass Fraction (%)
Isopropyl Alcohol	-	-	-	-	-	-	-	-	-	-
Propylene Glycol Monomethyl Ether	-	-	-	-	-	-	-	-	-	-
Propylene Glycol 1-Monomethyl Ether Acetate	0.015	0.067	0.02	0.082	100%	-	-	-	-	-
Butyl Acetate	-	-	-	-	-	0.036	0.173	0.05	0.209	100%
TOTAL UNCONTROLLED LOSSES FOR 1 FAB:	**0.01**	**0.07**	**0.02**	**0.08**	**-**	**0.04**	**0.17**	**0.05**	**0.21**	**-**
TOTAL UNCONTROLLED VOC LOSSES FOR 1 FAB:					**-**					**-**
TOTAL CONTROLLED VOC LOSSES FOR 1 FAB:	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**-**	**<0.01**	**<0.01**	**<0.01**	**0.01**	**-**
TOTAL CONTROLLED VOC LOSSES FOR 2 FABS:	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**-**	**<0.01**	**0.02**	**<0.01**	**0.02**	**-**

[1]Tank emissions simulated in Promax. Report available upon request.

Appendix B

Facility HAPs Usage
TSMC Phoenix Project
Maricopa County, Arizona

Chemical Used - Public	Scrubber Systems	HAPs	HAPs Emission (lb/hr)	HAPs Emission (ton/yr)
Component A	AEX	ETHYLENE GLYCOL	0.2	0.7
Component B	VEX (RCTO)	HYDROGEN FLUORIDE	0.1	0.5
Component C	AEX	ETHYLENE GLYCOL	0.2	0.7
PH3 SDS3 JY VCR	SEX	PHOSPHINE	0.0001	0.0003
PH3,5N7,44L,40LB,DISS632	SEX	PHOSPHINE	0.0016	0.007
Pura Leveler, 4L/BT	SEX	ETHYLENE GLYCOL	0.0004	0.002
TEA,10KG/BT	SEX	TRIETHYLAMINE	0.0215	0.094
Viaform Extreme Leveler, 4L/BT(NOWPak)	SEX	ETHYLENE GLYCOL	0.000	0.002
Component D	SEX	Cobalt compound		
Component E	SEX	Cobalt compound		
Component F	SEX	Cobalt compound		
Component G	SEX	Cobalt compound		
Component H	SEX	Cobalt compound	0.0002	0.0007
Component I	SEX	Cobalt compound		
Component J	SEX	Cobalt compound		
Component K	SEX	Cobalt compound		
Component L	SEX	Cobalt compound		

Notes:
HAP emissions are quantified in Scrubber Emissions summary table.
Projected chemical usage is based on 2020 usage by a sister plant.
In the absence of stack test data, emissions are conservatively based on maximum anticipated solution concentration and 100% loss.

Appendix C

Specification Sheets

Emergency Engines

Fire Pump Engines

Hot Water Boilers

KOHLER®

Model: 2000REOZMD

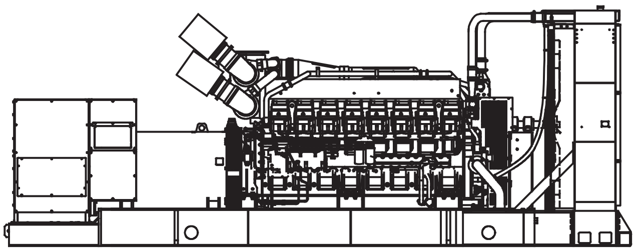
380-4160 V **Diesel**

ISO 9001 KOHLER NATIONALLY REGISTERED

Tier 2 EPA-Certified for Stationary Emergency Applications

Ratings Range

		60 Hz
Standby:	**kW**	1590-2000
	kVA	1988-2500
Prime:	**kW**	1440-1820
	kVA	1800-2275



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard one-year limited warranty covers all generator set systems and components. Two-, five-, and ten-year extended limited warranties are also available.
- Alternator features:
  - The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
  - Additional alternator voltages are available including 12.47 kV, 13.2 kV, and 13.8 kV medium voltages. Contact your local distributor for more detailed information.
  - The brushless, rotating-field alternator has broadrange reconnectability.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 3.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).
  - An electronic, isochronous governor delivers precise frequency regulation.
  - Multiple circuit breaker configurations.

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
7M4054	220/380	3	60	1590/1988	3020	1590/1988	3020	1440/1800	2735	1440/1800	2735
	240/416	3	60	1840/2300	3192	1840/2300	3192	1800/2250	3123	1680/2100	2915
	277/480	3	60	2000/2500	3007	2000/2500	3007	1820/2275	2736	1820/2275	2736
7M4056	220/380	3	60	1850/2313	3513	1790/2238	3400	1750/2188	3324	1650/2063	3134
	240/416	3	60	2000/2500	3470	1950/2438	3383	1820/2275	3157	1780/2225	3088
	277/480	3	60	2000/2500	3007	2000/2500	3007	1820/2275	2736	1820/2275	2736
7M4058	220/380	3	60	2000/2500	3798	1950/2438	3703	1820/2275	3457	1790/2238	3400
	240/416	3	60	2000/2500	3470	2000/2500	3470	1820/2275	3157	1820/2275	3157
	277/480	3	60	2000/2500	3007	2000/2500	3007	1820/2275	2736	1820/2275	2736
7M4176	220/380	3	60	2000/2500	3798	2000/2500	3798	1820/2275	3457	1820/2275	3457
7M4292	347/600	3	60	2000/2500	2406	2000/2500	2406	1820/2275	2189	1820/2275	2189
7M4374	2400/4160	3	60	2000/2500	347	2000/2500	347	1820/2275	316	1820/2275	316

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Alternator Specifications

Specifications		Alternator
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid State, Volts/Hz
Insulation:		NEMA MG1
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1, Sealed
Coupling		Flexible Disc
Amortisseur windings		Full
Rotor balancing		125%
Voltage regulation, no-load to full-load		Controller Dependent
One-step load acceptance		100% of Rating
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	7M4054 (4 bus bar)	7000
480 V	7M4056 (4 bus bar)	7200
480 V	7M4058 (4 bus bar)	11000
380 V	7M4176 (4 bus bar)	5400
600 V	7M4292 (4 bus bar)	4250
4160 V	7M4374 (6 lead)	6200

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Digital solid-state, volts-per-hertz voltage regulator with ±0.25% no-load to full-load regulation.
- Brushless alternator with brushless pilot exciter for excellent load response.

Application Data

Engine

Engine Specifications	
Manufacturer	Mitsubishi
Engine model	S16R-Y2PTAW2-1
Engine type	4-Cycle, Turbocharged
Cylinder arrangement	16 V
Displacement, L (cu. in.)	65.4 (3989)
Bore and stroke, mm (in.)	170 x 180 (6.69 x 7.09)
Compression ratio	14.0:1
Piston speed, m/min. (ft./min.)	648 (2126)
Main bearings: quantity, type	9, Precision Half-Shell
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	2180 (2923)
Cylinder head material	Cast Iron
Crankshaft material	Forged Steel
Governor type	Electronic
Frequency regulation, no-load to full-load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Exhaust

Exhaust System	
Exhaust manifold type	Dry
Exhaust flow at rated kW, m^3/min. (cfm)	544 (19209)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	526 (979)
Maximum allowable back pressure, kPa (in. Hg)	5.1 (1.5)
Exhaust outlet size at engine hookup, mm (in.)	See ADV drawing

Engine Electrical

Engine Electrical System	
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	30
Starter motor rated voltage (DC)	Dual, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each	Four, 1150
Battery voltage (DC)	12

Fuel

Fuel System	
Fuel supply line, min. ID, mm (in.)	19 (0.75)
Fuel return line, min. ID, mm (in.)	19 (0.75)
Max. lift, engine-driven fuel pump, m (ft.)	1.0 (3.0)
Max. fuel flow, Lph (gph)	660 (174)
Max. fuel pump restriction, kPa (in. Hg)	10 (3.0)
Max. return line restriction, kPa (in. Hg)	20 (5.9)
Fuel filter: quantity, type	4, Secondary
Recommended fuel	#2 Diesel

Lubrication

Lubricating System	
Type	Full Pressure
Oil pan capacity, L (qt.) §	200 (211)
Oil pan capacity with filter, L (qt.) §	230 (243)
Oil filter: quantity, type §	4, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Application Data

Cooling

Radiator System	
Ambient temperature, °C (°F)*	40 (104)
Engine jacket water capacity, L (gal.)	170 (44.9)
Radiator system capacity, including engine, L (gal.)	367 (96.9)
Engine jacket water flow, Lpm (gpm)	1850 (489)
Charge cooler water flow, Lpm (gpm)	920 (243)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Heat rejected to charge cooler water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	2057 (81)
Fan kWm (HP)	81 (109)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

High Ambient Radiator System	
Ambient temperature, °C (°F)*	50 (122)
Engine jacket water capacity, L (gal.)	170 (44.9)
Radiator system capacity, including engine, L (gal.)	386 (102)
Engine jacket water flow, Lpm (gpm)	1850 (489)
Charge cooler water flow, Lpm (gpm)	920 (243)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Heat rejected to charge cooler water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	2362 (93)
Fan kWm (HP)	63 (84)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	
Exhaust manifold type	Dry
Connection sizes:	
Jacket water engine inlet, mm (in.)	95 (3.75)
Jacket water engine outlet, mm (in.)	95 (3.75)
Intercooler water engine inlet, mm (in.)	83 (3.25)
Intercooler water engine outlet, mm (in.)	83 (3.25)
Static head allowable above engine, kPa (ft. H_2O)	98 (32.8)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

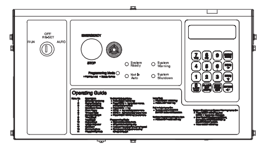
Operation Requirements

Air Requirements	
Radiator-cooled cooling air, m^3/min. (scfm)‡	2209 (78000)
High ambient radiator-cooled cooling air, m^3/min. (scfm)‡	2718 (96000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	991 (35100)
Combustion air, m^3/min. (cfm)	206 (7274)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	180 (10240)
Alternator, kW (Btu/min.)	97 (5516)

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

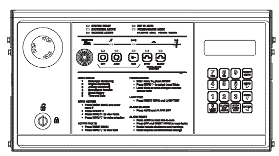
Fuel Consumption	
Diesel, Lph (gph) at % load	**Standby Rating**
100%	606 (160.1)
75%	442 (116.8)
50%	299 (79.0)
25%	164 (43.2)
Diesel, Lph (gph) at % load	**Prime Rating**
100%	536 (141.6)
75%	403 (106.6)
50%	271 (71.6)
25%	154 (40.6)

Controllers



Decision-Maker® 550 Controller
Provides advanced control, system monitoring, and system diagnostics with remote monitoring capabilities.
- Digital display and keypad provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or modem configuration
- Controller supports Modbus® protocol
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-46 for additional controller features and accessories.



Decision-Maker® 6000 Paralleling Controller
Provides advanced control, system monitoring, and system diagnostics with remote monitoring capabilities for paralleling multiple generator sets.
- Paralleling capability to control up to 8 generators on an isolated bus with first-on logic, synchronizer, kW and kVAR load sharing, and protective relays
  Note: Parallel with other Decision-Maker® 6000 controllers only
- Digital display and keypad provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or modem configuration
- Controller supports Modbus® protocol
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-107 for additional controller features and accessories.

Modbus® is a registered trademark of Schneider Electric.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the
US and Canada, phone 1-800-544-2444
KOHLERPower.com

Standard Features

- Alternator Protection
- Alternator Strip Heater (standard on 3300 volt and above)
- Customer Connection (Decision-Maker® 6000 controller only)
- Local Emergency Stop Switch
- Oil Drain Extension
- Operation and Installation Literature
- Radiator Core Guard

Available Options

Approvals and Listings

- ❑ California OSHPD Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing

Enclosed Unit

- ❑ Sound Enclosure/Fuel Tank Package
- ❑ Weather Enclosure/Fuel Tank Package

Open Unit

- ❑ Exhaust Silencer, Hospital (kit: PA-361627)
- ❑ Exhaust Silencer, Critical (kit: PA-361625)
- ❑ Flexible Exhaust Connector, Stainless Steel

Fuel System

- ❑ Flexible Fuel Lines
- ❑ Fuel Pressure Gauge
- ❑ Fuel/Water Separator

Controller

- ❑ Common Failure Relay
- ❑ Communication Products and PC Software
- ❑ Customer Connection (Decision-Maker® 550 controller only)
- ❑ Dry Contact (isolated alarm)
- ❑ Prime Power Switch
- ❑ Remote Audiovisual Alarm Panel (Decision-Maker® 550 controller only)
- ❑ Remote Emergency Stop
- ❑ Remote Mounting Cable
- ❑ Remote Serial Annunciator Panel
- ❑ Run Relay
- ❑ Manual Speed Adjustment (Decision-Maker® 550 and APM402 controllers only)

Cooling System

- ❑ Block Heater; 9000 W, 208 V, 1 Ph
- ❑ Block Heater; 9000 W, 240 V, (Select 1 Ph or 3 Ph)
- ❑ Block Heater; 9000 W, 380 V, 3 Ph
- ❑ Block Heater; 9000 W, 480 V, (Select 1 Ph or 3 Ph)
  Required for Ambient Temperatures Below 0°C (32°F)
- ❑ High Ambient Radiator
- ❑ Remote Radiator Cooling Setup

Electrical System

- ❑ Alternator Strip Heater (available up to 600 volt)
- ❑ Battery
- ❑ Battery Charger, Equalize/Float Type
- ❑ Battery Heater
- ❑ Battery Rack and Cables
- ❑ Line Circuit Breaker (NEMA type 1 enclosure)
- ❑ Line Circuit Breaker with Shunt Trip (NEMA type 1 enclosure)

Paralleling System

- ❑ Remote Voltage Adjustment Control
- ❑ Voltage Sensing (Decision-Maker® 6000 controller only)

Miscellaneous

- ❑ Air Cleaner, Heavy Duty
- ❑ Air Cleaner Restriction Indicator
- ❑ Crankcase Emission Canister
- ❑ Engine Fluids (oil and coolant) Added
- ❑ Oil Temperature Gauge
- ❑ Rated Power Factor Testing
- ❑ Spring Isolators

Literature

- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Warranty

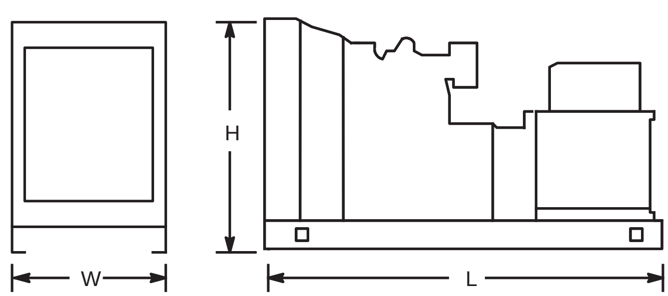
- ❑ 2-Year Basic Limited Warranty
- ❑ 2-Year Prime Limited Warranty
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

Other Options

- ❑ ____
- ❑ ____

Dimensions and Weights

Overall Size, L x W x H, max., mm (in.):	
40°C Radiator	6790 x 2426 x 2602 (267.3 x 95.5 x 102.4)
50°C Radiator	6831 x 2766 x 3091 (268.9 x 108.9 x 121.7)
Weight 40°C Radiator, wet, max., kg (lb.):	15422 (34000)
50°C Radiator	16329 (36000)



Note: This drawing is provided for reference only and should not be used for planning the installation. Contact your local distributor for more detailed information.

DISTRIBUTED BY:

CLARKE®
FIRE PUMP ENGINES

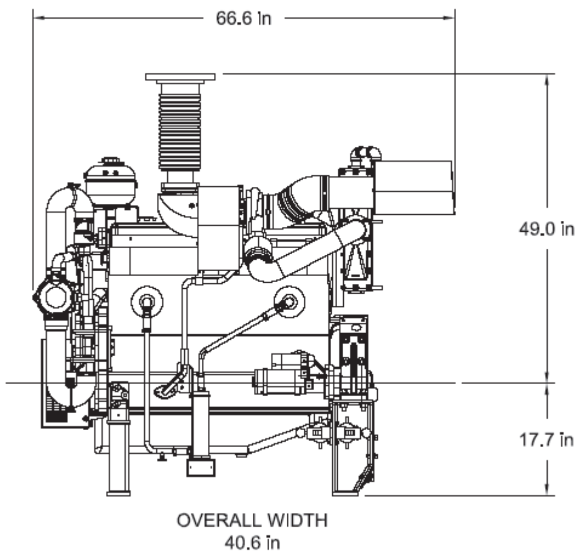
MODELS
DQ6H-UFAA4G DQ6H-UFAA60
DQ6H-UFAA40 DQ6H-UFAA88
DQ6H-UFAA48 DQ6H-UFAA50 DQ6H-UFAA98

FM-UL-cUL APPROVED RATINGS BHP/*KW*

DQ6H MODEL ♦ λ	RATED SPEED					
	1470		1760		2100	
DQ6H-UFAA48	240	*179*				
DQ6H-UFAA4G			290	*216*		
DQ6H-UFAA40					310	*231*
DQ6H-UFAA50					340	*254*
DQ6H-UFAA60			345	*257*	360	*269*
DQ6H-UFAA88			375	*280*		
DQ6H-UFAA98	300	*224*	410	*306*		

♦ All Models are available for Export

λ = Non-Emissionized



SPECIFICATIONS

ITEM	DQ6H MODELS						
	UFAA48	UFAA4G	UFAA40	UFAA50	UFAA60	UFAA88	UFAA98
Number of Cylinders	6						
Aspiration	TRWA						
Rotation*	CW						
Weight – lb (kg)	2500 (1134)						
Compression Ratio	17:1						
Displacement – cu. in. (l)	674 (11.1)						
Engine Type	4 Cycle, 2 Valves per Cylinder, In-Line						
Bore & Stroke – in. (mm)	4.84 x 6.1 (123 x 155)						
Installation Drawing	D658						
Wiring Diagram AC	C07651						
Wiring Diagram DC	C071842						
Engine Series	126 Series						
Speed Interpolation	Optional						

Abbreviations: CW – Clockwise TRWA – Turbocharged with Raw Water Aftercooling

*Rotation viewed from Heat Exchanger / Front of engine

CERTIFIED POWER RATING

- Each engine is factory tested to verify power and performance.

ENGINE RATINGS BASELINES

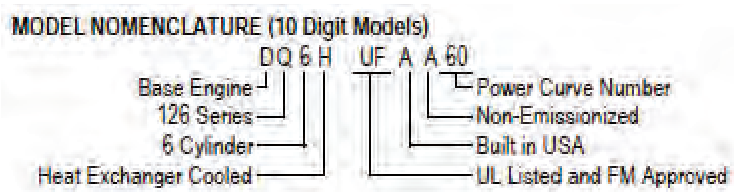
- Engines are to be used for stationary emergency standby fire pump service only. Engines are to be tested in accordance with NFPA 25.
- Engines are rated at standard SAE conditions of 29.61 in. (752.1 mm) Hg barometer and 77°F (25°C) inlet air temperature [approximates 300 ft. (91.4 m) above sea level] by the testing laboratory (see SAE Standard J 1349).
- A deduction of 3 percent from engine horsepower rating at standard SAE conditions shall be made for diesel engines for each 1000 ft. (305 m) altitude above 300 ft. (91.4 m)
- A deduction of 1 percent from engine horsepower rating as corrected to standard SAE conditions shall be made for diesel engines for every 10°F (5.6°C) above 77°F (25°C) ambient temperature.

c UL us   Meets NFPA 20 Requirements   FM APPROVED

ENGINE EQUIPMENT

EQUIPMENT	STANDARD	OPTIONAL
Air Cleaner	Direct Mounted, Washable, Indoor Service with Drip Shield	Disposable, Drip Proof, Indoor Service Outdoor Type, Single or Two Stage
Alternator	24V-DC, 45 Amps with Dual (2) V-Belt Drive with Guard	
Exhaust Protection	Blankets	
Coupling	Bare Flywheel	Listed Driveshaft CDS50-SC; Vertical Turbine Drivedisc
Exhaust Flex Connection	Stainless Steel Flex, 150# Flange Connection, 6”	Stainless Steel Flex, 150# Flange Connection, 8”
Flywheel Housing	SAE #1	
Flywheel Power Take Off	14.0” Industrial Flywheel Connection	
Fuel Connections	Fire Resistant, Flexible, USA Coast Guard Approved, Supply and Return Lines	
Fuel Filter	Primary and Secondary	
Fuel Injection System	Direct Injection, Inline Pump	
Engine Heater	230V-AC, 2000 Watt	115V-AC, 2000 Watt
Governor, Speed	Variable Speed, Mechanical	
Heat Exchanger	Tube and Shell Type, 60 PSI (4 BAR), NPT(F) Connections	Sea/Salt Water Compatible
Instrument Panel	Tachometer, Hourmeter, Water Temperature, Oil Pressure and Two (2) Voltmeters, Front Opening	
Junction Box	Integral with Instrument Panel; For DC Wiring Interconnection to Engine Controller	
Lube Oil Cooler	Engine Water Cooled, Plate Type	
Lube Oil Filter	Full Flow with By-Pass Valve	
Lube Oil Pump	Gear Driven, Gear Type	
Manual Start Control	On Instrument Panel with Control Position Warning Light	
Overspeed Control	Electronic with Reset and Test on Instrument Panel	
Raw Water Solenoid Operation	Automatic from Fire Pump Controller and from Engine Instrument Panel	
Run – Stop Control	On Instrument Panel with Control Position Warning Light	
Run Solenoid	24V-DC Energized to Stop	
Starters	One (1) 24V-DC with Two (2) Start Contactors	
Throttle Control	Adjustable Speed Control, Tamper Proof	
Water Pump	Centrifugal Type, Dual (2) V-Belt Drive with Guard	

Abbreviations: DC – Direct Current, AC – Alternating Current, SAE – Society of Automotive Engineers, NPT(F) – National Pipe Tapered Thread (Female)



CLARKE®

CLARKE Fire Protection Products, Inc.
3133 E. Kemper Rd., Cincinnati, Ohio 45241
United States of America
Tel +1-513-475-(FIRE)3473 Fax +1-513-771-0726
www.clarkefire.com

CLARKE UK, Ltd.
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United Kingdom
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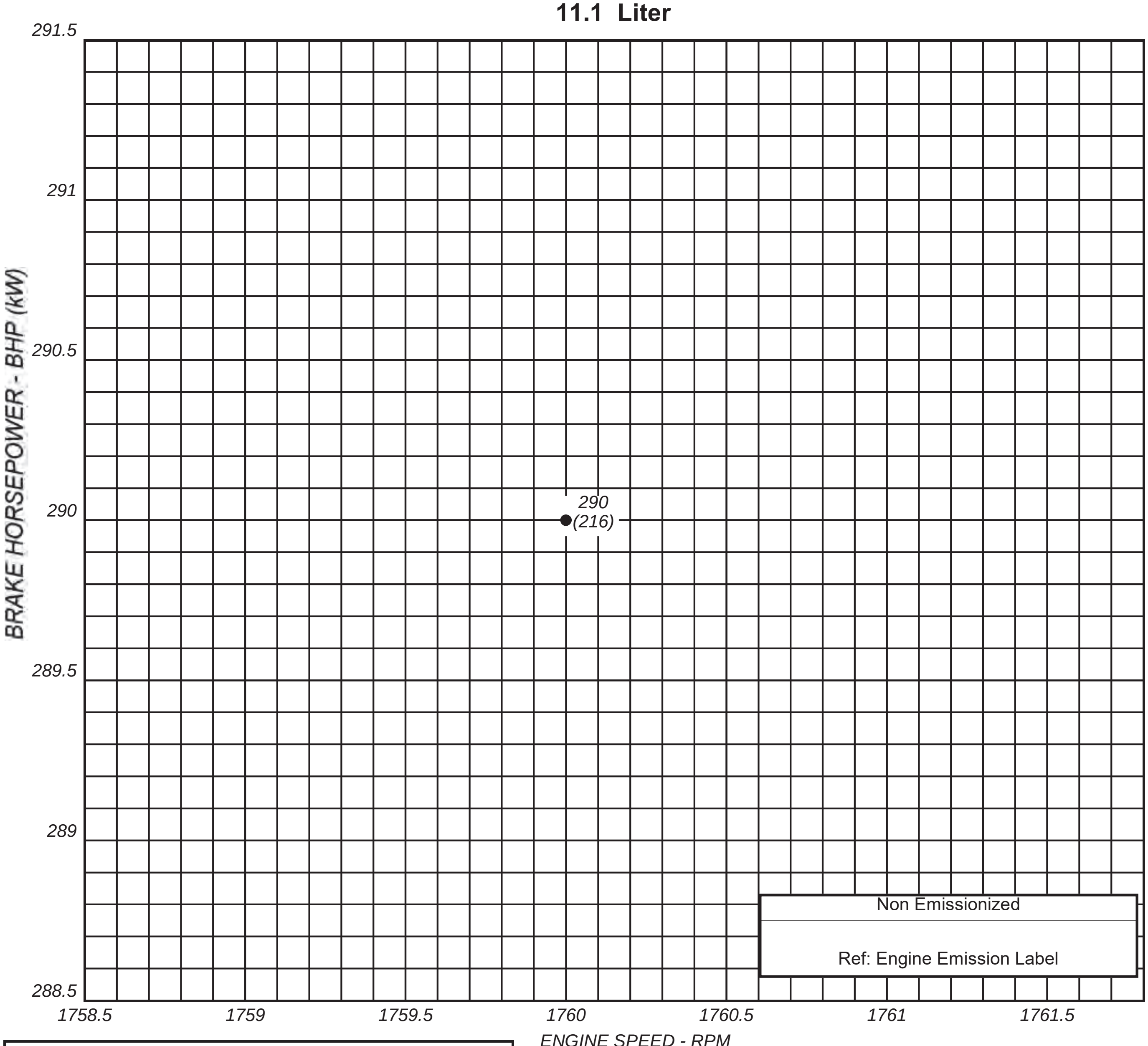
www.clarkefire.com

CLARKE

Fire Protection Products, Inc.

