OCTOBER 2014

INTERSTATE 64 / HIGH RISE BRIDGE CORRIDOR STUDY

CITY OF CHESAPEAKE, VA | STATE PROJECT #: 0064-131-783 | UPC: 104366

AIR QUALITY ANALYSIS TECHNICAL REPORT

INTERSTATE 64 / HIGH RISE BRIDGE CORRIDOR STUDY

Air Quality Analysis Technical Report
Document Errata

Errata Record Date: June 7, 2016

Summary: VDOT has developed updated 2025 and 2040 traffic volumes for the proposed Interstate 64 / High Rise Bridge Corridor Study. Specifically, detailed traffic forecasts were developed for the Eight Lane Build – Managed Alternative consisting of two high occupancy toll (HOT) lanes and two general purpose (GP) lanes (2 HOT / HOV-2 "free" + 2 GP) as described in the Traffic and Transportation Technical Report supporting the Draft Environmental Assessment (EA) for the project. The development of this data is consistent with commitments made in the Draft EA to evaluate a "worst case" scenario if a managed lane option was identified as the preferred alternative. An air study was completed in October 2014 for this project that identified the Eight Lane Build Alternative as the worst-case alternative and was supported with 2025 and 2040 traffic forecasts. Based on a review of these updated traffic projections and a comparison to traffic compiled for the previous study, the conclusions from the 2014 Air Quality Analysis are still valid and reasonable.

Original Text: N/A

Amended Text: See followings pages.

From: Sundra, Ed (FHWA)
To: Grinnell, Daniel T. (VDOT)
Cc: Smizik, Scott (VDOT); Ponticello, James (VDOT); Frost, Mack (FHWA)
Subject: RE: I-64 / High Rise Bridge Eight Lane Managed Alternative
Date: Tuesday, June 07, 2016 8:39:18 AM

Dan,

I concur with your approach for addressing CO and MSAT for the preferred alternative and the conclusions you have reached for purposes of completing the Revised EA.

Ed

From: Grinnell, Daniel T. (VDOT) [mailto:Daniel.Grinnell@VDOT.Virginia.gov]
Sent: Monday, June 06, 2016 2:31 PM
To: Sundra, Ed (FHWA)
Cc: Smizik, Scott (VDOT); Ponticello, James (VDOT)
Subject: I-64 / High Rise Bridge Eight Lane Managed Alternative

Ed,

VDOT has developed updated 2025 and 2040 traffic volumes for the proposed Interstate 64 / High Rise Bridge Corridor Study. Specifically, detailed traffic forecasts were developed for the Eight Lane Build – Managed Alternative consisting of two high occupancy toll (HOT) lanes and two general purpose (GP) lanes (2 HOT / HOV-2 "free" + 2 GP) as described in the Traffic and Transportation Technical Report supporting the Draft Environmental Assessment (EA) for the project. The development of this data is consistent with commitments made in the Draft EA to evaluate a "worst case" scenario if a managed lane option was identified as the preferred alternative. An air study was completed in October 2014 for this project that identified the Eight Lane Build Alternative as the worst-case alternative and was supported with 2025 and 2040 traffic forecasts. Based on a review of these updated traffic projections and a comparison to traffic compiled for the previous study, we believe that the conclusions from the 2014 Air Quality Analysis are still valid and reasonable given the Managed Lane Alternative now moving forward. The updated traffic projections throughout the project corridor can be provided if you'd like. Below is a discussion of the anticipated impact of the updated traffic for each applicable pollutant for your consideration.

CO

The Air Quality Analysis completed for the I-64/High Rise Bridge corridor study in October 2014 evaluated the two worst-case interchanges (I-64/I-464 and I-64/Rte. 17) and one worst-case intersection (George Washington Highway and South Military highway) in the project corridor for CO impacts based on the Eight Lane Build Alternative which was determined to represent the worst-case alternative for air quality purposes. For example, the 2014 Air Quality Analysis evaluated CO impacts at the I-64/I-464 interchange which had opening year (2025) and design year (2040) AWDT volumes of 353,600 vehicles per day (vpd) and 476,300 vpd, respectively. The updated 2025 and 2040 forecast AWDT for the Eight Lane Build – Managed Alternative for the same interchange are projected to be 0.89% and 1.1 % lower, respectively. Similar trends were found for the daily and

peak-hour volumes for the opening and design year for the other worst-case interchange and intersection analyzed in the 2014 Air Quality Analysis. The 2014 Air Quality Analysis found peak CO concentrations (estimated using worst case assumptions) to occur in the design year (2040) build scenario at the I-64/I-464 interchange, and they were predicted to be 4.9 ppm and 3.4 ppm for the 1-hour and 8-hour CO NAAQS, respectively, which are both well below the 1-hour and 8-hour CO NAAQS of 35 ppm and 9 ppm, respectively.

Since the 2014 Air Quality Analysis found peak CO concentrations to remain well below the CO NAAQS, and since the projected peak-hour and total traffic volumes at the worst-case interchanges and intersection for the Eight Lane Build – Managed Alternative remain below the traffic volumes analyzed in the 2014 Air Quality Analysis, we feel we can safely rely on its findings to satisfy all federal air quality requirements pertaining to CO.

Additionally, the current EPA emissions factor model (MOVES2014) generates lower CO emission factors than those generated from MOVES2010b which was used in the 2014 Air Quality Analysis, and therefore we would expect peak CO concentrations generated today to be even lower using the updated model. Last, we would note that the 1-hour and 8-hour CO background concentrations used in the 2014 Air Quality Analysis were 3.6 and 2.5 ppm, respectively, and due to improvements to overall air quality, recently-updated 1-hour and 8-hour CO background concentrations were found to be 2.0 and 1.1 ppm, respectively, which would further reduce peak CO concentrations.

MSAT

A quantitative MSAT analysis was completed as part of the 2014 Air Quality Analysis, and it showed that MSAT emissions are expected to decline significantly from Existing Year conditions to the project Opening Year (2025) build conditions, and will continue to decline even further out to the Design Year (2040) build conditions. The MSAT Analysis was a regional analysis that encompassed the entire project corridor. The changes in regional traffic volumes anticipated as a result of moving to the Eight Lane Build – Managed Alternative is considered insignificant compared to those used in the 2014 Air Quality Analysis, as the updated daily volumes forecast in 2025 and 2040 throughout the project corridor were found to decrease slightly. Additionally, a toll diversion analysis performed to quantify the diversion of traffic to other crossings of the Elizabeth River for the Eight Lane Build – Managed Alternative shows traffic projections to remain the same or drop for all alternative routes. Since MSAT emissions are generally proportional to VMT, it is expected that projected MSAT emissions impacts for the Eight Lane Build – Managed Alternative would be similar to or slightly lower than the Eight Lane Build Alternative. Therefore, the quantitative MSAT analysis completed as part of the 2014 Air Quality Analysis is still considered valid for this project.

Please advise if you concur with these approaches to satisfy the NEPA air quality requirements for this project. Please feel free to contact me if you need any additional information.

Dan Grinnell

Whitman, Requardt & Associates, LLP
Engineers · Architects · Environmental Planners Est. 1915

MEMORANDUM

Date: May 4, 2016

To: Scott Smizik - VDOT

From: Dana Trone - WRA

Subject: Traffic Forecasts for Eight Lane Build – Managed Lanes (2 HOT / HOV-2 "free" + 2 GP) Scenario

CC: Nick Nies - WRA

State Project Number: 0064-131-783

UPC: 104366

Project: Interstate 64 / High Rise Bridge Corridor Study

The purpose of this memorandum is to document additional traffic forecasting efforts for the Interstate 64 / High Rise Bridge Corridor Study. Specifically, detailed traffic forecasts were developed for the Eight Lane Build – Managed Alternative consisting of two high occupancy toll (HOT) lanes and two general purpose (GP) lanes (2 HOT / HOV-2 "free" + 2 GP) as described in the Traffic and Transportation Technical Report supporting the Draft Environmental Assessment (EA) for the project. This memorandum describes the assumptions and methodology used to develop the future year (2040) and interim year (2025) Average Weekday Daily Traffic (AWDT) volumes and the AM and PM peak hour traffic volumes for this scenario.

As part of the Traffic and Transportation Technical Report, detailed traffic forecasts were prepared for the Eight Lane Build Alternative. A toll diversion analysis was performed to quantify the diversion of traffic to other crossings of the Elizabeth River for the Eight Lane Build – Managed Alternatives. The toll diversion analysis considered a Low, Medium, and High Toll scenario to reflect various levels of diversion. Table 1 depicts the daily volume changes on each facility for the design year at the five crossings of the Elizabeth River compared to the "no toll" scenario. Reductions in traffic along I-64 at the High Rise bridge are anticipated to range from -2% to -3%. To reflect the worst-case scenario along I-64 and study area roadways in terms of the highest traffic volumes, the Low Toll scenario was utilized to develop traffic forecasts for the Eight Lane Build –Managed Alternative (2 HOT / HOV-2 "free" + 2 GP).

Table 1: Daily Volume Changes at Elizabeth River Crossings
Eight Lane Build – Managed Alternative (2 HOT / HOV-2 "free" + 2 GP)

Location	Daily Change in Traffic Volume		
	Low Toll	Medium Toll	High Toll
Route 58 / Midtown Tunnel	0.0%	0.0%	0.0%
Route 13 / Gilmerton Bridge	0.0%	0.0%	0.0%
I-264 / Downtown Tunnel	0.0%	0.0%	0.0%
I-64 / High Rise Bridge	-2.0%	-2.5%	-3.0%
Route 337 / Jordan Bridge	0.0%	0.0%	0.0%
Total of All Crossings	**-0.8%**	**-1.0%**	**-1.2%**

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Table 2 shows the reduction in traffic and the low toll traffic volumes expected on I-64 at the High Rise Bridge for the Eight Lane Build – Managed Alternative (2 HOT / HOV-2 "free" + 2 GP) for the Low Toll scenario. The traffic reduction was applied accordingly to the I-64 mainline traffic volumes, interchange ramps carrying traffic to and from I-64, and adjacent study intersections. While accounting for volume rounding, the ramp volumes were reduced proportionately to the I-64 mainline volumes. After traffic volume reductions were made, the traffic volumes were rebalanced as needed.

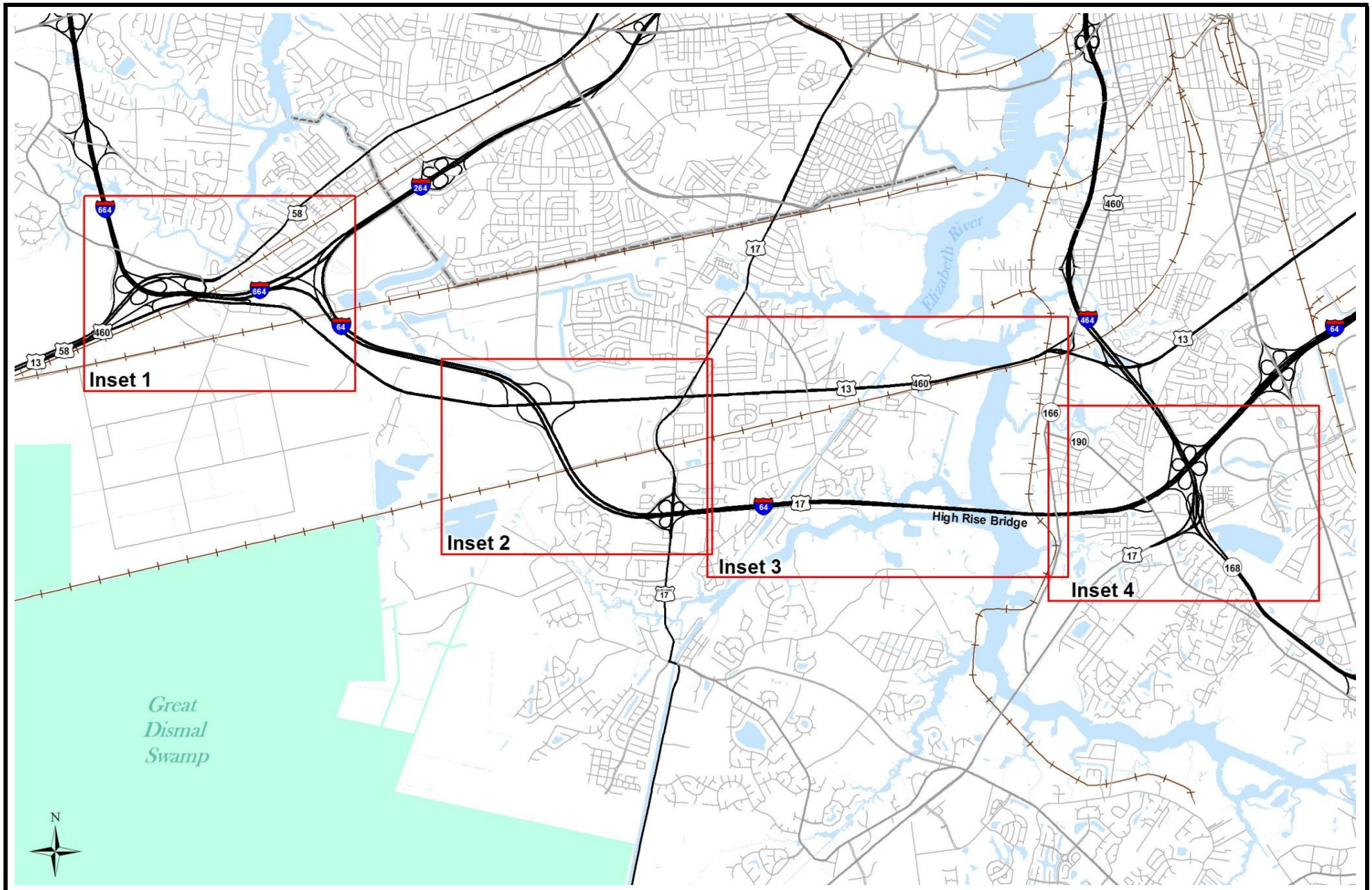
Table 2: 2040 and 2025 Eight Lane Build Low Toll Managed Lanes Scenario (Two HOT Lanes + Two General Purpose Lanes) Traffic Volumes at I-64 / High Rise Bridge

Scenario		Eight Lane Build Alternative			2% Traffic Reduction			Eight Lane Build Managed Alternative (HOT Lanes Scenario)						
		Daily[1]	AM	PM	Daily	AM	PM	Daily[1]	AM			PM		
									GP[2]	ML[3]	Total	GP[2]	ML[3]	Total
Year 2040	I-64 East (Traveling West)	70,000	5,560	6,290	-1,400	-110	-120	68,600	4,000	1,450	5,450	4,000	2,170	6,170
	I-64 West (Traveling East)	72,000	6,570	6,140	-1,400	-130	-120	70,600	4,000	2,440	6,440	4,000	2,020	6,020
Year 2025	I-64 East (Traveling West)	54,600	4,330	4,870	-1,100	-90	-100	53,500	4,000	240	4,240	4,000	770	4,770
	I-64 West (Traveling East)	56,100	5,300	4,780	-1,100	-110	-100	55,000	4,000	1,190	5,190	4,000	680	4,680

[1] Daily - Sum of General Purpose and Managed Lanes
[2] GP – General Purpose; traffic was distributed between the general purpose lanes and the managed lanes assuming that the general purpose lanes would operate at capacity (2,000 vehicles per hour per lane) and additional traffic would utilize the managed lanes
[3] ML – Managed Lanes

Based on the above assumptions, the Eight Lane Build – Managed Alternative (2 HOT / HOV-2 "free" + 2 GP) daily and peak hour traffic volumes for 2025 and 2040 are shown in the attached figures:

- Figure A – 2040 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes
- Figure B – 2040 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes
- Figure C – 2025 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes
- Figure D – 2025 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes



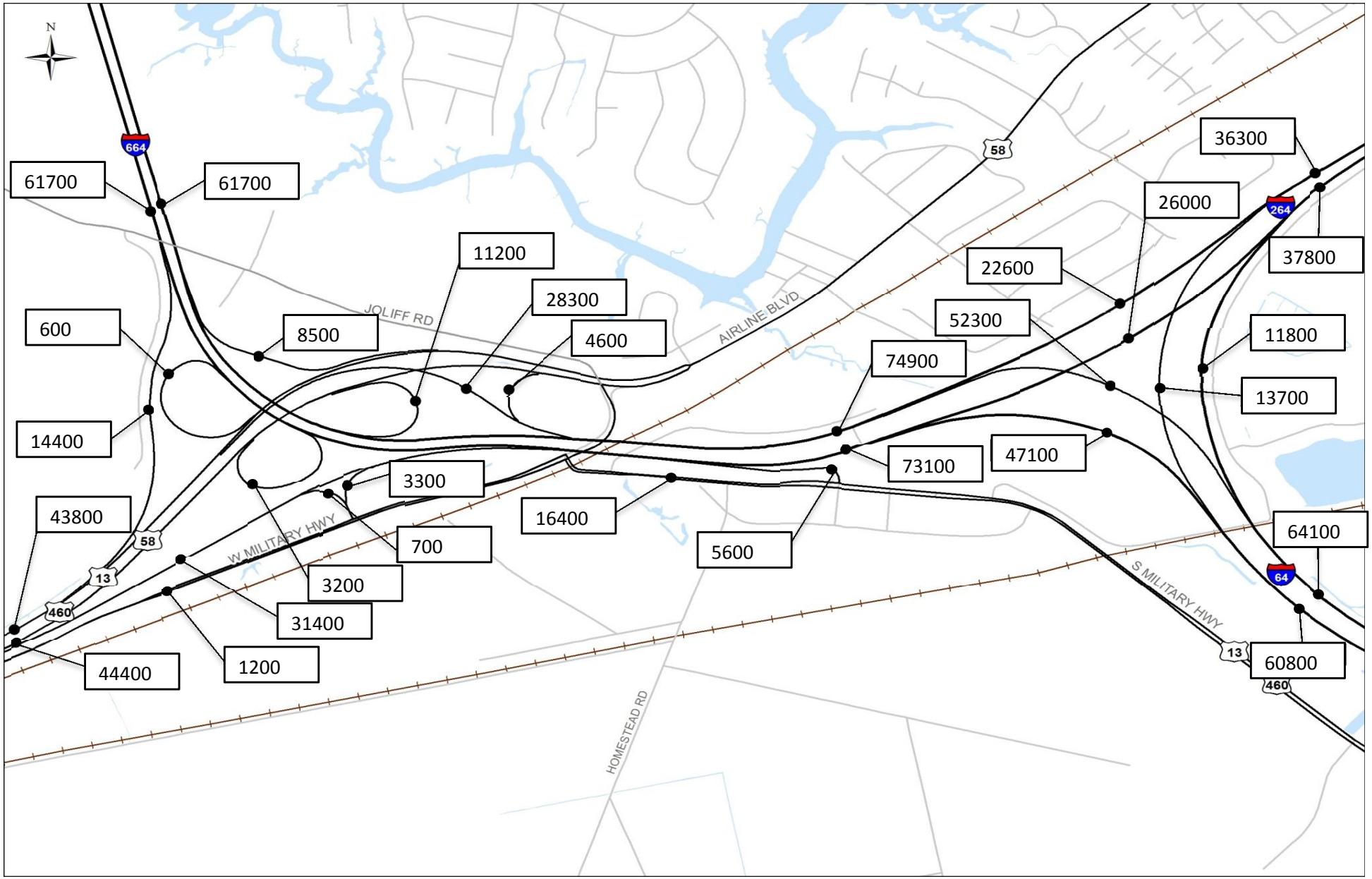
Interstate 64 / High Rise Bridge Corridor Study

Figure A.1 - Key Map

2040 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



VDOT

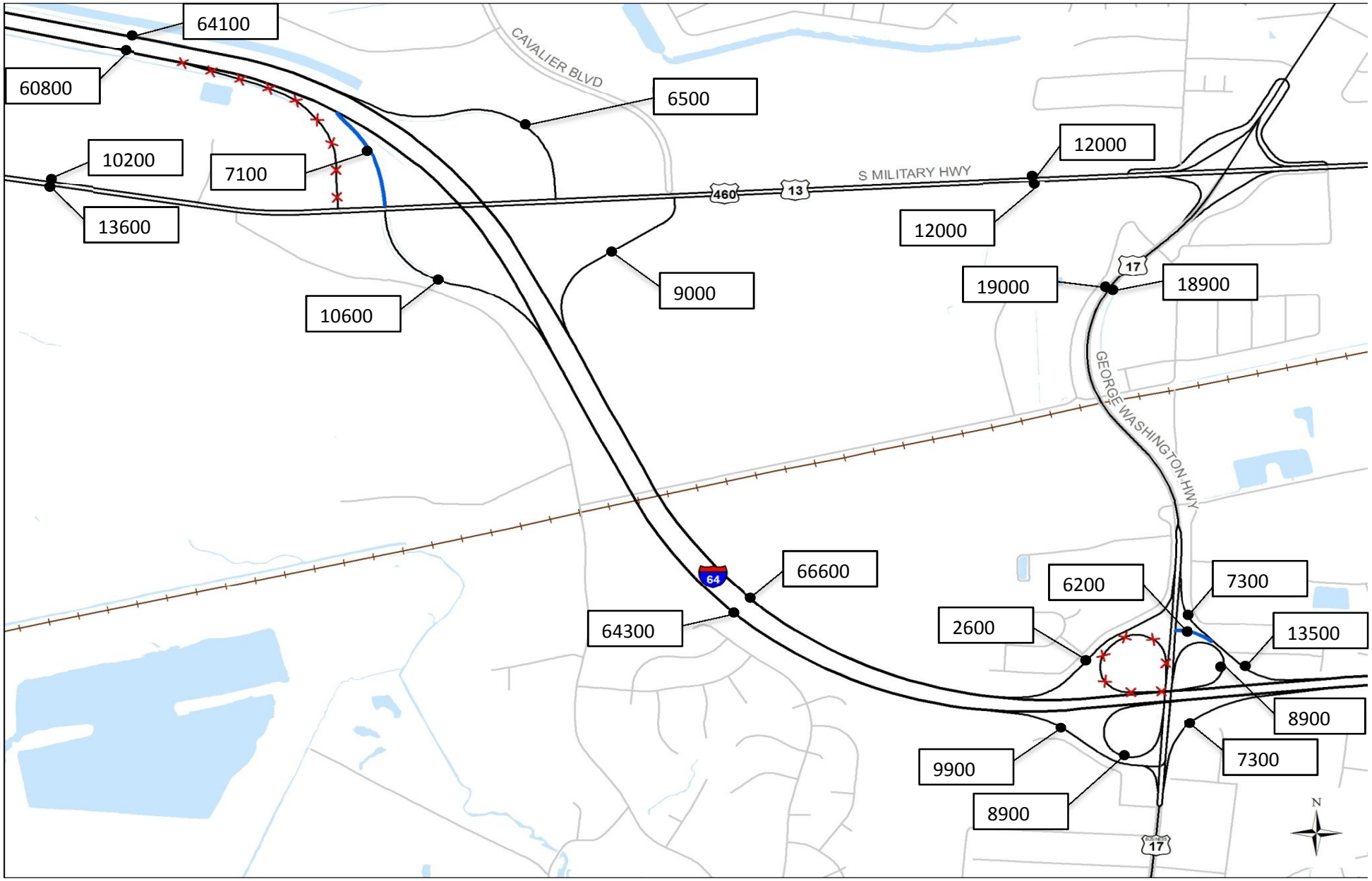
Interstate 64 / High Rise Bridge Corridor Study

