

Congestion and Air Quality Management Annual Report - Fiscal Year 2023

Appendix A: Quantitative Assessment Calculations

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For: DelDOT Division of Planning

1 INTRODUCTION

This appendix was prepared to provide a record of the calculations completed for the five projects assessed quantitatively for DelDOT's FY2022 submissions to the CMAQ PAS (see **Table 1**).

Table 1. FY2023 CMAQ Program Summary

Project Category	Project No.	Project Name
Bike and Ped Facility	T202301602	Milford US 113 Pathway – Phase 1
Bike and Ped Facility	T202301603	NW Front Street Pathway
Bike and Ped Facility	T202401201	South Little Creek Road Shared Use Path
Carpooling & Vanpooling	T202404801	Rideshare FY24
Congestion Reduction and Traffic Flow Improvements	T202104703	FY24 Transportation Management Improvements Statewide Projects

The methods for completing the emission reduction calculations are discussed in Section 3.0 of the *Congestion and Air Quality Management Annual Report - Fiscal Year 2023*. The following sections present the inputs, standard variables, and outputs generated used by DelDOT to complete these estimation procedures for each of the five quantitative assessments.

1.1 MILFORD US 113 PATHWAY – PHASE 1

This project was reported to PAS for FY2023 as a quantitative entry. The project is listed under CMAQ ID No. T202301602. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 2. *Milford US 113 Pathway Phase 1- Background*

Project Description	Project No.	T202301602
	Evaluation Year	2027
	Project Name	Milford US113 Pathway – Phase 1
	Parallel Route	US 113
	Limits	Buccaneer Street to The Plaza at Milford
	Length (mi)	0.75

Table 3. *Milford US 113 Pathway Phase 1 – Mode-Shift Estimate*

Input Variables	<i>Bike</i>	1
	<i>PED</i>	1
	<i>D¹</i>	250
	<i>AADT</i>	27,256
	<i>A²</i>	0.0014
	<i>C³</i>	0.0030
Mode Shift Estimate	<i>Total Annual Traffic</i>	9,948,440
	<i>Total Annual Trips reduced from Bike Improvements</i>	29,982
	<i>Total Annual Trips reduced from Ped Improvements</i>	29,982
	<i>Total Annual Trips Reduced</i>	59,963
	<i>Avg. Reduction in Daily Passenger Trips</i>	2.49
	<i>Final AADT</i>	164

¹This variable (D) is the number of days a year when the facility would be open per year. It is used to translate the change in AADT to annual trips converted. The longer a facility is predicted to be in use each year, the more trips converted each year.
²This variable (A) is used to determine what percentage of the AADT will be converted into pedestrian and cyclist trips. A is the variable that is used to adjust the AADT reduction estimate based on three criteria: the existing AADT on the parallel route, the length of the proposed facility, and the presence of a university nearby. Facilities adjacent to high-volume routes are assigned a lower adjustment factor than those on low-volume routes. Facilities at least a mile or more in length are assigned a higher adjustment factor than shorter facilities. Facilities near a university are assigned a higher adjustment factor than those that are not.
³The value of the variable (C) is determined by the number of activity centers within a 0.25 and 0.5-mile buffer around the project limits. Projects with many activity centers within their 0.25 and 0.5-mile buffer are assigned a larger credit than those with few.