FIRE PUMP MODEL: DQ6H-UFAA4G
Heat Exchanger Cooled/Turbocharged
Raw Water Charge Cooling
11.1 Liter



RESTRICTED:
USE ONLY FOR STAND-BY FIRE PUMP APPLICATIONS

ENGINE PERFORMANCE:
STANDARD CONDITIONS: (SAE J1349, ISO 3046)
77°F (25°C) AIR INLET TEMPERATURE
29.61 IN. (751.1MM) HG BAROMETRIC PRESSURE
#2 DIESEL FUEL (SEE C13940)

KEVIN KUNKLER 01MAR11

●——● *NAMEPLATE BHP (MAXIMUM PUMP LOAD)*

CREATED	DATE CREATED	
KTK	03/01/11	
ENGINE MODEL DQ6H-UFAA4G		
DRAWING NO. C133486		REV A

CLARKE®

DQ6H-UFAA4G
INSTALLATION & OPERATION DATA (I&O Data)
USA Produced

Basic Engine Description

Engine Manufacturer	PU126TI
Ignition Type	Compression (Diesel)
Number of Cylinders	6
Bore and Stroke - in (mm)	4.84 (123) X 6.1 (155)
Displacement - in³ (L)	674.5 (11.1)
Compression Ratio	17:1
Valves per cylinder	
Intake	1
Exhaust	1
Combustion System	Direct Injection
Engine Type	In-Line, 4 Stroke Cycle
Fuel Management Control	Mechanical, Inline Pump
Firing Order (CW Rotation)	1-5-3-6-2-4
Aspiration	Turbocharged
Charge Air Cooling Type	Raw Water
Rotation, viewed from front of engine, Clockwise (CW)	Standard
Engine Crankcase Vent System	Open
Installation Drawing	D658
Weight - lb (kg)	2500 (1130)

Power Rating	**1760**
Nameplate Power - HP (kW)[1]	290 (216)

Cooling System - [C051529]	**1760**
Engine Coolant Heat - Btu/sec (kW)	139 (147)
Engine Radiated Heat - Btu/sec (kW)	19.6 (20.7)
Heat Exchanger Minimum Flow	
60°F (15°C) Raw H_20 - gal/min (L/min)	25 (94.6)
100°F (37°C) Raw H_20 - gal/min (L/min)	30 (114)
Heat Exchanger Maximum Cooling Raw Water	
Inlet Pressure - psi (bar)	60 (4.1)
Flow - gal/min (L/min)	80 (303)
Typical Engine H_20 Operating Temp - °F (°C)	170 (76.7) - 190 (87.8)
Thermostat	
Start to Open - °F (°C)	181 (82.8)
Fully Opened - °F (°C)	203 (95)
Engine Coolant Capacity - qt (L)	36 (34.1)
Coolant Pressure Cap - lb/in² (kPa)	10 (68.9)
Maximum Engine Coolant Temperature - °F (°C)	203 (95)
Minimum Engine Coolant Temperature - °F (°C)	160 (71.1)
High Coolant Temp Alarm Switch - °F (°C)	205 (96.1)

Electric System - DC	**Standard**	
System Voltage (Nominal)	24	
Battery Capacity for Ambients Above 32°F (0°C)		
Voltage (Nominal)	12	{C07633}
Qty. Per Battery Bank	2	
SAE size per J537	8D	
CCA @ 0°F (-18°C)	1400	
Reserve Capacity - Minutes	430	
Battery Cable Circuit, Max Resistance - ohm	0.0012	
Battery Cable Minimum Size		
0-120 in. Circuit Length [2]	00	
121-160 in. Circuit Length [2]	000	
161-200 in. Circuit Length [2]	0000	
Charging Alternator Maximum Output - Amp,	45	{65.26101-7153C}
Starter Cranking Amps, Rolling - @60°F (15°C)	250	{65.26101-7070D}

NOTE: This engine is intended for indoor installation or in a weatherproof enclosure. [1]Derate 3% per every 1000 ft. [304.8 m] above 300 ft. [91.4 m] and derate 1% for every 10 °F [5.55 °C] above 77° [25°C]. [2]Positive and Negative Cables Combined Length.

CLARKE®

DQ6H-UFAA4G
INSTALLATION & OPERATION DATA (I&O Data)
USA Produced

Exhaust System (Single Exhaust Outlet)	**1760**	
Exhaust Flow - ft.³/min (m³/min)	1427 (40.4)	
Exhaust Temperature - °F (°C)	796 (424)	
Maximum Allowable Back Pressure - in H_20 (kPa)	30 (7.5)	
Minimum Exhaust Pipe Dia. - in (mm)[3]	6 (152)	
Fuel System	**1760**	
Fuel Consumption - gal/hr (L/hr)	22 (83.3)	
Fuel Return - gal/hr (L/hr)		
Fuel Supply - gal/hr (L/hr)		
Fuel Pressure - lb/in² (kPa)	25 (172) - 35 (241)	
Minimum Line Size - Supply - in.	.50 Schedule 40 Steel Pipe	
Pipe Outer Diameter - in (mm)	0.848 (21.5)	
Minimum Line Size - Return - in.	.375 Schedule 40 Steel Pipe	
Pipe Outer Diameter - in (mm)	0.675 (17.1)	
Maximum Allowable Fuel Pump Suction Lift with clean Filter - in H_20 (mH_20)	31 (0.8)	
Maximum Allowable Fuel Head above Fuel pump, Supply or Return - ft (m)	9 (2.7)	
Fuel Filter Micron Size	5	
Heater System	**Standard**	**Optional**
Engine Coolant Heater		
Wattage (Nominal)	2000	2000
Voltage - AC, 1 Phase	230 (+5%, -10%)	115 (+5%, -10%)
Part Number	{C122193}	{C122189}
Air System		
Combustion Air Flow - ft.³/min (m³/min)	610 (17.3)	
Air Cleaner	**Standard**	**Optional**
Part Number	{C03244}	{C03330}
Type	Indoor Service Only, with Shield	Canister, Single-Stage
Cleaning method	Washable	Disposable
Dirty Air Cleaner - in H_20 (kPa)	14 (3.5)	14 (3.5)
Clean Air Cleaner - in H_20 (kPa)	7 (1.7)	7 (1.7)
Maximum Allowable Temperature - °F (°C)	130 (54.4)	
Lubrication System		
Oil Pressure - normal - lb/in² (kPa)	65 (448) - 77 (531)	
Low Oil Pressure Alarm Switch - lb/in² (kPa)	20 (138)	
In Pan Oil Temperature - °F (°C)	180 (82.2) - 248 (120)	
Total Oil Capacity with Filter - qt (L)	24.4 (23.1)	
Lube Oil Heater	**Optional**	**Optional**
Wattage (Nominal)	150	150
Voltage	240V (+5%, -10%)	120V (+5%, -10%)
Part Number	C04430	C04431
Performance	**1760**	
BMEP - lb/in² (kPa)	193 (1330)	
Piston Speed - ft/min (m/min)	1789 (545)	
Mechanical Noise - dB(A) @ 1m	C133939	
Power Curve	C133846	

[3]Minimum Exhaust Pipe Diameter is based on: 15 feet of pipe, one 90° elbow, and one Industrial silencer. A Back-pressure flow analysis must be performed on the actual field installed exhaust system to assure engine maximum allowable back pressure is not exceeded. See Exhaust Sizing Calculator on www.clarkefire.com.
{ } indicates component reference part number.

DQ6H
ENGINE MATERIALS AND CONSTRUCTION

Air Cleaner
Type……………………………. Indoor Usage Only
Oiled Fabric Pleats
Material……………………… Surgical Cotton
Aluminum Mesh

Air Cleaner - Optiona
Type…………………………. Canister
Material……………………… Pleated Paper
Housing……………………… Enclosed

Camshaft
Material……………………… Carbon Steel
Induction Hardening
Location……………………… In Block
Drive…………………………. Gear, Spur
Type of Cam………………… Ground

Charge Air Cooler
Type…………………………. Raw Water Cooled
Materials (in contact with raw water)
Tubes………………………. 90/10 CU/NI
Headers……………………. 36500 Muntz
Covers……………………… 83600 Red Brass
Plumbing…………………… 316 Stainless Steel/ Brass
90/10 Silicone

Coolant Pump
Type…………………………. Centrifugal
Drive…………………………. Gear

Coolant Thermostat
Type…………………………. Full Blocking
Qty…………………………… 2

Cooling Loop (Galvanized)
Tees, Elbows, Pipe………… Galvanized Steel
Ball Valves…………………. Brass ASTM B 124
Solenoid Valve……………. Brass
Pressure Regulator……….. Bronze
Strainer……………………… Cast Iron (1/2"- 1" Loops)
or Bronze (1.25" - 2" Loops)

Cooling Loop (Sea Water)
Tees, Elbows, Pipe………… 316 Stainless Steel
Ball Valves…………………. 316 Stainless Steel
Solenoid Valve……………. 316 Stainless Steel
Pressure Regulator/Strainer. Cast Brass ASTM B176 C87800

Cooling Loop (316SS)
Tees, Elbows, Pipe………… 316 Stainless Steel
Ball Valves…………………. 316 Stainless Steel
Solenoid Valve……………. 316 Stainless Steel
Pressure Regulator/Strainer. 316 Stainless Steel

Connecting Rod
Type…………………………. Diagonally Split
Material……………………… Die Forged Steel

Crank Pin Bearings
Type…………………………. One Piece
Material……………………… Steel backed, Lead Bronze

Crankshaft
Material……………………… Forged Steel
Type of Balance……………. Dynamic

Cylinder Block
Type…………………………. One Piece with
Non-Siamese Cylinders
Material……………………… Cast Iron Alloy

Cylinder Head
Type…….. ……………………. 3 Cyl. Slab
Material…… …………………. Cast Iron

Cylinder Liners
Type…………………………… Centrifugal Cast, Dry Liner
Material……………………….. Alloy Iron Plateau, Honed

Valves
Type…………………………… Poppet
Arrangement…………………. Overhead Valve
Number/Cylinder……………. 1 intake
1 exhaust
Operating Mechanism………. Mechanical Rocker Arm
Valve Seat Insert…………… Replaceable

Fuel Pump
Type…………………………… Piston
Drive…………………………… Cam Lobe

Heat Exchanger - Standard (Non-Sea Water Compatible)
Type…………………………… Tube & Shell
Materials (in contact with raw water)
Tubes………………………… Copper
Headers……………………… Rubber
Shell…………………………. Aluminum
Housings…………………… Cast Iron
Electrode……………………. Zinc

Heat Exchanger - Optional (Sea Water Compatible)
Type………………………… Tube & Shell
Materials (in contact with raw water)
Tubes………………………… Copper
Headers……………………… Copper
Shell…………………………. Copper
Electrode……………………. Zinc

Injection Pump
Type…………………………… In-Line
Drive…………………………… Gear

Lubrication Cooler
Type…………………………… Plate

Lubrication Pump
Type…………………………… Gear
Drive…………………………… Gear

Main Bearings
Type…………………………… Precision Half Shells
Material……………………….. Steel Backed, Lead Bronze

Piston
Type and Material…………… Aluminum Alloy with Reinforced
Top Ring Groove
Cooling……………………….. Oil Jet Through Drive

Piston Pin
Type…………………………… Fixed

Piston Rings
Number/Piston………………. 3
Top…………………………….. Keystone Barrel Faced-
Gas Nitride Coated
Second……………………….. Tapered Cast Iron
Hard Chrome Coated
Third…………………………… Double Rail Type
w/Expander Spring

DATUMS:
-A- - MOUNTING FACE OF FLYWHEEL
-B- - ENGINE CRANKSHAFT HORIZONTAL ℄
-C- - ENGINE CRANKSHAFT VERTICAL ℄
- CENTER OF GRAVITY
- CLOCKWISE (CW) ROTATION WHEN VIEWED FROM FRONT OF ENGINE

CAUTION:
ALL PLUMBING MUST BE SUPPORTED AND/OR ISOLATED SO THAT NO WEIGHT OR STRESS IS APPLIED TO ANY ENGINE COMPONENT

ATTENTION:
REFER TO THE SPECIFIC MODELS' "INSTALLATION AND OPERATION DATA" FOR INSTALLATION GUIDELINES

AVAILABLE MODELS:
DQ6H-UFAA4G, DQ6H-UFAA48, DQ6H-UFAA40, DQ6H-UFAA50, DQ6H-UFAA60, DQ6H-UFAA88, DQ6H-UFAA98

*DQ6H-UFKA4G, DQ6H-UFKA48, DQ6H-UFKA40, DQ6H-UFKA50, DQ6H-UFKA60, DQ6H-UFKA88, DQ6H-UFKA98

(ALL MODELS ARE TURBOCHARGED WITH RAW WATER AFTER COOLING)

NOTES:
1) FUEL SUPPLY PIPING FROM TANK TO ENGINE SHOULD BE 1/2" MINIMUM PIPE DIAMETER
2) FUEL RETURN PIPING FROM TANK TO ENGINE SHOULD BE 3/8" MINIMUM PIPE DIAMETER

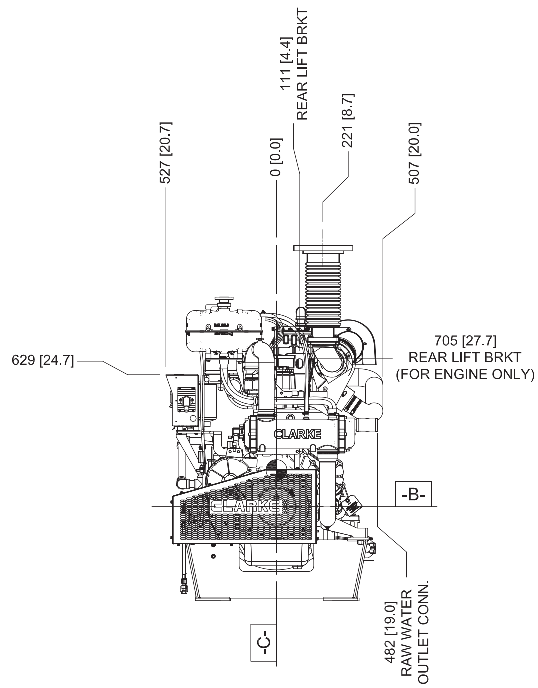
DRAWING SUBJECT TO CHANGE WITHOUT NOTICE

DO NOT SCALE

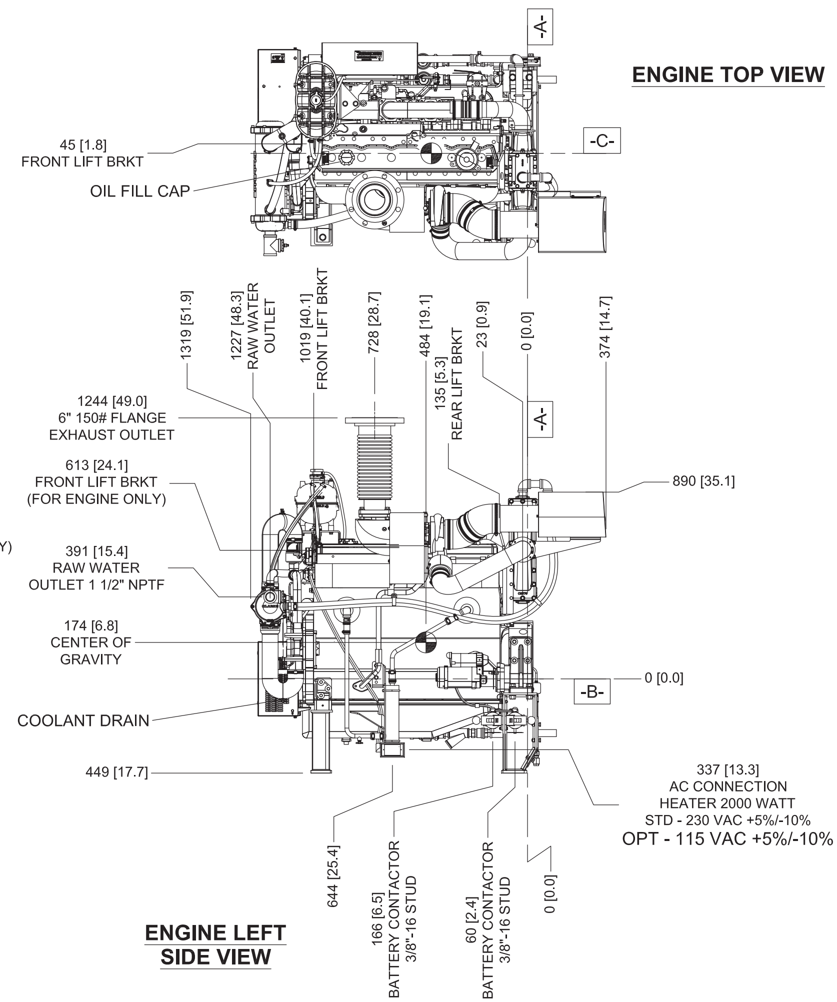
NOTE:
THE LOOP SHOWN IS BASED ON STANDARD LOOP CONSTRUCTION AND FM SIZING CONDITIONS

FOR ALTERNATE LOOP CONSTRUCTION (STAINLESS STEEL, SEA WATER, AND HIGH PRESSURE) SIZES MAY VARY

FOR ENGINES BUILT IN USA BEGINNING APRIL 2015



ENGINE FRONT VIEW



ENGINE TOP VIEW

ENGINE LEFT SIDE VIEW

REV	DESCRIPTION	ECN#	DWN	APVD	DATE
J	1-1/2" NIPPLE AND 90° ELBOW ADDED TO SIDE OUTLET OF HEAT EXCHANGER	3278	JDH	[illegible]	12JUN14
K	FUEL SUPPLY AND RETURN CALLOUTS WERE IN ERROR	3784	MLL	JCA	17OCT14
L	ADDED COOLING LOOP/PIPING KIT	3631	KFB	[illegible]	30JAN15
M	ADDED FLYWHEEL INFO	4179	JGV	[illegible]	05AUG15
N	RAW WATER OUTLET SIZE WAS 1 1/4"	4345	CMM	[illegible]	01DEC15
P	UPDATED COOLING LOOP, ADDED INDICATOR PLATES	4359	PMK	[illegible]	15DEC15
Q	UPDATED COOLANT GEOMETRY TO SHOW ISOLATORS	4475	JGV	JCA	07MAR16
R	REMOVED ENGINE MODELS DQ6H-UFAAX8 / DQ6H-UFKAX8	4764	RDR	[illegible]	25OCT16
S	ADDED DIMS TO ENGINE LIFTING BRACKETS	5061	MDM	[illegible]	26JUN17

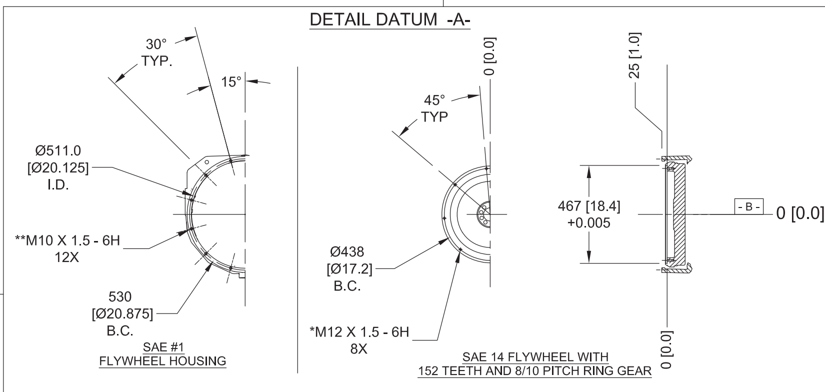
MACHINE TOLERANCE: DECIMAL mm / inch; X. ± 1.5; X.X ± 0.8 / ± 0.06; X.XX ± 0.3 / ± 0.03; X.XXX ± 0.025 / ± 0.01; X.XXXX ± 0.001; ANGULAR: ± 0.5°
FABRICATION TOLERANCE: DECIMAL mm / inch; X. ± 3; X.X ± 1.5 / ± 0.12; X.XX ± 0.06; ANGULAR: ± 1.0°

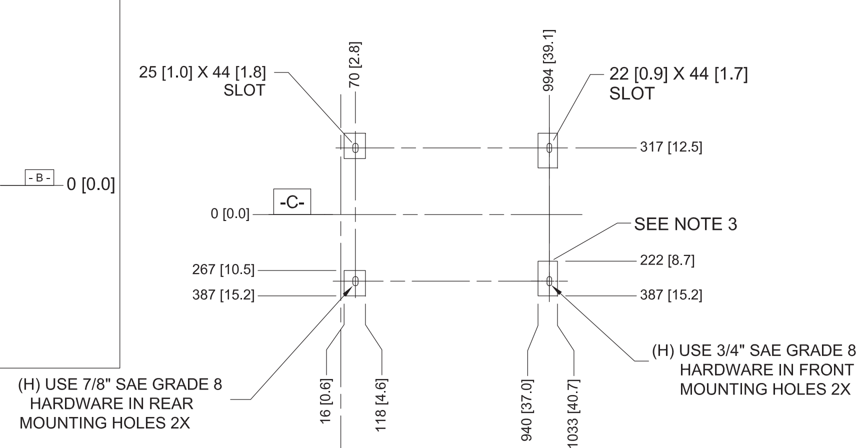
CONTROLLED DRAWING: YES / NO

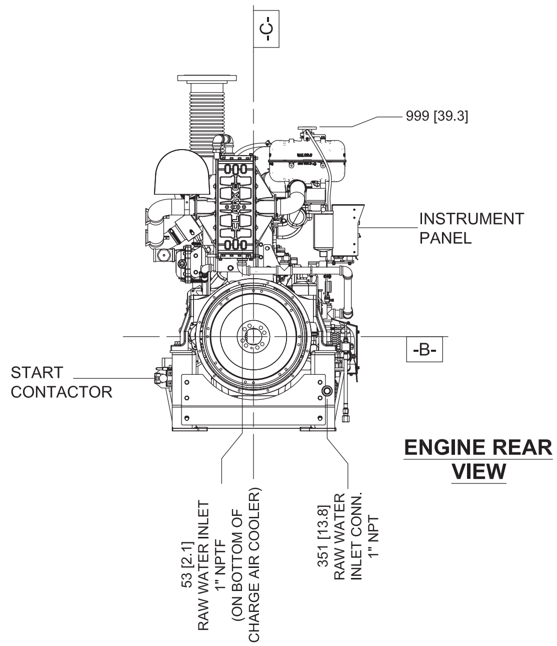
CLARKE
Fire Protection Products, Inc.