Figure A.2 - Inset 1

2040 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



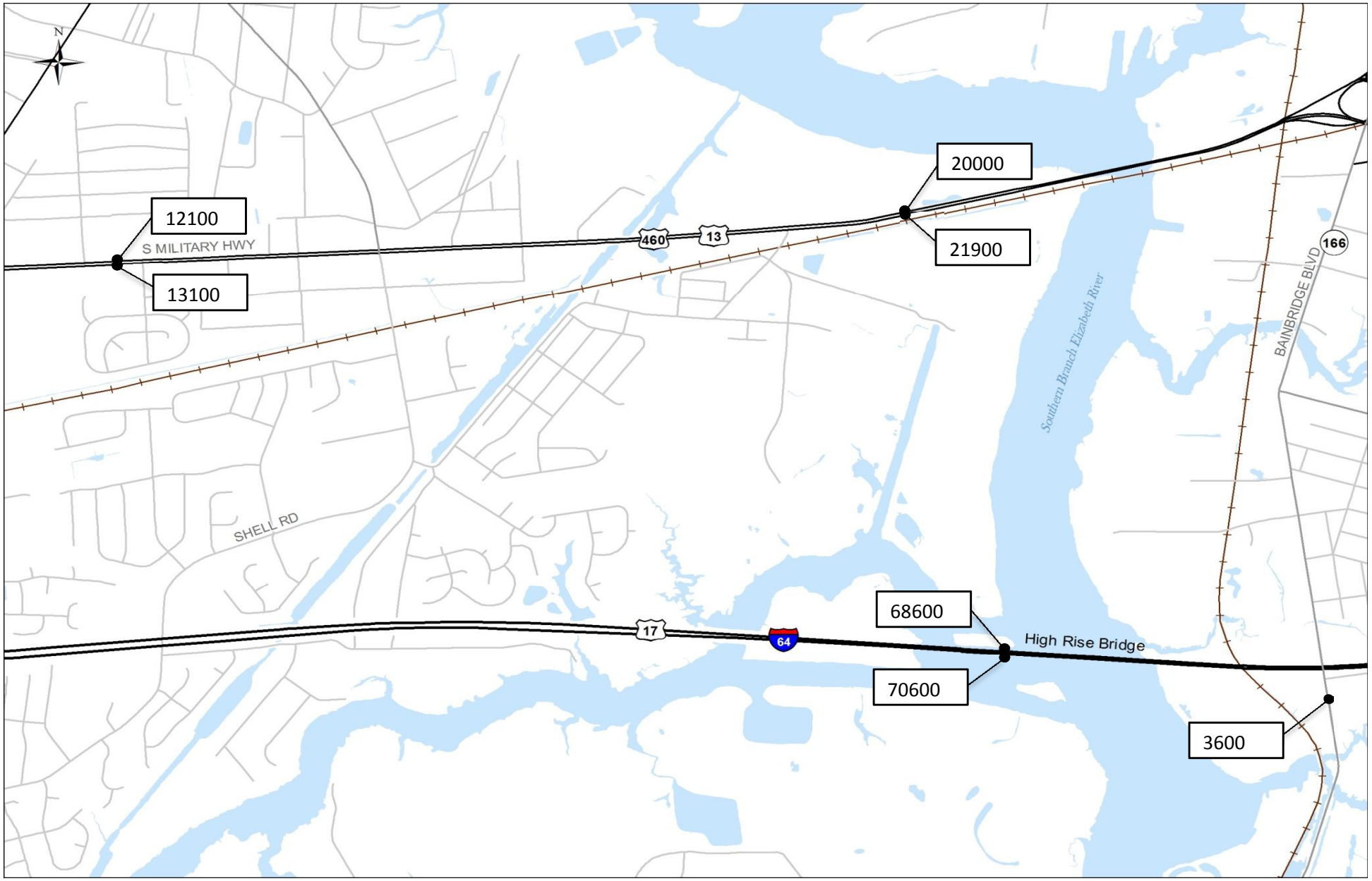
Interstate 64 / High Rise Bridge Corridor Study

Figure A.3 - Inset 2

2040 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



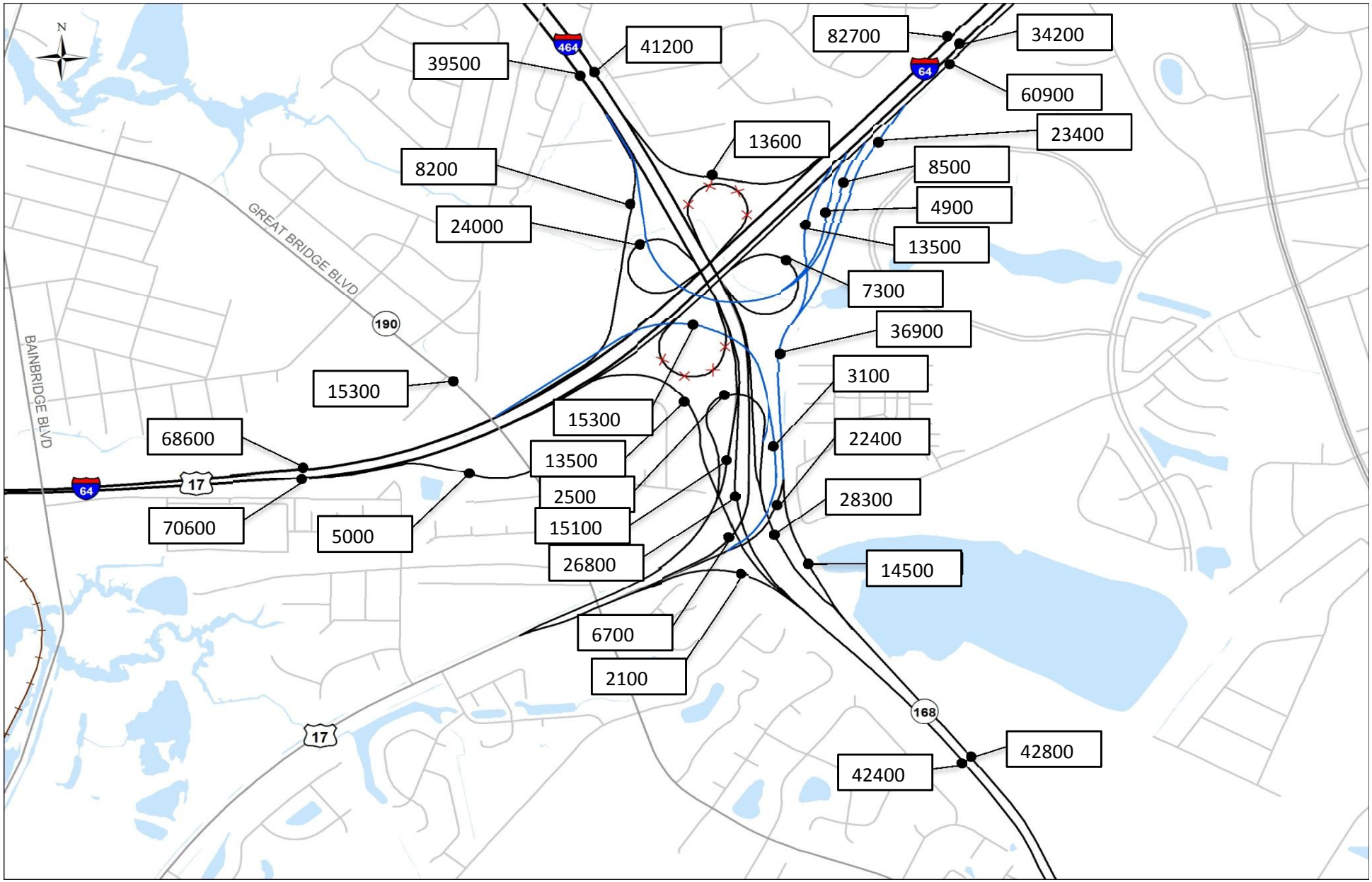
Interstate 64 / High Rise Bridge Corridor Study

Figure A.4 - Inset 3

2040 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



VDOT

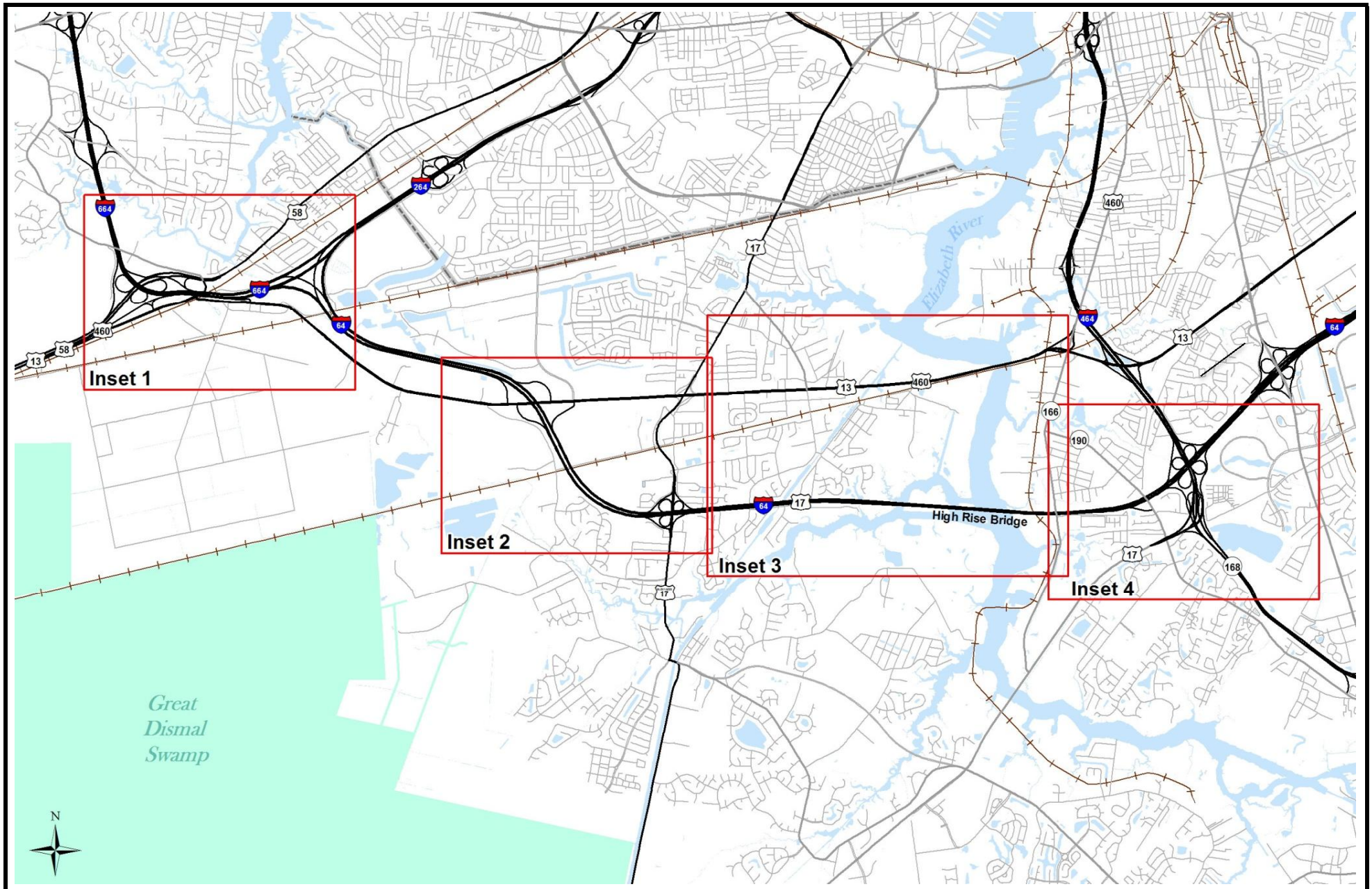
Interstate 64 / High Rise Bridge Corridor Study

Figure A.5 - Inset 4

2040 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



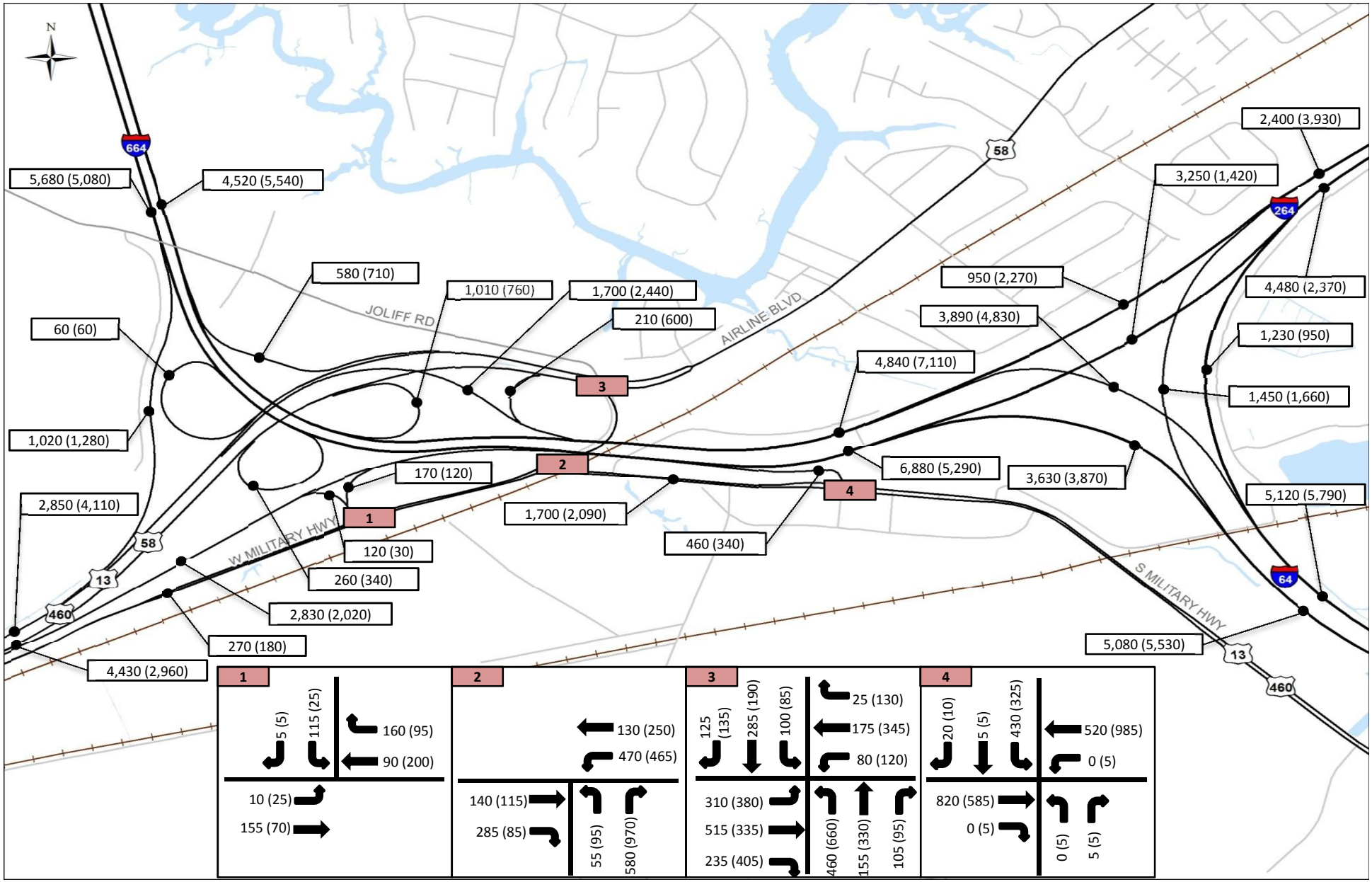
Interstate 64 / High Rise Bridge Corridor Study

Figure B.1 - Key Map

2040 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

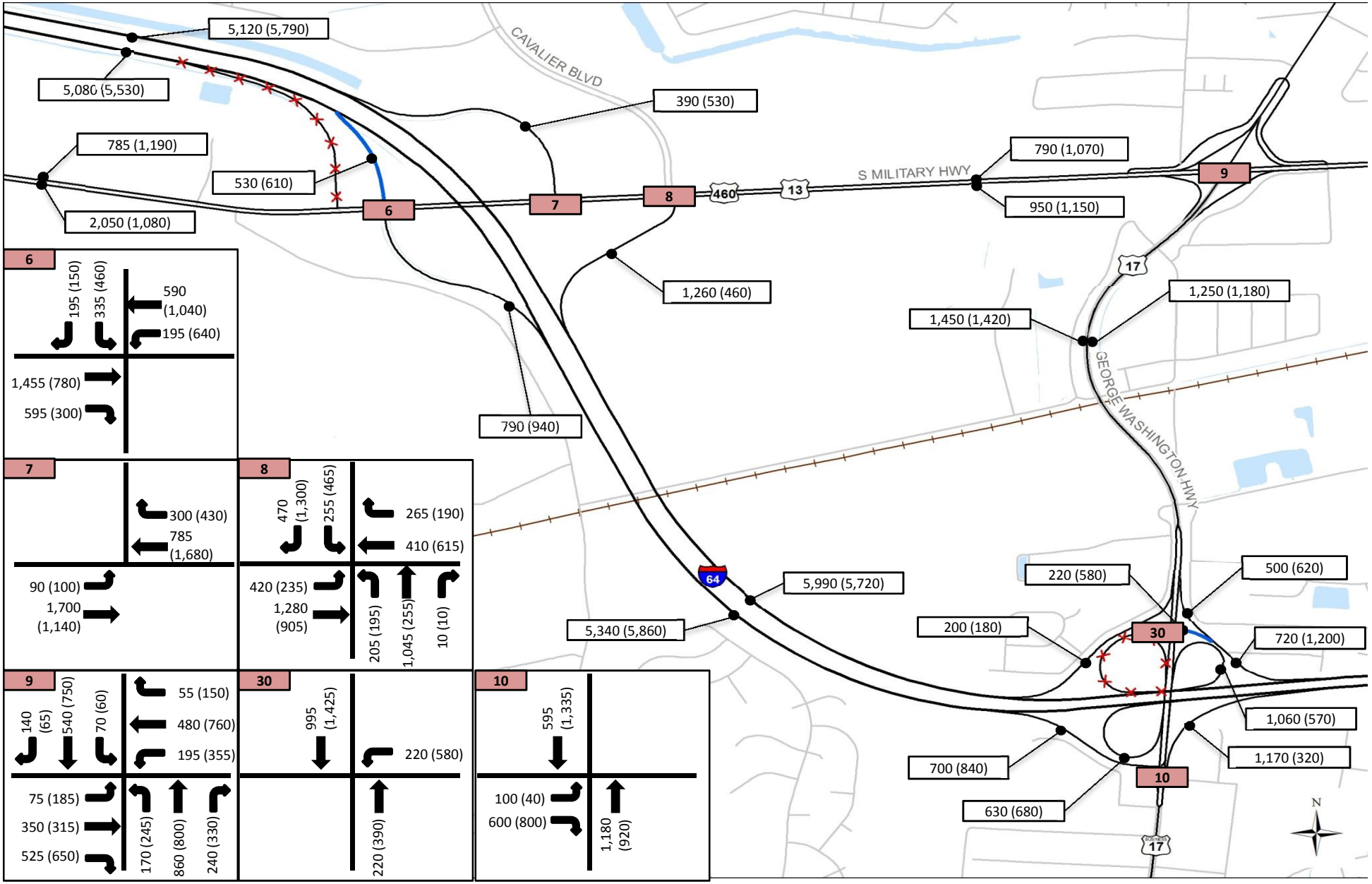
Interstate 64 / High Rise Bridge Corridor Study

Figure B.2 - Inset 1

2040 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

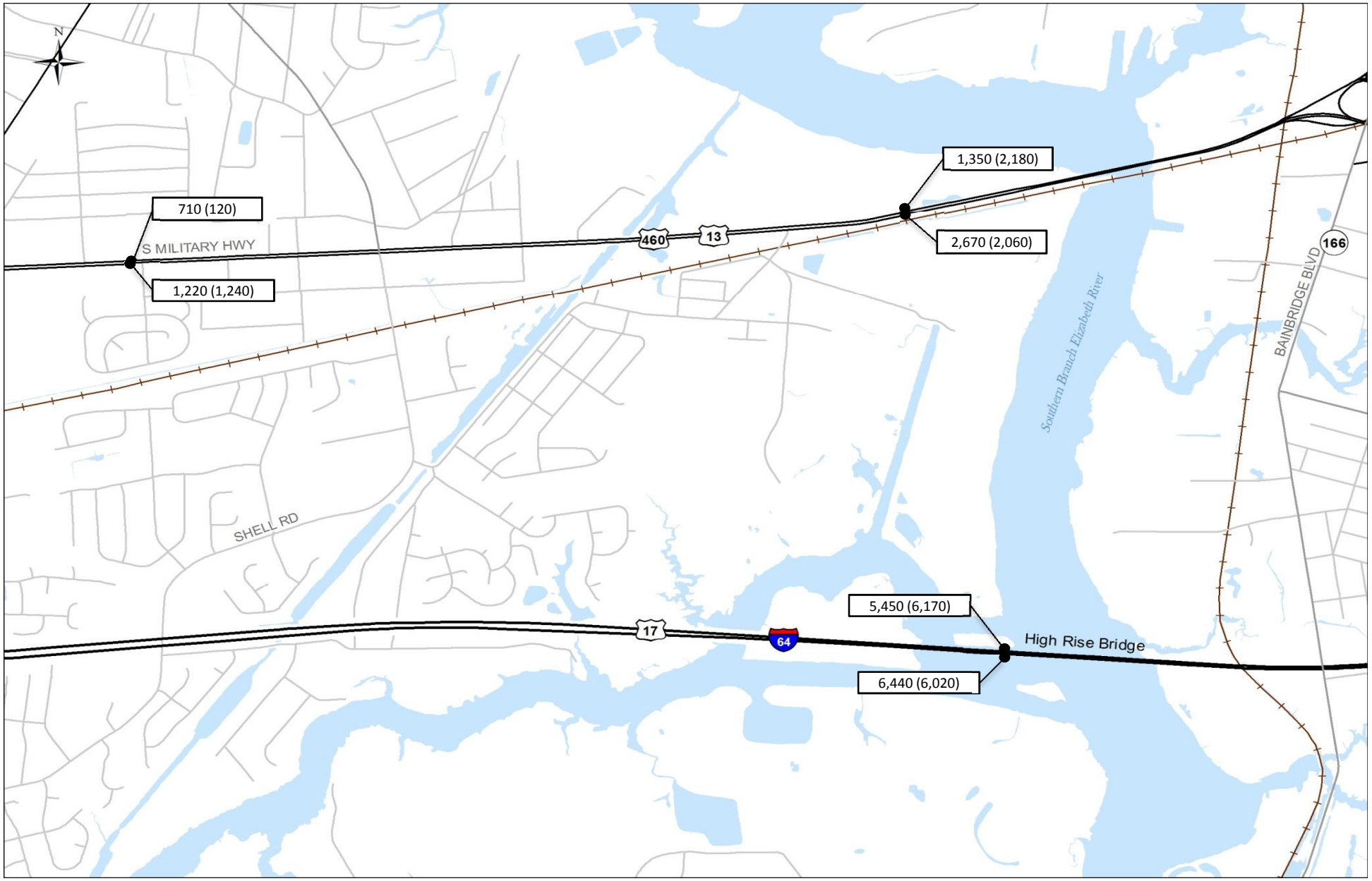
Interstate 64 / High Rise Bridge Corridor Study