Figure 1. Milford US 113 Pathway Phase 1– Project Datasheet

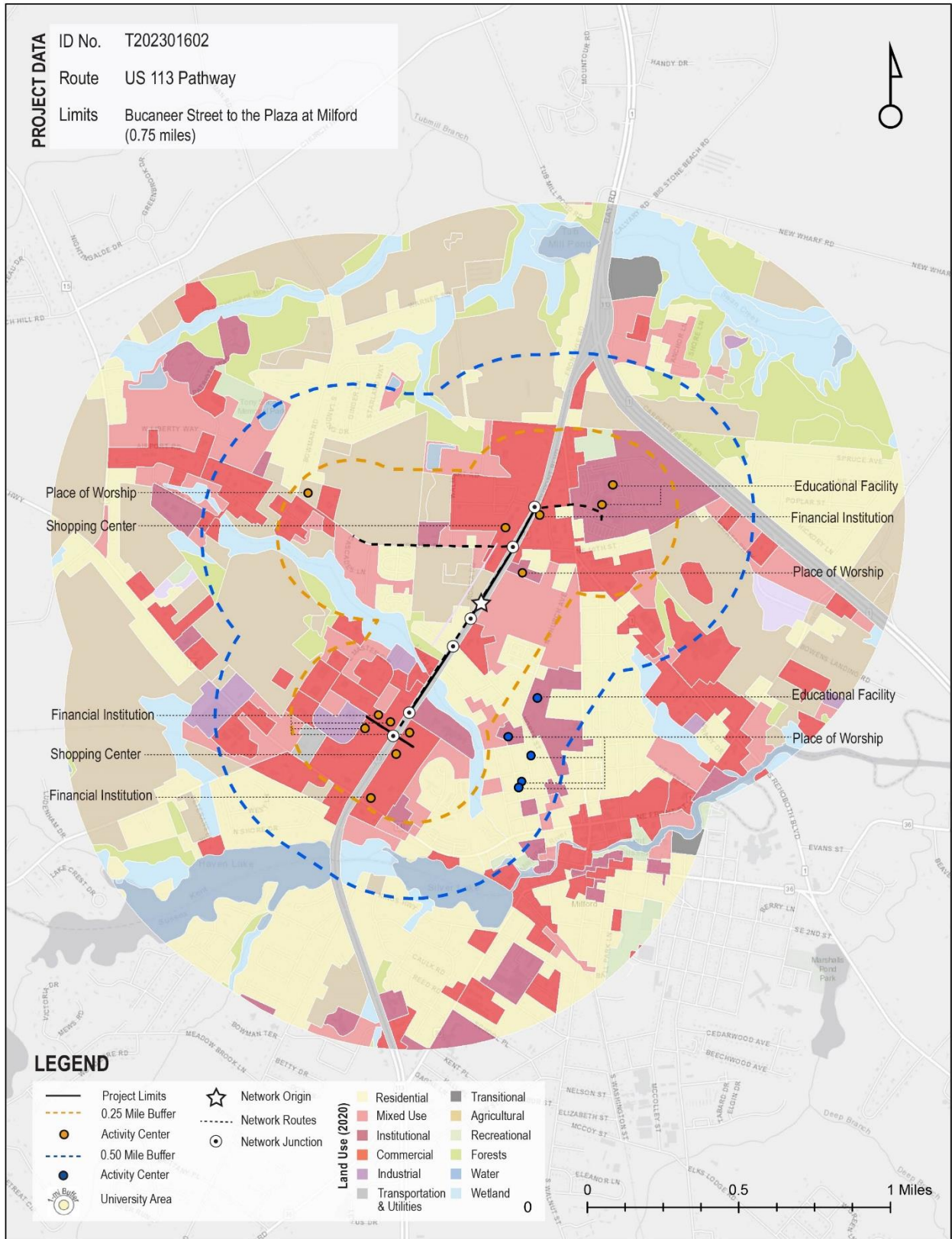



Figure 2. Milford US 113 Pathway Phase 1 – CMAQ Toolkit Output



Bicycle and Pedestrian Improvements

This calculator will estimate the reduction in emissions resulting from improvements to bicycle and pedestrian infrastructure and associated mode shift from passenger vehicles to bicycling or walking, including but not limited to sidewalks, dedicated bicycle infrastructure, improved wayfinding, mid-block crossing installations, bike share systems, and bike parking improvements.

Navigator

Bicycle and Pedestrian Improvements

INPUT User Guide

(1) What is your project evaluation year? Reset Interface

(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.

Daily Passenger Vehicle Trips		
Before	After	Change
27,256	27092	164

(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:

Trip Distance Source: < Fill National Values

(3b) If you selected "Average" above, enter the typical one-way trip distance. If you selected "Distribution" above, enter the typical distribution of one-way trip distances.

Typical Trip Distance (miles one way)	Distribution of Trip Distances (daily fraction per mileage bin)					Sum
	x < 1	1 ≤ x < 2	2 ≤ x < 3	3 ≤ x < 4	4 ≤ x ≤ 5	
<input type="text" value="2.5"/>						

OUTPUT Calculate Output

EMISSION REDUCTIONS		
Pollutant	Total	*Units in kg/day unless otherwise noted
Carbon Monoxide (CO)	1.231	
Particulate Matter <2.5 μm (PM _{2.5})	0.004	
Particulate Matter <10 μm (PM ₁₀)	0.015	
Nitrogen Oxide (NOx)	0.079	
Volatile Organic Compounds (VOC)	0.072	
Carbon Dioxide Equivalent (CO ₂ e)	125,259	
Total Energy Consumption (MMBTU/day)	1.630	

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1.2 NW Front Street Pathway

This project was reported to PAS for FY2023 as a quantitative entry. The project is listed under CMAQ ID No. T202301603. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 4. NW Front Street Pathway - Background

Project Description	Project No.	T202301603
	Evaluation Year	2027
	Project Name	NW Front Street Pathway
	Parallel Route	Bike and Pedestrian Improvements
	Limits	NW Front Street
	Length (mi)	Maple Ave to before US 113

Table 5. NW Front Street Pathway – Mode-Shift Estimate

Input Variables	<i>Bike</i>	1
	<i>PED</i>	-
	<i>D¹</i>	250
	<i>AADT</i>	7,088
	<i>A²</i>	0.0019
	<i>C³</i>	0.0030
Mode Shift Estimate	<i>Total Annual Traffic</i>	2,587,120
	<i>Total Annual Trips reduced from Bike Improvements</i>	8,683
	<i>Total Annual Trips reduced from Ped Improvements</i>	-
	<i>Total Annual Trips Reduced</i>	8,683
	<i>Avg. Reduction in Daily Passenger Trips</i>	2.49
	<i>Final AADT</i>	24

¹This variable (D) is the number of days a year when the facility would be open per year. It is used to translate the change in AADT to annual trips converted. The longer a facility is predicted to be in use each year, the more trips converted each year.