DRWN	RTOLLE
DATE	12/9/2010
ENGR	KKUNKLER
MATERIAL	
ASSEMBLY	DQ6H-UFAA/-UFKA
NAME	INSTALLATION DRAWING, DQ6H-UFAA/-UFKA MODELS, DIESEL FIRE PUMP DRIVER
PART NO.	D658
REV	S
SCALE	NTS
UNITS	MM [INCH]
PAGE	1 OF 2

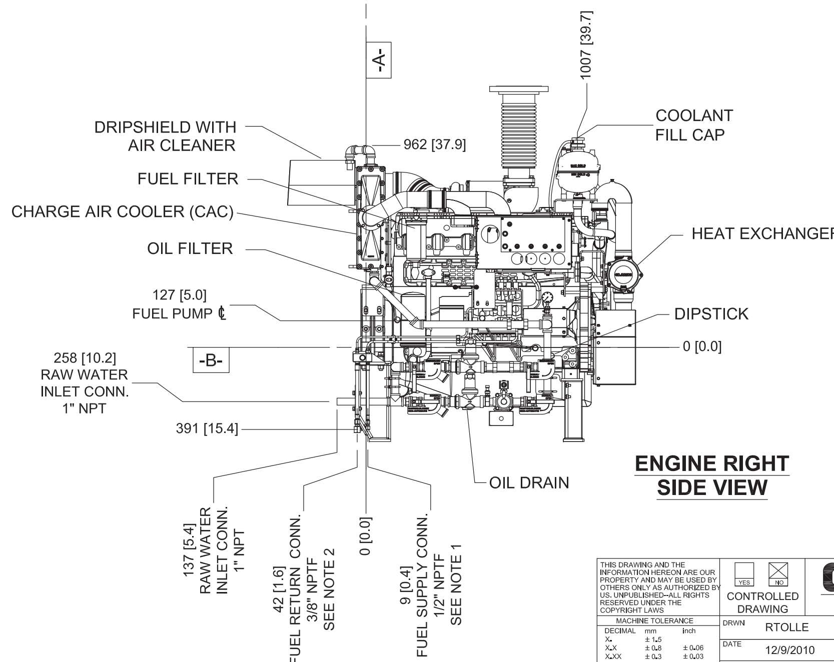
DETAIL DATUM -A-







ENGINE REAR VIEW



ENGINE RIGHT SIDE VIEW

NOTES:
1) FUEL SUPPLY PIPING FROM TANK TO ENGINE SHOULD BE 1/2" MINIMUM PIPE DIAMETER
2) FUEL RETURN PIPING FROM ENGINE TO TANK SHOULD BE 3/8" MINIMUM PIPE DIAMETER
3) ENGINE MOUNTING FEET ARE SYMMETRICAL ABOUT CRANKSHAFT CENTERLINE DATUM -C-

MACHINE TOLERANCE

DECIMAL	mm	inch
X.	± 1.5	
X.X	± 0.8	± 0.06
X.XX	± 0.3	± 0.03
X.XXX	± 0.025	± 0.01
X.XXXX		± 0.001

ANGULAR: ± 0.5'

FABRICATION TOLERANCE

DECIMAL	mm	inch
X.	± 3	
X.X	± 1.5	± 0.12
X.XX		± 0.06

ANGULAR: ± 1.0'

YES NO CONTROLLED DRAWING

CLARKE *Fire Protection Products, Inc.*

DRWN	RTOLLE
DATE	12/9/2010
ENGR	KKUNKLER
MATERIAL	
ASSEMBLY	DQ6H

NAME: INSTALLATION DRAWING DQ6H-UFAA MODELS DIESEL FIRE PUMP DRIVER

PART NO.	REV
D658	S

SCALE	UNITS	PAGE	OF
NTS	MM [INCH]	2	2

DQ6H-UFAA4G
FIRE PUMP DRIVER
NOISE DATA

Mechanical Engine Noise *

RPM	BHP	OVERALL	Octave Band									
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz	16k Hz
		dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1760	290	109.2	67	69.2	82.6	89.2	97.1	99.7	104.9	103.4	101.7	101.7

Raw Exhaust Engine Noise **

RPM	BHP	OVERALL	Octave Band									
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz	16k Hz
		dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1760												

** Values above are provided at 3.3ft (1m) from engine block and do not include the raw exhaust noise.*

*** Values above are provided at 23ft (7m), 90° horizontal, from a vertical exhaust outlet and does not include noise created mechanically by the engine.*

The above data reflects values for a typical engine of this model, speed and power in a free-field environment.

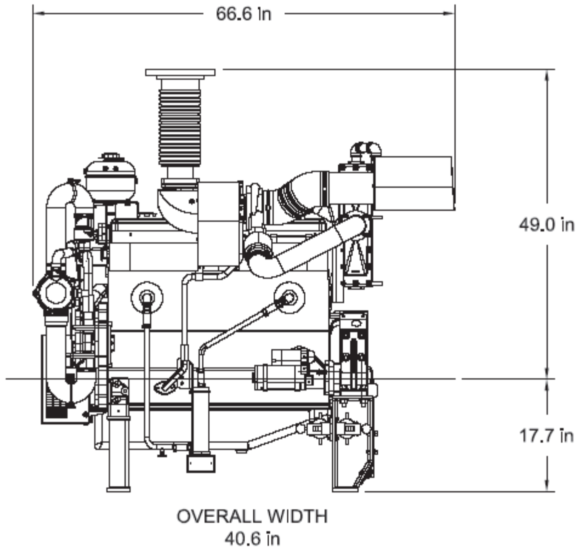
Installation specifics such as background noise level and amplification of noise levels from reflecting off of surrounding objects, will affect the overall noise levels observed. As a result of this, Clarke makes no guarantees to the above levels in an actual installation.

FM-UL-cUL APPROVED RATINGS BHP/*KW*

DQ6H MODEL ♦ λ	RATED SPEED 1470		1760		2100	
DQ6H-UFAA48	**240**	*179*				
DQ6H-UFAA4G			**290**	*216*		
DQ6H-UFAA40					**310**	*231*
DQ6H-UFAA50					**340**	*254*
DQ6H-UFAA60			**345**	*257*	**360**	*269*
DQ6H-UFAA88			**375**	*280*		
DQ6H-UFAA98	**300**	*224*	**410**	*306*		

♦ All Models are available for Export

λ = Non-Emissionized



SPECIFICATIONS

ITEM	DQ6H MODELS: UFAA48	UFAA4G	UFAA40	UFAA50	UFAA60	UFAA88	UFAA98
Number of Cylinders	6						
Aspiration	TRWA						
Rotation*	CW						
Weight – lb (kg)	2500 (1134)						
Compression Ratio	17:1						
Displacement – cu. in. (l)	674 (11.1)						
Engine Type	4 Cycle, 2 Valves per Cylinder, In-Line						
Bore & Stroke – in. (mm)	4.84 x 6.1 (123 x 155)						
Installation Drawing	D658						
Wiring Diagram AC	C07651						
Wiring Diagram DC	C071842						
Engine Series	126 Series						
Speed Interpolation	Optional						

Abbreviations: CW – Clockwise TRWA – Turbocharged with Raw Water Aftercooling

*Rotation viewed from Heat Exchanger / Front of engine

CERTIFIED POWER RATING

- Each engine is factory tested to verify power and performance.

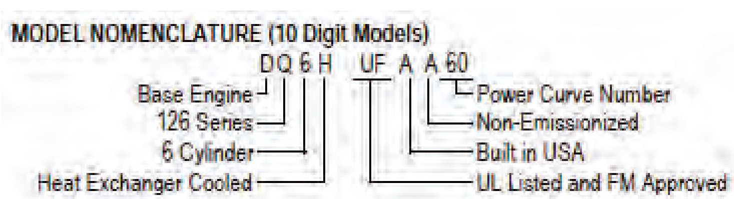
ENGINE RATINGS BASELINES

- Engines are to be used for stationary emergency standby fire pump service only. Engines are to be tested in accordance with NFPA 25.
- Engines are rated at standard SAE conditions of 29.61 in. (752.1 mm) Hg barometer and 77°F (25°C) inlet air temperature [approximates 300 ft. (91.4 m) above sea level] by the testing laboratory (see SAE Standard J 1349).
- A deduction of 3 percent from engine horsepower rating at standard SAE conditions shall be made for diesel engines for each 1000 ft. (305 m) altitude above 300 ft. (91.4 m)
- A deduction of 1 percent from engine horsepower rating as corrected to standard SAE conditions shall be made for diesel engines for every 10°F (5.6°C) above 77°F (25°C) ambient temperature.

ENGINE EQUIPMENT

EQUIPMENT	STANDARD	OPTIONAL
Air Cleaner	Direct Mounted, Washable, Indoor Service with Drip Shield	Disposable, Drip Proof, Indoor Service Outdoor Type, Single or Two Stage
Alternator	24V-DC, 45 Amps with Dual (2) V-Belt Drive with Guard	
Exhaust Protection	Blankets	
Coupling	Bare Flywheel	Listed Driveshaft CDS50-SC; Vertical Turbine Drivedisc
Exhaust Flex Connection	Stainless Steel Flex, 150# Flange Connection, 6”	Stainless Steel Flex, 150# Flange Connection, 8”
Flywheel Housing	SAE #1	
Flywheel Power Take Off	14.0” Industrial Flywheel Connection	
Fuel Connections	Fire Resistant, Flexible, USA Coast Guard Approved, Supply and Return Lines	
Fuel Filter	Primary and Secondary	
Fuel Injection System	Direct Injection, Inline Pump	
Engine Heater	230V-AC, 2000 Watt	115V-AC, 2000 Watt
Governor, Speed	Variable Speed, Mechanical	
Heat Exchanger	Tube and Shell Type, 60 PSI (4 BAR), NPT(F) Connections	Sea/Salt Water Compatible
Instrument Panel	Tachometer, Hourmeter, Water Temperature, Oil Pressure and Two (2) Voltmeters, Front Opening	
Junction Box	Integral with Instrument Panel; For DC Wiring Interconnection to Engine Controller	
Lube Oil Cooler	Engine Water Cooled, Plate Type	
Lube Oil Filter	Full Flow with By-Pass Valve	
Lube Oil Pump	Gear Driven, Gear Type	
Manual Start Control	On Instrument Panel with Control Position Warning Light	
Overspeed Control	Electronic with Reset and Test on Instrument Panel	
Raw Water Solenoid Operation	Automatic from Fire Pump Controller and from Engine Instrument Panel	
Run – Stop Control	On Instrument Panel with Control Position Warning Light	
Run Solenoid	24V-DC Energized to Stop	
Starters	One (1) 24V-DC with Two (2) Start Contactors	
Throttle Control	Adjustable Speed Control, Tamper Proof	
Water Pump	Centrifugal Type, Dual (2) V-Belt Drive with Guard	

Abbreviations: DC – Direct Current, AC – Alternating Current, SAE – Society of Automotive Engineers, NPT(F) – National Pipe Tapered Thread (Female)



CLARKE®

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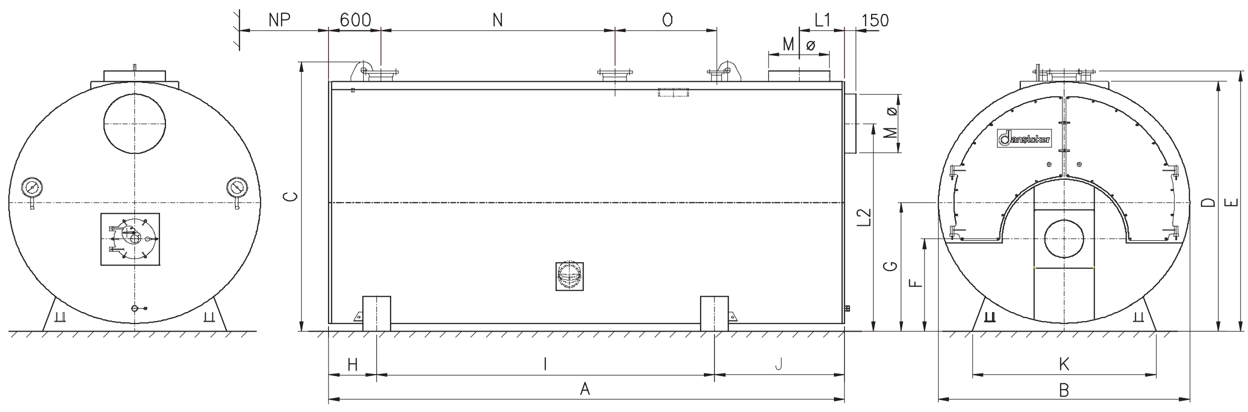
Tel +44-1236-429946 Fax +44-1236-427274
www.clarkefire.com

Member of the Danstoker Group

GLOBAL No.1-13

Low Temperature Hot Water Boiler
High Temperature Hot Water Boiler



For exact measures: Please consult the Arrangement drawing

	Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13
Heat Output	**kW**	1000	1250	1500	2000	2500	3000	3500	4250	5000	6000	7500	8500	10000
A	mm	3200	3350	3500	3900	4075	4350	4500	4850	5150	5450	5750	5950	6700
A og H (16 bar-g boilers)	mm	+350	+350	+350	+350	+350	+400	+400	+400	+400	+450	+450	+450	+450
B	mm	1690	1840	1840	1970	2040	2200	2290	2370	2480	2660	2830	2900	2980
C	mm	2020	2170	2170	2300	2370	2530	2630	2710	2820	3000	3170	3240	3320
D	mm	1805	1960	1960	2095	2165	2330	2400	2490	2595	2760	2940	3010	3095
E	mm	1920	2070	2070	2200	2270	2430	2520	2600	2710	2890	3060	3130	3210
F	mm	680	735	735	775	800	862	895	935	964	1030	1081	1113	1140
G	mm	945	1020	1020	1085	1120	1200	1245	1285	1340	1430	1515	1550	1590
H	mm	550	550	550	550	550	550	550	550	550	600	600	600	600
I	mm	1500	1650	1800	2200	2375	2575	2700	3050	3350	3500	3700	3800	4550
J	mm	1150	1150	1150	1150	1150	1225	1250	1250	1250	1350	1450	1550	1550
K	mm	1235	1345	1345	1440	1490	1610	1675	1730	1810	1940	2065	2120	2160
L1	mm	385	385	385	385	385	385	450	450	450	450	520	520	520
L2	mm	1520	1645	1645	1750	1795	1930	2020	2075	2160	2315	2460	2505	2560
Mø (inside diameter)	mm	250	300	300	350	400	450	450	500	550	600	650	700	750
N	mm	750	900	1050	1450	1625	1625	1600	1950	2100	2400	2600	2700	3450
NP	mm	1900	2030	2200	2580	2750	2930	3050	3400	3700	3900	4100	4200	4950
O	mm	875	875	875	875	875	1075	1075	1075	1175	1175	1175	1175	1175
Length furnace excl. VK	mm	2350	2500	2650	3050	3225	3425	3550	3900	4200	4450	4650	4750	5500
Lengts furnace incl. VK	mm	2725	2875	3025	3425	3600	3800	3950	4300	4600	4850	5150	5350	6100
Diameter furnace	mm	660	760	760	830	900	960	1022	1080	1130	1208	1310	1360	1410
Flue gas resistance (⊠)	mbar	5,0	4,5	6,0	6,5	7,0	7,5	8,0	8,0	8,0	8,0	10,0	11,0	12,5
Flue gas temp.. (⊠)	ºC	205/240	205/240	205/240	205/240	205/240	205/240	205/240	205/240	205/240	205/240	205/240	205/240	205/240
Pressuredrop waterside @ Δt 30 C	mbar	35	25	30	25	35	50	35	50	25	30	50	25	35
Water content	m^3	2,71	3,35	3,55	4,71	5,2	6,8	7,45	8,55	10,2	12,6	14,9	15,1	19,0
Flue gas volume	m^3	2,0	2,5	2,6	3,3	4,0	4,6	5,6	6,9	7,7	9,3	11,5	12,3	15,5
Weight 4,0 bar-g	ton	3,1	3,8	3,9	4,7	5,2	6,3	7,0	8,5	9,0	10,9	13,2	14,0	16,6
Weight 6,0 bar-g	ton	3,2	3,9	4,0	4,8	5,4	6,6	7,6	8,7	9,8	11,8	13,7	15,2	18,1
Weight 10,0 bar-g	ton	3,8	4,5	4,7	5,6	6,3	7,7	8,9	10,2	11,5	13,8	16,1	18,9	21,2
Weight 16,0 bar-g	ton	4,6	5,6	5,9	6,9	7,8	9,8	11,1	12,8	13,9	16,9	19,4	20,8	27,0

(⊠) @ N-gas / gasolie $O_{2\ tør}$ = 2,1%, t: 75/60 ºC / 130/100 ºC, The manufacture reserves the right to make alterations. 06-09-10

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Sydbank A/S

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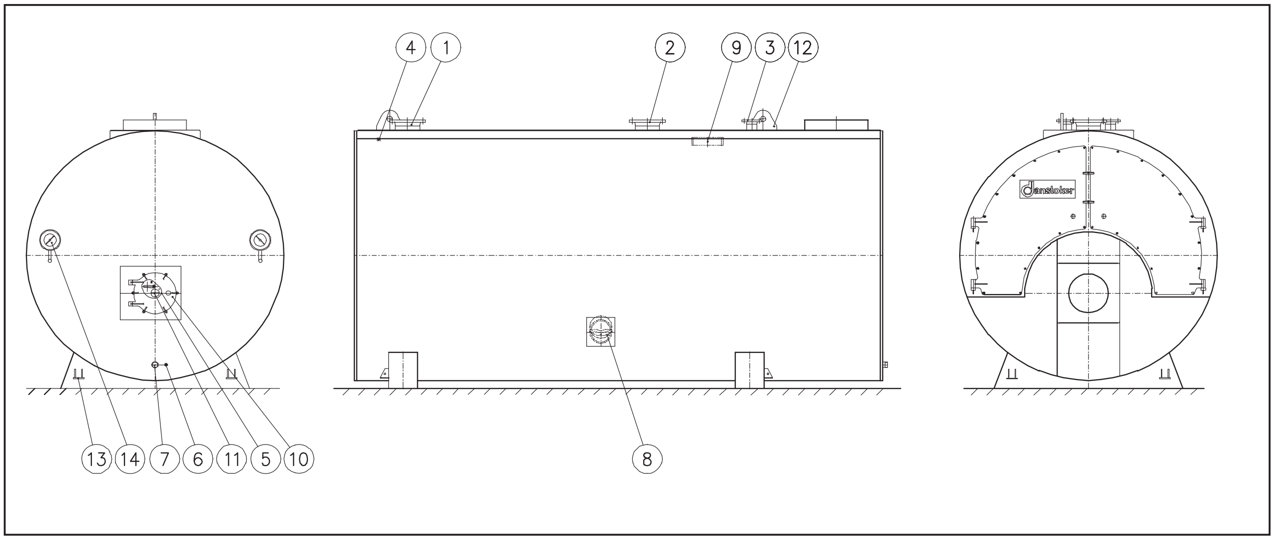
GLOBAL No.1-13

Low Temperature Hot Water Boiler
High Temperature Hot Water Boiler



		Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13
	Heat Output	kW	1000	1250	1500	2000	2500	3000	3500	4250	5000	6000	7500	8500	10000
Pos	**Branch**														
1	Flow	DN	80	100	100	125	125	125	150	150	200	200	200	250	250
2	Return	DN	80	100	100	125	125	125	150	150	200	200	200	250	250
3	Safety valve **4,0 Bar-g**	DN	2 x 32	2 x 40	2 x 40	2 x 50	2 x 65	2 x 65	2 x 65	2 x 80	2 x 80	2 x 80	2 x 100	2 x 100	2 x 125
3	Safety valve **6,0 Bar-g**	DN	2 x 32	2 x 32	2 x 40	2 x 40	2 x 50	2 x 50	2 x 65	2 x 65	2 x 65	2 x 80	2 x 80	2 x 100	2 x 100
3	Safety valve **10,0 Bar-g**	DN	2 x 25	2 x 25	2 x 32	2 x 32	2 x 40	2 x 40	2 x 50	2 x 50	2 x 50	2 x 65	2 x 65	2 x 65	2 x 85
3	Safety valve **16,0 Bar-g**	DN	2 x 25	2 x 25	2 x 25	2 x 32	2 x 32	2 x 32	2 x 40	2 x 40	2 x 40	2 x 50	2 x 50	2 x 65	2 x 65
4	Measuring 4 x	RG	3/4”	3/4”	¾”	¾”	3/4”	3/4”	¾”	3/4”	¾”	3/4”	3/4”	3/4”	3/4”
5	Measuring	RG	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”	1/4”
6	Standstill shunt	RG	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”	3/4”
7	Drain	RG	2”	2”	2”	2”	2”	2”	2”	2”	2”	2”	2”	2”	2”

Pos		**Pos**	
8	Head hole 220 x 320 mm	**12**	Lifting Eyes (2 pcs.)
9	Man hole 320 x 420 mm	**13**	Handling Brackets
10	Access door (Inspection)	**14**	Cleaning Covers
11	Inspection hole		

The manufacture reserves the right to make alterations.

Appendix D

BACT Calculations

PTE Calculations

Please refer to Baseine Emission Calculations

Potential emissions for the existing engine are based on manufacturer guarantees.

NO_X emissions (existing), tons	5.10
NO_X Emissions associated with replacement units, tons	0.51
NO_X emissions reduction, tons	4.59
Net Emissions Reduction, tons	4.59

Pollutant	**NO_X**	**% red.**
Existing PTE (tons/yr)	5.10	~
Tier 4 Engines PTE (tons/yr)	0.51	90%

Tons of emissions potentially saved per year by purchasing new engines: **4.59**

Emission reduction - cost per ton: **$207,133.98**

Tier 4 Engine

Interest

Preferred Commercial Lending Rate (i)	6.00%
Project Duration in Years (n)	20

Capital Recovery Factor

$$(A/P, i\%, n) = \frac{i(1+i)^n}{(1+i)^n - 1}$$

(A/P, 6.00%, 1) 0.0872

Description of Cost

Capital Cost	
Equipment Installation Costs	**Estimate**
Quoted cost for a Tier 4 engine, 1000 kW	$9,263,157.89
Additional capital cost to accommodate tax, transport, etc. (15%)	$1,389,473.68
Capital Cost Summary	**$10,652,631.58**
Additional Annual Cost	$22,000.00
Annual Cost Summary	**$22,000.00**
ANNUALIZED COST OF CONTROL* *(Capital Cost*Capital Recovery Factor) + Annual Cost*	**$950,744.96**

*Equipment capital costs, installation costs, and annual maintenance costs were taken from manufacturer quotes. Emissions reduction % is based on the difference between manufacturer emission guarantees for the existing generator and Tier 4 emission standards for a comparably-sized new generator.

Appendix E

Air Dispersion Modeling Analysis Report

Air Dispersion Modeling Report – Revision 2

TSMC Phoenix Project
Phoenix, Maricopa County, Arizona
MCAQD Permit No. To Be Assigned

TSMC Arizona Corp

March 08, 2022

Contents

Figure index

Table index

Appendices

1. Introduction

1.1 Project Information

Table 1 Project Information

Item	Information
Owner/Operator	TSMC
Facility Name	TSMC Arizona – Fab 21
Facility Address	NW corner of 43rd Avenue and State Route 303 Phoenix, AZ 85084
Contact Person Name, Title, Email, Phone Number	Qi Zhang, Senior Air Quality Specialist qi.zhang@ghd.com, (832) 380-7633
Facility Classification	Non-Title V
Application Type	New Source

1.2 Project Overview

Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC) has submitted a minor source Non-Title V (NTV) air permit application for a new semiconductor manufacturing plant located in Maricopa County. The facility will consist of two Fabrication Facilities (Fab1 and Fab2) in which semiconductor chips are manufactured. Both fabs will have support equipment including natural gas fired boilers, diesel fired emergency generators, fire pump engines, rotor concentrator thermal oxidizers and cooling towers.

Due to emissions above modeling thresholds, an air dispersion analysis is required as a part of the NTV air permit application. This modeling report outlines the approach and results for the dispersion modeling analysis of site wide emission sources using AERMOD in accordance with Maricopa County Air Quality Department (MCAQD) modeling guidance.

Please note that this Air Dispersion Modeling Report – Revision 2 replaces the modeling report that was initially submitted with the NTV application, as several model inputs have been revised.