Figure B.3 - Inset 2

2040 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

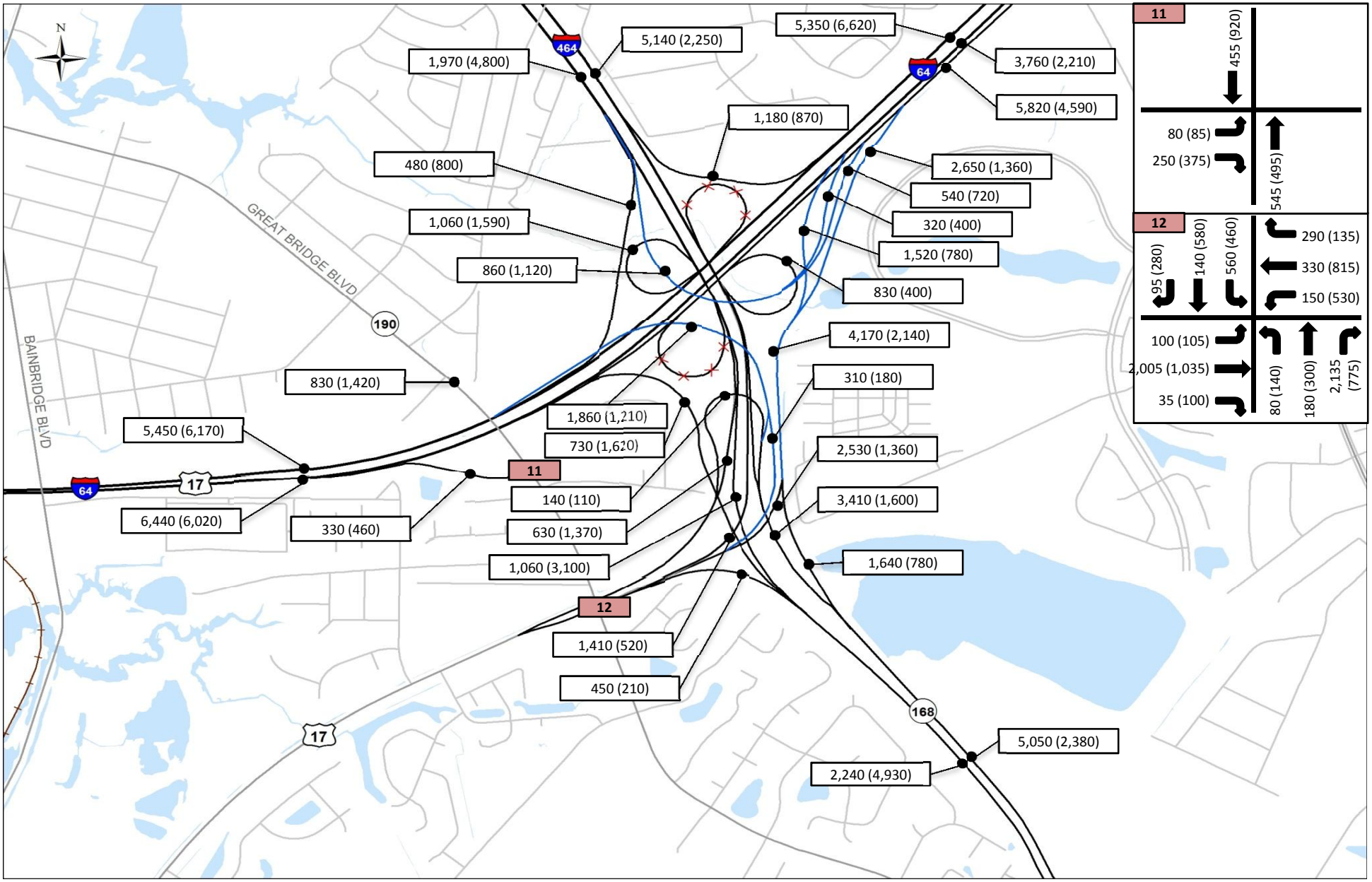
Interstate 64 / High Rise Bridge Corridor Study

Figure B.4 - Inset 3

2040 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

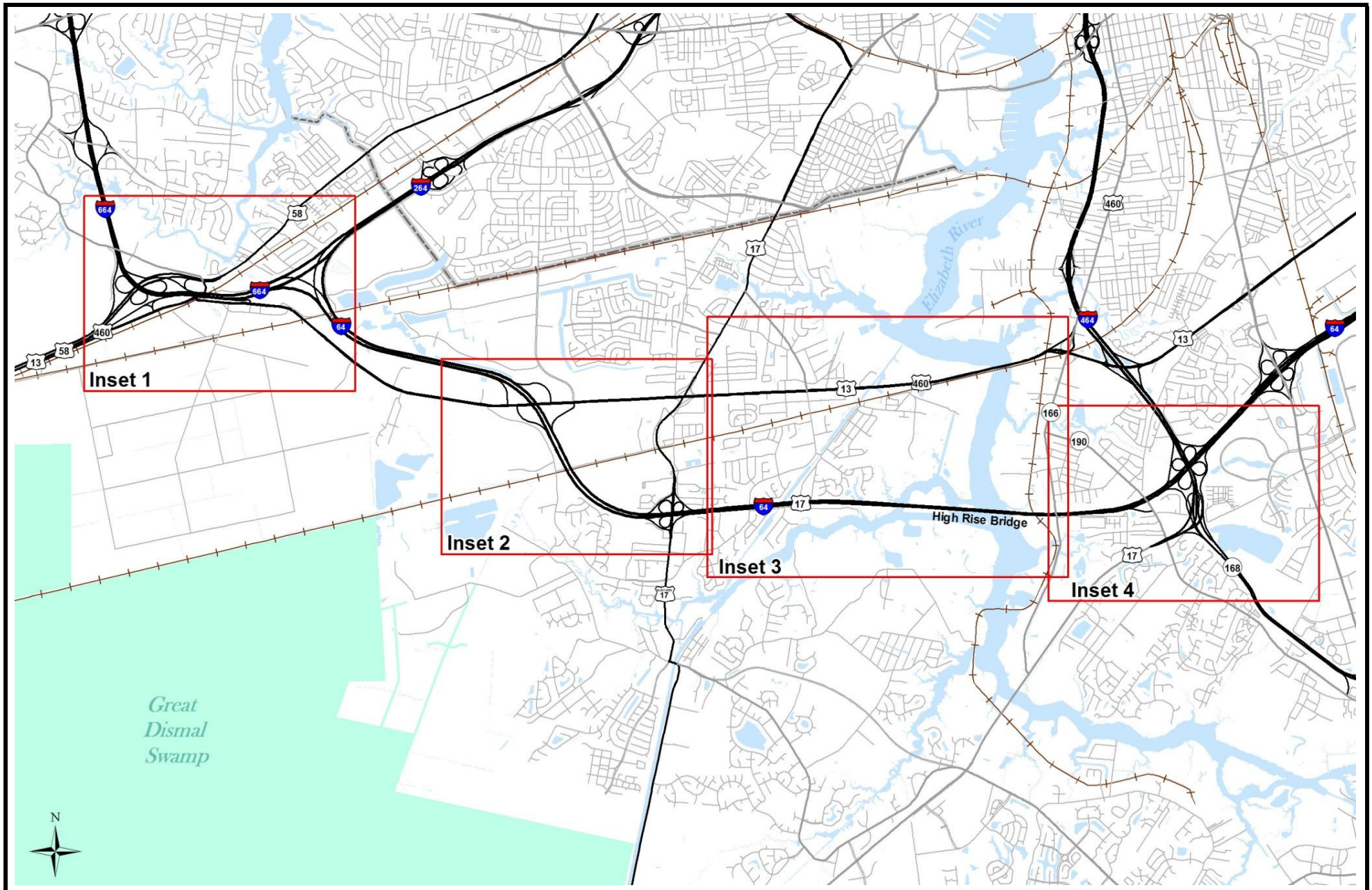
Interstate 64 / High Rise Bridge Corridor Study

Figure B.5 - Inset 4

2040 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



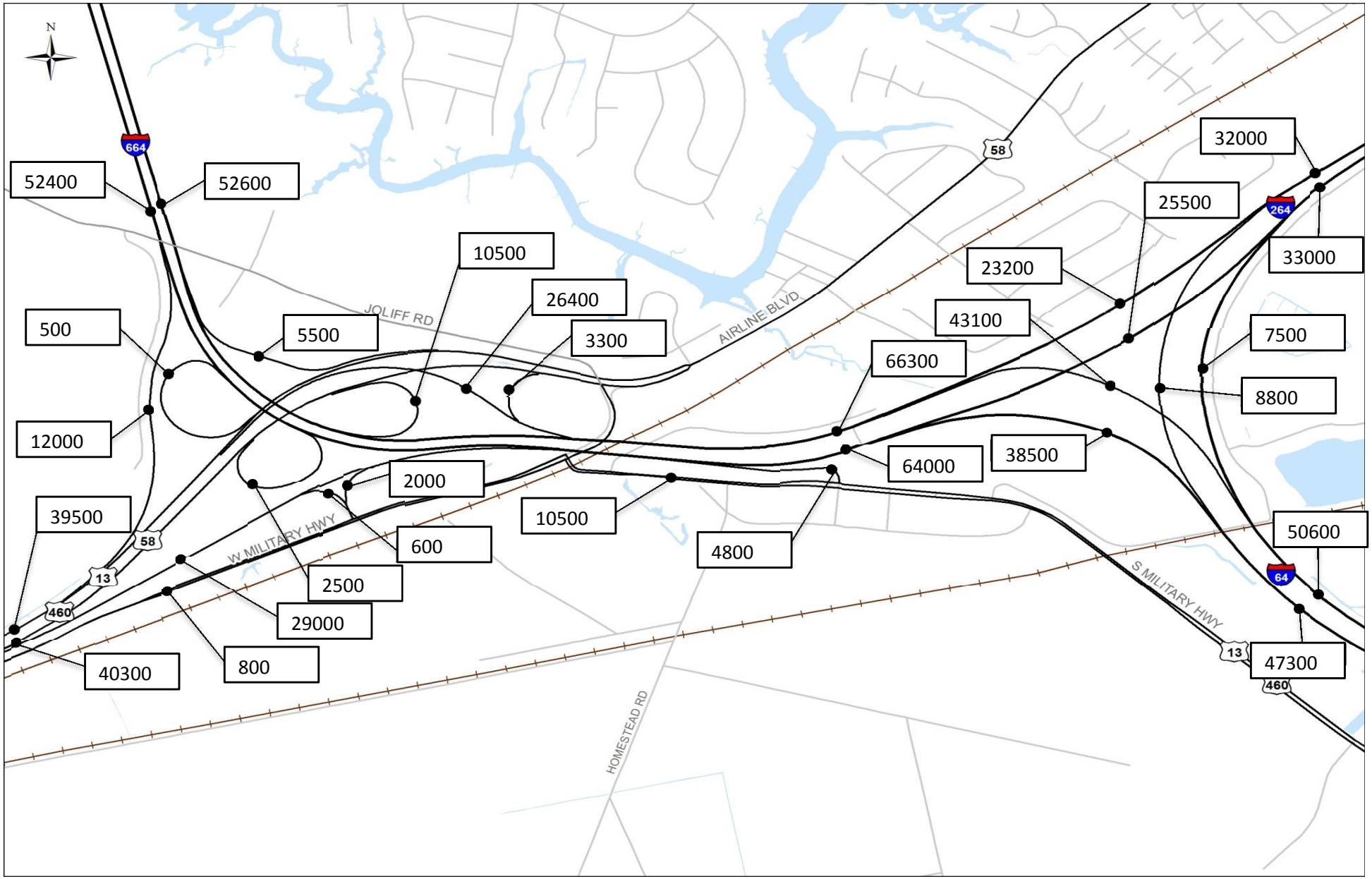
Interstate 64 / High Rise Bridge Corridor Study

Figure C.1 - Key Map

2025 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



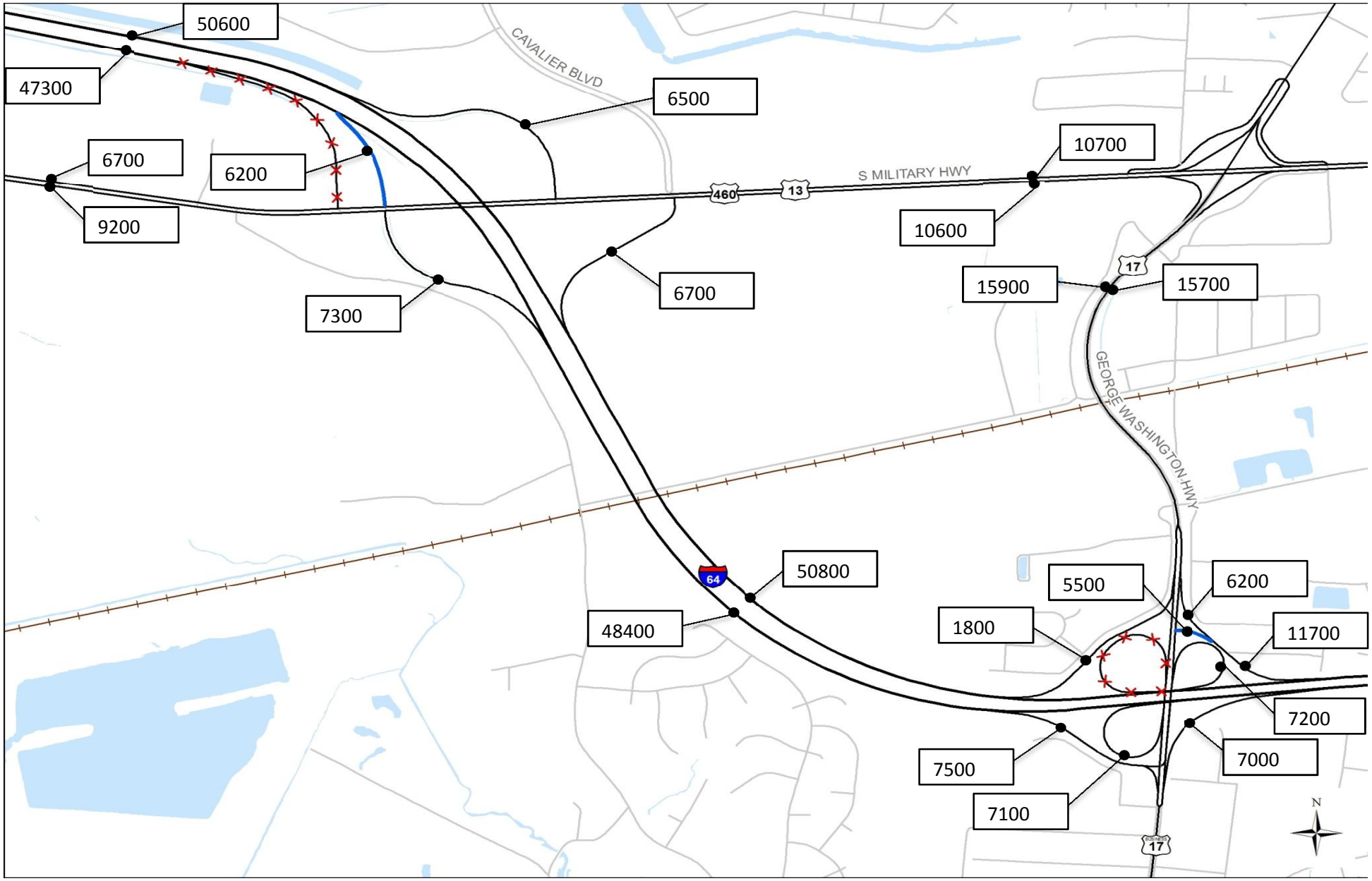
Interstate 64 / High Rise Bridge Corridor Study

Figure C.2 - Inset 1

2025 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



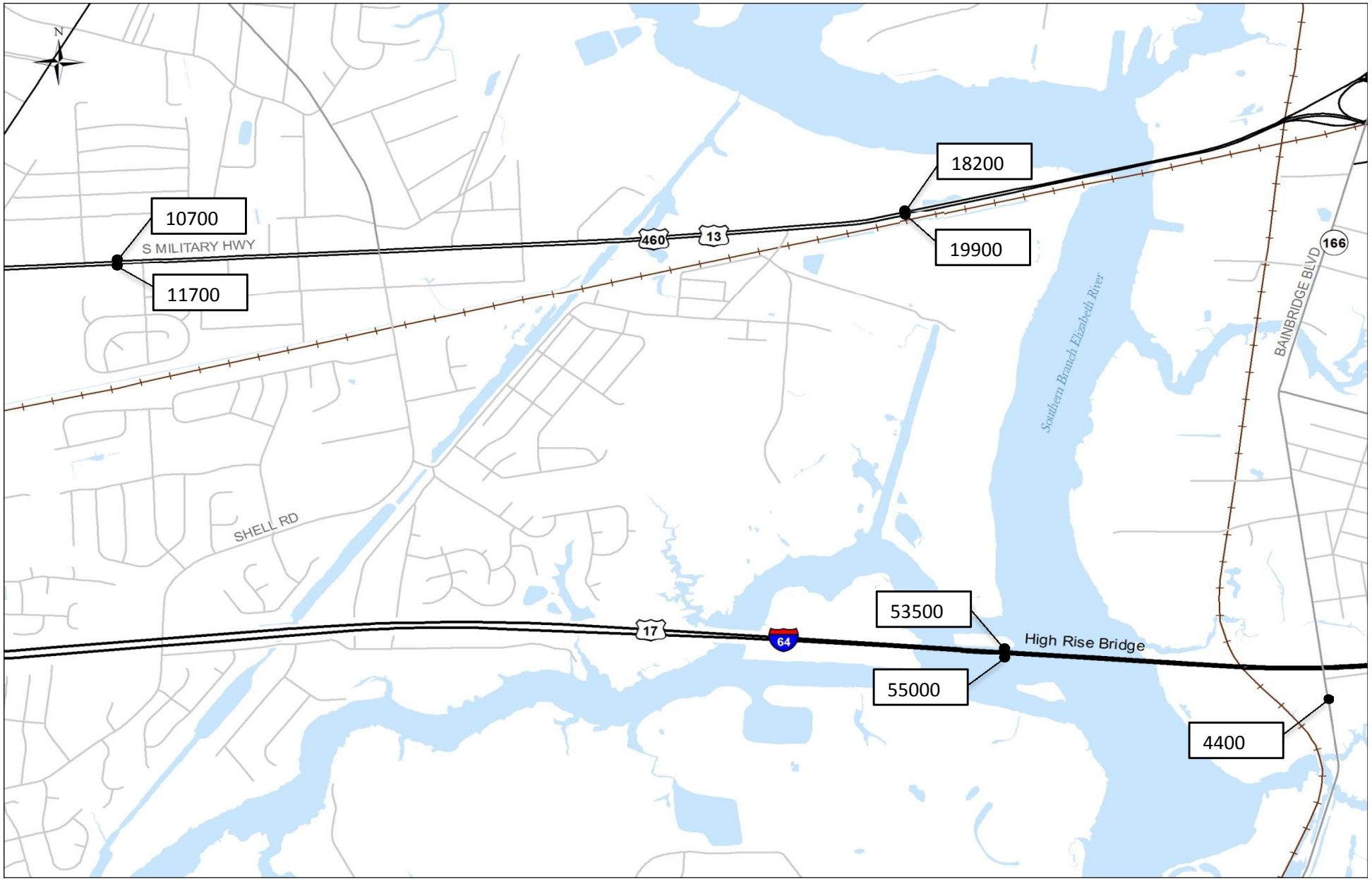
Interstate 64 / High Rise Bridge Corridor Study

Figure C.3 - Inset 2

2025 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



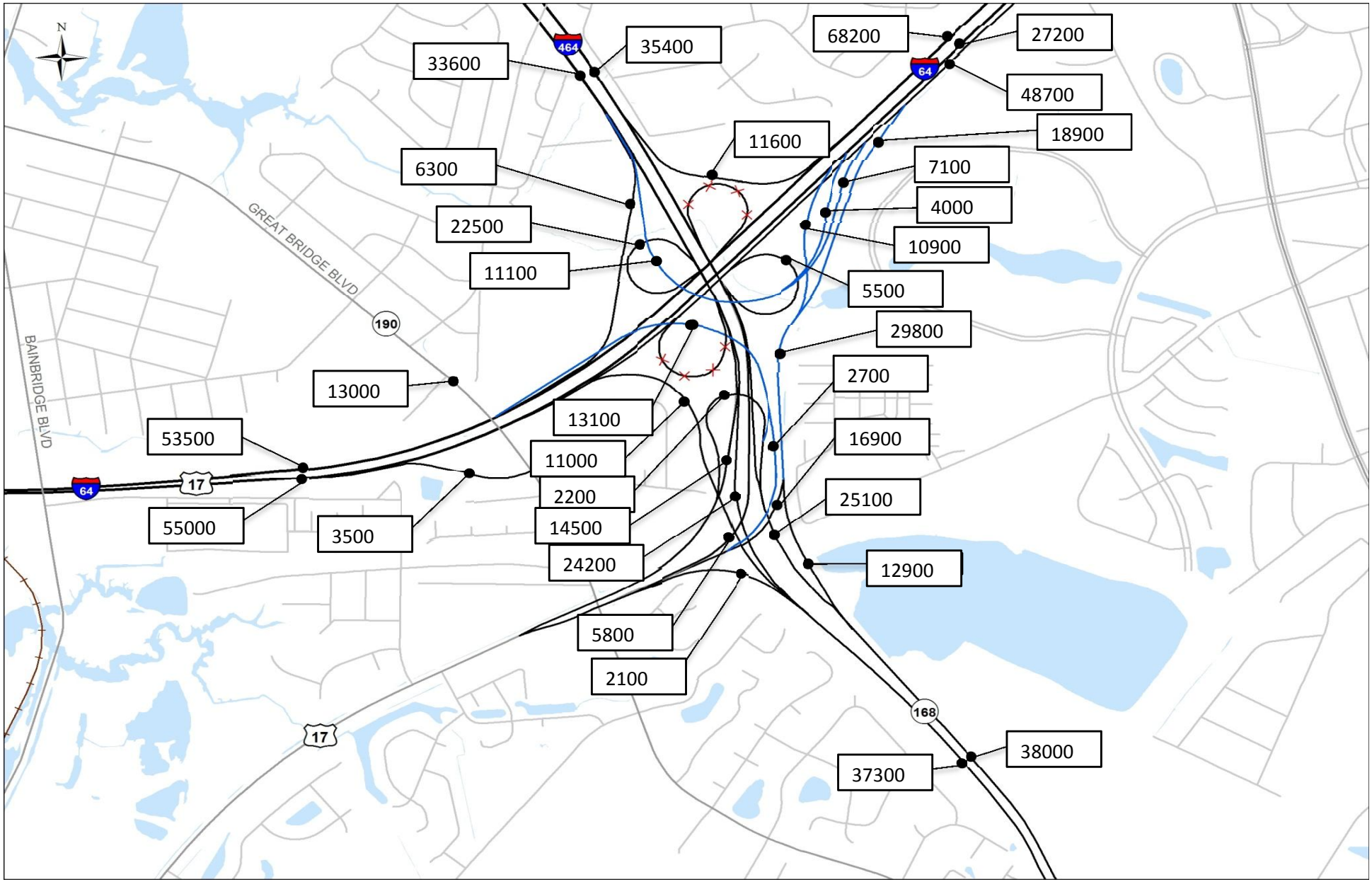
Interstate 64 / High Rise Bridge Corridor Study