²This variable (A) is used to determine what percentage of the AADT will be converted into pedestrian and cyclist trips. A is the variable that is used to adjust the AADT reduction estimate based on three criteria: the existing AADT on the parallel route, the length of the proposed facility, and the presence of a university nearby. Facilities adjacent to high-volume routes are assigned a lower adjustment factor than those on low-volume routes. Facilities at least a mile or more in length are assigned a higher adjustment factor than shorter facilities. Facilities near a university are assigned a higher adjustment factor than those that are not.

³The value of the variable (C) is determined by the number of activity centers within a 0.25 and 0.5-mile buffer around the project limits. Projects with many activity centers within their 0.25 and 0.5-mile buffer are assigned a larger credit than those with few.

Figure 3. NW Front Street Pathway – Project Datasheet

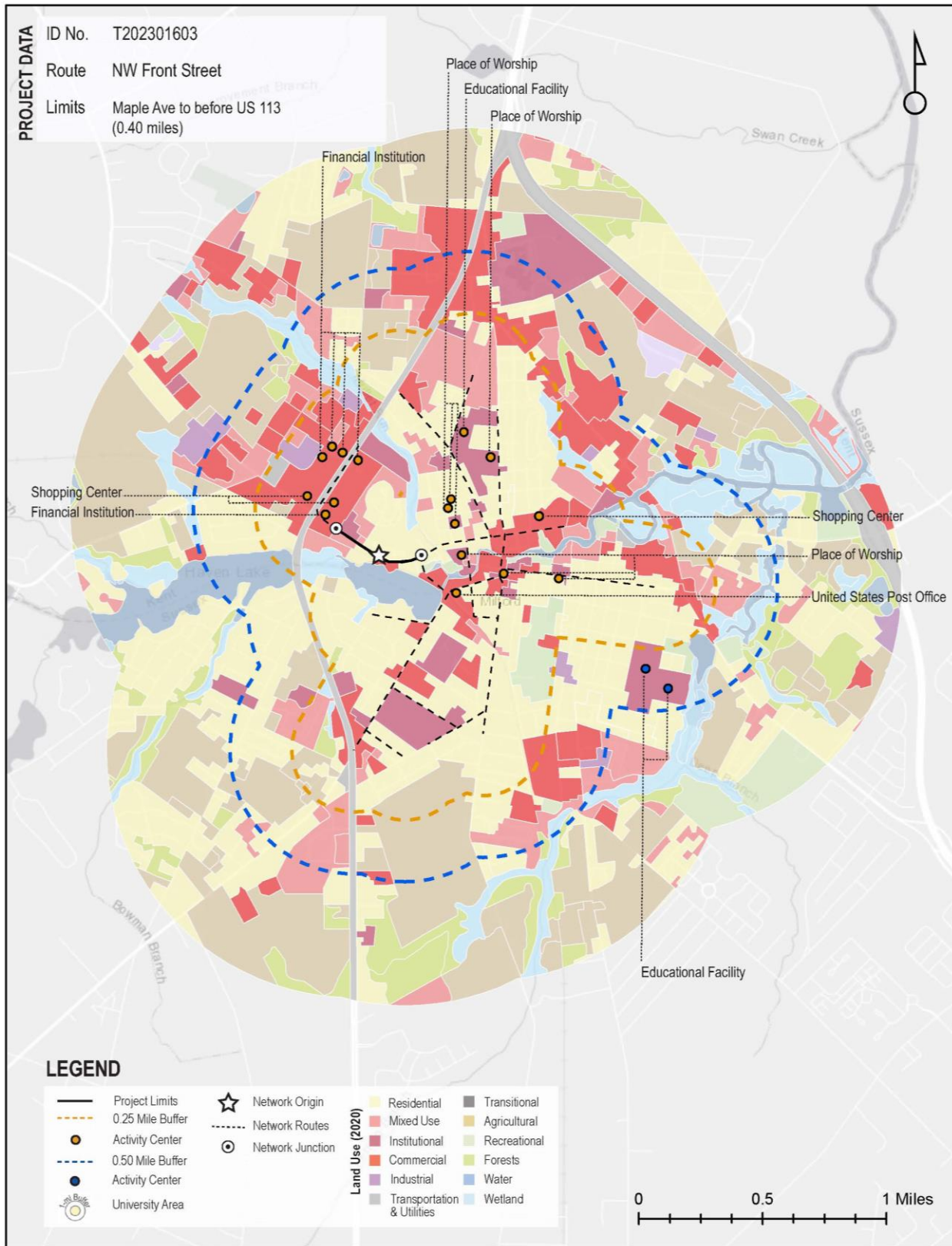
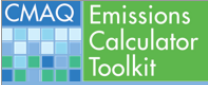