2. Modeling Methods

2.1 General Modeling Approaches

This modeling analysis follows the general modeling approaches as outlined in the following guidance documents:

– Minor New Source Review Air Dispersion Modeling Guideline, Maricopa County Air Quality Department, June 27, 2016.

– Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, Air Quality Permit Section, Air Quality Division, Arizona Department of Environmental Quality, December 1, 2015.

– ADEQ Guidance on How to Comply with the Arizona State Hazardous Air Pollutant Program, Air Quality Permit Section, Air Quality Division, Arizona Department of Environmental Quality, August 29, 2007.

– Appendix W to 40 CFR Part 51, Guideline on Air Quality Models, the United States Environmental Protection Agency, January 17, 2017.

Any modeling techniques deviating from the guidance documents were not encountered in this modeling analysis.

2.2 Dispersion Model

AERMOD and associated programs are used in this air dispersion modeling analysis. Versions of the modeling suites are listed as follows:

- AERMOD – v21112
- AERMAP – v18081
- Building Profile Input Program (BPIP) plume rise model enhancements (PRIME) – v04274

Based on review of aerial imagery, the site is located in and surrounded by rural areas. Therefore, rural dispersion parameters were used in this modeling evaluation.

Additionally, no schools were identified within two (2) miles of the facility. A site plan with facility boundary and 2-mile buffer are shown on **Figure 1**.

2.3 Air Pollutants Modeled

Criteria pollutants evaluated in this air dispersion modeling analysis include carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter less than 10 micron aerodynamic diameter (PM_{10}), particulate matter less than 2.5 micron aerodynamic diameter ($PM_{2.5}$) and sulfur dioxide (SO_2).

The following table summarizes the averaging period, primary National Ambient Air Quality Standards (NAAQS), Significant Impact Level (SIL), and attainment status of criteria pollutants included in the modeling evaluation.

Table 2 Facility Criteria Air Pollutants Modeled

Pollutant	Averaging Period	Primary NAAQS (µg/m3)	SIL (µg/m3)	Attainment or Non-Attainment Pollutant
CO	1-hr	40,000	2,000	Attainment
CO	8-hr	10,000	500	Attainment
NO_2	1-hr	188	7.5	Attainment
NO_2	Annual	100	1.0	Attainment
PM_{10}	24-hr	150	5	Non-Attainment
$PM_{2.5}$	24-hr	35	1.2	Attainment
$PM_{2.5}$	Annual	12	0.2	Attainment
SO_2	1-hr	196	7.8	Attainment
SO_2	3-hr	1,300	25	Attainment

Notes:
µg/m^3 - micrograms per cubic meter
hr - hour

The updated Ambient Ratio Method (ARM2) was used to characterize the nitrogen oxide (NO_x) to NO_2 conversion in this project. The ARM2 method is a Tier 2 default regulatory option that replaced the original ambient ratio method (ARM) in the latest updates to the Guideline in Air Quality Models (Appendix W). The regulatory default minimum NO_2/NO_x in stack ratio of 0.5 was used in this evaluation.

In addition to the criteria pollutants listed above, hazardous air pollutants (HAPs) with emission rates above the de minimis rates in Table 1 of the ADEQ 2007 HAP guidance were included in this modeling evaluation. Below are the HAPs evaluated:

- Hydrofluoric Acid (HF)
- Hydrochloric Acid (HCl)
- Arsine (AsH_3)
- Benzene (C_6H_6)
- Formaldehyde (HCHO)

– Ethylene Glycol ($C_2H_6O_2$)
– Cobalt (Co)

2.4 Emission Units and Source Types

The emission units and source types at the TSMC Facility modeled are in the table below.

Table 3 Facility Emission Units and Source Types

Emission Point Number	Source Description	Source Type	Release Type	Source Quantity
1A101 through 1A118	AAS_SEX (Acid) Scrubbers	Point	Vertical	18
1A131 through 1A139	AAS_SEX-Bench Scrubbers	Point	Vertical	9
1A201 through 1A206	AAS_AEX (Ammonia) Scrubbers	Point	Vertical	6
1A301 through 1A306	Zeolite Roter Oxidizers	Point	Vertical	6
1A401 through 1A403	Wastewater (Acid) Scrubbers	Point	Vertical	3
1B501 through 1B503	1,500 kilowatt Hot Water Boilers	Point	Capped	3
1C601 through 1C614	Cooling Towers	Point	Vertical	14
1G701 through 1G738	Generators	Point	Vertical	22
1FP	Fire Water Pump	Point	Capped	1
2A101 through 2A118	AAS_SEX (Acid) Scrubbers	Point	Vertical	18
2A131 through 2A139	AAS_SEX-Bench Scrubbers	Point	Vertical	9
2A201 through 2A206	AAS_AEX (Ammonia) Scrubbers	Point	Vertical	6
2A301 through 2A306	Zeolite Roter Oxidizers	Point	Vertical	6
2A401 through 2A403	Wastewater (Acid) Scrubbers	Point	Vertical	3
2B501 through 2B503	1,500 kilowatt Hot Water Boilers	Point	Capped	3
2C601 through 2C614	Cooling Towers	Point	Vertical	14
2G701 through 2G738	Generators	Point	Vertical	0
2FP	Fire Water Pump	Point	Capped	1

Locations of the sources are shown in **Figure 2A** and **Figure 2B,** and detailed stack parameters are summarized in **Appendix A**.

2.5 Meteorological Data Set and Processing

Pre-processed meteorological data from the Arizona Department of Environmental Quality was used in this modeling evaluation. The meteorological data includes years 2014 through 2018 processed with AERMET version 19191 and the adjusted u star option using the Phoenix Airport surface station (WBAN# 23183) and the Tucson International Airport upper air station (WBAN# 23160).

2.6 Receptor Arrays

This modeling evaluation used receptor grid recommendations described in MCAQD's Minor Source NTV Air Dispersion Modeling Guidelines. The proposed grid spacing is included in the table below.

Table 4 Facility Receptor Grid

Distance from All Emission Sources (m)	Receptor Spacing (m)
Fence Line	25
300	25
1,000	100
5,000	500
10,000	1,000
Note: m - meters	

2.7 Terrain Processing

The project was modeled using the Elevated Terrain Mode. Elevations for the project were obtained from National Elevation Dataset (NED) GeoTIFF files from the United States Geological Survey (USGS) with a resolution of 1/3 arc (~10 m) for the modeling domain. The AERMAP processor version 18081 was used to process the NED files and generate source, building, and receptor and hill height elevations, as applicable.

2.8 Operating Schedule

Routine manufacturing equipment is represented as operating 24 hours per day, 365 days per year, and therefore, no operating schedule adjustment is used in AERMOD.

Functional testing of emergency generators and fire pump engines are represented no more than eighteen (18) hours per year, and are limited to no more than one test per day; therefore, the following modeling techniques are used:

– One hour NO_2 and SO_2 – Intermittent emission source guidance are used to model annual average emissions for the short term analyses

– Twenty-four hour PM_{10} and $PM_{2.5}$ – A scaler of maximum 1-hour of operation in any 24-hour period is used

2.9 Building Downwash

Building downwash effects were included using BPIP to calculate inputs to the PRIME in AERMOD. Building input information is provided in **Appendix A**.

2.10 Background Pollutant Concentrations

Background concentrations are added to modeling results to determine compliance with the NAAQS. The available background concentration data for the closest monitors to the site in Maricopa County are presented in Table 5. :

Table 5 Background Concentrations

Pollutant	Averaging Period	AQS Monitor Code, Name	Description of Value	Background Concentration (µg/m^3)
NO_2	1-hr	04-013-9997, JLG Supersite	1-hr 98 percentile, 3-year average from 2018 to 2020	**91**
NO_2	Annual	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**25**
PM_{10}	24-hr	04-013-4016, Zuni Hills	Highest concentration from 2018 to 2020 (2018 value), excluding exceptional events	**131**
$PM_{2.5}$	24-hr	04-013-2001, Glendale	24-hr 98 percentile, 3-year average from 2018 to 2020	**17.87**

Pollutant	Averaging Period	AQS Monitor Code, Name	Description of Value	Background Concentration (µg/m^3)
$PM_{2.5}$	Annual	04-013-2001, Glendale	3-year average from 2018 to 2020	**7.1**
SO_2	1-hr	04-013-9997, JLG Supersite	1-hr 99 percentile, 3-year average from 2018 to 2020	**12**
SO_2	3-hr	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**20**
CO	1-hr	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**2,444**
CO	8-hr	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**1,948**

The main monitor selection criteria used in this modeling analysis is based on proximity of the monitor to the proposed site. Availability of data is also considered when selecting the monitor. Based on a cursory review of the land use surrounding the site and the monitor, the monitors selected to represent the site are located in larger population and more densely industrial areas than the proposed site location. Therefore, we believe that the selected monitors provide a conservative representation of the background concentrations around the site.

Background concentration calculations are provided in **Appendix A**.

2.11 Effects of Nearby Facilities

Based on communication with MCAQD, no nearby sources are necessary for this modeling evaluation. It is assumed that the effect from nearby sources is included in the background value used.

2.12 Secondary Formation of $PM_{2.5}$

In the ambient air, $PM_{2.5}$ is not only directly emitted from industrial sources, but also formed secondarily due to photochemical reactions of precursor pollutants including NO_x and SO_2.

The complex chemistry of secondarily formed $PM_{2.5}$ is well documented and has historically presented significant challenges with the identification and establishment of particular models for assessing the impacts of individual stationary sources on the secondary formation of $PM_{2.5}$. AERMOD can be used to simulate the dispersion of direct $PM_{2.5}$ emissions but not the contribution from secondary formation of $PM_{2.5}$. As part of the revisions made to the Appendix W (January 17, 2017), the EPA promulgated a two-tiered demonstration approach for addressing single source impacts on secondary $PM_{2.5}$.

The first tier involves the use of technically credible relationships between precursor emissions and a source's impact in combination with other supportive information and analysis for the purpose of estimating secondary impacts from a particular source. The EPA developed a Tier I demonstration tool for secondary $PM_{2.5}$ precursor emissions called Modeled Emission Rates for Precursors (MERPs). As precursors of secondary $PM_{2.5}$ formation, NO_x, and SO_2 emissions are not expected to be significant enough to result in quantifiable secondary formation of $PM_{2.5}$. Therefore, TSMC proposes to use the worst case MERP value for the entire state of Arizona for this analysis. The worst case MERP values and project emissions are shown in the table below.

Table 6 Worst Case MERP Values and Emissions for Secondary $PM_{2.5}$ (tpy)

Precursor	MERP 24-Hour $PM_{2.5}$	MERP Annual $PM_{2.5}$	Project Emissions
NO_x	15,260	105,871	86.8*
SO_2	1,918	31,245	1.2

3. Modeling Results and Compliance Demonstration

3.1 NAAQS Impact Evaluation

Criteria pollutants were modeled according to methods described in Section 2 of this report. As a conservative approach, the High 1st High (H1H) values of all short-term analyses are reported as the modeling results. Modeling results are presented in the table below.

Table 7 Modeling Results and Compliance Demonstration

Pollutant	Averaging Period	Site-Wide Impact (µg/m³)	SIL (De Minimis Level) (µg/m³)	Background (µg/m³)	Total Site + Background (µg/m³)	NAAQS (µg/m³)	Pass? (Yes/No)
CO	1-Hour	362.91	2,000	-	-	-	Yes
CO	8-Hour	228.87	500	-	-	-	Yes
NO_2	1-Hour	48.79	7.5	91	140	188	Yes
NO_2	Annual	2.88	1	25	28	100	Yes
PM_{10}	24-Hour	8.86	5	131	140	150	Yes
$PM_{2.5}$	24-Hour	8.05	1.2	17.87	26	35	Yes
$PM_{2.5}$	Annual	2.68	0.2	7.1	9.8	12	Yes
SO_2	1-Hour	1.25	7.8	-	-	-	Yes
SO_2	3-Hour	3.58	25	-	-	-	Yes

Notes:
$PM_{2.5}$ impact results include secondary formation from precursors.
µg/m³ - micrograms per cubic meter

Site-wide impacts for CO 1-Hour, CO 8-Hour, and SO_2 3-Hour were below each of their respective SIL de minimis levels and therefore NAAQS compliance was not evaluated for these pollutants and averaging periods.

Site-wide impacts for NO_2 1-Hour, NO_2 Annual, SO_2 1-Hour, PM_{10} 24-Hour, $PM_{2.5}$ 24-Hour and $PM_{2.5}$ Annual were each summed with their respective background concentration and then compared with their respective NAAQS. Site-wide impacts plus background totals are below the NAAQS for each of these pollutants and averaging periods and therefore do not cause nor contribute to an exceedance of the NAAQS.

3.2 HAP Results Evaluation

HAPs were modeled according to methods described in Section 2 of this report. Modeling results are presented in the table below.

Table 8 HAP Modeling Results and Compliance Demonstration

Pollutant	Averaging Period	Site-Wide Impact (µg/m³)	Acute AAC (µg/m³)	Chronic AAC (µg/m³)	Pass? (Yes/No)
HF	1-Hour	2.37	9,800	-	Yes
HF	Annual	0.16	-	14.6	Yes
HCl	1-Hour	4.52	16,000	-	Yes
HCl	Annual	0.23	-	20.9	Yes
AsH_3	1-Hour	5.48E-03	2500	-	Yes
AsH_3	Annual	1.70E-04	-	4.41E-04	Yes
Benzene	1-Hour	0.71	1,276,000	-	Yes

Pollutant	Averaging Period	Site-Wide Impact ($\mu g/m^3$)	Acute AAC ($\mu g/m^3$)	Chronic AAC ($\mu g/m^3$)	Pass? (Yes/No)
Benzene	Annual	1.10E-04	-	0.243	Yes
Formaldehyde	1-Hour	0.07	17,000	-	Yes
Formaldehyde	Annual	3.40E-04	-	0.146	Yes
Ethylene Glycol	Annual	8.38E-02	-	417	Yes
Cobalt	Annual	4.00E-05	-	6.86E-04	Yes

Notes:
Acute and chronic ambient air concentration (AAC) standards from Table 3 of ADEQ HAP modeling guidance, August 2007.
$\mu g/m^3$ - micrograms per cubic meter

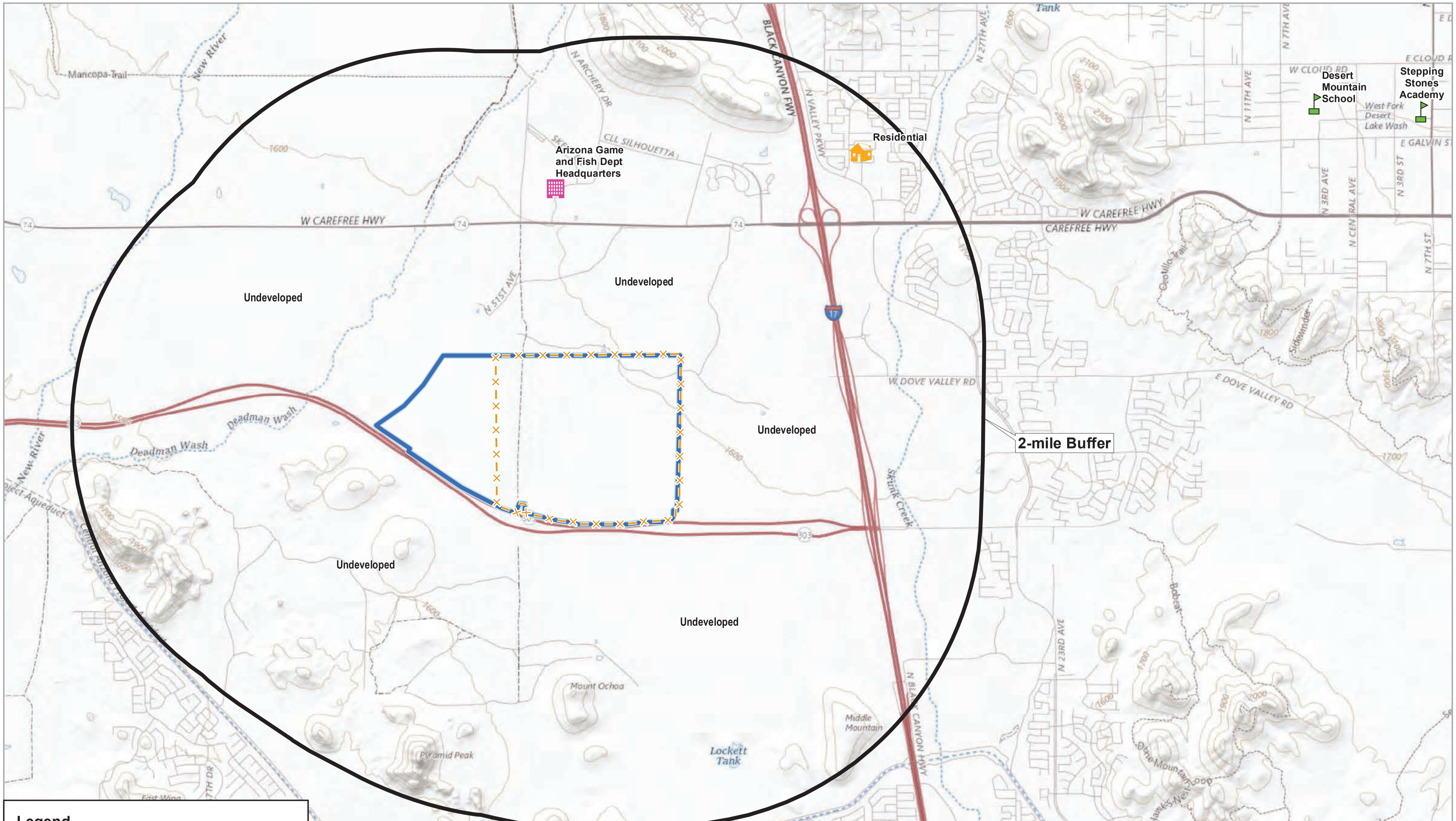
Site-wide impacts for each HAP modeled are below their respective acute (1-Hour averaging period) and chronic (Annual averaging period) ambient air concentration (AAC) standards.

3.3 Model Input and Output Files

Digital copies of all files relating to the modeling evaluation will be provided to MCAQD including:

– AERMOD Input and Output files
– SFC and .PFL meteorological files
– Terrain files (National Elevation Dataset GeoTIFF files from the USGS)
– BPIP Building Downwash files

Figures



Legend

- Residential
- Office
- School
- Approximate Fence Line
- Site Boundary
- 2-mile Buffer

NOTE:

NO SCHOOLS WERE IDENTIFIED WITHIN 2 MILES OF THE SITE BOUNDARY.

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Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Arizona Central FIPS 0202 Feet

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TSMC PHOENIX PROJECT
PHOENIX, ARIZONA

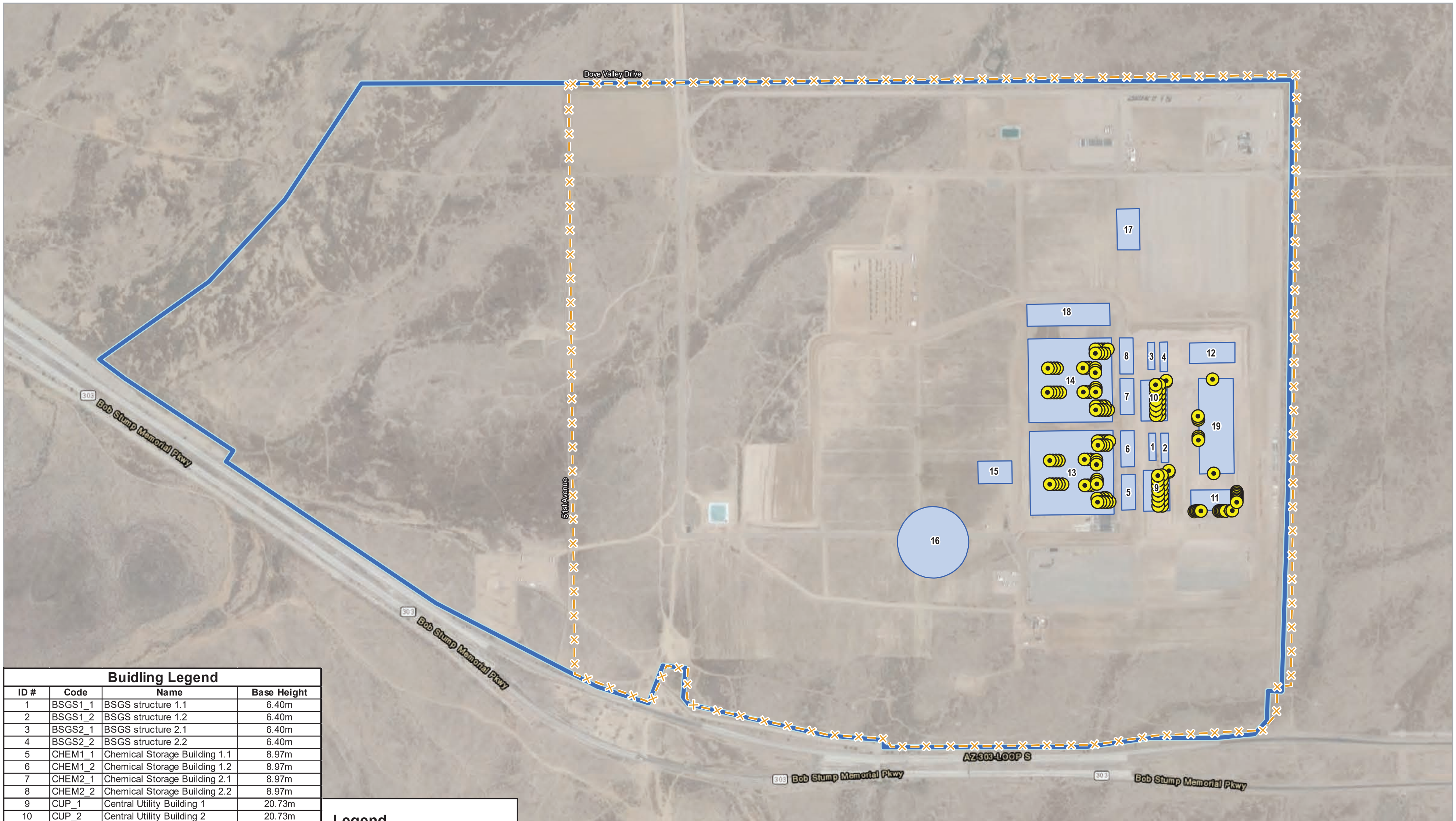
SITE PLAN

Project No. 11218799-03
Report No. NSR
Date 5/25/2021

FIGURE 1

G:\562\11218799\GIS\Maps\Deliverables\NSR\11218799-03(NSR)GIS-DL001_Site Map.mxd
Print date: 25 May 2021 - 12:20

Data source: USGS 7.5-minute Quadrangle Maps. Created by: cgerdts



Buidling Legend

ID #	Code	Name	Base Height
1	BSGS1_1	BSGS structure 1.1	6.40m
2	BSGS1_2	BSGS structure 1.2	6.40m
3	BSGS2_1	BSGS structure 2.1	6.40m
4	BSGS2_2	BSGS structure 2.2	6.40m
5	CHEM1_1	Chemical Storage Building 1.1	8.97m
6	CHEM1_2	Chemical Storage Building 1.2	8.97m
7	CHEM2_1	Chemical Storage Building 2.1	8.97m
8	CHEM2_2	Chemical Storage Building 2.2	8.97m
9	CUP_1	Central Utility Building 1	20.73m
10	CUP_2	Central Utility Building 2	20.73m
11	ELE_1	Electrical Building 1	11.23m
12	ELE_2	Electrical Building 2	11.23m
13	FAB_1	Fabrication Building 1	30.25m
14	FAB_2	Fabrication Building 2	30.25m
15	GOWN	GOWN	29.41m
16	OFFBLD	Office Building	25.30m
17	VEND	Vendor Building	10.06m
18	WH	Warehouse	23.93m
19	WWT	Wastewater Treatment Unit	15.27m

Legend

- Point Source
- Approximate Fence Line
- Site Boundary
- Buildings

Notes:
m - Values denote building heights in meters.
* see Figure 2B for Point source identification information.