Figure C.4 - Inset 3

2025 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



VDOT

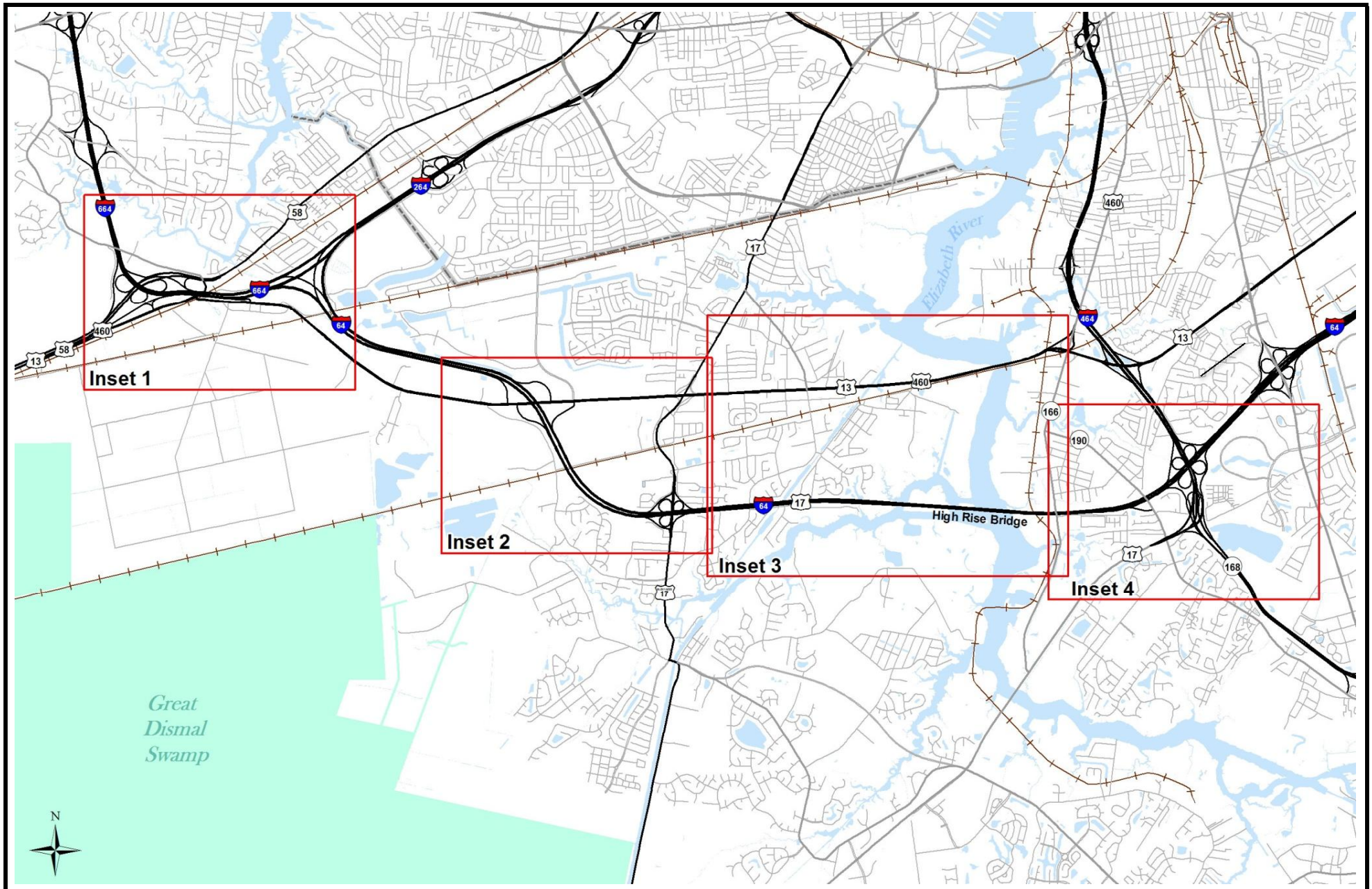
Interstate 64 / High Rise Bridge Corridor Study

Figure C.5 - Inset 4

2025 8 Lane Build – Managed Alternative (HOT Lanes) Daily Traffic Volumes

Not to Scale

May 2016



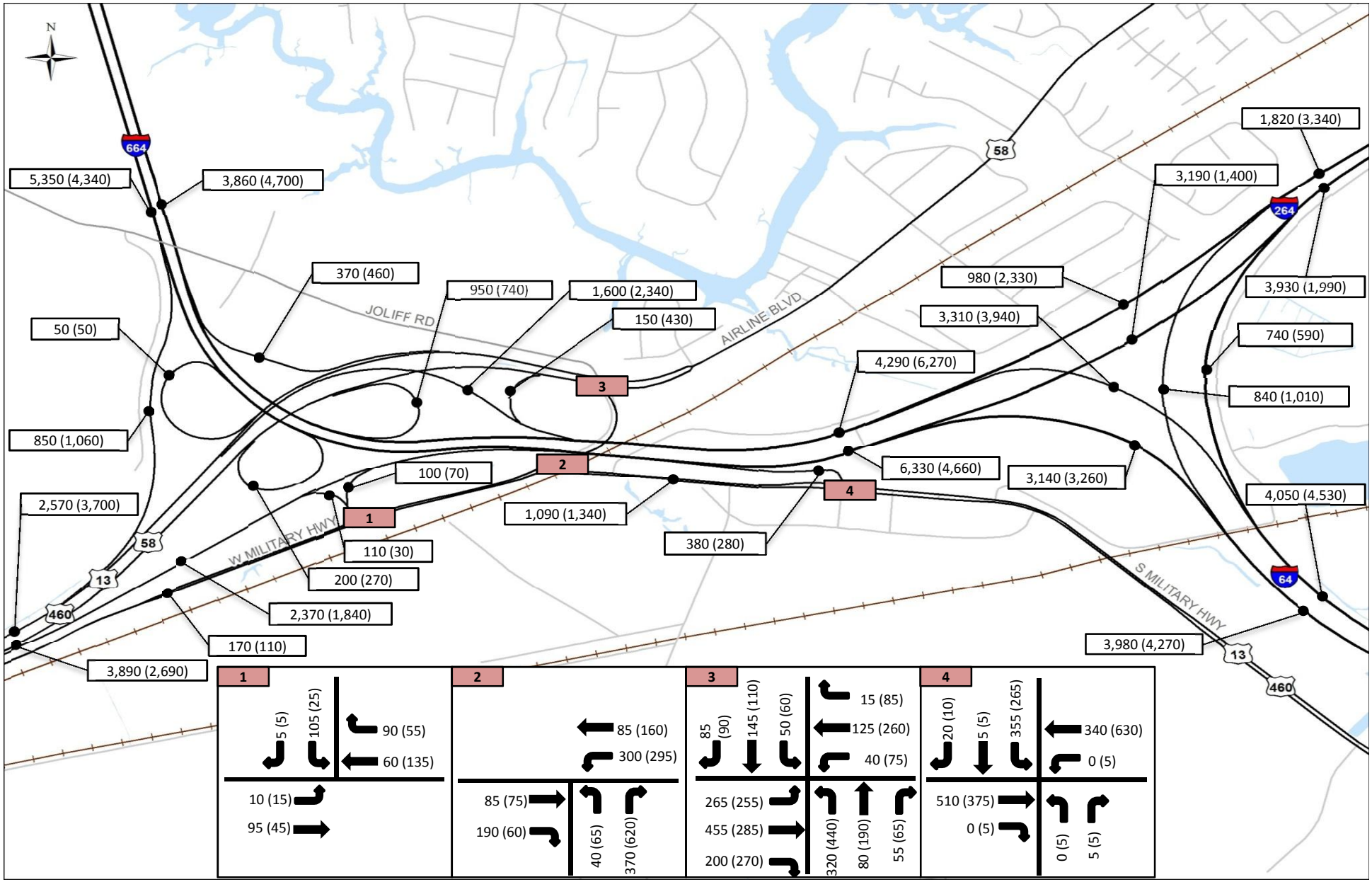
Interstate 64 / High Rise Bridge Corridor Study

Figure D.1 - Key Map

2025 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

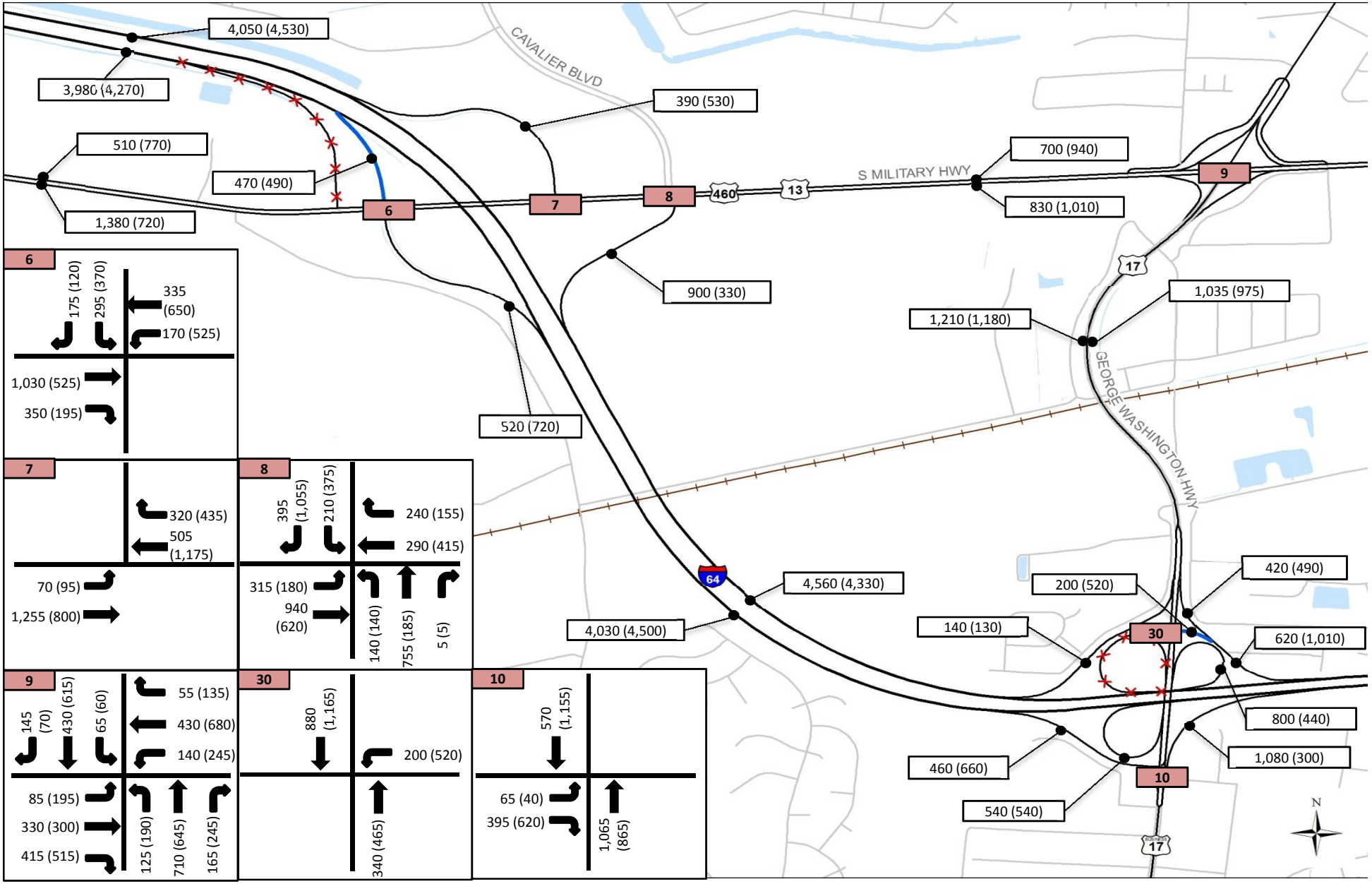
Interstate 64 / High Rise Bridge Corridor Study

Figure D.2 - Inset 1

2025 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

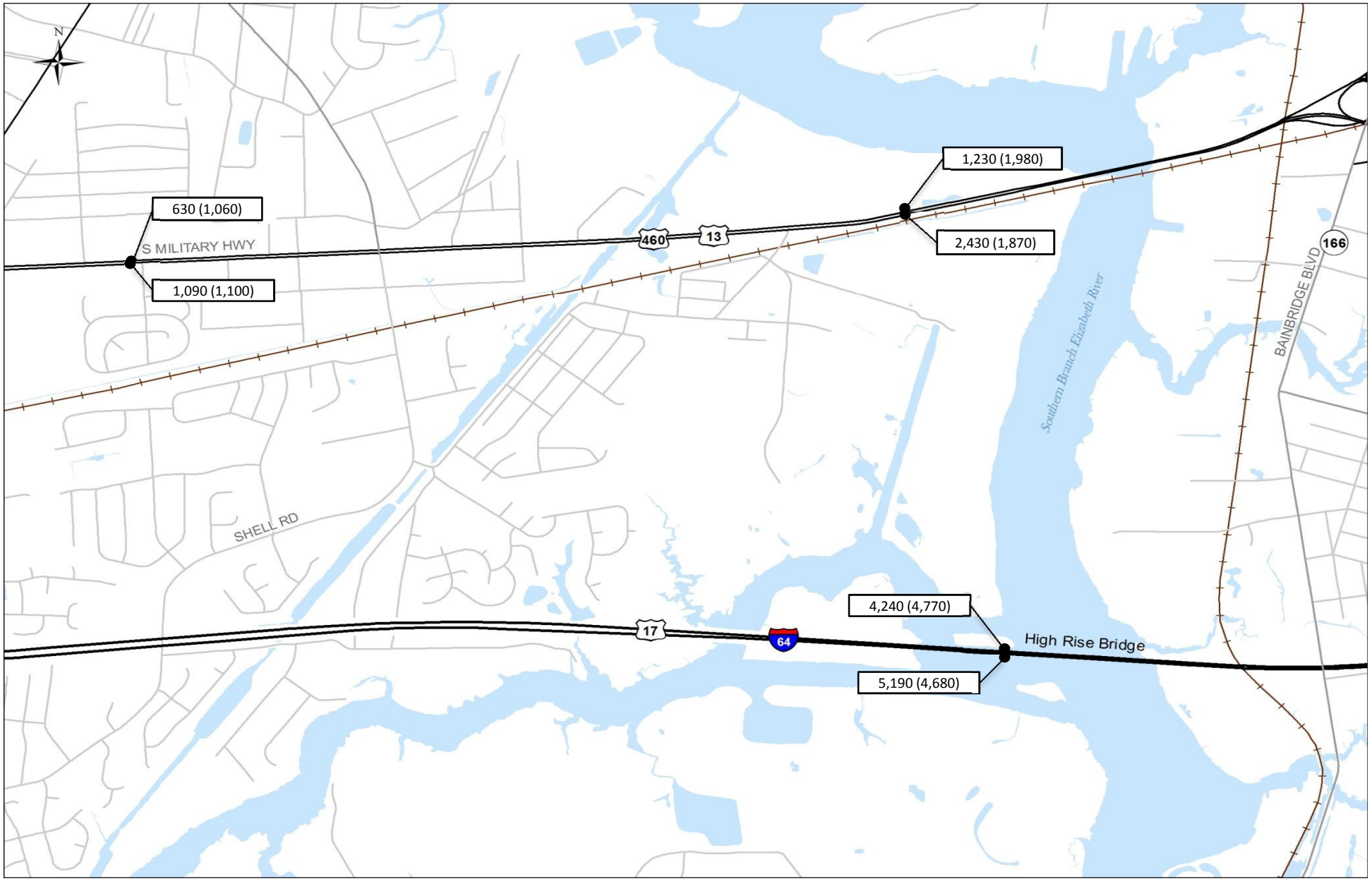
Interstate 64 / High Rise Bridge Corridor Study

Figure D.3 - Inset 2

2025 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

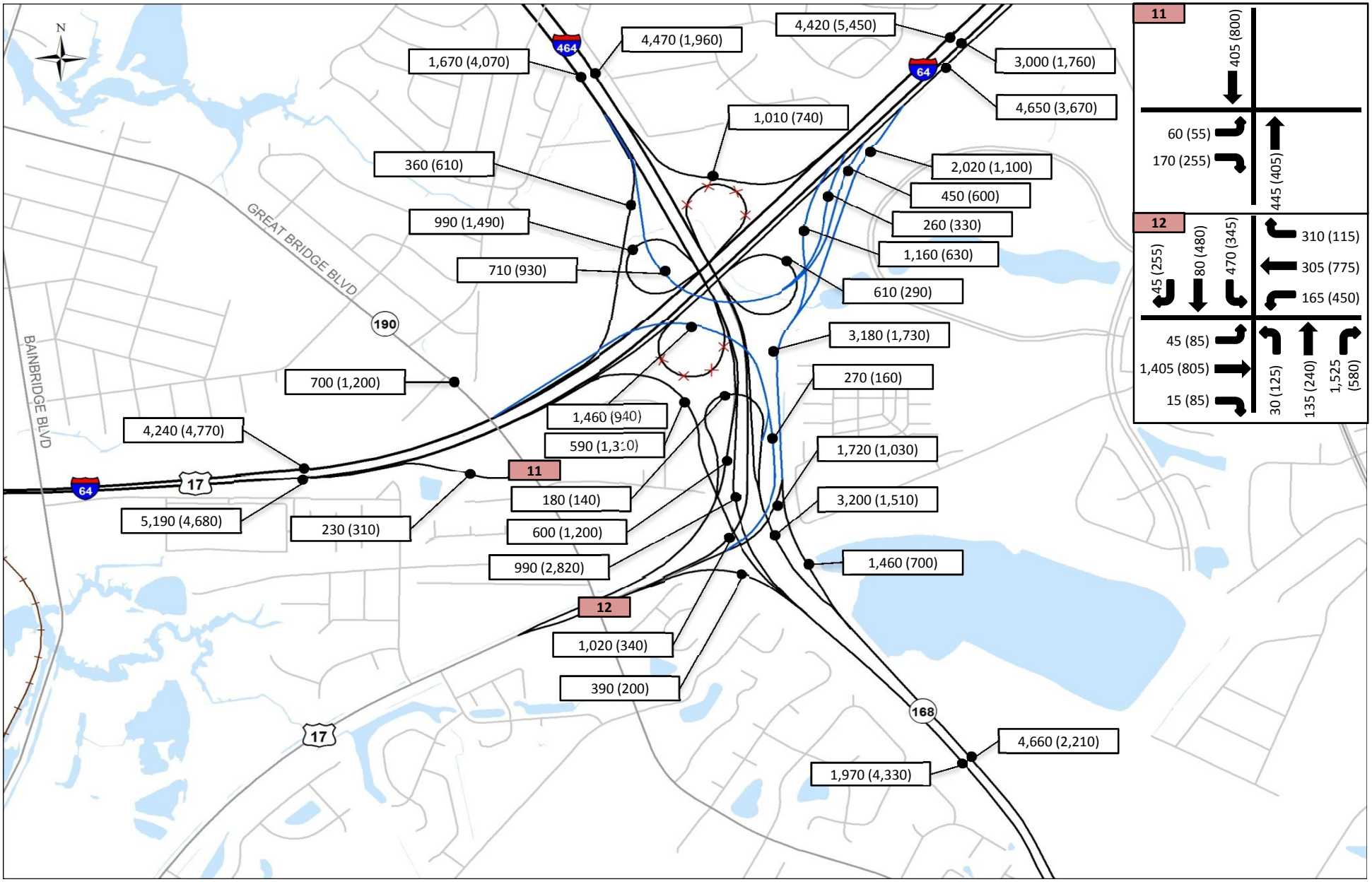
Interstate 64 / High Rise Bridge Corridor Study

Figure D.4 - Inset 3

2025 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016



AM (PM) Peak Hour Volumes

Interstate 64 / High Rise Bridge Corridor Study

Figure D.5 - Inset 4

2025 8 Lane Build – Managed Alternative (HOT Lanes) Peak Hour Traffic Volumes

Not to Scale

May 2016

DRAFT AIR QUALITY ANALYSIS TECHNICAL REPORT
Interstate 64 / High Rise Bridge Corridor Study
Chesapeake, Virginia

VDOT Project No. 0064-131-783
UPC No. 104366

HMMH Report No. 306210.001
October 2014

Prepared for:

Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219

VDOT Project No. 0064-131-783
UPC No. 104366

Prepared by:

HARRIS MILLER MILLER & HANSON INC.

77 South Bedford Street
Burlington, MA 01803
T 781.229.0707
F 781.229.7939

In Association with:

Whitman, Requardt & Associates, LLP
9030 Stony Point Parkway, Suite 220
Richmond, VA 23235

EXECUTIVE SUMMARY

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA) as the lead federal agency, and the United States Coast Guard as a cooperating agency, has initiated the Interstate 64/High Rise Bridge Corridor Study to evaluate options to improve transportation conditions along the Interstate 64 (I-64) corridor between the Interstate 464 (I-464) interchange and the Interstate 664 (I-664) and Interstate 264 (I-264) interchanges at Bowers Hill in the City of Chesapeake, Virginia (Chesapeake). Pursuant to the National Environmental Policy Act of 1969, as amended, (NEPA) and in accordance with FHWA regulations, an Environmental Assessment (EA) has been prepared to analyze the potential social, economic, and environmental effects associated with the proposed project[1].

Federal funding is involved with the Project and federal approvals are required; therefore, compliance with NEPA and the Clean Air Act (CAA) is required. NEPA requires consideration of whether the proposed action will have an adverse effect on air quality in the study area and a quantitative carbon monoxide (CO) and Mobile Source Air Toxics (MSAT) analysis have been prepared accordingly. The CAA requires a transportation air quality conformity demonstration with any State Implementation Plan (SIP) for any U.S. Environmental Protection Agency (EPA) criteria pollutant in non-attainment or maintenance areas.

The City of Chesapeake is located in Hampton Roads Ozone Attainment/Maintenance Area for the 1997 8-hour ozone standards and in an attainment area for all other National Ambient Air Quality Standards (NAAQS), including the 2008 8-hour ozone NAAQS. As such, all reasonable precautions should be taken to limit the emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx). Accordingly, the following Virginia Department of Environmental Quality (VDEQ) air pollution regulations will be adhered to during the construction: 9 VAC 5-130 et seq., Open Burning restrictions, 9 VAC 5-45, Article 7 et seq., Cutback Asphalt restrictions, and 9 VAC 5-50, Article 1 et seq., Fugitive Dust precautions.

The Project was added to the Hampton Roads Transportation Planning Organization fiscal year (FY) 2012-2015 transportation improvement program (TIP) and the 2034 long range transportation plan (LRTP) as a study-only project on March 21, 2013 by the HRTPO Board; and as such, did not initiate a new regional conformity demonstration. Additionally, the EPA revoked the 1997 8-hour ozone standard for transportation conformity purposes effective July 20, 2013, and therefore transportation conformity requirements do not currently apply throughout the study corridor.

An air quality impact assessment of peak carbon monoxide (CO) concentrations was conducted since the projected average daily traffic (ADT) exceeds the quantitative analysis thresholds specified in the 2009 VDOT and FHWA Project-Level Carbon Monoxide Air Quality Studies Agreement (*Agreement*). The worst-case CO ground level impacts were estimated at receptor locations in close proximity to the worst-case intersections and interchanges in the study corridor based on Level of Service (LOS), traffic

[1] NEPA and FHWA's regulations for Environmental Impact and Related Procedures can be found at 42 USC § 4332(c), as amended, and 23 CFR § 771, respectively.

volumes, public access, and reasonableness. The worst-case ground level CO impacts were found to remain well below the CO NAAQS at all modeled receptor locations.