Figure 4. NW Front Street Pathway - CMAQ Toolkit Output



Bicycle and Pedestrian Improvements

This calculator will estimate the reduction in emissions resulting from improvements to bicycle and pedestrian infrastructure and associated mode shift from passenger vehicles to bicycling or walking, including but not limited to sidewalks, dedicated bicycle infrastructure, improved wayfinding, mid-block crossing installations, bike share systems, and bike parking improvements.

Navigator

Bicycle and Pedestrian Improvements

INPUT User Guide

(1) What is your project evaluation year? Reset Interface

(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.

Daily Passenger Vehicle Trips		
Before	After	Change
7,088	7064	24

(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:

Trip Distance Source: ← Fill National Values

(3b) If you selected "Average" above, enter the typical one-way trip distance. If you selected "Distribution" above, enter the typical distribution of one-way trip distances.

Typical Trip Distance (miles one way)	Distribution of Trip Distances (daily fraction per mileage bin)					Sum
	$x < 1$	$1 \leq x < 2$	$2 \leq x < 3$	$3 \leq x < 4$	$4 \leq x \leq 5$	
<input type="text" value="2.5"/>						

OUTPUT

Calculate Output

EMISSION REDUCTIONS		
Pollutant	Total	Units in kg/day unless otherwise noted
Carbon Monoxide (CO)	0.180	
Particulate Matter <2.5 μm (PM _{2.5})	0.001	
Particulate Matter <10 μm (PM ₁₀)	0.002	
Nitrogen Oxide (NOx)	0.012	
Volatile Organic Compounds (VOC)	0.011	
Carbon Dioxide Equivalent (CO ₂ e)	18.331	
Total Energy Consumption (MMBTU/day)	0.239	

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1.3 South Little Creek Road Shared Use Path

This project was reported to PAS for FY2023 as a quantitative entry. The project is listed under CMAQ ID No. T202401201. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 6. South Little Creek Road Shared Use Path - Background

Project Description	Project No.	T202401201
	Evaluation Year	2028
	Project Name	South Little Creek Road Shared Use Path
	Parallel Route	Bike and Pedestrian Improvements
	Limits	South Little Creek Road
	Length (mi)	Horsepond Road to US 13

Table 7. South Little Creek Road Shared Use Path – Mode-Shift Estimate

Input Variables	<i>Bike</i>	1
	<i>PED</i>	-
	<i>D¹</i>	250
	<i>AADT</i>	11,319
	<i>A²</i>	0.0155
	<i>C³</i>	0.0030
Mode Shift Estimate	<i>Total Annual Traffic</i>	4,131,435
	<i>Total Annual Trips reduced from Bike Improvements</i>	52,350
	<i>Total Annual Trips reduced from Ped Improvements</i>	-
	<i>Total Annual Trips Reduced</i>	52,350
	<i>Avg. Reduction in Daily Passenger Trips</i>	2.49
	<i>Final AADT</i>	143

¹This variable (D) is the number of days a year when the facility would be open per year. It is used to translate the change in AADT to annual trips converted. The longer a facility is predicted to be in use each year, the more trips converted each year.

²This variable (A) is used to determine what percentage of the AADT will be converted into pedestrian and cyclist trips. A is the variable that is used to adjust the AADT reduction estimate based on three criteria: the existing AADT on the parallel route, the length of the proposed facility, and the presence of a university nearby. Facilities adjacent to high-volume routes are assigned a lower adjustment factor than those on low-volume routes. Facilities at least a mile or more in length are assigned a higher adjustment factor than shorter facilities. Facilities near a university are assigned a higher adjustment factor than those that are not.

³The value of the variable (C) is determined by the number of activity centers within a 0.25 and 0.5-mile buffer around the project limits. Projects with many activity centers within their 0.25 and 0.5-mile buffer are assigned a larger credit than those with few.