Paper Size ANSI B
0 480 960
Feet
Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

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TSCM PHOENIX PROJECT
PHOENIX, ARIZONA

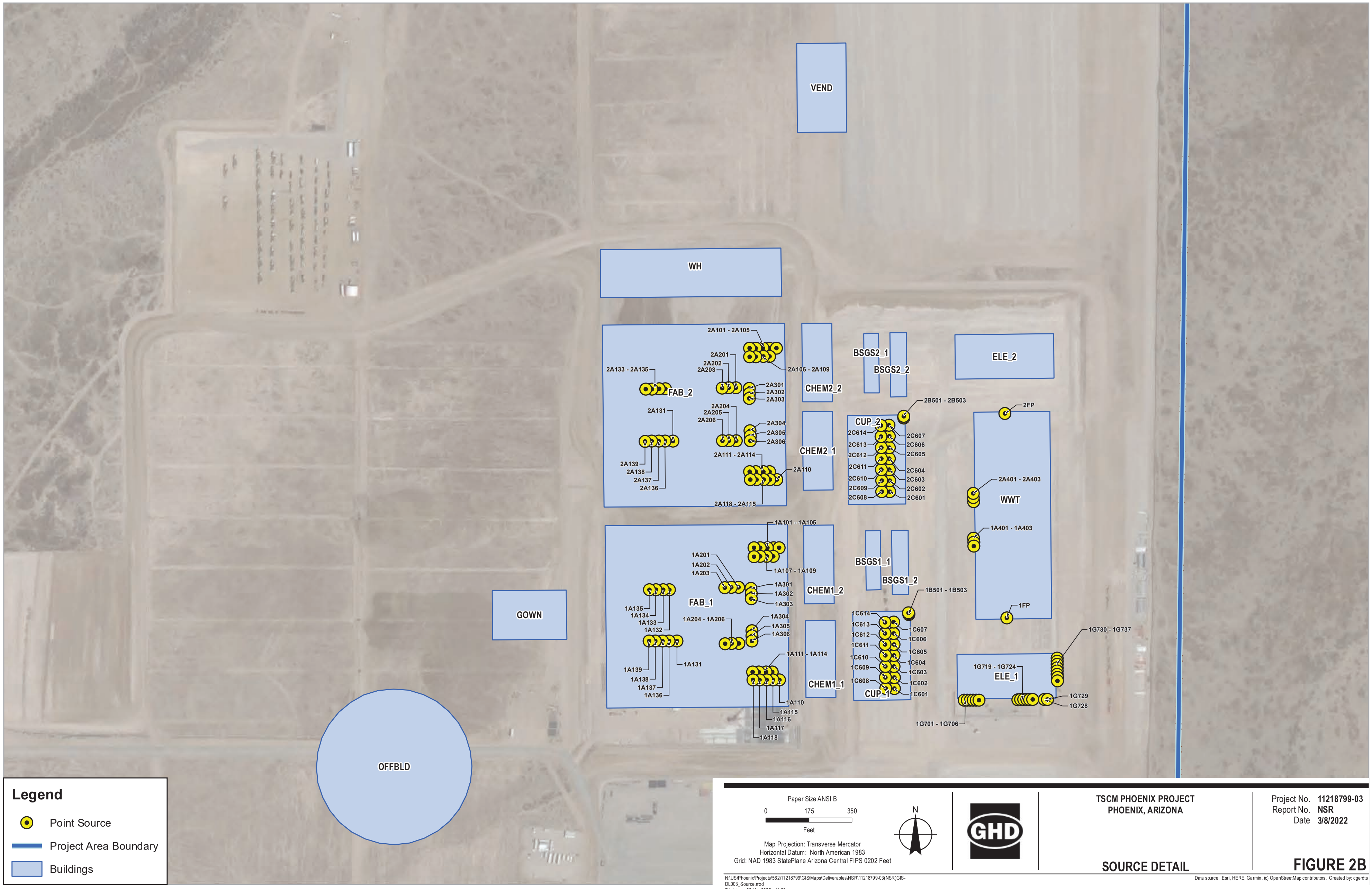
FACILITY PLOT PLAN

Project No. 11218799-03
Report No. NSR
Date 3/8/2022

FIGURE 2A

C:\Users\cgerdts\OneDrive - GHD\Desktop\11218799-03(NSR)GIS-DL002_Fac.mxd
Print date: 08 Mar 2022 - 11:58

Data source: Esri, HERE, Garmin, (c) OpenStreetMap contributors. Created by: cgerdts



Legend

- Point Source
- Project Area Boundary
- Buildings

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Arizona Central FIPS 0202 Feet

GHD

TSCM PHOENIX PROJECT
PHOENIX, ARIZONA

SOURCE DETAIL

Project No. 11218799-03
Report No. NSR
Date 3/8/2022

FIGURE 2B

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Print date: 08 Mar 2022 - 11:53

Data source: Esri, HERE, Garmin, (c) OpenStreetMap contributors. Created by: cgerdts

Appendix A

Modeling Input Supplemental Information

Appendix A

Modeling Input Supplemental Information - Buildings
TSMC Phoenix Project
Maricopa County, Arizona

Building ID	Description	Tier Number	Tier Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	UTM X1 (m)	UTM Y1 (m)
FAB_1	Fabrication Building 1	1	30.25		225	225	270	392690.02	3738054.1
FAB_2	Fabrication Building 2	1	30.25		225	225	270	392689.01	3738302.1
WWT	Wastewater Treatment Unit	1	15.27		255.51	93.7	270	393146.7	3738190.3
CHEM1_1	Chemical Storage Building 1.1	1	8.97		96.84	36.99	270	392935.13	3738192.72
CHEM1_2	Chemical Storage Building 1.2	1	8.97		96.84	36.99	270	392935.13	3738301.7
WH	Warehouse	1	23.93		59.35	223.29	90	392910.32	3738335.82
CUP_1	Central Utility Building 1	1	20.73		70.71	109.73	180	393065.78	3737945.6
CUP_2	Central Utility Building 2	1	20.73		70.71	109.73	180	393061.64	3738187.7
ELE_1	Electrical Building 1	1	11.23		121.92	54.86	180	393245.84	3738286.3
VEND	Vendor Building	1	10.06		109.73	60.96	90	392992.71	3738537.64
OFFBLD	Office Building	1	25.3	192.02				392426.99	3737759.09
BSGS1_1	BSGS structure 1.1	1	6.4		73.15	18.29	270	393011.5	3738045.25
BSGS1_2	BSGS structure 1.2	1	6.4		79.25	20.12	270	393043.94	3738045.3
GOWN	Gown Building	1	29.41		60.96	91.44	90	392641.54	3737914.51
BSGS2_1	BSGS structure 2.1	1	6.4		73.15	18.29	270	393011.5	3738288.63
BSGS2_2	BSGS structure 2.2	1	6.4		79.25	20.12	270	393043.94	3738289.32

Notes:
m - meters
deg - degrees

Appendix A

Modeling Input Supplemental Information - Stacks
TSMC Phoenix Project
Maricopa County, Arizona

Type	ID	Description	X1	Y1	Height	Exit Temperature	Exit Velocity	Diameter	Release Type	Operation Time
			(m)	(m)	(m)	(K)	(m/s)	(m)		hrs/yr
POINT	1A101	AAS_SEX (Acid) Scrubber 1	392898.08	3738025.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A102	AAS_SEX (Acid) Scrubber 2	392890.35	3738025.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A103	AAS_SEX (Acid) Scrubber 3	392881.32	3738025.3	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A104	AAS_SEX (Acid) Scrubber 4	392873.59	3738025.3	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A105	AAS_SEX (Acid) Scrubber 5	392904.63	3738025.3	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A106	AAS_SEX (Acid) Scrubber 6	392897.49	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A107	AAS_SEX (Acid) Scrubber 7	392889.37	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A108	AAS_SEX (Acid) Scrubber 8	392881.47	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A109	AAS_SEX (Acid) Scrubber 9	392873.74	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A110	AAS_SEX (Acid) Scrubber 10	392903.82	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A111	AAS_SEX (Acid) Scrubber 11	392895.06	3737872.1	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A112	AAS_SEX (Acid) Scrubber 12	392887.32	3737872.1	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A113	AAS_SEX (Acid) Scrubber 13	392878.3	3737872.1	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A114	AAS_SEX (Acid) Scrubber 14	392870.56	3737872	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A115	AAS_SEX (Acid) Scrubber 15	392895.67	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A116	AAS_SEX (Acid) Scrubber 16	392887.93	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A117	AAS_SEX (Acid) Scrubber 17	392878.91	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A118	AAS_SEX (Acid) Scrubber 18	392871.17	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A131	AAS_SEX-Bench Scrubber 1	392777.53	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A132	AAS_SEX-Bench Scrubber 2	392768.77	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A133	AAS_SEX-Bench Scrubber 3	392761.03	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A134	AAS_SEX-Bench Scrubber 4	392752.01	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A135	AAS_SEX-Bench Scrubber 5	392744.27	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A136	AAS_SEX-Bench Scrubber 6	392767.64	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A137	AAS_SEX-Bench Scrubber 7	392759.91	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A138	AAS_SEX-Bench Scrubber 8	392750.88	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A139	AAS_SEX-Bench Scrubber 9	392743.15	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	1A201	AAS_AEX (Ammonia) Scrubber 1	392854.09	3737976.7	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	1A202	AAS_AEX (Ammonia) Scrubber 2	392845.07	3737976.7	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	1A203	AAS_AEX (Ammonia) Scrubber 3	392837.33	3737976.7	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	1A204	AAS_AEX (Ammonia) Scrubber 4	392853.96	3737907.5	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	1A205	AAS_AEX (Ammonia) Scrubber 5	392844.94	3737907.5	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	1A206	AAS_AEX (Ammonia) Scrubber 6	392837.2	3737907.5	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	1A301	Zeolite Roter Oxidizer 1	392869.60	3737975.20	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	1A302	Zeolite Roter Oxidizer 2	392869.61	3737969.00	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	1A303	Zeolite Roter Oxidizer 3	392869.62	3737962.70	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	1A304	Zeolite Roter Oxidizer 4	392870.24	3737923.10	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	1A305	Zeolite Roter Oxidizer 5	392870.25	3737916.90	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	1A306	Zeolite Roter Oxidizer 6	392870.26	3737910.60	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	1A401	Wastewater Scrubber 1	393145.00	3738035.00	17.81	295.65	21.77	1.14	VERTICAL	8,760
POINT	1A402	Wastewater Scrubber 2	393145.00	3738030.00	17.81	295.65	21.77	1.14	VERTICAL	8,760
POINT	1A403	Wastewater Scrubber 3	393145.00	3738025.00	17.81	295.65	21.77	1.14	VERTICAL	8,760
POINT	1B501	1,500 kW Hot Water Boiler 1	393063.90	3737941.57	27.43	478.15	5.19	0.35	CAPPED	300
POINT	1B502	1,500 kW Hot Water Boiler 2	393063.90	3737942.57	27.43	478.15	5.19	0.35	CAPPED	300
POINT	1B503	1,500 kW Hot Water Boiler 3	393063.90	3737943.57	27.43	478.15	5.19	0.35	CAPPED	300
POINT	1C601	Cooling Tower 1	393045.36	3737850.18	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C602	Cooling Tower 2	393045.36	3737863.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C603	Cooling Tower 3	393045.36	3737877.48	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C604	Cooling Tower 4	393045.36	3737891.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C605	Cooling Tower 5	393045.36	3737904.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C606	Cooling Tower 6	393045.36	3737918.38	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C607	Cooling Tower 7	393045.36	3737932.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C608	Cooling Tower 8	393034.64	3737850.18	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C609	Cooling Tower 9	393034.64	3737863.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C610	Cooling Tower 10	393034.64	3737877.48	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C611	Cooling Tower 11	393034.64	3737891.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C612	Cooling Tower 12	393034.64	3737904.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C613	Cooling Tower 13	393034.64	3737918.38	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1C614	Cooling Tower 14	393034.64	3737932.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	1FP 1	Fire Water Pump	393185.00	3737936.17	17.98	697.15	36.91	0.20	CAPPED	18
POINT	1G701	Generator 1	393131.67	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G702	Generator 2	393135.33	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G703	Generator 3	393139.00	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G704	Generator 4	393142.67	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G705	Generator 5	393146.33	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G706	Generator 6	393150.00	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G719	Generator 19	393197.67	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G720	Generator 20	393201.33	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G721	Generator 21	393205.00	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G722	Generator 22	393208.67	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G723	Generator 23	393212.33	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G724	Generator 24	393216.00	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G728	Generator 28	393230.67	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G729	Generator 29	393234.33	3737835.05	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G730	Generator 30	393246.70	3737886.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G731	Generator 31	393246.70	3737882.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G732	Generator 32	393246.70	3737878.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G733	Generator 33	393246.70	3737874.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G734	Generator 34	393246.70	3737870.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G735	Generator 35	393246.70	3737866.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G736	Generator 36	393246.70	3737862.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	1G737	Generator 37	393246.70	3737858.00	13.00	792.15	61.42	0.41	VERTICAL	18
POINT	2A101	AAS_SEX (Acid) Scrubber 1	392898.08	3738025.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A102	AAS_SEX (Acid) Scrubber 2	392890.35	3738025.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A103	AAS_SEX (Acid) Scrubber 3	392881.32	3738025.3	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A104	AAS_SEX (Acid) Scrubber 4	392873.59	3738025.3	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A105	AAS_SEX (Acid) Scrubber 5	392904.63	3738025.3	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A106	AAS_SEX (Acid) Scrubber 6	392897.49	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A107	AAS_SEX (Acid) Scrubber 7	392889.37	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A108	AAS_SEX (Acid) Scrubber 8	392881.47	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A109	AAS_SEX (Acid) Scrubber 9	392873.74	3738014.6	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A110	AAS_SEX (Acid) Scrubber 10	392903.82	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A111	AAS_SEX (Acid) Scrubber 11	392895.06	3737872.1	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A112	AAS_SEX (Acid) Scrubber 12	392887.32	3737872.1	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A113	AAS_SEX (Acid) Scrubber 13	392878.3	3737872.1	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A114	AAS_SEX (Acid) Scrubber 14	392870.56	3737872	46.49	295.65	21.65	1.4	VERTICAL	8,760

ID	NO_2 1-hour and Annual		CO 1- and 8-hour		SO_2 1-hour		SO_2 3-hour		PM_{10} 24-hour		$PM_{2.5}$ 24-hour		$PM_{2.5}$ Annual	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
1A101	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A102	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A103	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A104	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A105	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A106	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A107	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A108	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A109	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A110	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A111	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A112	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A113	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A114	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A115	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A116	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A117	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A118	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
1A131	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A132	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A133	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A134	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A135	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A136	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A137	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A138	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A139	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02	2.19E-01	2.760E-02	2.19E-01	2.76E-02
1A201	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03	8.37E-03	1.054E-03	8.37E-03	1.05E-03
1A202	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03	8.37E-03	1.054E-03	8.37E-03	1.05E-03
1A203	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03	8.37E-03	1.054E-03	8.37E-03	1.05E-03
1A204	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03	8.37E-03	1.054E-03	8.37E-03	1.05E-03
1A205	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03	8.37E-03	1.054E-03	8.37E-03	1.05E-03
1A206	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03	8.37E-03	1.054E-03	8.37E-03	1.05E-03
1A301	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02	6.394E-01	8.057E-02	6.394E-01	8.06E-02
1A302	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02	6.394E-01	8.057E-02	6.394E-01	8.06E-02
1A303	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02	6.394E-01	8.057E-02	6.394E-01	8.06E-02
1A304	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02	6.394E-01	8.057E-02	6.394E-01	8.06E-02
1A305	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02	6.394E-01	8.057E-02	6.394E-01	8.06E-02
1A306	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02	6.394E-01	8.057E-02	6.394E-01	8.06E-02
1A401	-	-	-	-	-	-	-	-	1.825E-01	2.300E-02	1.825E-01	2.300E-02	1.825E-01	2.30E-02
1A402	-	-	-	-	-	-	-	-	1.825E-01	2.300E-02	1.825E-01	2.300E-02	1.825E-01	2.30E-02
1A403	-	-	-	-	-	-	-	-	1.825E-01	2.300E-02	1.825E-01	2.300E-02	1.825E-01	2.30E-02
1B501	5.018E-01	6.322E-02	4.215E-01	5.311E-02	1.129E-02	1.422E-03	1.129E-02	1.422E-03	3.813E-02	4.805E-03	3.813E-02	4.805E-03	1.306E-03	1.65E-04
1B502	5.018E-01	6.322E-02	4.215E-01	5.311E-02	1.129E-02	1.422E-03	1.129E-02	1.422E-03	3.813E-02	4.805E-03	3.813E-02	4.805E-03	1.306E-03	1.65E-04
1B503	5.018E-01	6.322E-02	4.215E-01	5.311E-02	1.129E-02	1.422E-03	1.129E-02	1.422E-03	3.813E-02	4.805E-03	3.813E-02	4.805E-03	1.306E-03	1.65E-04
1C601	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C602	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C603	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C604	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C605	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C606	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C607	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C608	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C609	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C610	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C611	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C612	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C613	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1C614	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03	1.525E-02	1.921E-03	1.525E-02	1.92E-03
1FP 1	4.892E-03	6.164E-04	2.064E+00	2.600E-01	8.977E-06	1.131E-06	4.369E-03	5.504E-04	4.960E-03	6.250E-04	4.960E-03	6.250E-04	1.191E-01	1.50E-02
1G701	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G702	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G703	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G704	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G705	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G706	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G719	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G720	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G721	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G722	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G723	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G724	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G728	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G729	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G730	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G731	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G732	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G733	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G734	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G735	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G736	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
1G737	5.293E-02	6.669E-03	2.884E+00	3.633E-01	7.290E-05	9.185E-06	3.548E-02	4.470E-03	3.404E-02	4.289E-03	3.404E-02	4.289E-03	1.679E-03	2.12E-04
2A101	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A102	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A103	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A104	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A105	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A106	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A107	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A108	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A109	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A110	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A111	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A112	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A113	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02
2A114	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02	1.83E-01	2.300E-02	1.83E-01	2.30E-02

ID	HF		HCl		AsH_3		Ethylene Glycol		Cobalt		Benzene 1-hour (Acute)		Benzene Annual (Chronic)		Formaldehyde 1-hour (Acute)		Formaldehyde Annual (Chronic)	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
1A101	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A102	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A103	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A104	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A105	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A106	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A107	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A108	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A109	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A110	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A111	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A112	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A113	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A114	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A115	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A116	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A117	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A118	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
1A131	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A132	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A133	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A134	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A135	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A136	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A137	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A138	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A139	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06	-	-	-	-	-	-	-	-	-	-	-	-
1A201	-	-	-	-	-	-	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
1A202	-	-	-	-	-	-	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
1A203	-	-	-	-	-	-	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
1A204	-	-	-	-	-	-	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
1A205	-	-	-	-	-	-	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
1A206	-	-	-	-	-	-	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
1A301	1.895E-02	2.39E-03	-	-	-	-	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
1A302	1.895E-02	2.39E-03	-	-	-	-	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
1A303	1.895E-02	2.39E-03	-	-	-	-	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
1A304	1.895E-02	2.39E-03	-	-	-	-	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
1A305	1.895E-02	2.39E-03	-	-	-	-	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
1A306	1.895E-02	2.39E-03	-	-	-	-	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
1A401	1.89E-02	2.39E-03	2.54E-02	3.19E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1A402	1.89E-02	2.39E-03	2.54E-02	3.19E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1A403	1.89E-02	2.39E-03	2.54E-02	3.19E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1B501	-	-	-	-	-	-	-	-	-	-	1.05E-05	1.33E-06	3.61E-07	4.55E-08	3.76E-04	4.74E-05	1.29E-05	1.62E-06
1B502	-	-	-	-	-	-	-	-	-	-	1.05E-05	1.33E-06	3.61E-07	4.55E-08	3.76E-04	4.74E-05	1.29E-05	1.62E-06
1B503	-	-	-	-	-	-	-	-	-	-	1.05E-05	1.33E-06	3.61E-07	4.55E-08	3.76E-04	4.74E-05	1.29E-05	1.62E-06
1C601	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C602	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C604	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C605	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C606	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C607	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C608	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C609	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C610	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C611	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C612	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C613	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1C614	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1FP 1	-	-	-	-	-	-	-	-	-	-	7.11E-04	8.96E-05	6.40E-06	8.06E-07	7.23E-05	9.11E-06	6.50E-07	8.20E-08
1G701	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G702	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G703	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G704	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G705	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G706	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G719	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G720	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G721	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G722	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G723	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G724	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G728	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G729	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G730	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G731	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G732	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G733	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G734	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G735	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G736	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
1G737	-	-	-	-	-	-	-	-	-	-	5.77E-03	7.27E-04	1.19E-05	1.49E-06	5.87E-04	7.39E-05	1.21E-06	1.52E-07
2A101	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A102	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A103	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A104	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A105	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A106	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A107	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A108	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A109	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A110	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A111	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A112	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A113	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A114	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-

Appendix A

Modeling Input Supplemental Information - Stacks
TSMC Phoenix Project
Maricopa County, Arizona

Type	ID	Description	X1	Y1	Height	Exit Temperature	Exit Velocity	Diameter	Release Type	Operation Time
			(m)	(m)	(m)	(K)	(m/s)	(m)		hrs/yr
POINT	2A115	AAS_SEX (Acid) Scrubber 15	392895.67	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A116	AAS_SEX (Acid) Scrubber 16	392887.93	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A117	AAS_SEX (Acid) Scrubber 17	392878.91	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A118	AAS_SEX (Acid) Scrubber 18	392871.17	3737862.2	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A131	AAS_SEX-Bench Scrubber 1	392777.53	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A132	AAS_SEX-Bench Scrubber 2	392768.77	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A133	AAS_SEX-Bench Scrubber 3	392761.03	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A134	AAS_SEX-Bench Scrubber 4	392752.01	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A135	AAS_SEX-Bench Scrubber 5	392744.27	3737974.7	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A136	AAS_SEX-Bench Scrubber 6	392767.64	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A137	AAS_SEX-Bench Scrubber 7	392759.91	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A138	AAS_SEX-Bench Scrubber 8	392750.88	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A139	AAS_SEX-Bench Scrubber 9	392743.15	3737911.4	46.49	295.65	21.65	1.4	VERTICAL	8,760
POINT	2A201	AAS_AEX (Ammonia) Scrubber 1	392854.09	3737976.7	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	2A202	AAS_AEX (Ammonia) Scrubber 2	392845.07	3737976.7	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	2A203	AAS_AEX (Ammonia) Scrubber 3	392837.33	3737976.7	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	2A204	AAS_AEX (Ammonia) Scrubber 4	392853.96	3737907.5	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	2A205	AAS_AEX (Ammonia) Scrubber 5	392844.94	3737907.5	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	2A206	AAS_AEX (Ammonia) Scrubber 6	392837.2	3737907.5	46.49	295.65	21.3178	0.99	VERTICAL	8,760
POINT	2A301	Zeolite Roter Oxidizer 1	392869.60	3737975.20	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	2A302	Zeolite Roter Oxidizer 2	392869.61	3737969.00	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	2A303	Zeolite Roter Oxidizer 3	392869.62	3737962.70	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	2A304	Zeolite Roter Oxidizer 4	392870.24	3737923.10	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	2A305	Zeolite Roter Oxidizer 5	392870.25	3737916.90	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	2A306	Zeolite Roter Oxidizer 6	392870.26	3737910.60	46.49	310.15	16.93	1.50	VERTICAL	8,760
POINT	2A401	Wastewater Scrubber 1	393145.00	3738035.00	17.81	295.65	21.77	1.14	VERTICAL	8,760
POINT	2A402	Wastewater Scrubber 2	393145.00	3738030.00	17.81	295.65	21.77	1.14	VERTICAL	8,760
POINT	2A403	Wastewater Scrubber 3	393145.00	3738025.00	17.81	295.65	21.77	1.14	VERTICAL	8,760
POINT	2B501	1,500 kW Hot Water Boiler 1	393063.90	3737941.57	27.43	478.15	5.19	0.35	CAPPED	300
POINT	2B502	1,500 kW Hot Water Boiler 2	393063.90	3737942.57	27.43	478.15	5.19	0.35	CAPPED	300
POINT	2B503	1,500 kW Hot Water Boiler 3	393063.90	3737943.57	27.43	478.15	5.19	0.35	CAPPED	300
POINT	2C601	Cooling Tower 1	393045.36	3737850.18	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C602	Cooling Tower 2	393045.36	3737863.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C603	Cooling Tower 3	393045.36	3737877.48	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C604	Cooling Tower 4	393045.36	3737891.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C605	Cooling Tower 5	393045.36	3737904.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C606	Cooling Tower 6	393045.36	3737918.38	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C607	Cooling Tower 7	393045.36	3737932.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C608	Cooling Tower 8	393034.64	3737850.18	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C609	Cooling Tower 9	393034.64	3737863.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C610	Cooling Tower 10	393034.64	3737877.48	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C611	Cooling Tower 11	393034.64	3737891.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C612	Cooling Tower 12	393034.64	3737904.78	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C613	Cooling Tower 13	393034.64	3737918.38	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2C614	Cooling Tower 14	393034.64	3737932.08	45.67	308.15	7.50	8.5	VERTICAL	8,760
POINT	2FP 1	Fire Water Pump	393185.00	3737936.17	17.98	697.15	36.91	0.20	CAPPED	18