The study is located in the City of Chesapeake which is designated as attainment for the coarse particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$) NAAQS; therefore transportation conformity requirements pertaining to particulate matter do not apply for this Project. In addition, the latest 2011-2013 monitoring data reported by the VDEQ show that the 24-hour and annual $PM_{2.5}$ background concentrations throughout the study corridor are 22 micrograms per cubic meter (ug/m^3) and 8.7 ug/m^3, respectively, which are both well below the respective $PM_{2.5}$ NAAQS of 35 ug/m^3 and 12 ug/m^3.

The analysis also evaluated potential impacts from MSATs in the affected network which includes the Study Corridor. As the Build Alternatives are anticipated to add significant capacity to the existing and/or proposed new roadway networks where design year traffic is projected to be 140,000 to 150,000 annual average traffic (AADT) or greater, the Project is best characterized as one with "High Potential MSAT Effects" under the 2012 FHWA interim guidance update document. Overall, the results of the MSAT analysis are consistent with the national MSAT emission trends predicted by MOVES and indicate that no meaningful increases in MSATs have been identified and are not expected to cause an adverse effect on human health as a result of the Study Alternatives. There could be increases in MSAT levels in a few localized areas where VMT increases. However, EPA's vehicle and fuel regulations are expected to result in significantly lower MSAT levels in the future than exist today due to cleaner engine standards coupled with fleet turnover.

Emissions produced during the construction of the Project would be short-term or temporary in nature. In order to mitigate these emissions, construction activities will be performed in accordance with VDOT's current "Road and Bridge Specifications". The specifications require compliance with all applicable local, state, and federal regulations.

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1.0 PROJECT BACKGROUND

Potential air quality impacts associated with the proposed I-64/High Rise Bridge Corridor Study in the City of Chesapeake were assessed by Harris Miller Miller & Hanson Inc. (HMMH). The purpose of the project is to improve transportation conditions along the Interstate 64 (I-64) corridor between the Interstate 464 (I-464) interchange and the Interstate 664 (I-664) and Interstate 264 (I-264) interchanges at Bowers Hill in the City of Chesapeake, Virginia (Chesapeake).

Federal funding is involved with the Study Alternatives; therefore, compliance with the NEPA and the CAA is required. NEPA requires a discussion of the transportation-related air quality concerns in the study area and a summary of any carbon monoxide analysis performed, and the CAA requires a transportation conformity demonstration with any SIP for any EPA criteria pollutant in non-attainment or maintenance areas. The City of Chesapeake is located in Hampton Roads Ozone Attainment/Maintenance Area for the 1997 8-hour ozone standards. The area is designated as attainment for all other NAAQS.

1.1 Project Description

The study area for the Interstate 64/High Rise Bridge Corridor Study is located in the southwestern quadrant of the Hampton Roads Beltway, which is formed by a loop of I-64 and I-664 (**Figure 1**). The study area encompasses approximately eight-miles of I-64, consisting of two travel lanes in each direction, between the I-464 interchange and the I-664 and I-264 interchanges at Bowers Hill. It includes interchanges along I-64 at Military Highway (Route 13), George Washington Highway (Route 17), and Great Bridge Boulevard (VA Route 190). The G.A. Treakle Memorial Bridge (High Rise Bridge), a mile-long double-leaf drawbridge that spans the Southern Branch of the Elizabeth River, also is included in the study area.

Within the study area, I-64 connects to numerous businesses, homes, schools, and recreational areas throughout Chesapeake. Due to the loop that I-64 follows through the Hampton Roads region of the Commonwealth of Virginia (Virginia), I-64 West travels in an easterly direction and I-64 East travels westerly through the study area. For the purpose of the EA, I-64 will be described in terms of the road name and not the direction of the road.

The study area extends beyond the interchanges described above to ensure the impacts of any of the proposed transportation improvements are adequately documented. The study area consists of (**Figure 1**):

- Four interchanges (estimated at 3,000 feet in diameter/1,051 acres combined);
- Mainline along I-64 (100 feet on each side from existing edge of pavement – estimated at 327 acres); and,
- High Rise Bridge (600 feet from the center line for a total of 1,200 feet – estimated at 308 acres).

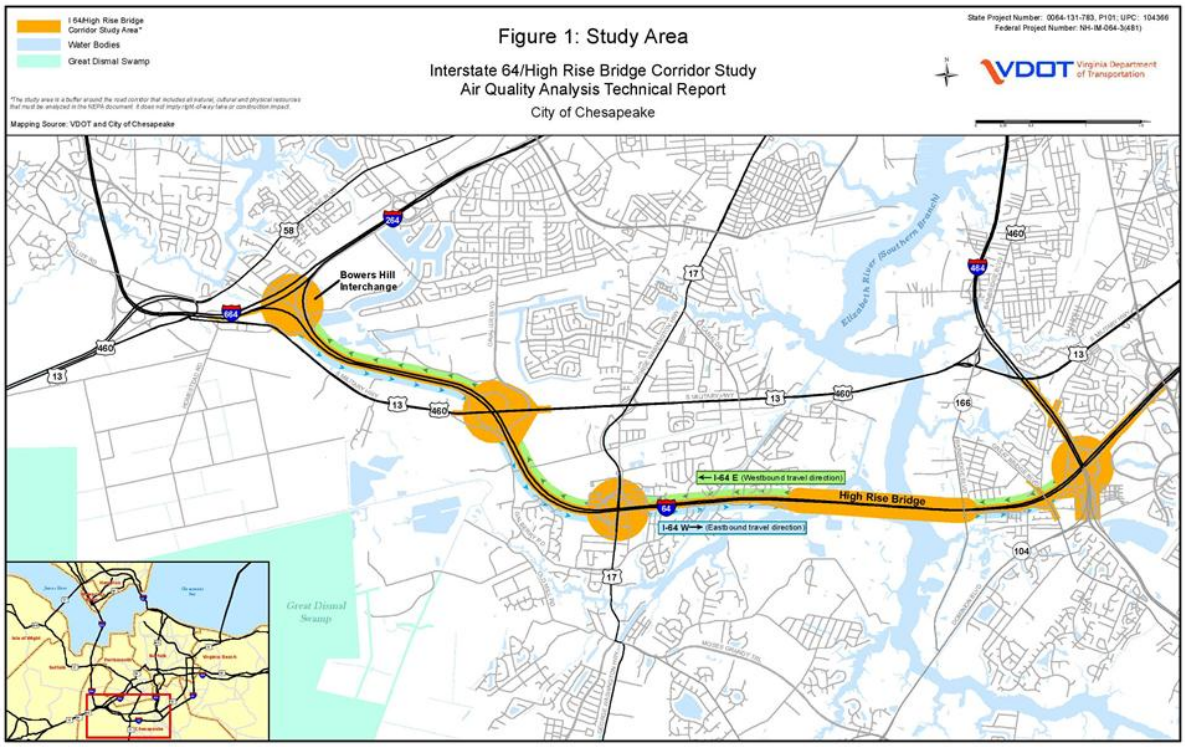


Figure 1 Study Area

Additionally, as discussed in the ***Alternatives Development Technical Report*** (VDOT, 2014a)[2], potential or estimated environmental impacts of the alternatives retained for detailed study were estimated based on the alternative's area of impact (or footprint) within the substantially larger study area. The area of impact has been estimated for alternative comparison purposes and decision-making during the NEPA process, but would be further refined if and when an alternative advanced to design.

1.2 Proposed Alternatives

To address the identified purpose and need of the I-64/High Rise Bridge Corridor Study (**See EA Chapter 1.0)**, alternatives were developed, as described in the ***Alternatives Development Technical Report*** (VDOT, 2014a). Initial analysis included Eight and Ten Lane Build Alternatives. Prior to the completion of this technical report, FHWA and VDOT agreed to move forward with retaining the Eight Lane Build Alternatives, as they would generally provide Level of Service "C" for the majority of the study area in the design year and be consistent with FHWA's Performance Based Practical Design policy (FHWA, 2014). Details on the analyses conducted to support this decision are included in the ***Alternatives Development Technical Report*** (VDOT, 2014a) and the ***Traffic and Transportation Technical Report*** (VDOT, 2014c)[3]. Therefore, the analyses of the Eight Lane Build Alternative and

[2] Virginia Department of Transportation [VDOT]. (2014a). *Alternatives Development Technical Memorandum*. Richmond, Virginia: Virginia Department of Transportation. (Unpublished Report).

[3] Virginia Department of Transportation [VDOT]. (2014c). *Traffic and Transportation Technical Report*. Richmond, Virginia: Virginia Department of Transportation. (Unpublished Report).

Eight Lane Build – Managed Alternative are included in this technical report, and the analyses of these alternatives are described in the following sections.

Due to the number of possible managed lane scenarios, there have been no specific operational scenarios identified at this stage of the study. Accordingly, the following three operational scenarios were developed to establish a sample range of travel demand conditions for the Eight Lane Build - Managed Alternative: High Occupancy Vehicle (HOV), High Occupancy Toll (HOT), and All Tolled. For the purpose of this report, potential impacts associated with the Eight Lane Build – Managed Alternative assume the same footprint as the respective general purpose (GP) Build Alternative. However it should be noted, of the three scenarios developed for the Eight Lane Build - Managed Alternative, the HOV and All Tolled lane scenarios would fit within the footprint of the Eight Lane Build Alternative. Furthermore, if a specific managed lane scenario is identified as the Preferred Alternative, impact estimates may need to be updated in the Revised EA and associated technical reports.

1.2.1 No Build Alternative

In accordance with the regulations implementing NEPA (40 CFR § 1502.14(d)), the No Build Alternative has been included for evaluation in the EA to serve as a benchmark for the comparison of future conditions and impacts. The No Build Alternative would retain the existing I-64 interstate, associated interchanges and the High Rise Bridge in their present configurations, and allow for routine maintenance and safety upgrades. This alternative also assumes that the projects currently programmed and funded in VDOT's Fiscal Year 2015-2020 Six-Year Improvement Program and the Hampton Roads Transportation Planning Organization's Constrained Long Range Plan would be implemented as discussed in the ***Alternatives Development Technical Report*** (VDOT, 2014a) and the ***Traffic and Transportation Technical Report*** (VDOT, 2014c).

1.2.2 Eight Lane Build Alternative

This alternative would include construction of four additional lanes of capacity (two lanes in each direction) on I-64 within the study area. The eight lanes under this alternative are GP Lanes and are available for use without any restrictions or tolls. Wherever possible, the additional lanes would be constructed towards the existing median of I-64. The widening of I-64 to eight lanes also would require the reconstruction of I-264 ramp bridge over I-64 to the I-664 ramp; widening of I-64 bridge over Rotunda Avenue; improvements to Route 13 interchange: widening of I-64 bridges over Yadkin Road; improvements to Route 17 interchange; widening of I-64 bridge over Shell Road; extensions of the culvert along Gilmerton Deep Creek Canal; reconstruction of the High Rise Bridge (see bridge options discussed in Section 1.2.4); reconstruction of the Route 190 bridge over I-64; and improvements at the I-464 interchange.

1.2.3 Eight Lane Build - Managed Alternative

The Eight Lane Build-Managed Alternative would be similar to the Eight Lane Build Alternative, providing four additional lanes of capacity (two lanes in each direction) on I-64. However, some or all of the travel lanes would be managed using tolls and/or vehicle occupancy restrictions. Additionally, expanded local/express bus service or bus rapid transit could be accommodated with this alternative in the GP or the managed lanes. Numerous managed lane scenarios are possible depending on the type of strategy selected including, but not limited to, HOV lanes, HOT lanes, occupancy restrictions (at least 2

or 3 occupants), or time of day/day of week restrictions. The following three operational scenarios were evaluated to identify a sample range of potential conditions for this Build Alternative:

- HOV;
- All lanes tolled; or
- Two HOT Lanes + Two General Purpose Lanes (2 HOT / HOV-2 "free" + 2 GP).

This study does not identify what type of managed lane would be constructed. Moreover, if this alternative is identified as the Preferred Alternative, subsequent studies may be required to refine the specifics of the managed lanes throughout the study area. These specifics could include the identification of additional costs and impacts not quantified as part of this study, including those associated with providing access between the GP and managed lanes at intersections and/or between interchanges.

1.2.4 High Rise Bridge

Fixed-Span Bridge – 95 Foot Vertical Clearance

This alternative would consist of a high-level, fixed-span bridge measuring 95 feet at mean high water (MHW). This alternative would include the construction of a new bridge carrying eastbound traffic south of the existing bridge. The proposed eastbound roadway approach would be shifted south, by approximately 100 feet, to tie in with the proposed location of the new bridge. The existing I-64 drawbridge would remain in service during the construction of the new bridge but could then be demolished to build a new fixed span bridge to current design standards. Additionally, this alternative includes consideration of widening the horizontal clearance from 125 feet to 135 feet. The typical section would vary to match the mainline alternative; however, the bridge would include 14-foot wide shoulders on the inside and outside due to the high truck volume that utilizes I-64 as specified in the VDOT Bridge Design Manual (VDOT, 2014b).

Fixed-Span Bridge – 135 Foot Vertical Clearance

This alternative would consist of a high-level, fixed-span bridge measuring 135 feet at MHW. This alternative would include the construction of a new bridge carrying eastbound traffic south of the existing bridge. The proposed eastbound roadway approach would be shifted south, by approximately 100 feet, to tie in with the proposed location of the new bridge. The existing I-64 drawbridge would remain in service during the construction of the new bridge, but could then be demolished to build a new fixed span bridge to current design standards. Additionally, this alternative includes consideration of widening the horizontal clearance from 125 feet to 135 feet. The typical section would vary to match the mainline alternative; however, the bridge would include 14-foot wide shoulders on the inside and outside due to the high truck volume that utilizes I-64 as specified in the VDOT Bridge Design Manual (VDOT, 2014b).

1.3 Traffic Summary

The traffic analysis for the project was conducted for the 2013 base year, the anticipated opening/interim year 2025 and the 2040 design year. For the air quality analysis, the relevant traffic components utilized from the traffic study were the level of service (LOS), average annual weekday traffic (AWDT), peak-hourly AWDT, congested speeds, turning movements, roadway grade and signal timing data for each Alternative. For this study, AWDT was estimated for each study alternative which is based on weekday

traffic volumes and is considered conservative compared to annual average daily traffic (AADT) which includes average weekday and weekend traffic volumes, which tends to result in slightly lower traffic volumes compared to AWDT. The traffic study consisted of evaluating the Study Alternatives to alleviate traffic congestion and address roadway deficiencies within the study area.

Detailed traffic forecasts and analysis as described above were performed for the No Build and Eight Lane Build Alternatives. For the Eight Lane Build - Managed Alternative, three operational scenarios were considered as described above in **Section 1.2.3**. For the HOV scenario, traffic forecasts and LOS analyses were performed along the I-64 freeway segments within the study area based on the anticipated distribution of traffic between the general purpose and HOV lanes. Other than the redistribution of traffic between the lanes of I-64, it is anticipated that there would be no other changes to traffic volumes within the overall study area.

For the two scenarios that involve tolling (all lanes tolled and 2 HOT / HOV-2 "free" + 2 GP), a toll diversion analysis was performed to quantify the potential diversion of traffic from I-64 to alternative routes due to various tolling scenarios rather than to determine an ultimate tolling scenario including toll rates. LOS analyses for these two scenarios were performed along I-64 at the High Rise Bridge, since this location has the highest traffic volumes within the study area.

The traffic studies for the Eight Lane Build - Managed Alternative did not identify the type or detailed design of managed lane alternatives under consideration. Moreover, if one of the Eight Lane Build - Managed Alternative scenarios is identified as the Preferred Alternative, additional traffic data and analysis may be required for the particular managed lane scenario and design chosen, and potential air quality impacts may need to be re-assessed.

2.0 REGULATORY REQUIREMENTS

This section provides an overview of regulations and guidance applicable to the project-level air quality analysis.

2.1 National Environmental Policy Act

Air quality is an environmental concern within the broad purview of NEPA. The key action forcing component of NEPA was the introduction of a requirement for federal agencies to prepare a "detailed statement" addressing the environmental impacts of their proposed projects and programs. The requirements of NEPA have been further defined in the Council of Environmental Quality's (CEQ) NEPA regulations that apply to all federal agencies and the FHWA/FTA joint NEPA procedures.

The text of the NEPA statute, the CEQ NEPA regulations (40 CFR 1500) and FHWA's NEPA regulations (23 CFR 771) do not contain specific requirements for air quality analyses, however, the current guidance focuses on CO[4] and MSATs[5]. Unlike the transportation conformity requirements discussed in **Section 2.6**, NEPA applies to all federally-funded projects and other federal discretionary

[4] FHWA-VDOT, " Project-Level Carbon Monoxide Air Quality Studies Agreement", letter agreement executed February 27, 2009.
[5] FHWA "Interim Guidance Update on Mobile Source Air Toxics Analysis in NEPA" (December 2012).

decisions or approvals of state or private developments. Thus, in some circumstances it may be prudent to conduct a hot-spot or other air quality analyses under NEPA even though such an analysis is not required for transportation conformity. Guidance documents addressing air quality analysis under NEPA as distinct from conformity are summarized in **Sections 2.2** through **2.6** below.

2.2 Mobile Source Air Toxics (MSATs)

In December of 2012, FHWA issued the Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA[6]. The update reflects the recent implementation of the EPA Motor Vehicle Emission Simulator (MOVES) model for estimating MSAT emissions from mobiles sources along with updating the scientific research in the MSAT arena.

The EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer drivers from their 1999 National Air Toxics Assessment. The seven compounds identified were acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases, formaldehyde, naphthalene, and polycyclic organic matter (POM). While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

The FHWA guidance presents a tiered approach for assessing MSATs in NEPA documents and identified three levels of analysis. The three levels are for projects with no meaningful MSAT effects, low potential MSAT effects, and high potential MSAT effects respectively. The FHWA guidance defines the levels of analysis for each type of MSAT effect:

- No analysis for projects with no potential for meaningful MSAT effects;
- A qualitative analysis for projects with low potential MSAT effects; and
- A quantitative analysis for projects with high potential MSAT effects.

The Study Alternatives were evaluated against each threshold criteria in order to determine the type of MSAT analysis required to satisfy NEPA.

2.3 Programmatic Agreements

Programmatic agreements are legal documents between the US Department of Transportation (DOT) and a state DOT that are designed to help streamline the environmental clearance process for transportation projects by eliminating the need for project-specific modeling for projects that are expected to have minor or no impacts. Programmatic agreements can help focus limited resources on assessing larger projects with greater potential for air quality impacts.

2.3.1 Project-Level Carbon Monoxide Air Quality Studies Agreement

On February 27, 2009, the FHWA and VDOT finalized an agreement for addressing project-level CO air quality analyses in NEPA documents. Under this *Agreement*, project-level air quality (hot-spot) analyses are typically conducted for CO for projects that exceed ADT and level of service thresholds specified in the *Agreement*, or for any project for which an Environmental Impact Statement is being prepared.

[6] FHWA (December 2012).

2.4 Clean Air Act

2.4.1 National Ambient Air Quality Standards

Pursuant to the Federal CAA of 1970, the EPA established National Ambient Air Quality Standards (NAAQS) for major pollutants known as "criteria pollutants." Currently, the EPA regulates six criteria pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter, and lead (Pb). Particulate matter (PM) is divided into two particle size categories: particles with a diameter less than 10 micrometers (PM_{10}) and those with a diameter of less than 2.5 micrometers ($PM_{2.5}$). **Table 1** shows the primary and secondary NAAQS for the criteria pollutants. The NAAQS are two-tiered: the first tier (primary) is intended to protect public health; the second tier (secondary) is intended to protect public welfare and prevent further degradation of the environment.

Section 176(c) of the CAA requires federal agencies to ensure that all of their actions conform to applicable implementation plans for achieving and maintaining the NAAQS. Federal actions must not cause or contribute to any new violation of any standard, increase the frequency or severity of any existing violation, or delay timely attainment of any standard.

Table 1 National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standards [1,2]	Secondary Standards [1,3]
CO	8-hour	9 ppm (10 mg/m^3)	None
	1-hour	35 ppm (40 mg/m^3)	None
Lead [4]	Rolling 3-Month Average[5]	0.15 µg/m^3	Same as Primary
NO_2	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	Same as Primary
	1-hour	0.100 ppm[6]	None
PM_{10}	Annual Arithmetic Mean	None	None
	24-hour	150 µg/m^3	Same as Primary
$PM_{2.5}$	Annual Arithmetic Mean	12 µg/m^{3,9}	15 µg/m^3
	24-hour	35 µg/m^3	Same as Primary
O_3	8-hour (2008 standard)	0.075 ppm	Same as Primary
	8-hour (1997 standard)	0.08 ppm	Same as Primary
	1-hour	0.12 ppm[7]	Same as Primary
SO_2	1-hour	75 ppb[8]	None
	3-hour	None	0.5 ppm

Notes:
1. National standards (other than ozone, particulate matter, and those based on annual averages) are not to be exceeded more than once per year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over three years, is equal to or is less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m^3 is equal to or is less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98% of the daily concentrations, averaged over three years, are equal to or are less than the standard.
2. Primary Standards: Levels necessary to protect public health with an adequate margin of safety.
3. Secondary Standards: Levels necessary to protect the public from any known or anticipated adverse effects.
4. Lead is categorized as a "toxic air contaminant" with no threshold exposure level for adverse health effects determined.
5. National lead standard, rolling three-month average: final rule signed October 15, 2008.
6. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).
7. EPA revoked the 1-hour ozone standard in all areas; however, some areas have continuing obligations under that standard.
8. Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
9. EPA updated the NAAQS for $PM_{2.5}$ to strengthen the primary annual standard to 12 ug/m^3.

The standards in **Table 1** apply to the concentration of a pollutant in outdoor ambient air. If the air quality in a geographic area is equal to or is better than the national standard, it is typically designated by EPA as an attainment area. Areas where air quality does not meet the national standard are typically classified as non-attainment areas. Once the air quality in a non-attainment area improves to the point where it meets the standards and the additional redesignation requirements in the CAA [Section 107(d)(3)(E)], EPA may redesignate the area back into attainment subject to the requirements in an associated maintenance plan (typically referred to as Maintenance Areas).

The Clean Air Act Amendments (CAAA) of 1990 requires states to designate the status of all areas within their borders as being in or out of compliance with the NAAQS. The CAAA further defines non-attainment areas for ozone based on the severity of the violation as marginal, moderate, serious, severe, and extreme. In an effort to further improve the nation's air quality, the EPA strengthened the 8-hour ozone standard most recently in 2008. The project is located in an area that is currently designated as

attainment/maintenance under the 1997 8-hour ozone standards and in attainment under the 2008 8-hour ozone standards.

Each state is required to prepare a SIP that outlines measures the region will implement to attain the applicable air quality standard in non-attainment areas, and to maintain compliance with the applicable air quality standard in maintenance areas.

2.5 Description of Project-Level Criteria Pollutants

Carbon monoxide (CO) is a toxic colorless and odorless gas that results from the incomplete combustion of gasoline and other fossil fuels. Because CO disperses quickly the concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways conveying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban "street canyon" conditions.

Particulate matter is a broad class of air pollutants that exists as liquid droplets or solids, with a wide range of size and chemical composition. Particulate matter is emitted by a variety of sources, both natural and man-made. Major man-made sources of particulate matter include the combustion of fossil fuels in vehicles, power plants and homes, construction activities, agricultural activities, and wood-burning fireplaces. Smaller particulates less than or equal to 10 and 2.5 microns in size (PM_{10} and $PM_{2.5}$) are of particular health concern because they can get deep into the lungs and affect respiratory and heart function.