Figure 5. South Little Creek Road Shared Use Path – Project Datasheet

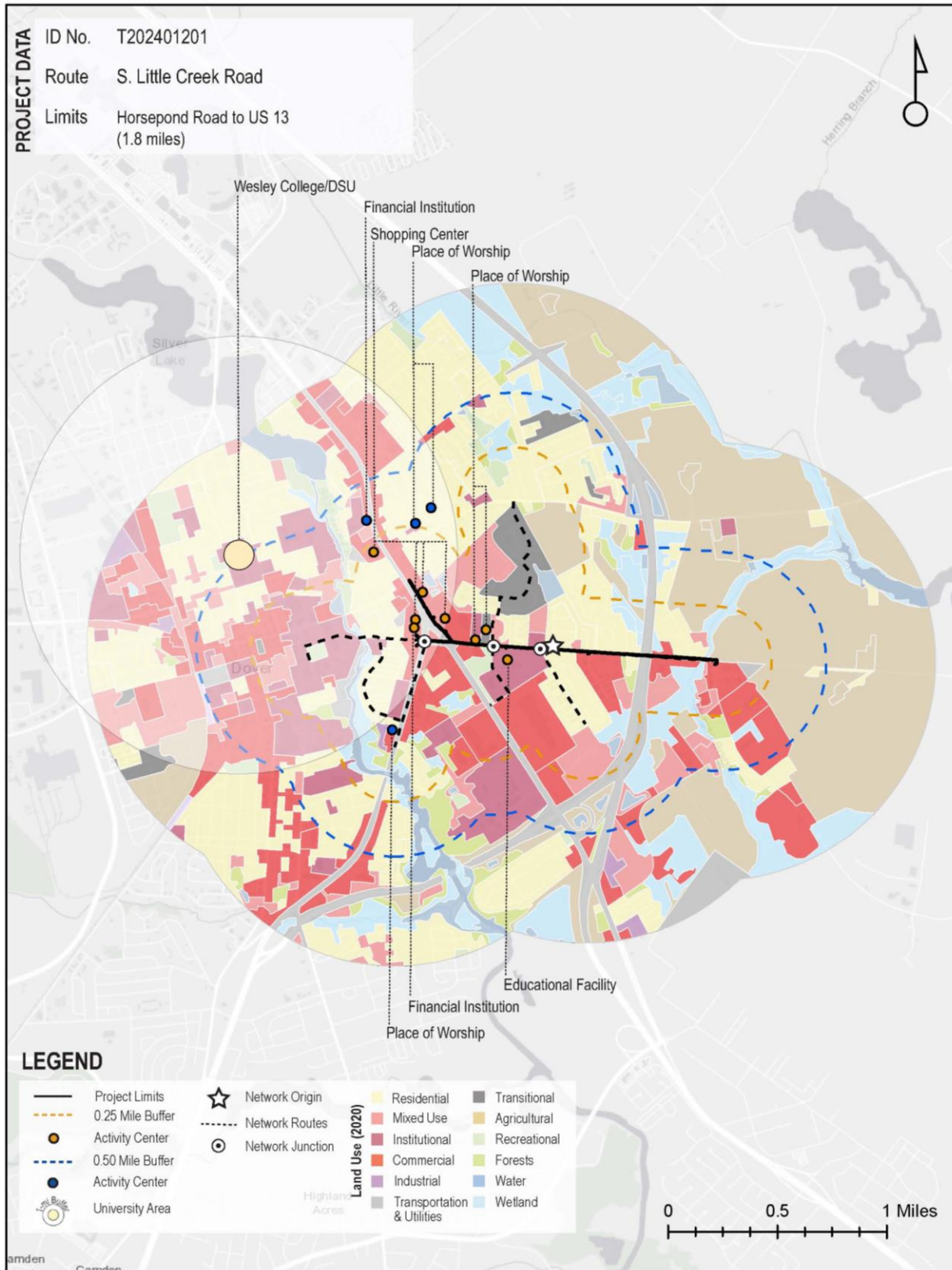
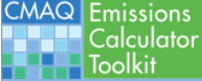


Figure 6. South Little Creek Road Shared Use Path – CMAQ Toolkit Output



Bicycle and Pedestrian Improvements

This calculator will estimate the reduction in emissions resulting from improvements to bicycle and pedestrian infrastructure and associated mode shift from passenger vehicles to bicycling or walking, including but not limited to sidewalks, dedicated bicycle infrastructure, improved wayfinding, mid-block crossing installations, bike share systems, and bike parking improvements.

Navigator

Bicycle and Pedestrian Improvements

INPUT User Guide

(1) What is your project evaluation year? Reset Interface

(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.

Daily Passenger Vehicle Trips

Before	After	Change
11,319	11176	143

(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:

Trip Distance Source

<- Fill National Values

(3b) If you selected "Average" above, enter the typical one-way trip distance. If you selected "Distribution" above, enter the typical distribution of one-way trip distances.