ID	NO_2 1-hour and Annual		CO 1- and 8-hour		SO_2 1-hour		SO_2 3-hour		PM_{10} 24-hour	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
2A115	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02
2A116	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02
2A117	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02
2A118	4.07E-01	5.13E-02	3.35E-01	4.22E-02	-	-	-	-	1.83E-01	2.300E-02
2A131	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A132	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A133	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A134	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A135	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A136	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A137	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A138	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A139	-	-	-	-	-	-	-	-	2.19E-01	2.760E-02
2A201	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03
2A202	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03
2A203	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03
2A204	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03
2A205	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03
2A206	-	-	-	-	-	-	-	-	8.37E-03	1.054E-03
2A301	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02
2A302	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02
2A303	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02
2A304	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02
2A305	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02
2A306	6.465E-01	8.146E-02	4.499E-01	5.669E-02	4.475E-02	5.638E-03	4.475E-02	5.638E-03	6.394E-01	8.057E-02
2A401	-	-	-	-	-	-	-	-	1.825E-01	2.300E-02
2A402	-	-	-	-	-	-	-	-	1.825E-01	2.300E-02
2A403	-	-	-	-	-	-	-	-	1.825E-01	2.300E-02
2B501	5.018E-01	6.322E-02	4.215E-01	5.311E-02	1.129E-02	1.422E-03	1.129E-02	1.422E-03	3.813E-02	4.805E-03
2B502	5.018E-01	6.322E-02	4.215E-01	5.311E-02	1.129E-02	1.422E-03	1.129E-02	1.422E-03	3.813E-02	4.805E-03
2B503	5.018E-01	6.322E-02	4.215E-01	5.311E-02	1.129E-02	1.422E-03	1.129E-02	1.422E-03	3.813E-02	4.805E-03
2C601	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C602	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C603	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C604	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C605	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C606	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C607	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C608	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C609	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C610	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C611	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C612	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C613	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2C614	-	-	-	-	-	-	-	-	2.541E-02	3.201E-03
2FP 1	4.892E-03	6.164E-04	2.064E+00	2.600E-01	8.977E-06	1.131E-06	4.369E-03	5.504E-04	4.960E-03	6.250E-04

ID	$PM_{2.5}$ 24-hour		$PM_{2.5}$ Annual		HF		HCl		AsH_3	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
2A115	1.83E-01	2.300E-02	1.83E-01	2.30E-02	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A116	1.83E-01	2.300E-02	1.83E-01	2.30E-02	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A117	1.83E-01	2.300E-02	1.83E-01	2.30E-02	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A118	1.83E-01	2.300E-02	1.83E-01	2.30E-02	1.67E-02	2.11E-03	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A131	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A132	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A133	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A134	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A135	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A136	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A137	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A138	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A139	2.19E-01	2.760E-02	2.19E-01	2.76E-02	4.54E-03	5.72E-04	2.54E-02	3.19E-03	3.15E-05	3.97E-06
2A201	8.37E-03	1.054E-03	8.37E-03	1.05E-03	-	-	-	-	-	-
2A202	8.37E-03	1.054E-03	8.37E-03	1.05E-03	-	-	-	-	-	-
2A203	8.37E-03	1.054E-03	8.37E-03	1.05E-03	-	-	-	-	-	-
2A204	8.37E-03	1.054E-03	8.37E-03	1.05E-03	-	-	-	-	-	-
2A205	8.37E-03	1.054E-03	8.37E-03	1.05E-03	-	-	-	-	-	-
2A206	8.37E-03	1.054E-03	8.37E-03	1.05E-03	-	-	-	-	-	-
2A301	6.394E-01	8.057E-02	6.394E-01	8.06E-02	1.895E-02	2.39E-03	-	-	-	-
2A302	6.394E-01	8.057E-02	6.394E-01	8.06E-02	1.895E-02	2.39E-03	-	-	-	-
2A303	6.394E-01	8.057E-02	6.394E-01	8.06E-02	1.895E-02	2.39E-03	-	-	-	-
2A304	6.394E-01	8.057E-02	6.394E-01	8.06E-02	1.895E-02	2.39E-03	-	-	-	-
2A305	6.394E-01	8.057E-02	6.394E-01	8.06E-02	1.895E-02	2.39E-03	-	-	-	-
2A306	6.394E-01	8.057E-02	6.394E-01	8.06E-02	1.895E-02	2.39E-03	-	-	-	-
2A401	1.825E-01	2.300E-02	1.825E-01	2.30E-02	1.89E-02	2.39E-03	2.54E-02	3.19E-03	-	-
2A402	1.825E-01	2.300E-02	1.825E-01	2.30E-02	1.89E-02	2.39E-03	2.54E-02	3.19E-03	-	-
2A403	1.825E-01	2.300E-02	1.825E-01	2.30E-02	1.89E-02	2.39E-03	2.54E-02	3.19E-03	-	-
2B501	3.813E-02	4.805E-03	1.306E-03	1.65E-04	-	-	-	-	-	-
2B502	3.813E-02	4.805E-03	1.306E-03	1.65E-04	-	-	-	-	-	-
2B503	3.813E-02	4.805E-03	1.306E-03	1.65E-04	-	-	-	-	-	-
2C601	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C602	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C603	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C604	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C605	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C606	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C607	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C608	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C609	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C610	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C611	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C612	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C613	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2C614	1.525E-02	1.921E-03	1.525E-02	1.92E-03	-	-	-	-	-	-
2FP 1	4.960E-03	6.250E-04	1.191E-01	1.50E-02	-	-	-	-	-	-

ID	Ethylene Glycol		Cobalt		Benzene 1-hour (Acute)		Benzene Annual (Chronic)		Formaldehyde 1-hour (Acute)		Formaldehyde Annual (Chronic)	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
2A115	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A116	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A117	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A118	5.54E-05	6.98E-06	1.01E-05	1.28E-06	-	-	-	-	-	-	-	-
2A131	-	-	-	-	-	-	-	-	-	-	-	-
2A132	-	-	-	-	-	-	-	-	-	-	-	-
2A133	-	-	-	-	-	-	-	-	-	-	-	-
2A134	-	-	-	-	-	-	-	-	-	-	-	-
2A135	-	-	-	-	-	-	-	-	-	-	-	-
2A136	-	-	-	-	-	-	-	-	-	-	-	-
2A137	-	-	-	-	-	-	-	-	-	-	-	-
2A138	-	-	-	-	-	-	-	-	-	-	-	-
2A139	-	-	-	-	-	-	-	-	-	-	-	-
2A201	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
2A202	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
2A203	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
2A204	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
2A205	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
2A206	6.376E-02	8.03E-03	-	-	-	-	-	-	-	-	-	-
2A301	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
2A302	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
2A303	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
2A304	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
2A305	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
2A306	-	-	-	-	7.12E-06	8.97E-07	7.12E-06	8.97E-07	2.54E-04	3.20E-05	2.54E-04	3.20E-05
2A401	-	-	-	-	-	-	-	-	-	-	-	-
2A402	-	-	-	-	-	-	-	-	-	-	-	-
2A403	-	-	-	-	-	-	-	-	-	-	-	-
2B501	-	-	-	-	1.05E-05	1.33E-06	3.61E-07	4.55E-08	3.76E-04	4.74E-05	1.29E-05	1.62E-06
2B502	-	-	-	-	1.05E-05	1.33E-06	3.61E-07	4.55E-08	3.76E-04	4.74E-05	1.29E-05	1.62E-06
2B503	-	-	-	-	1.05E-05	1.33E-06	3.61E-07	4.55E-08	3.76E-04	4.74E-05	1.29E-05	1.62E-06
2C601	-	-	-	-	-	-	-	-	-	-	-	-
2C602	-	-	-	-	-	-	-	-	-	-	-	-
2C603	-	-	-	-	-	-	-	-	-	-	-	-
2C604	-	-	-	-	-	-	-	-	-	-	-	-
2C605	-	-	-	-	-	-	-	-	-	-	-	-
2C606	-	-	-	-	-	-	-	-	-	-	-	-
2C607	-	-	-	-	-	-	-	-	-	-	-	-
2C608	-	-	-	-	-	-	-	-	-	-	-	-
2C609	-	-	-	-	-	-	-	-	-	-	-	-
2C610	-	-	-	-	-	-	-	-	-	-	-	-
2C611	-	-	-	-	-	-	-	-	-	-	-	-
2C612	-	-	-	-	-	-	-	-	-	-	-	-
2C613	-	-	-	-	-	-	-	-	-	-	-	-
2C614	-	-	-	-	-	-	-	-	-	-	-	-
2FP 1	-	-	-	-	7.11E-04	8.96E-05	6.40E-06	8.06E-07	7.23E-05	9.11E-06	6.50E-07	8.20E-08

Notes:

Sources operates less than 100 hours per year (emergency engines and fire water pumps), are treated as intermittent sources for 1-hr NO_2 and 1-hr SO_2 modeling.
Emergency engines and fire water pumps are assumed to operate at a maximum of 1 hour per day for PM_{10} and $PM_{2.5}$ 24-hr averaging period modeling.
NO_2 - nitrogen dioxide
CO - carbon monoxide
SO_2 - sulfur dioxide
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ - Particulate Matter less than 2.5 micron aerodynamic diameter
m - meter
K - Kelvin
m/s - meters per second
hrs/yr - hours per year
lb/hr - pounds per hour
g/s - grams per second
kW - kilowatt

Appendix A

Modeling Input Supplemental Information - Monitor
TSMC Phoenix Project
Maricopa County, Arizona

Pollutant:	**NO_2**			
AQS ID:	04-013-9997		Street Address and City:	4530 N 17th Avenue, Phoenix
Link to Data Source:	https://aqs.epa.gov/aqsweb/airdata/download_files.html		County:	Maricopa
Metrics for averaging time:	1st Year Concentration (µg/m^3)	2nd Year Concentration (µg/m^3)	3rd Year (most recent) Concentration (µg/m^3)	Calculated Background Concentration (µg/m^3)
1-hr 98 percentile	94.00	91.00	89.00	91
Annual Average			25.00	25

Pollutant:	**$PM_{2.5}$**			
AQS ID:	04-013-2001		Street Address and City:	6000 W Olive Ave, Glendale
Link to Data Source:	https://aqs.epa.gov/aqsweb/airdata/download_files.html		County:	Maricopa
Metrics for averaging time:	1st Year Concentration (µg/m^3)	2nd Year Concentration (µg/m^3)	3rd Year (most recent) Concentration (µg/m^3)	Calculated Background Concentration (µg/m^3)
24-hr 98 percentile	19.50	15.10	19.00	17.87
Annual Average	7.30	6.40	7.60	7.1

Pollutant:	**PM_{10}**			
AQS ID:	04-013-4016		Address:	10851 W Williams Rd, Sun City
Link to Data Source:	https://aqs.epa.gov/aqsweb/airdata/download_files.html		County:	Maricopa
Metrics for averaging time:	1st Year Concentration (µg/m^3)	2nd Year Concentration (µg/m^3)	3rd Year (most recent) Concentration (µg/m^3)	Calculated Background Concentration (µg/m^3)
H2H 24-hr Avg	131	59	88	131

Pollutant:	**CO**			
AQS ID:	04-013-9997		Address:	4530 N 17th Avenue, Phoenix
Link to Data Source:	https://aqs.epa.gov/aqsweb/airdata/download_files.html		County:	Maricopa
Metrics for averaging time:	1st Year Concentration (µg/m^3)	2nd Year Concentration (µg/m^3)	3rd Year (most recent) Concentration (µg/m^3)	Calculated Background Concentration (µg/m^3)
H1H 1-hr Avg			2,444	2,444
H1H 8-hr Avg			1,948	1,948

Pollutant:	**SO2**			
AQS ID:	04-013-9997		Address:	4530 N 17th Avenue, Phoenix
Link to Data Source:	https://aqs.epa.gov/aqsweb/airdata/download_files.html		County:	Maricopa
Metrics for averaging time:	1st Year Concentration (µg/m^3)	2nd Year Concentration (µg/m^3)	3rd Year (most recent) Concentration (µg/m^3)	Calculated Background Concentration (µg/m^3)
1-hr 99 percentile	16	8	13	12
H1H 3-hr Avg			20	20

Notes:

NO_2 - nitrogen dioxide
PM_{10} - Particulate Matter less than 10 micron aerodynamic diameter
$PM_{2.5}$ - Particulate Matter less than 2.5 micron aerodynamic diameter
CO - carbon monoxide
SO_2 - sulfur dioxide
µg/m^3 - micrograms per cubic meter

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Appendix F

Chemical Summary

Appendix F
Chemical Summary
TSMC Phoenix Project
Maricopa County, Arizona

Chemical Used	2020 F18P1 Usage	Unit	Scrubber Systems
Component A	67,392	L	AEX
Component B	154,008	L	VEX (RCTO)
Component C	116,064	L	AEX
PH3 SDS3 JY VCR	19	KG	SEX
PH3,5N7,44L,40LB,DISS632	454	KG	SEX
Pura Leveler, 4L/BT	300	L	SEX
TEA,10KG/BT	265	kg	SEX
Viaform Extreme Leveler, 4L/BT(NOWPak)	376	L	SEX
Component D	83	KG	SEX
Component E	5	KG	SEX
Component F	10	KG	SEX
Component G	47	KG	SEX
Component H	92	KG	SEX
Component I	148,000	L	SEX
Component J	8,388	L	SEX
Component K	21,600	L	SEX
Component L	1,595	L	SEX

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NON-TITLE V
TECHNICAL SUPPORT DOCUMENT

FACILITY #:	F041443	**LEGACY PERMIT #:**	N/A
BUSINESS NAME:	Taiwan Semiconductor Manufacturing Company (TSMC)	**IMPACT PERMIT #:**	P0008497
SOURCE TYPE:	Semiconductor Fabrication	**REVISION TYPE(S):**	New Permit
PERMIT ENGINEER:	Ryan Dalrymple	**DATE PREPARED:**	03/21/2022

BACT: Yes	**MACT:**	No	**NSPS:** Yes	**SYNTH MINOR:** Yes	**AIRS:** Yes
DUST PLAN REQUIRED:		No	**DUST PLAN RECEIVED:** No		
O&M PLAN REQUIRED:		Yes	**O&M PLAN RECEIVED:** No		
PORTABLE SOURCE: No			**SITE VISIT: Waived**		**PUBLIC NOTICE:** Yes

PROCESS DESCRIPTION:
Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC) proposes to construct a semiconductor facility on an approximate 1,000-acre parcel near the City of Phoenix, Maricopa County, Arizona.

The proposed project includes two Fab buildings where semiconductor chips will be manufactured; and buildings containing support equipment, including natural gas fired boilers, diesel fired emergency generators, fire pump engines, and cooling towers. Supporting equipment will reside in the Wastewater Treatment Plant (WWTP), Chemical Storage, Bulk Specialty Gas System, and Central Utility Plant buildings. Criteria pollutant emissions from these sources include Volatile Organic Compounds (VOC), Nitrogen Oxides (NOx), Particulate Matter (PM2.5 and PM10), Sulfur Oxides (SOx), and Hazardous Air Pollutants (HAPs).

Process Overview
The semiconductor manufacturing process starts with thin disks of high purity silicon called wafers, which undergo various processes, including diffusion, ion implantation, photolithography, etching, layering, and oxidizing. These are cyclical processes; the sequence and the number of cycles will vary depending on the requirements of the integrated circuit design.

The manufacturing process of integrated circuits utilizes silicon wafers as the base material. The silicon wafers are exposed to oxygen at high temperatures to form a layer of silicon dioxide on the wafer surface. After the surface oxide film is formed, the photosensitive agent is coated to the wafers. After a wafer has been coated with photoresist and the photoresist has cured, the wafer is exposed to a light source and developed in combination with a photomask to form various types of circuits on the wafer. After etching, removing photoresist liquids, and doping, the wafer is deposited to form the circuits and electrodes for final testing.

Doping
A semiconductor is a material whose conductivity is between that of a conductor and a Non-conductor. Its ability to conduct electricity depends not only on the energy gap characteristics of its own material, but also is affected by foreign impurities. The energy levels generated by the donor and the acceptor increase the original conductivity of silicon. This action of adding a small amount of specific impurities to the semiconductor is called doping. Doping methods include ion implantation and diffusion.

The ion implantation method first ionizes the dopants (e.g., Arsine [AsH3]), and then with the use of an accelerator, the ionized dopants are directly injected into the silicon wafer to pre-set the dopants to form various N type or P type semiconductor regions. This method can accurately adjust the content (concentration) and distribution of the dopants in the wafer.

The diffusion method utilizes the dopants' mobility along its own concentration gradient at high temperatures (above about 800 degrees Celsius) to realize the doping of silicon wafers. Because it is not easy to control the concentration distribution of dopants by heat diffusion in hot furnace tubes, this method is mainly used to perform the distribution correction of dopants after implantation and restore the single crystal structure of the surface atoms at the silicon wafer

Layering (Thin Film)
The formation of a thin film of material on the wafer is due to the gas molecules or other particles spread on the surface of the wafer. These particles may be solidified due to the chemical reactions and deposit on the surface of the wafer, or they may lose part of their kinetic energy after undergoing surface diffusion and be adsorbed on the surface of the wafer and then deposited. Therefore, layering methods include physical and chemical vapor deposition.

Physical Vapor Deposition (PVD) is a technology that forms a thin film through physical processes, including evaporation and sputtering. In the evaporation process, the deposition material is evaporated by heating. Once the deposition material saturates in the vapor phase, it is then condensed and deposited to form a thin film on the wafer surface. The sputtering process uses the ions generated by the plasma to bombard the electrode of the deposition material, emitting particles of the deposition material to the vapor phase and then depositing a thin film on the wafer surface.

Chemical Vapor Deposition (CVD) is a thin film deposition technology that uses chemical reactions to generate solid products from gaseous reactants in the reactor that deposit on the surface of the wafer. Because it involves chemical reactions, it is called CVD. At present, it is the most important and the main thin film deposition technology in the semiconductor manufacturing process. It can deposit materials with precise composition and has better step coverage. Main CVD technologies include atmospheric pressure CVD, low pressure CVD, and plasma CVD.

Photolithography
Photolithography is the most important step in the entire semiconductor manufacturing process. Anything related to the metal oxide semiconductor device structure, such as the pattern of each layer of film and the area of impurities, are determined by this step. The basic procedure consists of three steps: photoresist coating, exposure, and development.

Photoresist is mainly composed of resin, photosensitizer, solvent, and several other different compositions. Negative photoresists produce chains when exposed to light and cannot dissolve in the developer, while positive photoresists themselves are difficult to dissolve in the developer, but dissociate into the developer solution when exposed to light.

Parallel light from the light source passes through the glass body photomask with a desired pattern and reaches the photoresist coated wafer. The projected light inherits the same pattern from the photomask, and therefore, exposes the photosensitive materials on the wafer surface. The exact same pattern on the photomask is transferred onto the wafer surface in this manner. During the development process, the exposed photoresist on the wafer surface is removed via a neutralization reaction, and then the desired pattern is retained on the wafer.

Etching
The etching process removes the deposited film material not coated and protected by the photoresist during the photolithography process. This is done via chemical reactions or physical processes to complete the final goal of transferring the mask pattern onto the film. The film developed and etched by photolithography will become a part of the semiconductor. Etching techniques including wet etching and dry etching.

Wet etching uses a chemical reaction between the film and a specific solution to remove the film not coated by the photoresist.

Dry etching uses plasma to etch the films. As the process does not involve any solution, it is called dry etching.

Planarization
Chemical Mechanical Planarization (or Polishing, CMP) is the process of injecting abrasive particles into the polishing

pad of the polishing machine to remove varying types of materials from the wafer. The purpose is to smooth the dielectric layer and the metal layer on the integrated circuit wafer to flatten it and achieve three-dimensional wiring or multilayer wiring, increasing the wiring density while reducing defects.

Cleaning Operations
Various organic and inorganic cleaners are used in enclosed hoods to clean equipment parts and quartz reaction chambers. Organic cleaners can include volatile organic compounds (VOC) emissions. Inorganic cleaners include acids such as hydrogen chloride (HCl), and bases such as ammonium hydroxide solution.

Cleaning operations are sources of both VOC and hazardous air pollutants (HAP) emissions. The enclosed hoods will have a positive pressure and each collection system will have a negative pressure so that the emissions can be collected and sent to an abatement device (i.e., Rotor Concentrator Thermal Oxidizers [RCTO]).

PERMIT HISTORY:

Date Received	Permit Number	Description
08/13/2021	P0008497	Submitted application for new permit for semiconductor fabrication plant.
3/15/2022	P0008947	TSMC submitted a revised application due to design changes in the planned facility.

PURPOSE FOR APPLICATION:
Permittee has submitted a Non-Title V permit application to construct and operate a new semiconductor fabrication facility.

A. APPLICABLE COUNTY REGULATIONS:

Rule 100: General Provisions and Definitions
Rule 200: Permit Requirements
Rule 220: Non-Title V Permit Provisions
Rule 241: Minor New Source Review – the facility is subject to RACT, BACT, and Ambient Air Quality Impact Analysis per Rule 241
Rule 280: Fees: Table H
(Semiconductor manufacturing subject to source testing)
Rule 300: Visible Emissions
Rule 320: Odors and Gaseous Contaminants
Rule 324: Stationary Reciprocating Internal Combustion Engines
Rule 338: Semiconductor Manufacturing

Best Available Control Technology (BACT) Analysis
County Rule 241 §304 lists the criteria pollutant thresholds for new and existing sources that trigger BACT requirements in Maricopa County. The permit application for the TSMC Phoenix facility has potential to emit BACT for: VOC, NOx, PM10, and PM2.5. A review of the processes at this source, their emissions, and applicable control technology; was completed and the following determinations for BACT and RACT were made.

Emergency Engines
This facility is permitted for 23 emergency compression-ignition engines; 22 of those being rated at 2,923 BHP for providing backup power, and one rated at 360 BHP for the pumping of water in case of fire. As of 12/22/2020, the Bay Area Air Quality Management District (BAAQMD) has set BACT for emergency compression-ignition engines, with a rated power output of >= 1,000 BHP, to be certified to EPA Tier 4 Non-Road Engine Emission Standards.

TSMC submitted a BACT cost analysis with their original permit application prior to design updates (Aug 2021) for 22 backup-power emergency engines using the EPA-approved "Annualized Cost of Control" method which compares the price/ton of NOx emissions for EPA Tier 2 certified engines vs. Tier 4 certified engines, over an estimated 20-year lifespan. This cost analysis was performed assuming a combined 29.22 tpy NOx emissions for the Tier 2 Engines scenario and 15.98 tpy NOx emissions for the Tier 4 Engines scenario (13.24 tpy NOx emission reduction). The results of this annualized cost analysis come to ~$105,000/ton NOx reduced. An updated cost analysis was provided with the updated application (Mar 2022) which uses the same methodology as the original but has an emission reduction cost per ton of NOx of ~$207,000 See Appendix D of the permit application for detailed information on the BACT cost analysis.

The permitted NOx emissions from emergency engines >= 1,000 BHP requested by the Permittee in the *original* application totaled 8.81 tpy. This is due to the limiting of the hours of operation of each of the 38 engines to no more than 18 hrs/yr. The updated permit application (Mar 2022) is permitted for ~5.1 tpy NOx. **Due to the relatively small contribution of NOx emissions from emergency engines, which are well under the BACT threshold, it was determined by MCAQD that BACT should not apply to the emergency engines >= 1,000 BHP at this facility.**

Cooling Towers
The semiconductor fab will be equipped with 28 total cooling towers (14 per fab) used to dissipate heat generated by fab processes. These cooling towers are open to the atmosphere and generate emissions of PM10/PM2.5 via mist drift carrying dissolved particulates.