2.6 Transportation Conformity

As discussed above, Chesapeake is located in EPA designated Attainment/Maintenance Area for the 1997 8-hour ozone standards and in an attainment area for all other NAAQS. The Commonwealth of Virginia has prepared a state implementation plan (SIP) that outlines the control measures that were implemented to achieve compliance and maintain the 1997 8-hour ozone NAAQS.

The EPA promulgated the Transportation Conformity Rule (40 CFR Parts 51 and 93) concerning applicability, procedures, and criteria that FHWA and Federal Transit Administration (FTA) must use in analyzing and determining conformity of transportation projects, programs, and plans. The Transportation Conformity Rule applies to these transportation projects, programs and plans in EPA designated non-attainment or maintenance areas (40 CFR 93.102(b)).

The federal conformity rule requires that a conforming transportation plan and program be in place at the time of the project approval (40 CFR 93.114), and for the project to be included in the conforming plan and program (40 CFR 93.115). The Project was included in the HRTPO fiscal year (FY) 2012-2015 TIP and the 2034 LRTP as a study-only project on March 21, 2013 by the HRTPO Board, and as such, did not initiate a new regional conformity determination. Additionally, the EPA revoked the 1997 8-hour ozone standard for transportation conformity purposes on July 20, 2013, and therefore transportation conformity requirements do not currently apply throughout the study corridor.

In March of 2006, EPA and FHWA issued joint guidance for conducting a hot-spot analysis for particulate matter. The guidance applies to projects within a maintenance or non-attainment area for $PM_{2.5}$ and outlines the criteria for determining whether a project is considered to be one of "air quality

concern". In December 2010, EPA issued updated modeling guidance for performing quantitative analyses of $PM_{2.5}$ and PM_{10} emissions for conforming with the $PM_{2.5}$ NAAQS. This guidance pertains to federal-funded or approved transportation projects that are deemed to be projects of air quality concern that are located in $PM_{2.5}$ non-attainment and maintenance areas. The Project is located in the City of Chesapeake which is designated as attainment for the coarse particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$) NAAQS; therefore transportation conformity requirements pertaining to particulate matter do not currently apply for this Project.

3.0 EXISTING CONDITIONS

3.1 Air Quality Attainment Status of the Project Area

To characterize the existing air quality conditions of the City of Chesapeake, the Virginia Air Quality Data Reports, prepared by the Virginia Department of Environmental Quality (VDEQ) Office of Air Quality Monitoring and the EPA, were reviewed. The analysis focused on regulated air pollutants contained in the NAAQS, specifically sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter (PM_{10} and $PM_{2.5}$). EPA has designated Chesapeake as an attainment/maintenance area for the 1997 eight-hour ozone standard. The area is designated as attainment for all other NAAQS.

3.2 Climate and Meteorology

Chesapeake is located in the southeastern part of the state, approximately five miles south of the City of Portsmouth and 18 miles southwest of the City of Virginia Beach and is included in the Hampton Roads metropolitan area. The climate of the area is influenced by the ocean. Winters are mild with limited snowfall and summers are hot and humid. The average annual temperature for the Virginia Beach-Norfolk area is 73 degrees Fahrenheit. The area typically receives 45 inches of rainfall annually and up to 2.5 inches of snow.

3.3 Ambient Air Quality Data and Trends

A review of the VDEQ ambient monitoring data shows that measured pollutant concentrations from all stations representative of the study area are below the NAAQS. For the 8-hour ozone standard for which the region is currently in attainment/maintenance, the Hampton Roads region recorded a 3-year design value (2011-2013) of 0.072 ppm which is below the 2008 8-hour ozone NAAQS of 0.075 ppm. A review of the VDEQ 10-year monitoring data shows that most criteria pollutants concentrations have generally been decreasing since 2003. The decrease in NO_x, VOCs, and CO emissions is due to a variety of control measures that have been implemented over the last two decades, including motor vehicle engine controls, reductions in evaporative emissions from gasoline stations and consumer products, as well as reductions from power plants, businesses and residential combustion sources.

4.0 PROJECT ASSESSMENT

The project-level analysis for highway projects under the federal guidance typically consists of an evaluation of the anticipated peak concentrations and/or emissions of carbon monoxide (CO), particulate

matter (PM), and Mobile Source Air Toxics (MSATs). The methodologies and assumptions proposed for addressing the type of analysis for each pollutant is discussed below and is consistent with FHWA and EPA guidance.

Traffic forecasts for the Study Alternatives were developed for the Existing (2013), Interim Year Build (2025) and Design Year Build (2040) conditions. As discussed in **Section 1.3**, traffic forecasts were performed for the No Build, Eight Lane Build Alternative, and for the Eight Lane Build – Managed Alternative.

An analysis of the traffic data was conducted to assess the anticipated air quality impacts from each of the Alternatives (i.e., the Eight Lane Build Alternative and the three Eight Lane Build - Managed scenarios; HOV, all lanes tolled, and 2 HOT / HOV-2 "free" + 2 GP) in order to determine the worst-case alternative for evaluation in the quantitative CO and MSAT analyses. For the HOV scenario, no diversion of traffic is anticipated from I-64 to any of the other roadways in the project corridor. As such, LOS and AM and PM peak-hour traffic volumes at all study area interchanges and intersections for this scenario are anticipated to be equal or lower than that for the Eight Lane Build Alternative.

For the two scenarios that involve tolling (all lanes tolled and 2 HOT / HOV-2 "free" + 2 GP), a toll diversion analysis was performed to quantify the potential diversion of traffic from I-64 to alternative routes due to various tolling scenarios. The diversion analysis identified daily volume changes at five crossings of the Elizabeth River including Route 13 / South Military Highway at the Gilmerton Bridge.

For the all lanes tolled scenario, the toll diversion analysis indicates that there would be varying traffic diversion off of the I-64 project corridor depending on the toll rate. For the 2 HOT / HOV-2 "free" + 2 GP scenario, the toll diversion analysis indicates there would be minimal diversion to parallel routes due to the shifting of some traffic volumes to the 2 HOT / HOV-2 "free" lanes and the remaining available capacity on the I-64 facility itself. Therefore, it is anticipated there would be little or no change in traffic volumes under this scenario when compared to the Eight Lane Build Alternative.

Since the traffic analysis showed that each of the Eight Lane Build - Managed Alternative scenarios are anticipated to result in equivalent or lower traffic volumes on the project corridor when compared to the Eight Lane Build Alternative, the Eight Lane Build Alternative was chosen as the worst-case alternative for evaluation in the quantitative CO and MSATs analyses that follow. However, since the traffic studies for the Eight Lane Build - Managed Alternative did not identify the type or detailed design of each of the managed lane scenarios under consideration, additional traffic data and analysis may be required if one of the managed lane scenarios is chosen as preferred, and the potential air quality impacts may need to be re-assessed.

4.1 Carbon Monoxide (CO) Analysis

In 2009, FHWA and VDOT finalized a 2009 Project-Level Air Quality Studies Agreement (e.g. *Agreement*) for addressing project-level CO impacts in NEPA documents. Under this *Agreement*, project-level air quality (hot-spot) analyses are typically conducted for CO for projects that exceed average daily traffic (ADT) and level of service (LOS) thresholds as specified in the *Agreement*. A CO hot-spot analysis was conducted for this Project because ADT volumes are expected to be above the ADT quantitative analysis thresholds identified in the *Agreement*.

The CO hot-spot analysis utilized the traffic assessment conducted by the design team for the 2013 Existing year, 2025 Interim year, and the 2040 Design year conditions.

4.1.1 Methodology

The microscale analysis typically examines worst-case ground-level CO impacts due to traffic flow in the immediate vicinity of a project intersection/interchange. CO is used in microscale studies to indicate roadway pollutant levels as it is the most abundant pollutant emitted by motor vehicles and can result in so-called "hot-spot" (i.e. high concentration) locations around congested intersections and interchanges. The NAAQS were developed by the EPA to protect human health against adverse health effects with an adequate margin of safety. These standards do not allow ambient CO concentrations to exceed 35 parts per million ("ppm") for a 1-hour averaging period and 9 ppm for an 8-hour averaging period, more than once per year at any location. The widespread use of advanced catalytic technologies on late-model vehicles has significantly reduced the occurrences of CO hotspots in recent years. Air quality models (computer simulation programs) are typically used to predict worst-case CO levels for both existing and future conditions to evaluate compliance of proposed roadways with the CO NAAQS.

The microscale analysis was conducted using the EPA MOVES (MOVES2010b) and CAL3QHC models to estimate worst-case CO concentrations at individual receptor (i.e. receiver) locations. Peak CO concentrations resulting from the project at each location were then added to the appropriate CO background concentrations to determine the worst-case CO impacts at each location. These values were then compared to the 1-hour and 8-hour CO NAAQS to determine compliance.

4.1.2 Interchanges/Intersections Studied

Table 2 provides the anticipated daily traffic volumes for the existing, 2025 Interim and 2040 Design Year Build conditions for each link studied under the No Build Alternative, and for the Eight Lane Build Alternative which was chosen as the worst-case alternative for evaluation as described above. A map showing the segment link locations for each inset are contained in **Appendix A** for the Existing, No Build and Eight Lane Build Alternative.

Specifically, average weekday daily traffic (AWDT) volumes along I-64 east of I-464 westbound inner loop are expected to reach 83,600 AWDT in the 2040 Design Year condition under the Eight Lane Build Alternative. There are other links within the study which are also expected to have daily traffic volumes above the thresholds identified in the *Agreement*. Therefore, a CO hot-spot analysis was conducted for the No Build and Eight Lane Build Alternative at the worst-case intersections/interchanges.

An analysis of the LOS was evaluated to confirm the worst-case intersection locations for inclusion in the CO hot-spot analysis. **Table 3** provides the LOS summary for each signalized and non-signalized intersection for the No Build and Eight Lane Build Alternatives for the existing, Interim year 2025 and Design year 2040 conditions.

A comparison of the Eight Lane Build Alternative for both 2025 and 2040 conditions show that there are four intersections that are predicted to operate at a LOS of E or F. The four intersections are:

- West Military Highway and Airline Boulevard at Joliff Road;
- George Washington Highway and South Military Highway;
- West Military Highway and South Military Highway; and

- South Military Highway and I-664 South Ramp at Shaefer Avenue.

The highest peak hourly volumes of the four intersections for the Eight Lane Build Alternative are expected to occur at the George Washington Highway and South Military Highway intersection, with worst-case AM and PM peak hour volumes of 3,740 and 4,705, respectively, for the 2040 conditions. The remaining three intersections are projected to have lower peak hour traffic volumes compared to the George Washington Highway and South Military Highway intersection.

Table 2 Existing, Interim and Design Year Projected AWDT

Location	Segment Name	2013 Count	2040 No Build	2040 Build 8 Lane	2025 No Build	2025 Build 8 Lane
	Inset 1					
R	I-664 west of I-264 WB Inner Loop	60,300	72,700	76,000	65,800	67,300
S	EB I-64 Inner Loop to NB I-664 Inner Loop	36,600	46,700	53,400	41,100	44,100
T	WB I-264 to WB I-664 Inner Loop	23,700	26,000	22,600	24,700	23,200
U	I-664 west of I-264 EB Outer Loop	57,700	70,600	74,000	63,400	64,900
V	SB I-664 to WB I-64	32,500	44,300	48,000	37,700	39,400
W	EB I-664 Outer Loop to EB I-264	25,200	26,300	26,000	25,700	25,500
X	WB I-264 east of I 664/I-64	28,800	33,600	36,500	31,000	32,200
Y	EB I-264 east of I 664/I-64	29,400	33,600	38,000	31,300	33,100
Z	EB I-64 Inner Loop to EB I-264	4,200	7,300	12,000	5,600	7,600
AA	WB I-264 to I-64 Outer Loop	5,100	7,600	13,900	6,300	9,000
AB	I-64 East heading toward I 264	40,800	54,000	65,400	46,700	51,700
AC	I64 West heading toward Route 460/13	37,600	51,900	61,900	44,000	48,400
	Inset 2					
A	WB I-64 West of US 13 (Inner Loop)	37,600	51,900	61,900	44,000	48,400
B	EB I-64 West of US 13 (Outer Loop)	40,800	54,000	65,400	46,700	51,700
C	SB US 13 West of I-64	3,900	10,600	10,400	6,900	6,800
D	NB US 13 west of I-64	5,700	14,200	13,800	9,500	9,300
E	WB I-64 to S Military Highway	5,600	8,100	7,200	6,700	6,300
F	SB US 13 to WB I-64	6,600	7,800	6,600	7,100	6,600
G	NB US 13 to WB I-64	4,600	9,800	10,800	6,900	7,400
H	EB I-64 to US 13 SB	4,800	9,000	9,200	6,700	6,800
I	WB I-64 East of US 13 (Inner Loop)	36,600	53,600	65,500	44,200	49,500
J	EB I-64 East of US 13 (Outer Loop)	39,000	55,200	68,000	46,300	51,900
K	SB US 17 North of I-64	13,500	19,700	19,300	16,300	16,100
L	NB US 17 North of I-64	13,300	19,500	19,200	16,100	15,900
M	EB I-64 to SB US 17	5,100	5,700	0	5,400	0
M-1	New EB I-64 to SB US 17	0	0	6,300	0	2,800
N	SB US 17 to EB I-64	1,400	3,300	2,700	2,200	1,900
V	EB I-64 to NB US 17*	5,300	5,500	7,500	5,200	6,300
P	NB US 17 to EB I-64	5,800	8,700	9,100	7,100	7,300
Q	WB I-64 to SB US 17	5,700	11,600	10,100	8,300	7,700
R	SB US 17 to WB I-64	5,700	7,000	9,100	6,300	7,200
S	NB US 17 to WB I-64	6,800	7,000	7,500	6,800	7,100
T	SB US 13 East of I-64	9,600	13,800	12,200	11,500	10,800
U	NB US 13 East of I-64	9,500	13,800	12,200	11,400	10,700
O	EB I-64 ramp to Route 17 SB**	10,400	11,200	13,800	10,800	11,900
*Equivalent to V in the Build Scenarios						
**Equivalent to O in the Build Scenarios						
	Inset 3					
A	SB US 13 West of Canal Drive	9,500	17,500	12,100	13,100	10,700
B	NB US 13 West of Canal Drive	10,500	18,700	13,100	14,100	11,700
C	SB US 13 West of Gilmerton Bridge	16,700	20,900	20,000	18,600	18,200
D	NB US 13 West of Gilmerton Bridge	18,300	22,900	21,900	20,300	19,900
E	I-64 East (Outer Loop) at High Rise Bridge	42,200	54,400	70,000	47,600	54,600
F	I-64 West (Inner Loop) at High Rise Bridge	43,400	56,000	72,000	49,000	56,100
G	Bainbridge Blvd South of I-64	5,000	4,000	3,600	4,600	4,400
	Inset 4					
A	I-64 East (Outer Loop) east of High Rise Bridge	42,200	54,400	70,000	47,600	54,600
B	I-64 West (Inner Loop) east of High Rise Bridge	43,400	56,000	72,000	49,000	56,100
C	Great Bridge Blvd North of I-64	11,100	17,700	15,300	14,000	13,000
D	SB I-464 North of I-64	28,900	42,000	39,700	34,700	33,700
E	NB I-464 North of I-64	30,700	41,800	41,400	35,600	35,500
F	SB I-464 to EB I-64	4,800	8,000	8,400	6,200	6,400
G	EB I-64 to SB I-464	21,300	28,000	24,000	24,300	22,500
H	I-64 West to SB 168*	11,400	12,900	15,600	12,100	13,300
I	EB I-64 to NB I-464	10,000	13,000	13,600	11,300	11,600
J	I-64 East of I-464 WB Inner Loop	57,300	74,500	83,600	64,900	69,000
K	I-64 East of I-464 EB Outer Loop	22,200	28,000	35,000	24,800	27,900
L	I-64 EB C-D Road from I-464 to Battlefield	38,900	51,100	60,900	44,300	48,700
M	WB I-64 to NB I-464	4,000	5,800	7,500	4,800	5,600
N	I-64 West to Great Bridge Blvd	2,400	2,800	5,100	2,500	3,600
O	SB I-464 to WB I-64**	9,200	12,600	13,400	10,700	11,100
P	WB I-64 to SB I-464	9,200	12,500	13,800	10,700	11,200
Q	NB Oak Grove Connector to WB Dominion Blvd	2,000	2,900	2,500	2,400	2,200
R	SB I-464 to WB Dominion Blvd	14,000	22,700	15,100	17,900	14,500
S	SB I-464 to SB Oak Grove Connector	22,200	26,700	26,800	24,200	24,200
T	EB Dominion Blvd to NB I-464	5,100	7,500	6,700	6,200	5,800
U	EB Dominion Blvd to SB Oak Grove Connector	2,000	2,000	2,100	2,000	2,100
V	EB Dominion/NB Oak Grove to I-64 West	24,100	31,600	36,900	27,400	29,800
W	EB Dominion Blvd to NB I-464	2,400	3,600	3,100	2,900	2,700
X	EB Dominion Blvd to WB I-64	12,400	17,600	22,400	14,700	16,800
Y	NB Oak Grove Connector to NB I-464	22,600	27,700	28,600	24,900	25,300
Z	NB Oak Grove Connector to WB I-64	11,700	14,000	14,500	12,700	12,900
AA	Oak Grove Connector SB	33,400	41,200	42,700	36,900	37,500
AB	Oak Grove Connector NB	34,300	41,700	43,100	37,600	38,200
AC	Flyover Ramp from EB Dominion Blvd and NB Oak Grove to I-64 West***	8,800	11,500	13,500	10,000	10,900
AD	Flyover Ramp from SB I-464 to I-64 West***	3,300	4,600	4,900	3,900	4,000
AE	Flyover Ramp from SB I-464 to I-64 West C-D Road***	5,900	8,000	8,500	17,400	7,100
AF	Flyover Ramp from EB Dominion Blvd and NB Oak Grove to I-64 West C-D Road***	15,300	20,100	23,400	17,400	18,900
***AC, AD, AE, AF New ramps under the Build Alternative						

See Appendix A for a map of the segment link locations.

Table 3 Level of Service (LOS) and Peak Hourly AM and PM Volumes for Each Alternative

						2025				2040			
				Existing		No Build		8-Lane Build		No Build		8-Lane Build	
Site Number	WRA Intersection	Intersection	Peak	Peak Volumes	LOS	Peak Volumes	LOS	Peak Volumes	LOS	Peak Volumes	LOS	Peak Volumes	LOS
1	3	W Military Hwy & Airline Blvd & Joliff Rd	AM	1005	C	1840	D	1845	D	2565	F	2580	F
			PM	1330	C	2165	D	2195	E	3190	E	3220	F
2	5	S Military Hwy & I-64 WB Off-Ramp	AM	1460	B	2265	B	2380	B	3295	F	3395	C
			PM	1180	B	1890	B	2140	C	2770	C	3395	C
3	8	I64 EB Off-Ramp/Cavalier Blvd & S Military Hwy	AM	2550	C	3545	E	3305	C	4835	F	4385	D
			PM	2310	B	3335	E	3145	B	4505	F	4185	C
4	9	George Washington Hwy & S Military Hwy	AM	2630	D	3430	F	3130	E	4425	F	3740	F
			PM	3300	F	4320	F	3930	F	5595	F	4705	F
5	11	Great Bridge Blvd & I-64 WB Off-Ramp	AM	890	A	1100	A	1090	A	1365	A	1340	A
			PM	1250	A	1545	A	1525	A	1915	B	1885	A
6	12	Great Bridge Blvd & Dominion Blvd	AM	3780	C	Intersection will become an interchange, All LOS are C or better		Intersection will become an interchange, All LOS are C or better		Intersection will become an interchange, All LOS are C or better		Intersection will become an interchange, All LOS are C or better	
			PM	3720	D								
7	1	W Military HWY @ 58 to 64 Ramps	AM	230	B	375	B	365	B	560	B	535	B
			PM	165	A	270	A	280	B	400	B	420	B
8	2	W Military HWY @ S Military HWY	AM	605	D	1065	B	1070	B	1625	D	1660	D
			PM	715	B	1270	C	1275	C	1965	F	1980	F
9	4	S Military HWY @ I664 South Ramp at Shaefer Avenue	AM	780	D	1170	D	1235	E	1665	F	1800	F
			PM	815	C	1250	E	1305	F	1800	F	1930	F
10	6	US 13 @ I 64W On Ramp	AM	1500	D	2245	F	Intersection will be merged with Site 2/WRA Intersection 5		3205	F	Intersection will be merged with Site 2/WRA Intersection 5	
			PM	1500	B	2190	F			3045	F		
11	7	US 13 @I64E On Ramp	AM	1680	B	2280	B	2165	A	3060	C	2895	A
			PM	1780	B	2520	C	3520	A	3330	D	3365	A
12	10	US 17 @I64W Off Ramp	AM	1810	C	2125	C	2125	A	2510	E	2513	A
			PM	2350	F	2680	F	2700	A	3110	F	3125	A
	30	US 17 @I64E Off Ramp	AM	New Intersection. Only Exists in the Build Condition		New Intersection. Only Exists in the Build Condition		1465	A	New Intersection. Only Exists in the Build Condition		1465	A
			PM					2175	B			2425	B

Of the four intersections which are expected to operate at a LOS of E or F, the George Washington Highway and South Military Highway intersection is expected to have the highest peak AM and PM volumes in areas where the public has access, and was therefore included in the CO hot-spot analysis for further evaluation.

The analysis also included an evaluation of the worst-case affected interchanges from the Eight Lane Build Alternative for inclusion in the air quality analysis. **Table 4** provides the predicted highest daily traffic volumes traveling through each affected interchange for 2025 and 2040 conditions. A comparison of the traffic volumes traveling through each interchange for each Eight Lane Build Alternative shows the highest traffic volumes are expected to occur at the I-64 and I-464 interchange for the 2040 (476,300) condition, which also is the location where the highest peak AWDT volumes are expected to occur (83,600) along the I-64 east of I-464 westbound inner loop roadway segment. The next highest traffic volumes are predicted to occur at the I-64 and Route 17 interchange (353,600), followed by I-64 and I-264 interchange (351,800), and the I-64 and Route 460/13 interchange (297,200).

Therefore, the two interchanges with the highest traffic volumes were considered worst-case locations and were therefore included in the CO hot-spot analysis for further evaluation:

- I-64 and I-464; and,
- I-64 and Route 17.

In summary, a review of the LOS, daily and peak traffic volumes for each analysis year determined that the three worst-case intersections/interchanges included in the CO hot-spot analysis for further evaluation were:

- George Washington Highway and South Military Highway (intersection);
- I-64 and I-464 (interchange); and
- I-64 and Route 17 (interchange)

The traffic analysis, as summarized above, has demonstrated that the intersection and two interchanges selected for evaluation in the CO hot-spot analysis have the worst-case LOS and/or highest traffic volumes within the study corridor, and are therefore representative of the locations where peak CO concentrations would be expected to occur. It is assumed that if these intersections/interchanges show peak ground level CO concentrations below the CO NAAQS, then all other locations in the study area will also be below the CO NAAQS.