Typical Trip Distance (miles)	Distribution of Trip Distances (daily fraction per)					Sum
	$x < 1$	$1 \leq x < 2$	$2 \leq x < 3$	$3 \leq x < 4$	$4 \leq x \leq 5$	
<input type="text" value="2.5"/>						

OUTPUT Calculate Output

EMISSION REDUCTIONS		
Pollutant	Total	*Miles in-hr/day unless otherwise noted
Carbon Monoxide (CO)	0.398	
Particulate Matter <2.5 μm (PM _{2.5})	0.003	
Particulate Matter <10 μm (PM ₁₀)	0.013	
Nitrogen Oxide (NO _x)	0.063	
Volatile Organic Compounds (VOC)	0.058	
Carbon Dioxide Equivalent (CO _{2e})	106,109	
Total Energy Consumption (MMBTU/day)	1,381	

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1.4 Rideshare FY2024

This project was reported to PAS for FY2023 as a quantitative entry. The project is listed under CMAQ ID No. T202404801. This obligation relates to a future service year of an ongoing DelDOT program. As a result, past assessments of annual program performance were used to predict the impact of the proposed obligation. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 8. Rideshare FY2024 - Background

Project Description	<i>Project No.</i>	T202404801
	<i>Project Name</i>	RIDESHARE FY24
	<i>Type</i>	CARPOOLING & VANPOOLING
	<i>Limits</i>	2024

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Table 9. Rideshare FY2024 – Financial Performance Projections

QUANTITATIVELY ASSESSED PROJECTS														
Programming Information			Daily Emission Benefit (kg/day)						\$ of CMAQ Funding per Kg of Daily Emission Reduction					
Project Year	State Project ID	CMAQ Capital Amount	VOC	CO	NOX	PM10	PM2.5	CO2	VOC	CO	NOX	PM10	PM2.5	CO2
2020	T202004802	360,000	0.141	5.375	0.082	0.02	0.425	772.415	\$ 2,553,191	\$ 66,977	\$ 4,390,244	\$ 18,000,000	\$ 847,059	\$ 466
2021	T202104801	384,000	0.167	5.987	0.093	0.023	0.442	858.682	\$ 2,299,401	\$ 64,139	\$ 4,129,032	\$ 16,695,652	\$ 868,778	\$ 447
2022	T202204802	333,767	0.187	8.247	0.558	0.033	0.140	1267.655	\$ 1,784,848	\$ 40,471	\$ 598,148	\$ 10,114,139	\$ 2,384,047	\$ 263
2023	T202304802	383,951	0.039	1.61	0.028	0.007	0.103	247.33	\$ 9,844,885	\$ 238,479	\$ 13,712,519	\$ 54,850,076	\$ 3,727,675	\$ 1,552
Average Financial Performance									\$ 4,120,582	\$ 102,516	\$ 5,707,486	\$ 24,914,967	\$ 1,956,890	\$ 682
FORECASTED PROJECTS														
Programming Information			Daily Emission Benefit (kg/day)						\$ of CMAQ Funding per Kg of Daily Emission Reduction					
Project Year	State Project ID	CMAQ Capital Amount	VOC	CO	NOX	PM10	PM2.5	CO2	VOC	CO	NOX	PM10	PM2.5	CO2
2024	T202404801	384,000	0.093	3.746	0.067	0.015	0.196	562.855	\$ 4,120,582	\$ 102,516	\$ 5,707,486	\$ 24,914,967	\$ 1,956,890	\$ 682

1.5 FY24 Transportation Management Improvements - Statewide Projects

This statewide Transportation Management Improvement project was reported to PAS for FY2023 as a quantitative entry. The project is listed under CMAQ ID No. T202304703. In total, the FY23 Transportation Management Improvements Statewide Projects involved predicting the emission reduction benefits likely to be generated from the development of four components. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 10. *FY24 Transportation Management Improvements Statewide Projects- Background*

Project Description	<i>Project No.</i>	T202404703
	<i>Evaluation Year</i>	2025
	<i>Project Name</i>	FY24 TRANSPORTATION MANAGEMENT IMPROVEMENTS STATEWIDE PROJECTS
	<i>Description</i>	<p>This effort is part of a larger, multi-year initiative administered by Delaware's Department of Transportation to continually invest in the Integrated Traffic Management Systems (ITMS) throughout the State of Delaware. The FY24 iteration includes four components:</p> <p>The ITMS Fiber Installation component involves two installations: I-95 between the Talley Maintenance Yard, and the bridge over Brandywine Creek, and US 13 from Tybouts Corner to Seienni Boulevard.</p> <p>The ITMS Wireless component includes four separate initiatives to expand DelDOT's wireless communications network and improve system reliability: the installation of 4.9 GHz point-to-multipoint access points at five existing camera poles; the integration of a 900 MHz wireless hub on Loockerman Street in Dover into the DelDOT fiber backbone; building a 11GHz point-to-point link to the I-95 Toll Plaza tower; the installation of six access points on the Lewis Division of Communications Tower.</p> <p>The AI-TOMS component involves expanding the system to include additional signal corridors within the three project areas (I-95 corridor in New Castle County, US 13 in the Smyrna/Dover area, and SR 1 corridor in the Beach resort area in Sussex County). This will include the continued integration of Unix traffic signal controllers into AI-TOMS and implementation of automated signal timing and control functions within the platform.</p> <p>The Indian River Inlet Bridge (IRIB) Variable Message Signs (VMS) component includes the installation of two VMS devices approaching the Indian River Inlet Bridge from the north and south in advance of major detour routes.</p>