The mass of PM emissions released into the atmosphere is determined by the total flow rate of water through cooling towers, the concentration of particulates in water, and the "drift rate;" which is the ratio of the mass of escaped water via mist to total flow throughput. **BACT for cooling towers per the EPA RACT/BACT clearinghouse is a cooling tower system equipped with high efficiency mist eliminators that achieve a maximum allowable drift rate of 0.0005%.** This BACT requirement has been written into the permit as an enforceable condition.

External Combustion Sources
Fuel-burning external combustion sources at this facility include six (6) boilers rated at ~5.12 MMBtu/hr each. The total permitted NOx emissions from these boiler units, using a conservative emission factor of 100 lbs/MMscf and an allowable annual operating limit of 300 hr/yr, comes to ~0.45 tpy. Twelve (12) RCTOs at this source use the same emission factor but are permitted for 24/7 operation and therefore have a potential to emit at ~17.0 tpy NOx. **These units have a combined ~17.5 tpy NOx PTE, well below the BACT threshold. Therefore, these units are subject to RACT as opposed to BACT.**

Solvent Storage Tanks
This facility is permitted for sixteen total volatile organic liquid storage tanks. Four 7,925 gallon vertical fixed roof tanks exist for each stored liquid mixture; Isopropyl Alcohol (IPA), Thinner-1, Thinner-3, and DP001. Breathing and working losses occur in the tank when VOC-saturated air is displaced during the transfer of organic liquid or from the natural heating and cooling of the tanks.

These VOC emissions from tanks are controlled through a vent to the RCTO units. The tank contents are under a N2 blanket and slight draw to allow any emissions that escape the blanket to be drawn into the VOC exhaust. RCTO units are already required to meet BACT for VOC destruction efficiency and therefore the VOC emissions from organic liquid storage tanks are in compliance with BACT requirements.

Process Emissions
Emissions from semiconductor manufacturing operations (known as *process emissions*) include VOC, NOx, CO, PM2.5, PM10, and HAPs. These process fumes are vented to one of two types of control equipment: scrubbers or thermal oxidizers. Photolithography, etching, and ammonium scrubber effluent gasses are vented to RCTOs for combustion. Etching, diffusion, vapor deposition, and general facility air are vented to acid and bench scrubbers. s. **Process emissions of NOx, VOC, PM2.5, and PM10 are at levels which require BACT.**

RCTO VOC:
Per BAAQMD BACT/TBACT workbook the RCTOs satisfy BACT for the control of VOC from photoresist operations so long as the following destruction efficiencies are achieved:

98.5% if inlet VOC concentration ≥2,000 ppmw
97% if inlet VOC concentration ≥2000 ppmw and <2,000 ppmw
90% if inlet VOC concentration <200 ppmw

OR

≤10 ppmv VOC concentration at outlet

Bench Scrubber VOC:
The permit application lists an estimated ~8.08 tpy VOC emissions from bench scrubbers. These scrubbers do not control for VOC emissions. MCAQD inquired as to the source of these VOC emissions and possible control strategies, as VOC is not typically present in large quantities in acid scrubber exhausts from semiconductor manufacturing operations.

According to TSMC, these emissions are carried over from source testing conducted on fabs in Taiwan. VOC emissions in the bench scrubber exhaust stream were so dilute that they were at 'non-detect' levels. Standard procedure for this scenario in the performance testing was to assume VOC emissions at the minimum detection limit. Therefore, according to TSMC, the estimated VOC emissions from bench scrubber units in the permit application are a significant overestimation and they expect similarly dilute streams at this fab. Therefore, BACT for VOC will not apply to bench scrubbers.

POU Combustion and Scrubbers NOx:
The permit application lists an estimated ~64.2 tpy NOx emissions from scrubber stacks. Though this facility is subject to NOx BACT requirements, the Permittee claims that it is technologically infeasible to control this NOx due to the configuration and makeup of tooling exhaust streams. This reasoning was provided to MCAQD by the Permittee in a memo dated July 26th, 2022 (attached below).

Semiconductor process tools use an array of chemicals with different physical properties that exhaust gases which may be flammable, pyrophoric, acidic, caustic, and/or are greenhouse gases. These potentially dangerous and unstable mixtures are routed to a point-of-use (POU) combustion chamber which is integrated directly into the tooling equipment to reduce these emissions for safety purposes. It's during this combustion phase in which the bulk of NOx generated from process tooling occurs. The primary generation arises from nitrogen-containing compounds such as ammonia (NH3), nitrogen trifluoride (NF3), and nitrous oxide (N20) in the exhaust streams which when combusted oxidizes the nitrogen to form NOx. Secondarily, NOx is generated from the combustion of natural gas which is the fuel source for the combustion chamber.

In the 7/26 memo the Permittee states that BACT for NOx generated by the POU combustion of process tools is "good operating practices" and "good engineering design." To provide justification for this BACT determination the Permittee performed a search of the following BACT databases for other semiconductor manufacturing facilities: BAAQMD BACT workbook, SCAQMD BACT guidelines, and SJVAPCD BACT clearinghouse. In addition, recently issued permits for Intel Ocotillo facility in Chandler, AZ; Samsung in Austin, TX; and Samsung in Taylor, TX. **This search returned no specific technology which can be substituted for or applied to the POU combustion chambers**.

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Intel Corporation has previously completed a similar technology review of POU devices for a LAER (lowest achievable emission rate) determination. Intel looked at other technologies which are typically used to control NOx emissions for other source types. Their findings come to a similar conclusion, that NOx control technologies for combustion sources are not technically feasible to control NOx from POU abatement equipment. These technologies are as follows:

1. Low-NOx burners: low NOx combustion technology has never been applied to burn-wet POUs. Burn-wet POUs are defined as a POU combustion chamber followed by a wet scrubber, which is the configuration TSMC and Intel use). This is due to the relatively small size of the natural gas burner in these units (~0.15 – 0.30 MMBtu/hr). Low-NOx burners in other equipment such as boilers are two order of magnitude larger in heating value. In addition, semiconductor fabs use batch processes which have varying chemistries that would affect the control needs.

2. SNCR, SCR, NSCR: These acronyms stand for Selective Non-Catalytic Reduction (SNCR), Selective Catalytic Reduction (SCR) and Non-Selective Catalytic Reduction (NSCR). These technologies are all used commercially for the reduction of NOx emissions at the end-point of the stack. In a semiconductor fab this would be after the POU device and wet scrubber. However, these devices operate when the gas streams has temperatures are in the range of 600-850^{o}F, high flow rates, and are fuel rich. Fab wet scrubber exhaust streams are typically around room temperature and have very low flows and concentrations.

3. Multi-Stage Wet Scrubbers: In a multiple-stage wet chemical Scrubber, NOx is removed through chemical adsorption in applications that typically are high in NOx concentration and at flowrates well below Intel's requirements. In the first stage of processing, NO in the exhaust is converted to NO2 using an oxidation agent. The NO2 entrained in the Scrubbers liquid is then reduced to a sodium salt using a reducing agent. Multi-stage NOx Scrubbers that are currently commercially operational are not designed to treat low NOx concentration exhaust and would not be practical to achieve significant control.

Scrubber/POU PM
Scrubber stacks at this source are estimated to emit ~50.9 tpy of PM. The majority of these PM emissions come from chemical vapor deposition (CVD) process equipment, which utilizes deposition gases to create a thin layer of material on the silicon substrate.

In determining BACT from scrubber units TSMC has referred to an in-depth BACT analysis for similar emissions processes and control technologies at the Intel Title V facility. This BACT analysis was submitted with Intel's 2017 significant permit revision (Legacy Permit No. V15002, Permit Revision 0.2.0.0, TSD Appendix D). The results of this top down BACT analysis with cost analysis are summarized in the paragraphs below.

In the presence of oxygen at high enough temperatures, oxidation will occur leading to the formation of PM in the process chamber. Gases from this process are routed to POU combustion chambers for the destruction of hazardous materials and greenhouse gases. This combustion phase is another much smaller source of PM from scrubber stacks. According to source testing from an Intel fab in Oregon, most of the PM is between 0.1 and 0.4 microns in size.

Wet scrubbers are designed for mass-transfer and not to efficiently abate PM emissions. Therefore, control of PM from scrubber exhaust would have to be done by installing additional control technology at the end of the stack. This control figuration has significant engineering challenges as the pressure drop across scrubbers is generally low, whereas PM control technology is done in a high pressure drop environment.

Step 1: Identify All Control Technologies

The following PM control devices were reviewed in the top-down BACT analysis for the inlet and exhaust of the centralized wet scrubbers at Fab 42, as well as the scrubbers at the existing facility (Fab 12, Fab 32S, and Fab 32). The same control technologies were evaluated as individual add-on controls at the exhaust of the POU abatement device at the Ocotillo Facility

1) Ceramic Filters
2) Fabric Filters
3) HEPA or ULPA Filters
4) Venturi Scrubber
5) Packed Bed Scrubber
6) Electrostaic Precipitator (ESP)

Step 2: Eliminate Technologically infeasible options

Ceramic Filters:

Ceramic filters were considered technologically infeasible since they would plug relatively quickly due to the significant amount of submicron particulate matter in the exhaust of both the POU abatement devices and the centralized wet scrubbers. A standby system would be needed in order to continue to abate the wet scrubbers while the filter media is being replaced. However, the large pressure difference between the offline and online systems would cause pressure sensitive process equipment upstream of the wet scrubbers to shut down, which would result in scrapped wafers

Fabric Filters:
Fabric filters were considered technologically infeasible due to their low removal efficiency of submicron particulate matter less than 0.3 microns in size. The majority of particulate matter in the exhaust of the POU abatement devices and the centralized wet scrubbers is between 0.1 to 0.4 microns.

HEPA or ULPA Filters:
HEPA or ULPA filters were considered technologically infeasible due to the significant amount of submicron size particulate matter exhaust of the POU abatement devices and inlet to centralized wet scrubbers, which would plug the filters relatively quickly requiring a standby system. The pressure drop across the filter media will increase until not enough airflow can from the process equipment can pass. This new pressure drop would be much higher than the pressure of the new filter media, which would result in a substantial pressure fluctuation when switching between the offline and online systems causing pressure sensitive process equipment to shut down and wafers to be scrapped.

Fiber Bed Filters:
Fiber bed filters were considered technologically infeasible since they are not replaced when spent and the significant amount of incondensable particulate matter in the exhaust of both the POU abatement devices and the centralized wet scrubbers will not be removed through self-cleaning. The submicron size particles would not coalesce in order to drain by gravity or be washed with water.

Venturi Scrubber:
Venturi scrubbers were considered technologically infeasible since it was uncertain if incondensable particulate matter exhausted from either the POU abatement devices or the centralized wet scrubbers would be abated due to the inability to induce inertial impaction on submicron and nanometer sized particulate as efficiently as larger size particles.

Packed Bed Scrubber:
Packed bed scrubbers were considered technologically infeasible since they are primarily designed to abate water soluble gases such as hydrogen fluoride (HF) and hydrogen chloride (HCl) and not submicron or nanometer sized particulate matter.

Step 3: Rank Remaining Control Technologies by control effectiveness:

Electrostatic Precipitator: A wet ESP would be the only feasibly control technology that would abate the particulate matter from the exhaust of the centralized wet scrubbers or the exhaust of the POU abatement devices, since they are designed to remove submicron matter as low as 0.2 microns, which are continuously washed off with water eliminating the potential for plugging.

Step 4: Cost Effectiveness Analysis:

Intel performed a cost effective analysis for both a single wet ESP at the exhaust of the centralized wet scrubber and for 240 wet ESPs at the exhausts of the POU abatement devices site-wide. The control cost for each configuration was estimated at:

Configuration	Cost per ton of PM Controlled
One (1) Centralized WESP	$159,172 / ton
240 WESPs at POU exhaust	$248,798 / ton

Agencies such as BAAQMD and SJVAPCD have cost effectiveness thresholds between $5,300/ton to $5,700/ton for controlling particulate matter, thus all of these control options were considered economically infeasible as BACT for the Ocotillo Facility

Step 5: BACT Selection

Based on the above BACT analysis, add-on control devices for particulate matter at the exhaust of the centralized wet scrubber or the POU abatement devices will not be required as BACT for the existing fabs (Fab 12, 32S, and 32) or Fab 42. Instead, as BACT for particulate matter from the centralized wet scrubbers, Intel will maintain good work practices for operating all fab processes at the Ocotillo Facility.

Enforceable conditions, including performance testing requirements, have been included in the permit to ensure compliance with BACT standards for all applicable emissions processes at this source.

B. MINOR NEW SOURCE REVIEW – Air Quality Impact Assessment Determination:

As required by County Rule 241 an Ambient Air Quality Impact Assessment (AAQIA) for NO2, PM10, PM2.5, and SO2 emissions was submitted as a part of this permit application. The impact assessment consists of an air dispersion model built using the AERMOD program which simulates the plume profile of emissions sources at this facility over a period of time using historical meteorological data.

The model "passes," and the permit may be issued IF: the significant impact level (SIL) for the source is not exceeded for the applicable thresholds. These thresholds are 7.5µm/m^3 for 1-hr NO2 and 1.0µm/m^3 for annual NO2. If SILs are exceeded then the analysis must progress to modeling with representative background information to compare to the annual and/or 1-hr NO2 National Ambient Air Quality Standards (NAAQS). These standards must not be exceeded by any one receptor in the grid (see *receptor grid* below) for the given design value. The annual NAAQS design value is based off of the highest average annual concentration in any 12-month period while the 1-hr NAAQS design value is based off of the 98th percentile highest average daily 1-hr concentration (high 8th-highest hour).

Methodology

After a review of the modelling protocol, it was found that the Permittee has followed MCAQD and ADEQ modeling guidelines in creating an approved air dispersion model using the AERMOD program. The model was run for a simulated period of five years for each engine separately using pre-processed meteorological data for Phoenix provided by the Arizona Department of Environmental Quality (ADEQ) from years 2014-2018.

EPA and ADEQ guidelines for intermittent sources such as emergency engine testing are permitted to annualize their emissions due to the difficulty of simulating intermittent sources. The Permittee has followed this guidance in their dispersion model for intermittent sources; which include emergency engines and boilers. Other sources of modelled pollutants are already permitted assuming 24/7/365 operation (8,760 hrs/yr).

Buildings located at the site were modelled and input to the program for the purposes of calculating building downwash using the BPIP plugin for AERMOD. Data for buildings may be found in the permit application and the AERMOD input files included in this document.

Elevation data from the USGS website Landfire.gov was used to create elevation points for the buildings, stacks, and receptors.

Background Concentration Data

The Permittee's dispersion models use single-value background data to add to the source emission concentrations. The data is sourced from MCAQD air monitors and uses pre-processed values from 2018-2020 using the US EPA AQS AMP450 report for the corresponding air monitor. CO and SO2 3-hr background concentrations use the most recent year (2020). A full listing of background concentrations can be found in *Table 5* of the modeling report submitted by the consultant as a part of the permit application.

MCAQD uses slightly different background concentration data which is more up to date. The year range for this data includes 2019-2021 and design values which match the corresponding NAAQS. This data excludes exceptional events. A discussion on the changes from differing background concentrations can be found in the *results* part of this section.

MCAQD Background Concentrations:

2021 Background Concentrations_20220

Permittee's Background Concentrations:

Table 5 Background Concentrations

Pollutant	Averaging Period	AQS Monitor Code, Name	Description of Value	Background Concentration ($\mu g/m^3$)
NO_2	1-hr	04-013-9997, JLG Supersite	1-hr 98 percentile, 3-year average from 2018 to 2020	**91**
NO_2	Annual	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**25**
PM_{10}	24-hr	04-013-4016, Zuni Hills	Highest concentration from 2018 to 2020 (2018 value), excluding exceptional events	**131**
$PM_{2.5}$	24-hr	04-013-2001, Glendale	24-hr 98 percentile, 3-year average from 2018 to 2020	**17.87**
$PM_{2.5}$	Annual	04-013-2001, Glendale	3-year average from 2018 to 2020	**7.1**
SO_2	1-hr	04-013-9997, JLG Supersite	1-hr 99 percentile, 3-year average from 2018 to 2020	**12**
SO_2	3-hr	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**20**
CO	1-hr	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**2,444**
CO	8-hr	04-013-9997, JLG Supersite	2020 concentration (most recent year)	**1,948**

Background concentration design values mirror the NAAQS design values for direct summation with the model results in order to compare to NAAQS standards.

Per the ADEQ modeling guidelines; EPA recommends that all nearby sources that are not adequately represented by background ambient monitoring data should be explicitly modeled as part of the NAAQS analysis. EPA establishes "a significant concentration gradient in the vicinity of the source under consideration" as the sole criterion for this determination. MCAQD determined that facilities collocated *within* the facility boundaries can cause this concentration gradient which is not accurately reflected by background monitor data and must therefore be included in the dispersion model. TSMC included stack emissions and building data for the collocated Linde and Air Liquide plants in their modelling in response to this request to ensure that those emissions would not cause an exceedance in any NAAQS. Emissions from these facilities were found to have no significant impact on the highest design value concentrations for pollutants due to their location on the west side of the TSMC parcel – with the main TSMC plant located on the east side.

NO2 Conversion

Modeling guidance permits the use of three approaches towards simulating NO_2 emissions to ambient air. Each approach is rated by tier with tier 1 being the most conservative approach and tier 3 being the least conservative (but usually more accurate).

The Permittee modeled the annual and 1-hr NO2 emissions using the tier 2 approach: Ambient Ratio Method (ARM2). ARM 2 is based on representative equilibrium ratios of NO2/NOx value that are based on ambient levels of NO2 and NOx derived from national data from the EPA's Air Quality System (AQS). TSMC opted to use the national default for ARM: a minimum ambient NO2/NOx ratio of 0.5 and a maximum ambient ratio of 0.8.

Receptor Grid

Receptors are fixed points in space at ground level in which AERMOD measures the concentration of the pollutant(s). Receptors are placed along the fenceline and in a grid surrounding the facility with receptor density decreasing with distance from the source(s).

Table 1 below shows the Permittee's receptor grid and the MCAQD reproduction receptor grid. The Permittee's grid was found to be inadequately dense in the range of 200m to 800m from the source boundary. During the reproduction simulation done by MCAQD this range of receptors was corrected to be in line with Arizona Department of Environmental Quality (ADEQ) modeling guidelines.

Table 1. Receptor Grid Spacing

Distance from Boundary	**Permittee Model**	**MCAQD Model**
Boundary	25m	25m
Boundary > 300m	25m	25m
300m > 1,000m	100m	100m
1,000m > 5,0000m	500m	500m
5,000m > 10,000m	1,000m	1,000m

Stack Information
A total of 138 stacks were modeled for all emission types combined for the TSMC facility and collocated facilities. All sources of process emissions are vented by a stack, with boilers and the fire pump utilizing a capped stack for rain protection. Table 3 of the modeling report below shows a list of all stacks used in this model. Four of these stacks are emergency generators modelled for the Linde hydrogen plant on-site as a part of representative background concentrations.

Results
Both the Permittee's and MCAQD's model demonstrate that **the modification to this facility is not likely to cause an exceedance in the NAAQS for any short or long-term NO2, PM10, PM2.5, CO, or SO2 standard.**

Even though the MCAQD model used the same source parameters, emissions rates, receptors, met data, and building locations; the results for each model differ slightly (except for PM10, for which the Permittee model is almost double MCAQD's) due primarily to using different background concentrations and modeled design values. MCAQD models use background concentrations over the years 2019-2021 using Source: US EPA AQS Report AMP450 (Quick Look Report). These background concentrations meet the design values and guidelines for use in dispersion modeling. The Permittee's model background concentrations for NO2 annual, PM10 24-hr, PM2.5 24-hr, SO2 3-hr, CO 1-hr, and CO 8-hr are all conservative values using the highest concentration in a one-year period (2020).

The Permittee's model forgoes the standard design values for their short-term modeled concentrations and uses maximum concentrations instead (high 1st high). This results in an overly conservative model output. In contrast, MCAQD followed published EPA design values and guidelines for model outputs. As an example, the NO2 1-hr design value is the 98th percentile of daily maximums (high 8th high).

Due to the conservative nature of the Permittee model, results from their protocol and methodology are deemed to be in compliance with the mNSR process and standards.

The Tables below lists both models' results compared to the NAAQS standard:

Table 2. AERMOD results summary for NO2 emissions

	Model Results (μg/m³)	**NAAQS Value Threshold (μg/m³)**

Modeler	1-hr	Annual	1-hr	Annual
Permittee	140.0	28.0	188	100
MCAQD	85.0*	27.9*	188	100

*MCAQD model uses conservative AP-42 emission factors for NOx emission from emergency engines due to the unavailability of site variation data from the manufacturer. Differences between 1-hr results between models due to background concentrations.

Table 3. AERMOD results summary for PM10 emissions

	Model Results (µg/m³)	NAAQS Value Threshold (µg/m³)
Modeler	**24-hr**	**24-hr**
Permittee	140*	150
MCAQD	64.0	150

Table 4. AERMOD results summary for PM2.5 emissions

	Model Results (µg/m³)		NAAQS Value Threshold (µg/m³)	
Modeler	**24-hr**	**Annual**	**24-hr**	**Annual**
Permittee	26.0	9.8	35	12
MCAQD	25.4	9.7	35	12

Table 5. AERMOD results summary for CO emissions

	Model Results (µg/m³)		NAAQS Value Threshold (µg/m³)	
Modeler	**1-hr**	**8-hr**	**1-hr**	**8-hr**
Permittee	362.9	228.9	40,075	10,305
MCAQD	349.2	211.8	40,075	10,305

Table 6. AERMOD results summary for SO2 emissions

	Model Results (µg/m³)		NAAQS Value Threshold (µg/m³)	
Modeler	**1-hr**	**3-hr**	**1-hr**	**3-hr**
Permittee	13.2	15.6	196.5	1,310
MCAQD	11.5	14.1	196.5	1,310

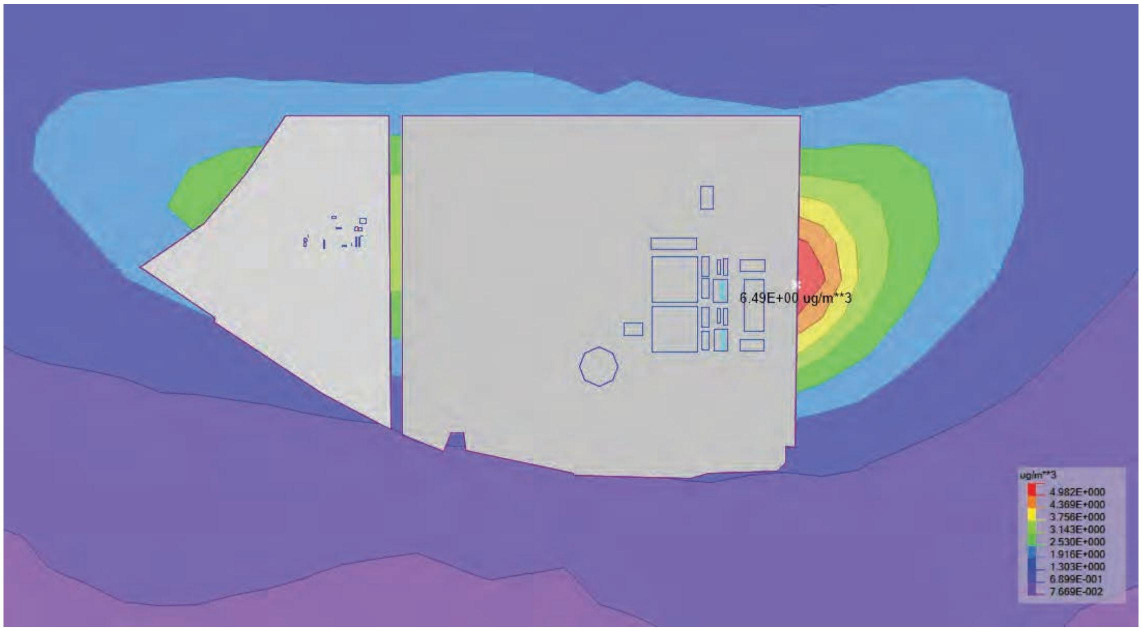


Figure 1. PM2.5 24-hr NAAQS model run at TSMC facility.