Table 4 Predicted Traffic Volumes Traveling Through the Interchange

Interchange	Segment Description	Existing	8-Lane Build 2025	8-Lane Build 2040	Ranking
I-64 and I-464					
	I64 EB out of the I64/I464 Interchange	42,200	54,600	70,000	
	I64 WB into the I64/I464 Interchange	43,400	56,100	72,000	
	Route 17 WB out of the I64/I464 Interchange	14,000	14,500	17,600	
	Route 17 EB into the I64/I464 Interchange	21,900	27,500	31,200	
	Route 168 SB out of the I64/I464 Interchange	33,400	37,500	42,700	
	Route 168 NB into the I64/I464 Interchange	34,300	38,200	43,100	
	I64 WB out of the I64/I464 Interchange	22,200	27,900	35,000	
	I64 EB into the I64/I464 Interchange	57,300	69,000	83,600	
	I464 NB out of the I64/I464 Interchange	30,700	35,500	41,400	
	I464 SB into the I64/I464 Interchange	28,900	33,700	39,700	
	Totals	328,300	394,500	476,300	1
I-64 and I-264					
	I664 NB out of the I664/264/I64 Interchange	60,300	67,300	76,000	
	I664 SB into the I664/264/I64 Interchange	57,700	64,900	74,000	
	I64 WB out of the I664/i264/I64 Interchange	37,600	48,400	61,900	
	I64 EB into the I664/i264/I64 Interchange	40,800	51,700	65,400	
	I264 NB out of the I664/I264/I64 Interchange	29,400	33,100	38,000	
	I264 SB out of the I664/I264/I64 Interchange	28,800	32,200	36,500	
	Totals	254,600	297,600	351,800	3
I-64 and Route 460/13					
	Route 460/13 WB out of the I64/Route460 Interchange	3,900	6,800	10,400	
	Route 460/13 EB into the I64/Route460 Interchange	5,700	9,300	13,800	
	I64 WB out of the I64/Route 460 Interchange	36,600	49,500	65,500	
	I64 EB into the I64/Route 460 Interchange	39,000	51,900	68,000	
	Route 460/13 EB out of the I64/Route 460 Interchange	5,900	10,700	12,200	
	I64 EB out of the I64/Route 460 Interchange	40,800	51,700	65,400	
	I64 WB into the I64/Route 460 Interchange	37,600	48,400	61,900	
	Totals	169,500	228,300	297,200	4
I-64 and Route 17					
	Route 17 South out of the I64/Route 17 Interchange	17,200	14,700	17,600	
	Route 17 NB into the I64/Route 17 Interchange	20,600	18,400	22,000	
	I64 WB out of the I64/Route 17 Interchange	43,400	56,100	72,000	
	I64 EB into the I64/Route 17 Interchange	42,200	54,600	70,000	
	Route 17 NB out of the I64/Route 17 Interchange	13,300	15,900	19,200	
	Route 17 SB into the I64/Route 17 Interchange	13,500	16,100	19,300	
	I64 EB out of the I64/Route 17 Interchange	39,000	51,900	68,000	
	I64 WB into the I64/Route 17 Interchange	36,600	49,500	65,500	
	Totals	225,800	277,200	353,600	2

4.1.3 MOVES Emissions Estimation

CO vehicle emission rates were estimated using the latest version of the EPA Motor Vehicle Emissions Simulator (MOVES2010b) model. The methodologies and assumptions used for the MOVES modeling were consistent with the EPA guidance document titled "Using MOVES in Project Level Carbon Monoxide Analyses."[7] Vehicle and fuels data required for input into the MOVES model was provided by VDOT for 2013, 2025 and 2040 conditions, consistent with the latest planning assumptions for the City

[7] EPA, December 2010, "Using MOVES in Project Level Carbon Monoxide Analyses", EPA-420-B-10-041

of Chesapeake. Specifically, fuel data, vehicle population data, and age distribution data were provided to populate the MOVES project data manager database. The source type hour fractions for each link were derived from the total source operating hours for each vehicle type and road type that were generated from a regional MOVES model run using the latest planning assumptions. MOVES input relies on link-specific data, therefore, a link file was developed for each worst-case intersection/ interchange studied for each analysis year. The link file includes road type, peak-hour volumes, link lengths, speed, and roadway grade. The roadway grades for the intersections/interchanges were provided by WRA/Jacobs traffic engineers based on roadway lengths and mapping survey data elevations for the existing roadways, along with maximum allowable roadway grades using the VDOT Road Design Manual as worst-case assumptions for the new roadways links. Worst-case meteorological data consistent with the VDOT Consulting Guide for Chesapeake (i.e., Hampton Roads) was also assumed in the project data manager database. A summary of the MOVES inputs are presented in **Table 5**.

Table 5 Summary of MOVES Inputs

Parameter	Assumption
Scale Menu	"Project" Domain
	Calculation Type "Inventory"
Min/Max Temperature	32°F
Relative Humidity	Relative Humidity=75%
Evaluation Month	January
Time Span	Year=(2013, 2025, 2040), AM Hour= 7AM to 8AM, PM Hour = 4PM to 5PM, Days=Weekdays
Geographic Bounds	Virginia, City of Chesapeake
Vehicles Equipment	All Vehicle Types for diesel and gasoline and CNG transit buses
Link Files	Roadway Specific
Roadway Grade/Link Speeds	Provided by VDOT/WRA
Fuel and I/M Inputs	Fuels Data Provided by VDOT, No I/M program in study corridor
Vehicle Population and Age Distribution	Provided by VDOT
Pollutants and Process Panel	CO Running and CO Crankcase
Output Panel	Grams and Miles Selected as Units, Population and Distance traveled

Mobile source emission factors were calculated based on the actual peak-hour congested speeds at which vehicles travel through the intersection/interchanges, while idle emissions are used to represent vehicles queuing. The MOVES runs were used to generate CO emission rates for input into the CAL3QHC dispersion model for the Existing (2013), Interim year (2025), and final Design year (2040) conditions. As an example of the emission rates, **Table 6** summarizes the emission factors generated by MOVES for each year and vehicle speed for the George Washington Highway/South Military Highway intersection, I-64 and Route 17 interchange, and I-64 and I-464 interchange. A sample MOVES input and output file is provided in **Appendix B**. A complete set of MOVES input/output files can be made available upon request.

Table 6 Summary of MOVES CO Emission Factors

	Vehicle Speed (mph)	2013 (g/mile)[1]	2025 (g/mile)[1]	2040 (g/mile)[1]
George Washington HWY & South Military HWY	Idle	24.89	5.51	4.46
	35	4.73	3.20	3.09
	50	4.2	2.80	2.75
I-64 & Route 17	Idle	24.89	5.51	4.46
	25	6.84	4.63	4.5
	30	N/A	5.37	5.21
	35	6.61	4.61	4.47
	40	6.6	N/A	N/A
	45	5.4	4.68	3.59
	50	N/A	4.78	4.67
	60	4.40	2.95	2.85
I-64 & I-464	25	6.84	N/A	N/A
	30	6.67	4.61	4.47
	35	6.61	5.55	5.40
	50	N/A	6.06	5.94
	60	4.43	2.95	2.85

Notes:
1. MOVES emission factors may vary for individual speeds based on average link grade.
2. N/A denotes vehicle speeds do not exist for this modeled Alternative.

4.1.4 CAL3QHC Dispersion Model

The latest version of the CAL3QHC model (04244)[8] was used to predict worst-case 1-hour CO concentrations from queue and free-flow links using the FHWA CAL3Interface[9]. The CAL3Interface is a software package that incorporates the EPA CAL3QHC dispersion model. The CAL3QHC model incorporated various worst-case default parameters per EPA guidance. The peak AM and PM 1-hour concentrations from CAL3QHC were scaled by a factor of 0.7[10] to estimate 8-hour concentrations. Traffic signal timing data provided by WRA were used for signalized intersections. Travel speeds were estimated based on field observations, the traffic analysis, and queuing at the intersections. A summary of inputs used in the CAL3Interface model are shown in **Table 7**.

[8] "User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections", EPA-454/R-92-006 (Revised), EPA, September 1995.
[9] See CAL3Interface – A Graphical User Interface for the CALINE3 and CAL3QHC Highway Air Quality Models", Michael Claggett, Ph.D., FHWA Resource Center, 2006.
[10] EPA guidance for estimating 8-hour concentrations from 1-hour concentrations.

Table 7 Summary of CAL3QHC Inputs

Description	Value
Surface Roughness Coefficient	175 Centimeters
CO Background Concentrations	3.6 ppm 1-hour, 2.5 ppm 8-hour (Hampton Roads)
Wind Speed	1.0 meter per second
Stability Class	Urban D
Mixing Height	1,000 meters
Wind Direction	5 degree increments

A sample CAL3QHC input and output file is provided in **Appendix C**. A complete set of CAL3QHC files can be made available upon request.

4.1.5 Receptors

For the modeling analysis, receptor locations were placed in the vicinity of each intersection/interchange at worst-case locations such as sidewalks, property lines, and parking lots where the public generally has access for the Existing and Eight Lane Build and No Build Alternatives. Consistent with EPA modeling guidelines[11], the receptors were located a minimum of 3 meters from the edge of the roadway and positioned at a height of 1.8 meters above the ground. **Figure 2** shows the receptor locations at the George Washington Highway and South Militia Highway intersection as modeled in CAL3QHC for the Existing and Eight Lane Build Alternatives, while **Figure 3** and **Figure 4** shows the receptor locations for the Existing and Eight Lane Build Alternative designs, respectively, for I-64 and Route 17 interchange. **Figure 5** and **Figure 6** show the receptor locations for the I-64 and I-464 northern section of the interchange, respectively for the Existing and Eight Lane Build Alternatives while **Figure 7** and **Figure 8** shows the receptor locations for the southern section of the same interchange as modeled in CAL3QHC for the Existing and Eight Lane Build Alternatives.

4.1.6 CAL3QHC Modeling Results

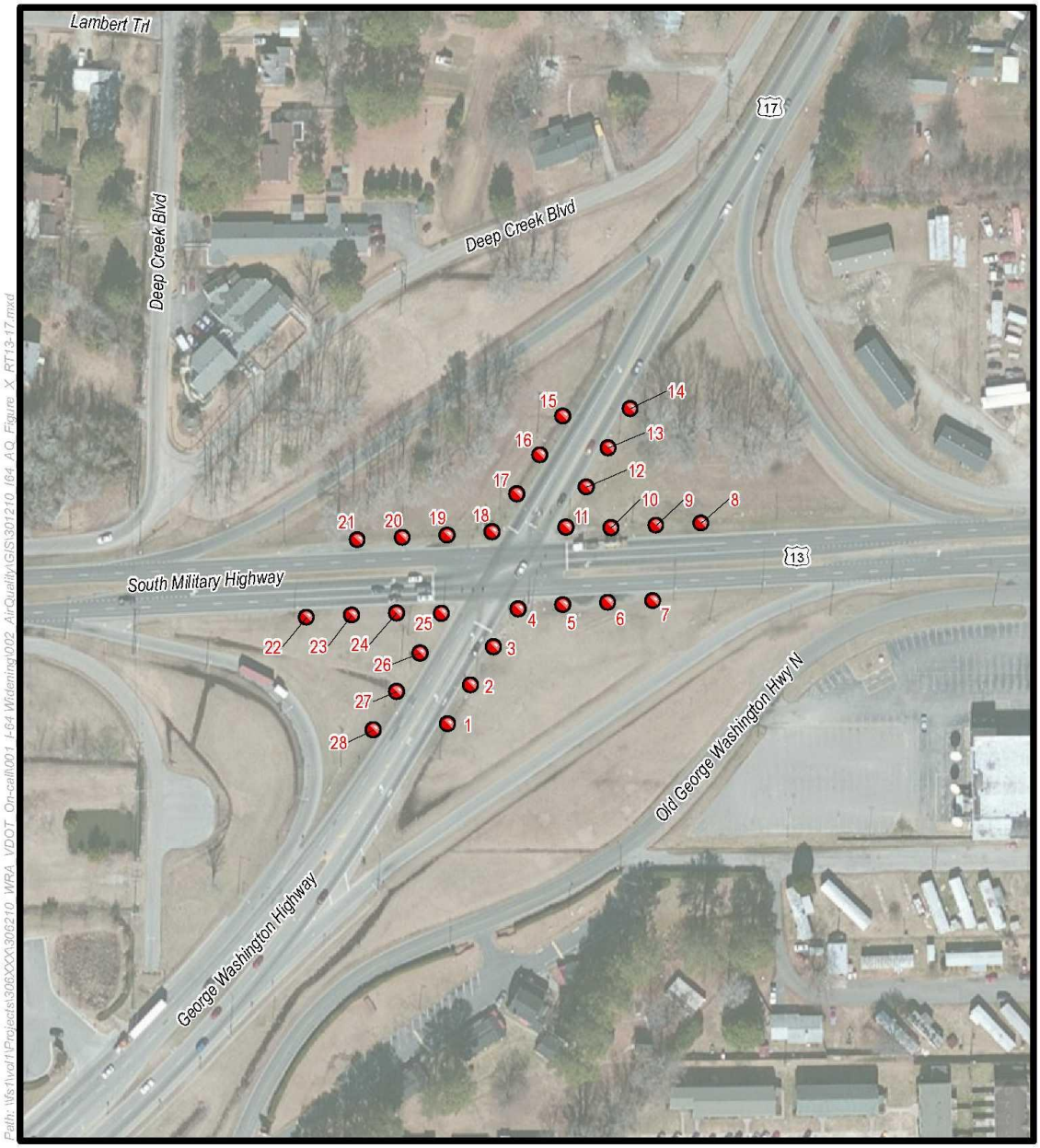
The results of the 1-hour and 8-hour CO hot-spot analysis for the worst-case intersection/interchange locations is presented in **Table 8** for the Existing, Interim and Design year Build and No Build conditions. The table includes the overall worst-case modeled concentrations for the AM and PM peak periods, and includes the modeled receptor number in parenthesis. The concentrations in **Table 8** also include the appropriate 1-hour and 8-hour background concentrations of 3.6 ppm and 2.5 ppm[12], respectively, for comparison to the CO NAAQS. Due to a limitation of 120 links allowed in the CAL3QHC model, the I-64 and I-464 interchange was divided into a northern and southern section (as shown in Figures 5 through 8); however, the same receptor locations were used for both sections of the interchange. As a conservative assumption for modeling this interchange, maximum 1-hour and 8-hour impacts from CAL3QHC were combined from the northern and southern sections, regardless of time and space for comparison to the NAAQS. The highest 1-hour predicted concentrations for the Existing, Interim and Design Build conditions were 4.7 ppm, 4.6 ppm and 4.9 ppm, respectively. The maximum 1-hour concentrations for all Existing and future Build conditions was predicted to occur at the I-64 and I-

[11] "Guidelines for Modeling Carbon Monoxide from Roadway Intersections", EPA-454/R-92-005, US EPA, 1992.
[12] Consultant Guide Air Quality Project-Level Analysis, Revision 18: VDOT Environmental Division, Air Section, May 2009, Appendix 3 Background Carbon Monoxide Values.

464 interchange (combined north and south). However, all predicted peak 1-hour CO concentrations are well below the 1-hour CO NAAQS of 35 ppm.

The peak 1-hour values generated by CAL3QHC were scaled by a persistence factor of 0.7 to generate peak 8-hour CO concentrations, and these values were then added to the appropriate background concentration for comparison to the CO NAAQS. The highest 8-hour concentrations for the Existing, Interim, and Design Build conditions were 3.3 ppm, 3.3 ppm and 3.4 ppm, respectively. Similar to the peak 1-hour concentrations, the maximum 8-hour CO concentrations was also predicted to occur at the I-64 and I-464 interchange (combined north and south) for the Existing and both future conditions. However, all predicted peak 8-hour CO concentrations are also well below the 8-hour CO NAAQS standard of 9 ppm.

These results demonstrate that the worst-case Eight Lane Build Alternative will not cause or contribute to a violation of the CO NAAQS within the study corridor, and thereby satisfies all NEPA and CAA requirements pertaining to CO. As discussed earlier, a comparison of the traffic associated with the Eight Lane Build - Managed Alternative scenarios to the Eight Lane Build Alternative showed that the Managed Lane Alternative scenarios are anticipated to have equivalent or lower traffic volumes throughout the entire project corridor, therefore peak CO concentrations for each of the Managed Lane scenarios are also anticipated to remain well-below the CO NAAQS.



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N W E S

0 150 300 Feet

Figure 2
CAL3QHC Receptor Locations: George Washington Highway & South Militia Highway for Existing and Build Conditions

HARRIS MILLER MILLER & HANSON INC.

Figure 2 CAL3QHC Receptor Locations: George Washington Highway & South Militia Highway for Existing and Eight Lane Build Conditions

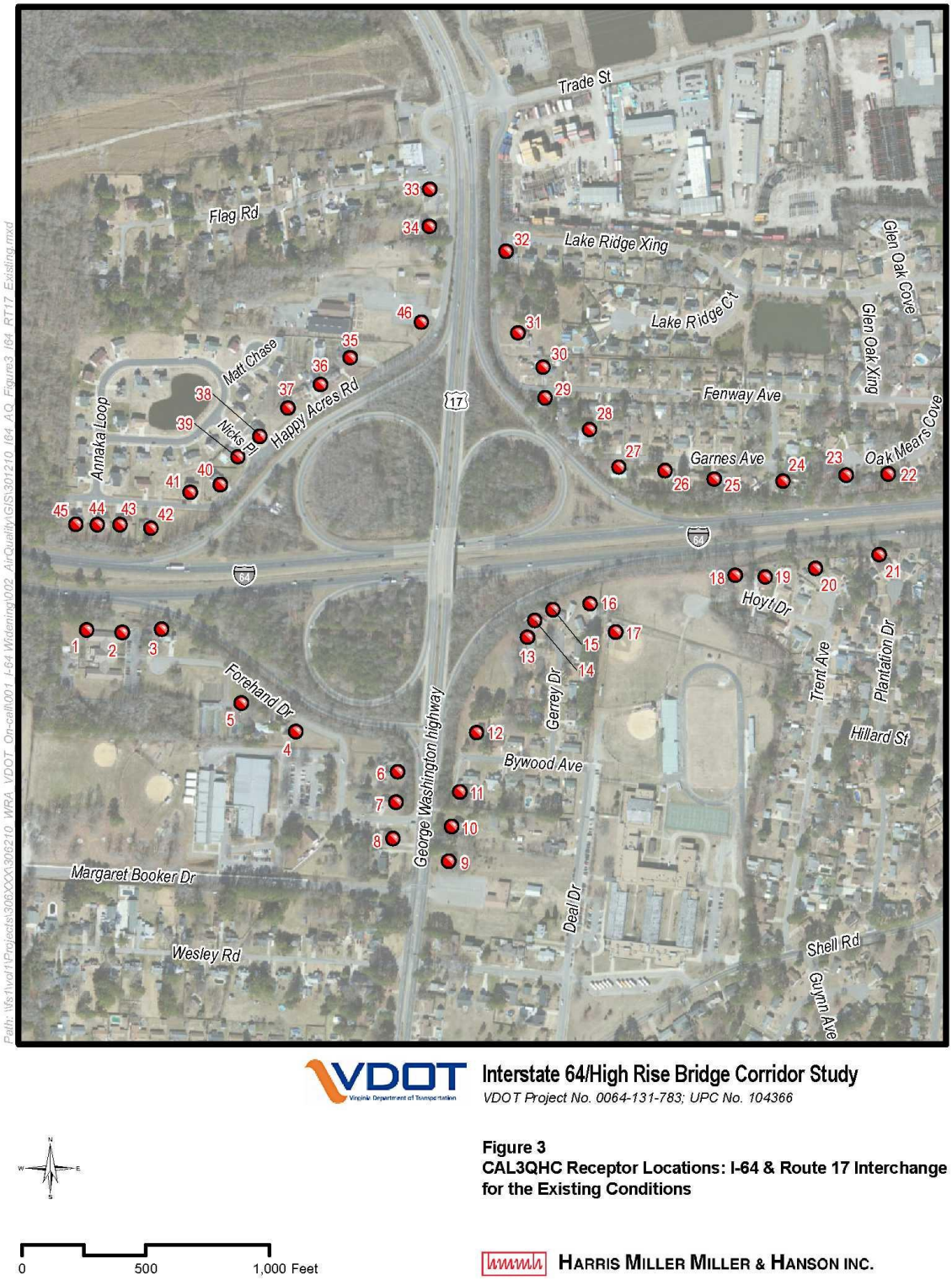

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Figure 3
CAL3QHC Receptor Locations: I-64 & Route 17 Interchange for the Existing Conditions

0 500 1,000 Feet

HARRIS MILLER MILLER & HANSON INC.

Figure 3 CAL3QHC Receptor Locations: I-64 & Route 17 Interchange for the Existing Conditions

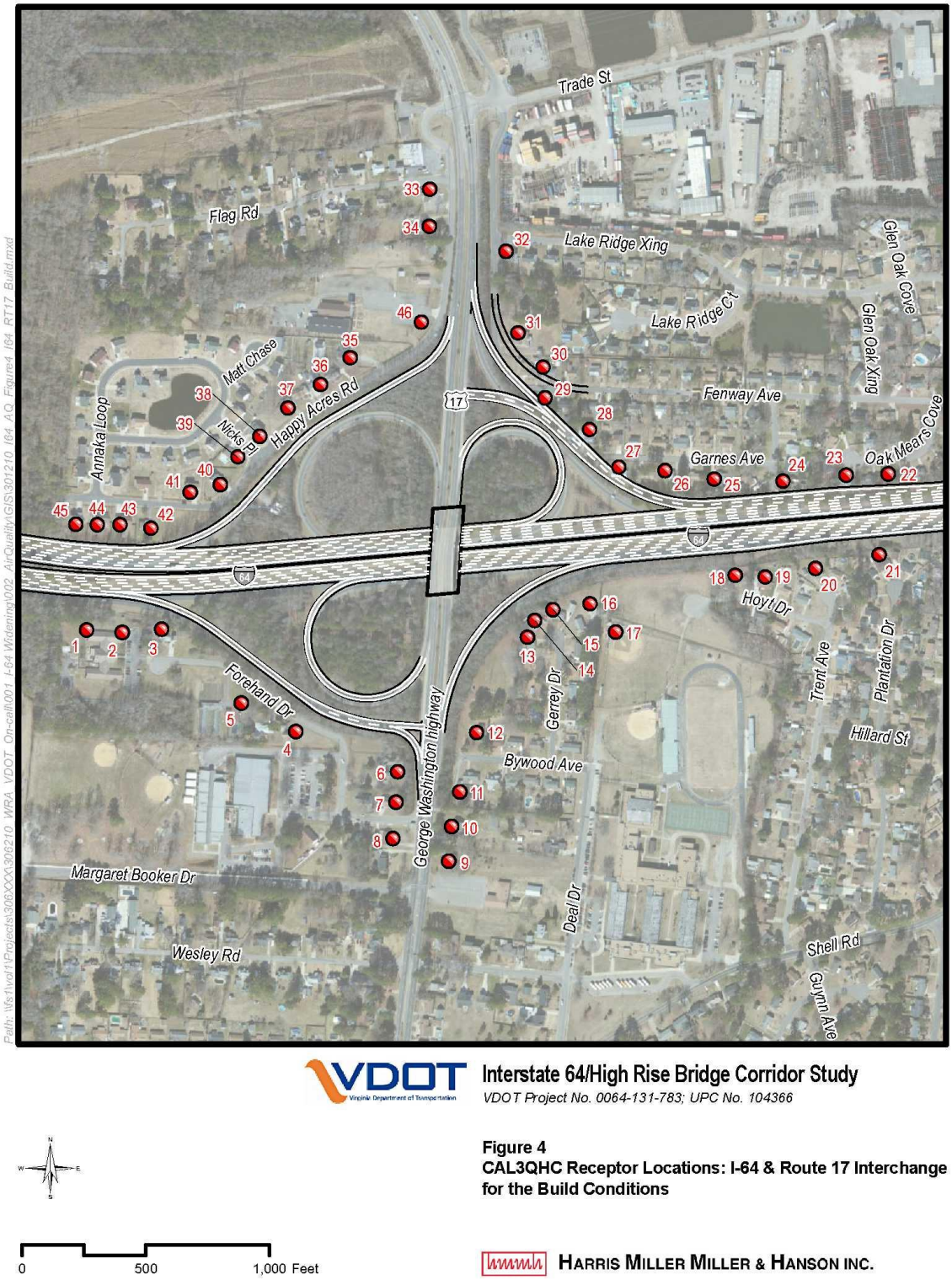

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Figure 4
CAL3QHC Receptor Locations: I-64 & Route 17 Interchange for the Build Conditions

0 500 1,000 Feet

HARRIS MILLER MILLER & HANSON INC.