Table 11. FY24 Transportation Management Improvements Statewide Projects – Financial Performance Projection

QUANTITATIVELY ASSESSED PROJECTS														
Programming Information			Daily Emission Benefit (kg/day)						\$ of CMAQ Funding per Kg of Daily Emission Reduction					
Project Year	State Project ID	CMAQ Capital Amount	VOC	CO	NOX	PM10	PM2.5	CO2	VOC	CO	NOX	PM10	PM2.5	CO2
2021	T202104703	720,000	0.802	20.194	3.728	0.883	3.662	20.194	\$897,756	\$35,654	\$193,133	\$815,402	\$196,614	\$35,654
2023	T202304703	2,176,000	0.663	24.253	4.052	0.696	2.670	3,560.360	\$3,280,309	\$89,722	\$537,027	\$3,127,440	\$815,112	\$611
Average Financial Performance									\$2,089,033	\$62,688	\$365,080	\$1,971,421	\$505,863	\$18,133
FORECASTED PROJECTS														
Programming Information			Daily Emission Benefit (kg/day)						\$ of CMAQ Funding per Kg of Daily Emission Reduction					
Project Year	State Project ID	CMAQ Capital Amount	VOC	CO	NOX	PM ₁₀	PM _{2.5}	CO ₂	VOC	CO	NOX	PM ₁₀	PM _{2.5}	CO ₂
2024	T202404703	2,096,000	1.003	33.435	5.741	1.063	4.143	115.592	\$2,089,033	\$62,688	\$365,080	\$1,971,421	\$505,863	\$18,133