Figure 1 above shows the dispersion for the 24-hr PM2.5 MCAQD model run. The concentration profile shows that particulate matter concentrations are expected to peak on the eastern border of the facility boundary. Background concentrations are not added to mapped results.

Figure 2. NO2 NAAQS model run at TSMC facility.

Figure 2 above shows the dispersion model for the NO2 MCAQD model runs. The concentration profile shows NO2 concentrations expected on the northern border of the facility boundary. Background concentrations are not added to mapped results.

C. APPLICABLE FEDERAL REGULATIONS:

40 CFR 60 Subpart IIII: Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

NSPS Subpart IIII applied to owners and operators of stationary compression ignition internal combustion engines that commenced construction or were modified/reconstructed after 07/11/2005. The stationary compression ignition ICEs that will be used at this facility are model year 2019 and therefore must **MEET** the requirements of 40 CFR 60

Subpart IIII.

40 CFR 60 Subpart Dc: Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

Per 40 CFR §60.40c this subpart applies to each steam generating unit for which construction, modification, or reconstruction is commenced after June 9, 1989; and that has a maximum design heat input capacity of 29 megawatts (MW) (100 million British thermal units per hour (MMBtu/hr)) or less, but greater than or equal to 2.9 MW (10 MMBtu/hr). The proposed steam generating units at this source are rated at a maximum capacity of ~5.12 MMBtu/hr and therefore are **EXEMPT** from 40 CFR 60 Subpart Dc.

40 CFR 63 Subpart BBBBB: NESHAP for Semiconductor Manufacturing

40 CFR 63 Subpart BBBBB establishes national emission standards for hazardous air pollutants (NESHAP) for semiconductor manufacturing facilities. Per §63.7181 this NESHAP applies only to semiconductor manufacturing facilities which are a major source of HAP. A major source a HAP is any facility which emits 10 tpy of any single HAP or 25 tpy of combined HAP. Enforceable limits in the permit keep this facility under the major source threshold and therefore this source is **EXEMPT** from the requirement of Subpart BBBBB.

D. AIR POLLUTION CONTROL EQUIPMENT/EMISSION CONTROL SYSTEM(s):

<table>
<tr><th>System description</th><th>Quantity</th><th>Comments:</th></tr>
<tr><td>Rotor Concentrator Thermal Oxidizers (RCTO), 3.458 MMBtu/hr</td><td>12 (6 per fab)</td><td>Controls VOC emissions vented from Fab operations.</td></tr>
<tr><td>Acid Scrubbers</td><td>36 (18 per fab)</td><td rowspan="4">Acid, bench, wastewater, and ammonia scrubbers which control primarily inorganic acids hydrogen fluoride (HF), nitric acid (HNO_3), hydrogen chloride (HCl), and sulfuric acid (H_2SO_4), as well as other compounds such as chlorine (Cl_2), acetonitrile (C_2H_3N), carbonyl sulfide (COS), and titanium tetrachloride ($TiCl_4$).

Bench Scrubbers consist of two scrubbers in series to control high concentration acid emissions.

Wastewater treatment scrubbers neutralize acid waste contained in process water as part of the wastewater treatment plant which recycles process water.

Ammonia scrubbers are alkaline and treat NH_3 in exhaust streams prior to emission to ambient air.

Emissions of Arsine (AsH_3) are routed to an absorption bed prior to the acid scrubber. The absorption bed is estimated to control ~99.5% of arsine emissions.</td></tr>
<tr><td>Bench Scrubbers</td><td>18 (9 per fab)</td></tr>
<tr><td>Ammonia Scrubbers</td><td>12 (6 per fab)</td></tr>
<tr><td>Wastewater Treatment Scrubbers</td><td>6 (3 per fab)</td></tr>
</table>

E. EMISSIONS:

Semiconductor Fabrication

Fab operations are vented to RCTOs and wet scrubbers which control pollutant emissions. Emissions from these fabrication operations can then be estimated based on previous stack testing of similar equipment, material balances, and engineering estimations for this facility.

A full detailed breakdown of semiconductor fabrication emission estimates is included with the permit application. MCAQD requires on-site performance testing of this air pollution control equipment once it is fully operational in order to establish emission factors for the enforcement of the requested emission limits based on the estimations (see: section G of this document).

Emergency Engines
Diesel engine emissions are calculated using the emission factors provided by the manufacturer. SO_X emissions are based on a sulfur content limit of 0.0015% by weight, in accordance with Rule 324 and NSPS Subpart IIII.

The operating limit, 18 hours per engine per consecutive 12-month period, was taken from the application and is written into the permit as an enforceable limit.

Fuel Burning Equipment
The burning of natural gas is a source of emissions of products of combustion. Emission factors from AP-42 Tables 1.4-1 and 1.4-2 are used to estimate emissions from fuel burning equipment which includes the boilers and RCTOs at this facility. It is assumed that all fuel burning equipment operates at full capacity 8,760 hrs/year

Cooling Towers
Emissions of particulate matter (PM) to ambient air occur from cooling towers due to water vapor escaping into the atmosphere which contains PM molecules. US EPA Chapter 13.4 contains emission factors and a method to calculate these PM emissions when given known values for water circulation rate and total dissolved solids (TDS) content of the water. Assumed parameters include a 0.0005% drift rate, 2000 ppm TDS, 16,120 gal/min flow rate for reach tower, and 31.3% of drift mass from cooling towers escaping by atmospheric dispersion. A total of 14 cooling towers are permitted for this source. See the appendix for detailed emission calculations.

$$PM\left(\frac{lbs}{hr}\right) = Water\ Circ.\ Rate\ (gpm) \times \frac{8.345lb}{gal} \times \frac{Drift\ Rate(\%)}{100} \times \frac{TDS(ppmw)}{1{,}000{,}000} \times \frac{60\ min}{hr} x\ 0.313$$

Storage Tanks
Storage of volatile components results in emission of those volatiles to the atmosphere from working and breathing losses. Working losses are emissions from vapors generated by the volatile material being transferred into or out of the storage tank. Breathing losses are generated when the vapors in the tank undergo a pressure rise due to the tank temperature rising from ambient heat and then escape through the tank vents.

This facility is permitted for sixteen total vertical, fixed-roof, 7,925 gallon capacity volatile organic liquid storage tanks. Four tanks exist for each stored liquid mixture; Isopropyl Alcohol (IPA), Thinner-1, Thinner-3, and DP001. Detailed speciation for these tanks can be found in the emission calculations spreadsheets attached in this document section. As part of the permit application TSMC simulated these losses using Promax, a chemical process simulator, which takes input parameters such as the physical tank makeup, liquid makeup, and internal/external temperatures; to determine emissions. These breathing and working loss emissions are vented to RCTOs for control of VOCs.

Facility-Wide Permitted Emissions [Tons/Year]

Pollutants	Boilers	Emergency Engines	Cooling Towers	Storage Tanks	RCTO's	Scrubbers	**Facility wide Annual Emissions**
CO:	0.56	3.37			11.8	52.8	90*
NOx:	0.67	5.85			17.0	64.2	90.0*
PM10:	0.051	0.19	3.10		16.8	50.9	63.0*
PM2.5:	0.051	0.19	1.86		16.8	50.9	63.0*
VOC:	0.037	0.31		0.2	7.93	11.82	90*
SOX:	0.004	0.01			1.2		1.2
Total HAPs							22.5*
Benzene							0.002
Toluene							0.001
Xylenes							0.000
Formaldehyde							0.01
HF							3.94
HCl							6.66

Cl_2							6.66
Acetonitrile							0.25
COS							1.28
$TiCl_4$							0.77
Arsine							0.01
Ethylene Glycol							3.36
Phosphine							0.02
Trimethylamine							0.22
Cobalt							0.00

* Facility-wide annual emissions may not exactly add up to the individual source-type contributions. They instead represent the enforceable emission limit written into the permit for the respective pollutant as requested by the source.

F041443_P0008497_EmissionCalcs.xlsx

F. HAP EMISSION IMPACTS:

Dispersion modeling using BREEZE AERMOD software was performed on atmospheric HAP emissions from this facility based on calculated hourly HAP emission rates assuming uniform emissions over 8760 hours per year at the estimated HAP PTE at the permitted emissions level. The results of this modeling were then compared to acute and chronic ambient air concentration (AAAC, CAAC) thresholds to see if the concentration of any one HAP may be in an amount to cause short and/or long term damage to public health.

MCAQD policy is to use SCREEN modeling for HAPs that are emitted by a source at a minimum hourly threshold. The AERMOD dispersion modeling software used by the Permittee is the same as used for the mNSR ambient air quality assessment and is a more accurate, less conservative way to model HAP concentrations. After review of the modeling protocol MCAQD has accepted the Permittee's HAP dispersion model for comparisons to acute and chronic ambient air concentrations.

Emissions were modelled using site data from the mNSR ambient air quality analysis which is discussed in detail in section B of this document.

Table 3. AERSCREEN HAPs Modeling Concentrations at the Ambient Air Boundary

		Screen Model Results (µg/m3)		**Ambient Air Conc. (µg/m3)**	
Pollutant	**Emissions (lbs/hr)**	**Max 1-hr Conc.**	**Annual Conc.**	**Acute**	**Chronic**
Hydrofluoric Acid	7,880	2.37	0.16	9.80E+03	1.46E+01
Hydrochloric Acid	13,320	4.52	0.23	1.6E+04	2.09E+1
Arsine	20	5.48E-03	1.70E-04	2.50E+03	4.41E-04
Benzene	2.0	0.71	1.10E-04	-	2.43E-01
Formaldehyde	0.23	0.07	3.40E-04	1.7E+04	1.46E-01
Ethylene Glycol	6,720	**-**	8.38E-02	-	4.17E+02
Cobalt	0.0	-	4.00E-05	-	6.86E-04

Table 3 above shows the results of the dispersion modeling analysis. AAC thresholds that are crossed by the concentration of emitted HAPs at the ambient air boundary at this source are shown in bold. **The modeling results show that this facility does not emit HAPs at a rate that are likely to cause short or long-term damage to public health.**

G. PERFORMANCE TESTING:

The Permittee shall conduct performance tests on all Rotor Concentrator Thermal Oxidizers (RCTO), all Acid Scrubbers, and all Bench (Acid) Scrubbers once per year from the date of the most recent test (no later than 14 months). Annual testing was chosen in lieu of 5-year testing due emission limits being so close to Title V thresholds and no material limitations being written into the permit as an enforceable condition.

RCTO parameters to be tested:

> VOC concentration in the RCTO inlet and exhaust streams to demonstrate compliance with the removal efficiency or outlet concentrations of the Permit Conditions. Testing shall establish a control efficiency which shall be used for mass balance calculations to maintain compliance with the permitted emission limit. Testing shall be done on both the concentrator and oxidizer exhausts.
>
> NOx concentration in the RCTO exhaust stream. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.
>
> CO Concentration in the RCTO exhaust stream. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.
>
> PM10 and PM2.5 concentrations in the RCTO exhaust stream. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.
>
> The combustion chamber temperature shall be recorded by the Permittee during the performance test. Following the performance test, the RCTO shall be operated at or above the combustion chamber temperature used to demonstrate compliance.

Estimated uncontrolled stack emissions of VOC from the six RCTOs at this facility trigger the requirement for best available control technology (BACT). Per the Bay Area Air Quality Management District (BAAQMD) BACT/TBACT Workbook the following control efficiencies/outlet concentration satisfy BACT:

98.5% when the inlet VOC concentration is greater than or equal to 2,000 ppmv measured as methane; or

97% when the inlet VOC concentration is greater than or equal to 200 but less than 2,000 ppmv measured as methane; or

90% when the inlet VOC concentration is less than 200ppmv measured as methane.

As an alternative to the destruction efficiency requirements the Permiteee may opt to have an RCTO outlet concentration of less than or equal to 10 ppmv VOC measured as methane.

Scrubber Parameters to be tested:

> Hydrofluoric Acid (HF) concentration in the scrubber exhaust streams. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.
>
> Hydrochloric Acid (HCl) concentration in the scrubber exhaust streams. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.
>
> PM_{10} and $PM_{2.5}$ concentration in the scrubber exhaust streams. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.
>
> NOx concentrations in the scrubber exhaust streams. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.

CO concentrations in the scrubber exhaust streams. Testing shall establish an emission factor to be used for compliance with the permitted emission limit.

H. REGULATORY REQUIREMENTS AND MONITORING:

Permit Conditions 1 thru 5 contain site-wide compliance duties for this source. Total permitted emissions are listed in Condition 1 and the enforceable calculations methodologies are listed in Condition 2. Condition 4 contains visible emissions compliance duties subject to County Rule 300.

Condition 4 contains bi-annual reporting requirements for emissions of VOC, PM10, NOx, and Total HAP due to the Permittee taking an enforceable and voluntary limit on these criteria pollutants to avoid triggering Title V permitting requirements.

Permit Conditions 6 thru 15 contain regulations and compliance duties for semiconductor fabrication operations at this source subject to County Rule 338 and performance testing conditions for the associated emission control systems per County Rule 270.

Condition 7 contains the O&M plan requirements which must be submitted within 45 days of initial permit issuance OR within 45 days of the equipment receiving exhaust; whichever comes last. RCTOs and wet acid scrubbers, and POU combustion devices are required to be included in O&M Plan.

Condition 8 contains the AMC demonsration requirements for interlocked POU devices. This section was written using the MCAQD Permitting Handbook, Section 6, "Guidelines for the Semiconductor Industry."

Condition 13 contains the performance testing duties and requirements for the RCTOs and Scrubbers at this facility which are required to be tested for various criteria pollutant emissions. See section E of this document for a detailed breakdown of performance testing requirements for this source.

Permit Conditions 16 thru 22 contain regulations and compliance duties for this source's emergency engines subject to County Rule 324 and Federal Regulation 40 CFR 60 Subpart IIII.

Condition 16 contains the annual hourly operation limit per engine of 18 hrs for the purposes of maintenance and readiness checks.

Condition 20 contains NSPS Subpart IIII requirements including the certified EPA tier standard for each engine model. These standards satisfy RACT requirements for emergency engines at this source.

Permit Conditions 23 and 24 contain regulations and compliance duties for this source's cooling towers. Cooling tower conditions are taken from County Rule 322 to satisfy to apply as RACT.

Condition 23.c contains the drift rate efficiency requirement of 0.0005% which satisfies BACT requirements for particulate emissions from cooling towers (see: section A of this document for more detail).

Permit Conditions 25 and 26 contain regulations and compliance duties for fuel burning equipment (boilers) located at this source.

Permit Conditions 27 thru 31 contain regulations and compliance duties for 16 organic liquid storage tanks and all waste solvent tanks at this facility subject to RACT Requirements. Language in this permit section was taken from County Rule 350.

VOC from tank vents is required to be vented to and controlled by the RCTO at a minimum control efficiency of 95%.

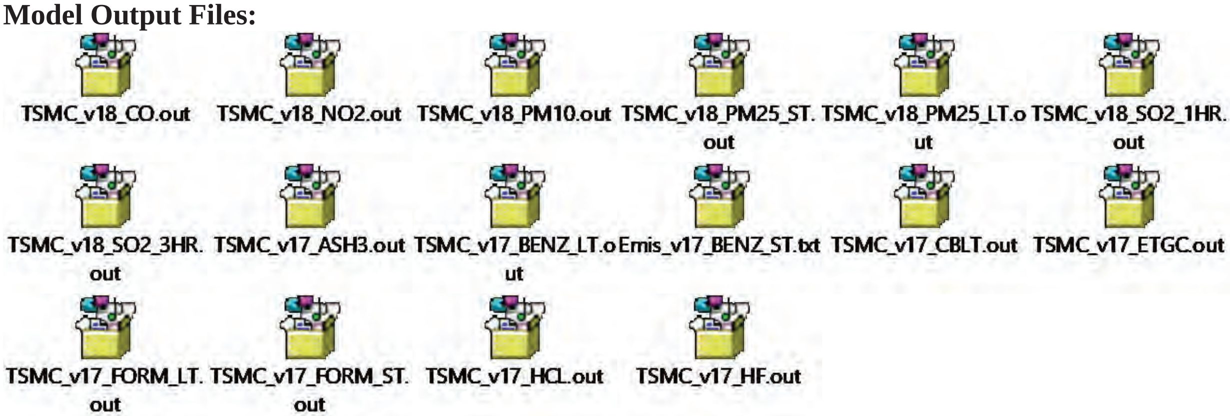
Permit Conditions 32 and 33 contain regulations and compliance duties for this source's wastewater treatment plant subject to County Rule 320.

Permit Conditions 34 thru 40 contain general Non-Title V Permit Conditions.

APPENDIX

Model Input Files:

Model Output Files:



EMISSION CALCULATION WORKSHEET FOR DIESEL FIRED ENGINES

Business Name: TSMC **Permit:** P0008497

Equipment and Emission Factors 0.001645

Equipment	BHP Rating	Operating Hours/Yr	Emission Factors (lbs/hp-hr)				Emission Factor Source
			CO	NO_X	PM_{10}	VOC	
Kohler/Mitsubishi S16R-	2,923	396	5.76E-03	0.01	3.29E-04	5.26E-04	Tier 2
CLARKE DQ6H-UFAA88	360	36	5.76E-03	1.00E-02	3.29E-04	5.26E-04	Tier 2

Emission Calculation:

$$Emission\left(\frac{lbs}{yr}\right) = Engine\ Rating\ (bhp) x\ Emission\ Factor\left(\frac{lb}{hp-hr}\right) x\ Op.time\left(\frac{hrs}{yr}\right)$$

Allowable Emissions

CO	**6,739 lbs/yr**	**3.37 tons/yr**
NO_X	**11,705 lbs/yr**	**5.85 tons/yr**
SO_X[1]	**15 lbs/yr**	**0.01 tons/yr**
PM_{10}	**386 lbs/yr**	**0.19 tons/yr**
$PM_{2.5}$[3]	**383 lbs/yr**	**0.19 tons/yr**
VOC	**617 lbs/yr**	**0.31 tons/yr**

[1]Based on an enforceable sulfur limit of 0.0015% by weight for diesel fuel.

[3]$PM_{2.5}$ = 0.991(PM_{10}) per SCAQMD Methodology to Calculate Particulate Matter (PM) 2.5

EMISSION CALCULATION WORKSHEET FOR COOLING TOWERS

Business Name: TSMC **Permit:** P0008497

Operating Hours: 8760 hrs/yr

Emission Calculation

$$PM\left(\frac{lbs}{hr}\right) = Water\ Circ.\ Rate\ (gpm) \times \frac{8.345 lb}{gal} \times \frac{Drift\ Rate(\%)}{100} \times \frac{TDS(ppmw)}{1{,}000{,}000} \times \frac{60\ min}{hr} x\ 0.313$$

Where: 0.313 is the fraction of solids-carrying drift that reaches the atmosphere[1].

PM_{10} Fraction of PM[2] =	1.00
$PM_{2.5}$ Fraction of PM_{10}[3] =	0.60

[1]EPA report: "Effects of Pathogenic and Toxic Materials Transported Via Cooling Device Drift - Vol 1." November 1979. Figure

[2]All PM emissions are assumed to be 10 microns or smaller (PM_{10})

[3]SCAQMD: Final –Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds" October 2006

Emissions:

Cooling Tower ID	Water Circulation Rate (gpm)	Quantity	TDS (ppmw)	Drift Rate[1,2]	PM lbs/hr
Cooling Towers	16,120	28	2000	0.0005%	0.71
					0.00
					0.00
					0.00
					0.00
Total:					0.71

[1]The drift rate was obtained from the manufacturer's data sheet.

Total Emissions:

PM:	**6,197 lbs/yr**	**3.10 tons/yr**
PM_{10}:	**6,197 lbs/yr**	**3.10 tons/yr**
$PM_{2.5}$:	**3,718 lbs/yr**	**1.86 tons/yr**

EMISSION CALCULATION WORKSHEET FOR NATURAL GAS FUEL BURNING EQUIPMENT (SMALL BOILERS < 100 MMBTU/HR)

Business Name: TSMC **Permit:** P0008497

Input Rating of Equipment, Btu/hr

1)	30,720,000	5.12 MMBtu/hr * 6 units	**Operating Time:**	1.216666	hr/day
2)				365	day/yr
3)				300	hr/yr
4)					
5)					
Totals	30,720,000	Btu/hr			

Emission Factors (AP-42 Chapter 1.4: Natural Gas Combustion)

Table 1.4-1: Emission factors for nitrogen oxides (NOx) and carbon monoxide (CO) from natural gas combustion

Table 1.4-2: Emission factors for criteria pollutants and greenhouse gases from natural gas combustion

CO:	84	lb/10^6 scf
NO_X:	100	lb/10^6 scf
SO_X:	0.6	lb/10^6 scf
PM10:	7.6	lb/10^6 scf
PM2.5:	7.6	lb/10^6 scf
VOC:	5.5	lb/10^6 scf

Constants

1,020 Btu/scf for Natural Gas

Emission Calculation:

$$Emission\left(\frac{lbs}{yr}\right) = \frac{Total\ Input\ Rating\ (\frac{Btu}{hr})}{1{,}020\ Btu/scf} \times \frac{Emission\ Factor\ (\frac{lb}{10^6 scf})}{1{,}000{,}000}\ x\ Operating\ time\ \left(\frac{hrs}{yr}\right)$$

Emissions

CO:	**1,123**	**lbs/yr**
NO_X:	**1,337**	**lbs/yr**
SO_X:	**8**	**lbs/yr**
PM10:	**102**	**lbs/yr**
PM2.5:	**102**	**lbs/yr**
VOC:	**74**	**lbs/yr**

PUBLIC NOTICE

Facility ID:	F041443
Permit Number:	P0008947
Company Name:	TSMC Arizona Corporation
Facility Address:	32200 North 43rd St. Phoenix, AZ 85083
Facility Type:	Semiconductor Fabrication
Air Contaminants:	Products of Combustion, Particulate Matter, Volatile Organic Compounds, Nitrogen Oxides, Sulfur Oxides, Carbon Monoxide, Hazardous Air Pollutants
Begin Posting Date:	
Site Contact Name and Email Address:	Robert Sandoval (sandoval@tsmc.com) Joy Jones (joyjones@tsmc.com)

NON-TITLE V
COMPLETENESS DETERMINATION CHECKLIST

Items 1-15 Front page: Items 1 to 15 (14 for Renewals) must be completed.

Notes to engineer:

- *For renewal applications the source must either answer 'No' to questions 2-5 or submit an application for a permit modification.*
- *Item 8: Many applicants do not know the SIC code or NAICS code for their industry. For a new application the code can be obtained by doing an on-line search. http://www.osha.gov/pls/imis/sicsearch.html*
- *Items 5, 7 and 14: These may be the same for many applicants.*

Complete: X Incomplete: ☐

Item 16: A simple site diagram has been included, preferably on a standard size paper. Detailed blueprints or construction drawings are not required.

Complete: X Incomplete: ☐ N/A: ☐

Item 17: A simple process flow diagram on a standard size paper is preferred. A process flow diagram may not be needed for some small businesses.

Complete: X Incomplete: ☐ N/A: ☐

Item 18: An O&M plan is required only for a control device. An O&M plan is not required for a spray booth. Instead of including the O&M plan with the application, an applicant may submit it after receiving the permit.

Complete: ☐ Incomplete: X N/A: ☐

Item 19: A dust control plan, if required, must accompany the permit application. The plan will be reviewed and approved by the dust compliance group.

Complete: ☐ Incomplete: ☐ N/A: X

Item 20: The applicant needs to complete only those sections of the permit application that are applicable.

Complete: X Incomplete: ☐ N/A: ☐

Notes to engineer:

- *Concerning Section Z: Many applicants will not be able to perform these engineering calculations. We will accept the permit application with a blank Section Z.*

Instructions for completing Sections A, B, C, D, E-1, E-2, F, G, H, I, J, K-1, K-2, K-3, K-4, L, M, X-1, X-2, Y and Z of the permit application are included at the beginning of each section and are self-explanatory.

In general, a material safety data sheet (MSDS) is required for each chemical used, stored or processed at the facility. Exceptions are for very common materials, such as gasoline, diesel, acetone, etc.

Business name: **TSMC**

Permit number: **P0008947**

Completeness review completed. Application determined to be: Complete: X Incomplete: ☐

Permit Engineer: **Ryan Dalrymple** Date: **3/21/2022**