Figure 7. ITS Network Maps - Northern Delaware

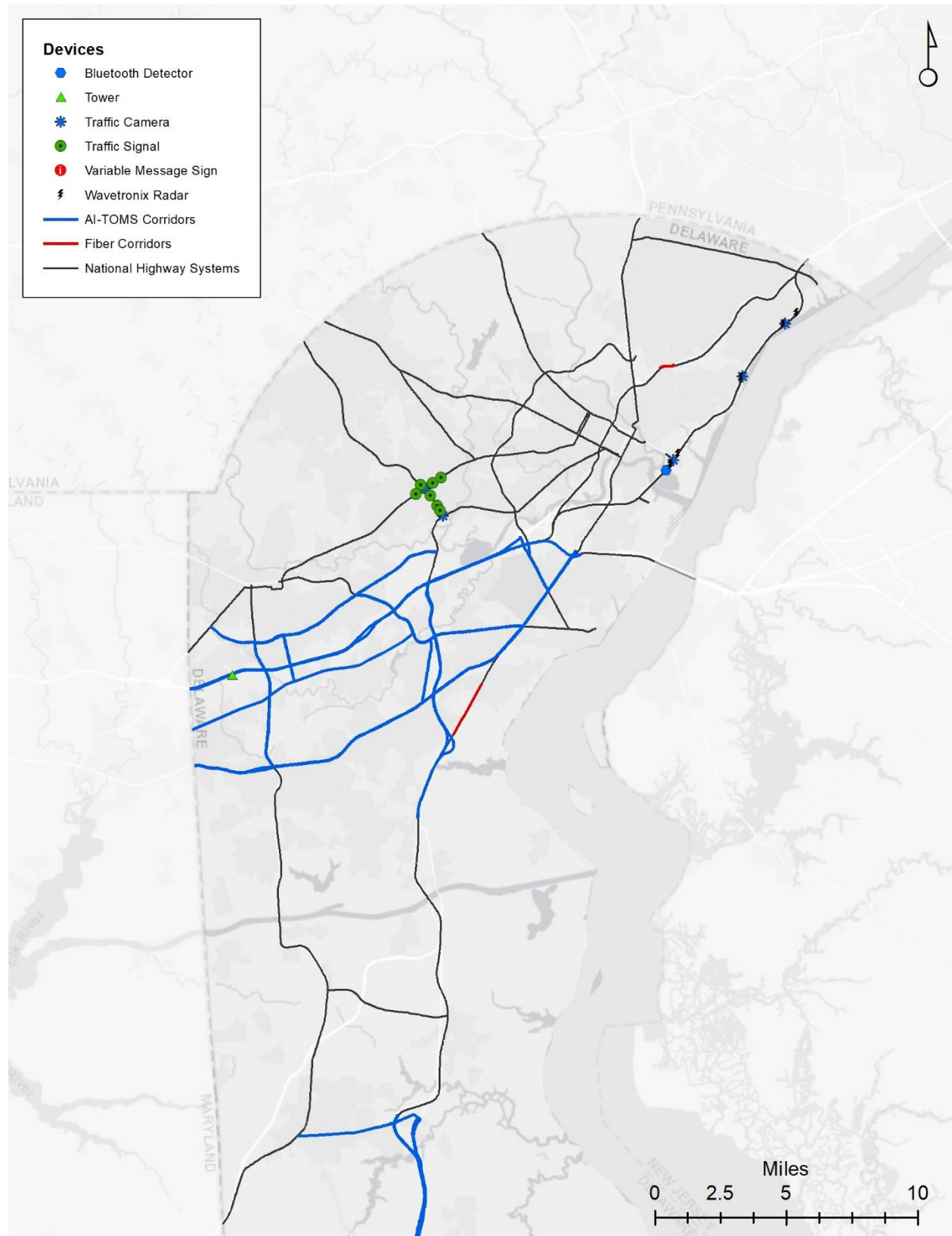


Figure 8. ITS Network Maps - Central Delaware

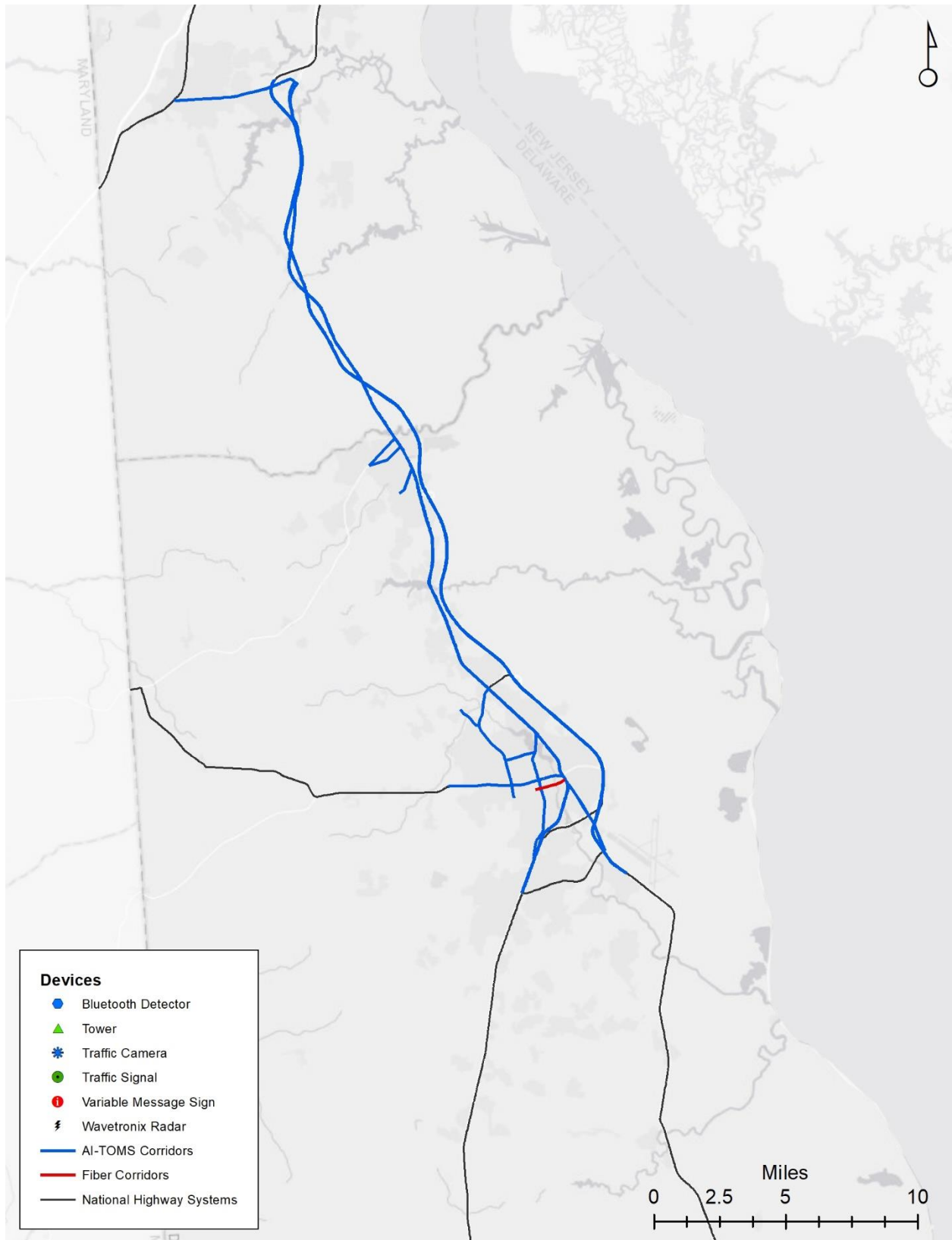


Figure 9. ITS Network Maps - Southern Delaware