Figure 4 CAL3QHC Receptor Locations: I-64 & Route 17 Interchange for the Eight Lane Build Conditions

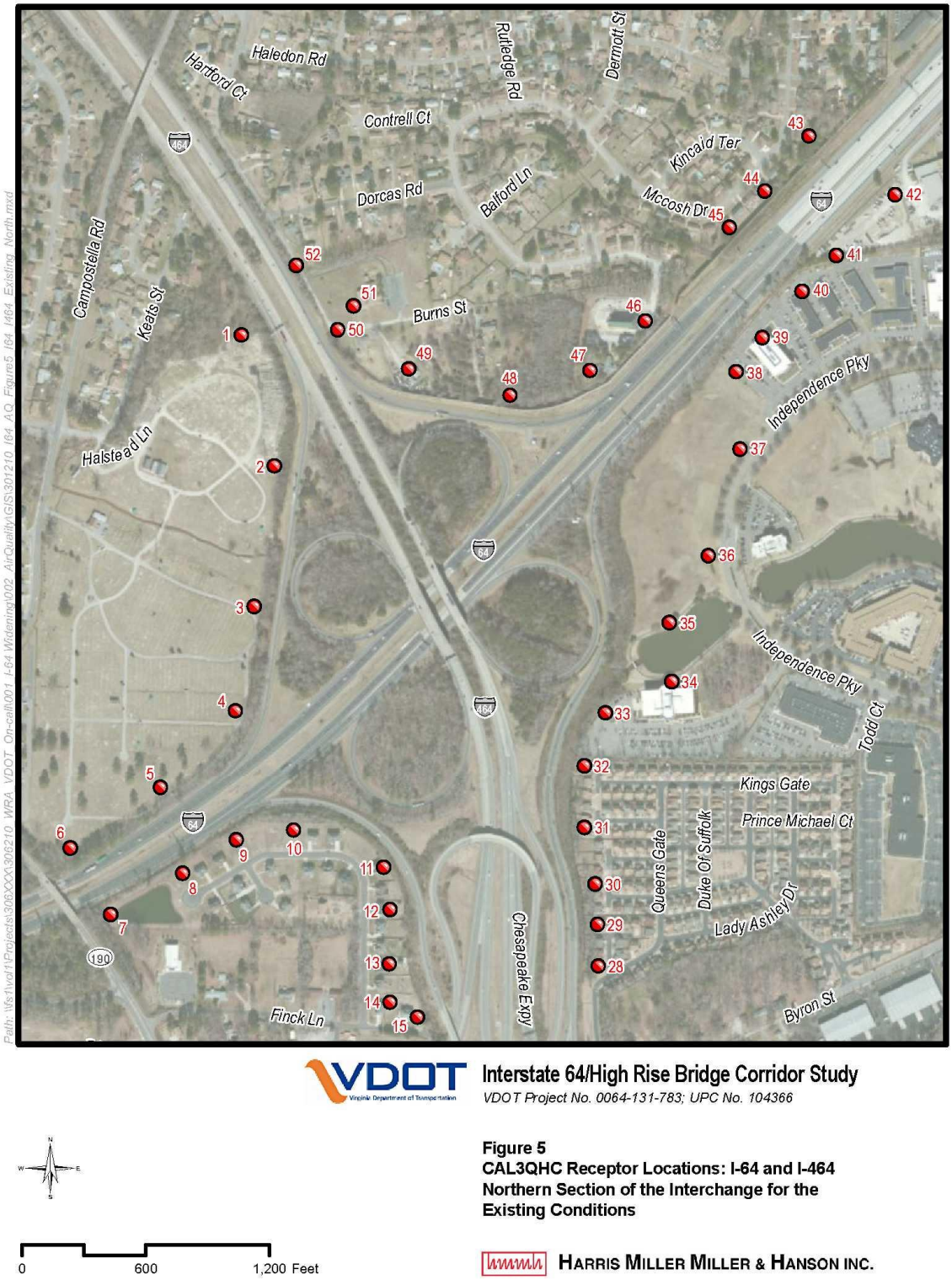

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Figure 5
CAL3QHC Receptor Locations: I-64 and I-464 Northern Section of the Interchange for the Existing Conditions

0 600 1,200 Feet

HARRIS MILLER MILLER & HANSON INC.

Figure 5 CAL3QHC Receptor Locations: I-64 and I-464 Northern Section of the Interchange for the Existing Conditions

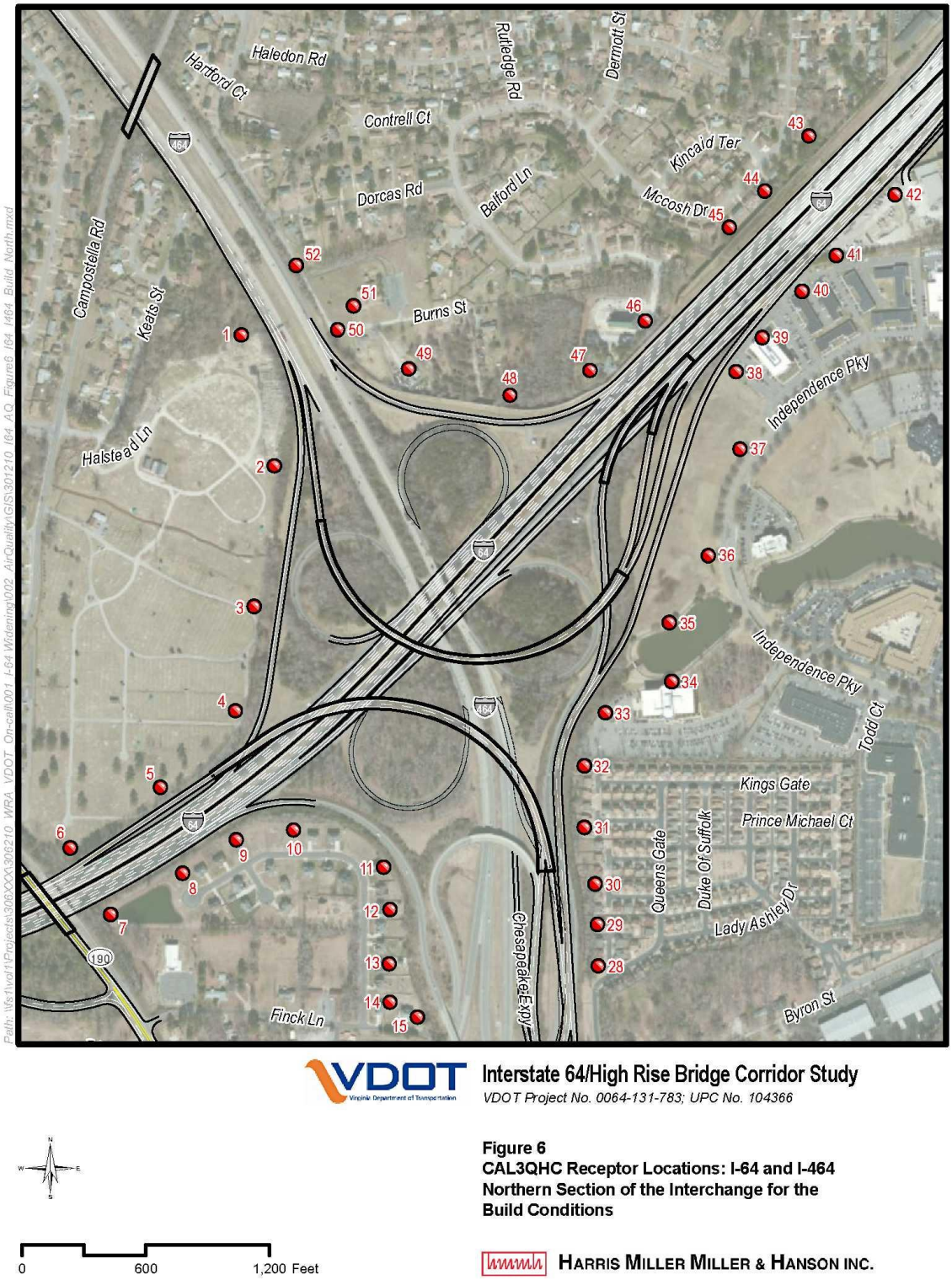

Figure 6 CAL3QHC Receptor Locations: I-64 and I-464 Northern Section of the Interchange for the Eight Lane Build Conditions

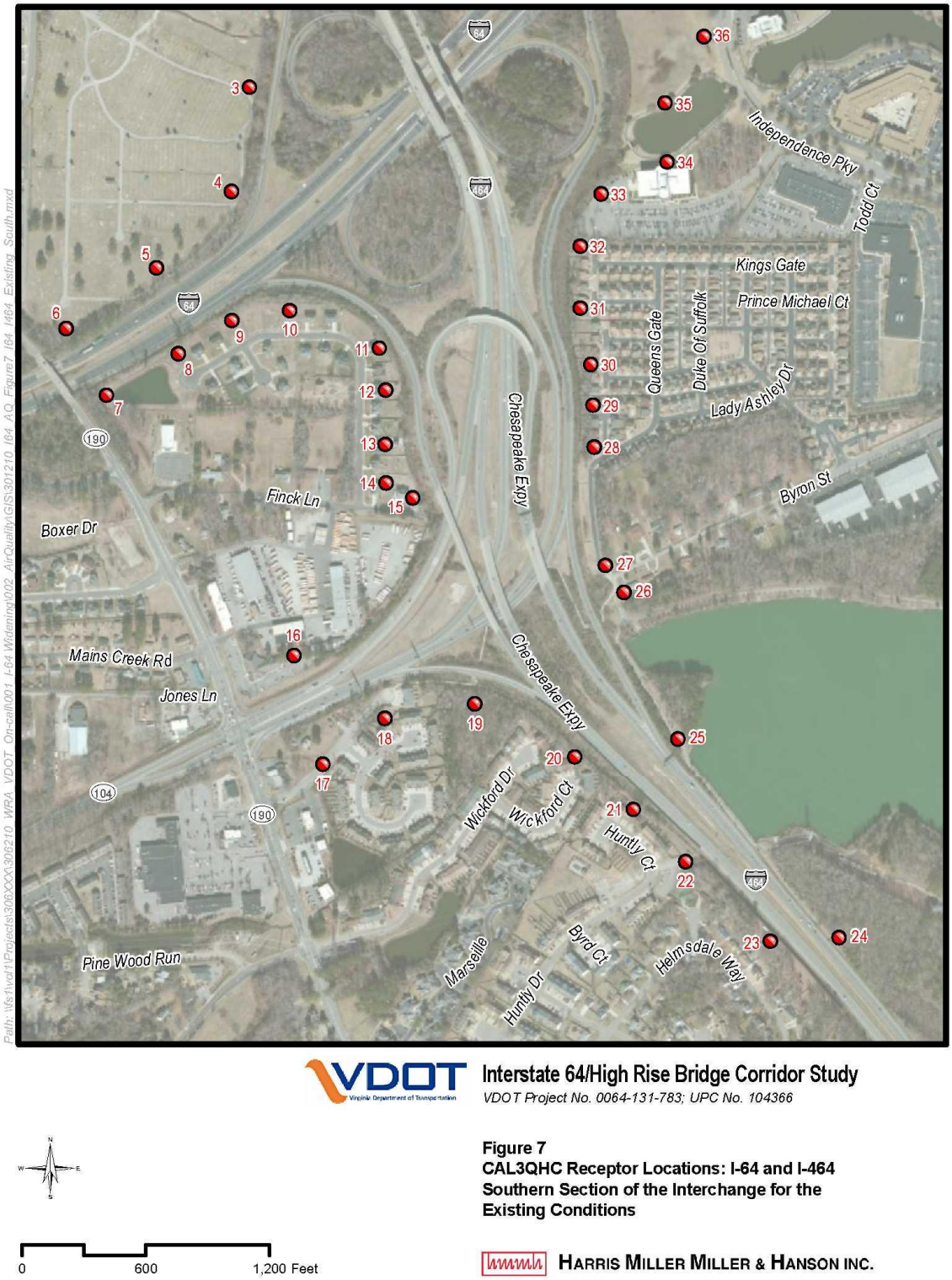

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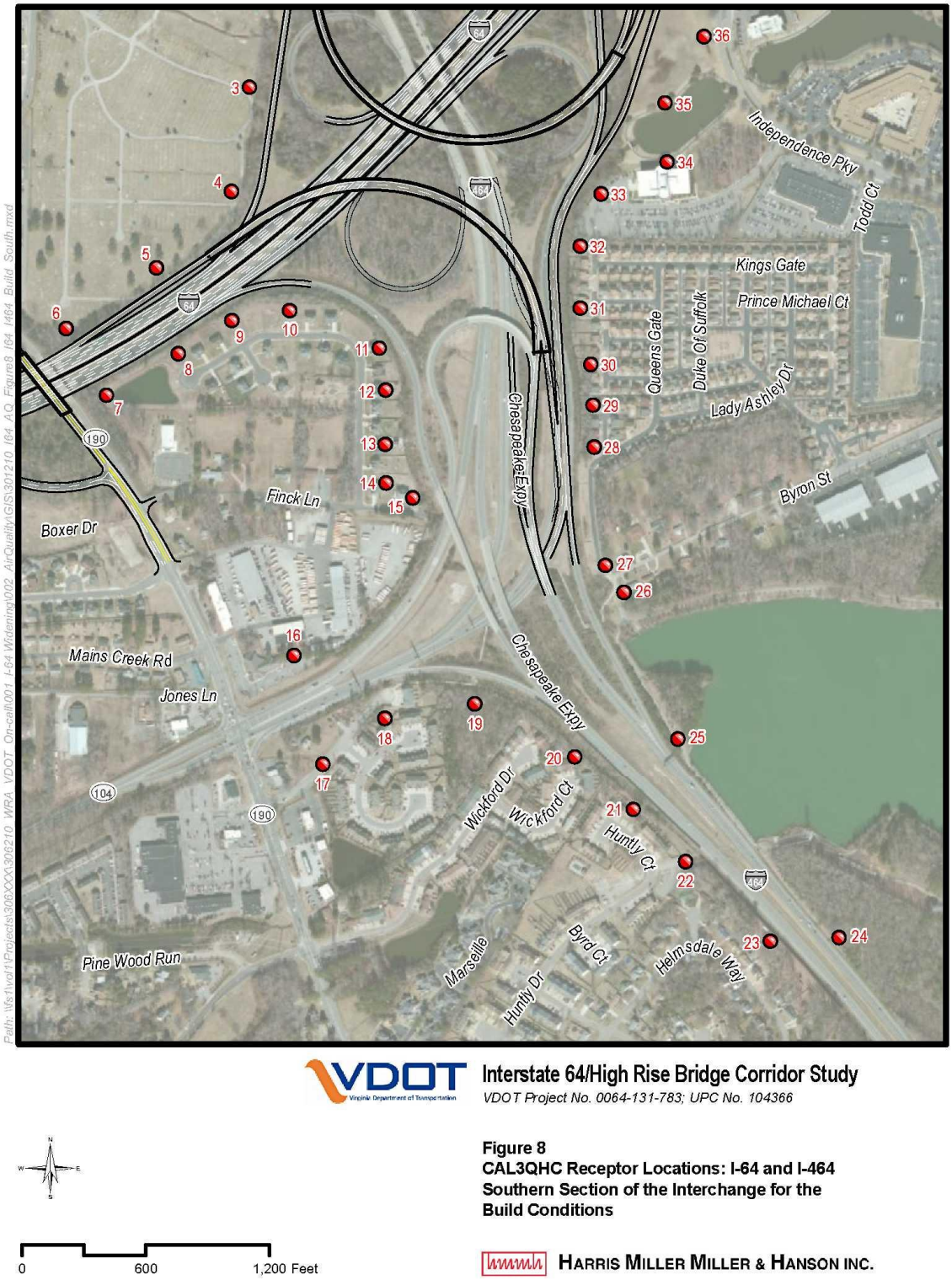
Figure 7
CAL3QHC Receptor Locations: I-64 and I-464 Southern Section of the Interchange for the Existing Conditions

HARRIS MILLER MILLER & HANSON INC.

Figure 7 CAL3QHC Receptor Locations: I-64 and I-464 Southern Section of the Interchange for the Existing Conditions



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VDOT Project No. 0064-131-783; UPC No. 104366

Figure 8
CAL3QHC Receptor Locations: I-64 and I-464 Southern Section of the Interchange for the Build Conditions

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Figure 8 CAL3QHC Receptor Locations: I-64 and I-464 Southern Section of the Interchange for the Eight Lane Build Conditions

Table 8 CAL3QHC CO Modeling Results for the Worst-Case Intersection/Interchanges

Intersection/Interchange	Averaging Period	2013[1,2]		2025[1,2]				2040[1,2]				NAAQS (ppm)
		Existing		No Build		Eight Lane Build		No Build		Eight Lane Build		
		Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	
George Washington Highway & South Militia Highway	1-hour	4.4(3)	4.5(3)	4.0(4)	4.2(18)	4.0(4)	4.2(18)	4.2(18)	4.2(4)	4.0(4)	4.2(18)	35
	8-hour	3.1(3)	3.1(3)	2.8(4)	2.9(18)	2.8(4)	2.9(18)	2.9(18)	2.9(4)	2.8(4)	2.9(18)	9
Interstate 64 and Route 17	1-hour	4.1(21)	4.2(21)	4.0(16)	4.0(21)	4.1(23)	4.2(23)	4.0(3)	4.0(3)	4.3(23)	4.3(22)	35
	8-hour	2.9(21)	2.9(21)	2.8(16)	2.8(21)	2.9(23)	2.9(23)	2.8(3)	2.8(3)	3.0(23)	3.0(22)	9
Interstate 64 and Interstate 464 (north)	1-hour	4.1(7)	4.1(9)	4.0(39)	3.9(1)	4.1(7)	4.1(39)	4.1(52)	4.0(40)	4.3(4)	4.1(5)	35
	8-hour	2.9(7)	2.9(9)	2.8(39)	2.7(1)	2.9(7)	2.9(39)	2.9(52)	2.8(40)	3.0(4)	2.9(5)	9
Interstate 64 and Interstate 464 (south)	1-hour	4.2(24)	4.2(23)	4.1(24)	4.1(23)	4.1(24)	4.1(23)	4.2(25)	4.1(23)	4.2(25)	4.1(23)	35
	8-hour	2.9(24)	2.9(23)	2.9(24)	2.9(23)	2.9(24)	2.9(23)	2.9(25)	2.9(23)	2.9(25)	2.9(23)	9
Interstate 64 and Interstate 464 (combined)[3]	1-hour	**4.7 (7,24)**	4.7 (9,23)	4.5 (39,24)	4.4 (1,23)	4.6 (7,24)	**4.6(39,23)**	4.7(52,25)	4.5 (40,23)	**4.9 (4,25)**	4.6 (5,23)	35
	8-hour	**3.3 (7,24)**	3.3 (9,23)	3.2(39,24)	3.1(1,23)	3.3(7,24)	**3.3 (39,23)**	3.3(52,25)	3.2 (40,23)	**3.4 (4,25)**	3.3 (5,23)	9

Notes:
1. Total concentration is the sum of the modeled concentration plus background concentrations.
2. Number in parenthesis represents the modeled receptor number of maximum modeled concentration from CAL3QHC. Please refer to Figures 2 through 8.
3. Peak concentrations for the I-64/I-464 interchange is represented as the sum of the maximum CAL3QHC concentrations from the northern and southern links plus monitored background regardless of space or time.

4.2 Particulate Matter

The project is located in Chesapeake which is designated by EPA as attainment for the coarse particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$) NAAQS; therefore transportation conformity requirements pertaining to particulate matter do not apply for this project. In addition, the latest 3-year (2011-2013) monitoring data reported by the VDEQ show that the 24-hour and annual $PM_{2.5}$ background concentrations in the study area are 22 micrograms per cubic meter (ug/m^3) and 8.7 ug/m^3, respectively, which are both well below the respective $PM_{2.5}$ NAAQS of 35ug/m^3 and 12 ug/m^3.

4.3 Mobile Source Air Toxics Analysis Methodology

In December of 2012, the FHWA issued an interim guidance update regarding the evaluation of MSAT in NEPA analyses and included projections utilizing the EPA MOVES emission model and updated research on air toxic emissions from mobile sources. The guidance includes three categories and criteria for analyzing MSATs in a NEPA documents:

1. No meaningful MSAT effects,
2. Low potential MSAT effects, and
3. High potential MSAT effects.

A qualitative analysis is required for projects which meet the low potential MSAT effects criteria while a quantitative analysis is required for projects meeting the high potential MSAT effects criteria.

Projects with Low Potential MSAT Effects are described as:

- *Those that serve to improve operations of highway, transit, freight without adding substantial new capacity or without creating a facility that is likely to significantly increase emissions. This category covers a broad range of project types including minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design year traffic is not projected to meet the 140,000 to 150,000 AADT criteria.*

Projects with High Potential MSAT Effects must:

- *Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location;*
- *Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000 or greater by the design year; and*
- *Proposed to be located in proximity to populated areas.*

In accordance with the MSAT guidance, the study area is best characterized as a project with "higher potential MSAT effects" since projected design year (see **Table 2**) traffic is expected to reach the 140,000 to 150,000 AADT thresholds. Specifically, the Design year Eight Lane Build Alternative is expected to have AWDT volumes on I-664 in the vicinity of I-264 reach 150,000 AWDT, and traffic volumes near the I-64 High Rise Bridge are expected to reach 142,000 AWDT. For this study, AWDT was estimated for each study alternative which is based on weekday traffic volumes and is considered conservative

compared to AADT which includes average weekday and weekend traffic volumes, which tends to result in slightly lower traffic volumes compared to AWDT. Therefore, predicted AWDT traffic is expected to be greater than the 140,000 AADT MSAT threshold. As a result, a quantitative assessment of MSAT emissions projections was conducted for the affected network consistent with FHWA guidance.

4.3.1 MSAT Background

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, when Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants (HAPs). The EPA assessed this expansive list in their 2007 rule on the Control of Hazardous Air Pollutants from Mobile Sources and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA). The seven compounds identified were:

1. acrolein;
2. benzene;
3. 1,3 butadiene;
4. diesel particulate matter;
5. formaldehyde;
6. naphthalene; and
7. polycyclic organic matter.

While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The 2007 EPA rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines.

4.3.2 Motor Vehicle Emissions Simulator (MOVES)

According to EPA, MOVES improves upon the previous MOBILE mode in several key aspects. MOVES is based on a vast amount of in-use vehicle data collected and analyzed since the latest release of MOBILE, including millions of emissions measurements from light-duty vehicles. Analysis of this data enhanced EPA's understanding of how mobile sources contribute to emission inventories and the relative effectiveness of various control strategies. In addition, MOVES accounts for the significant effects that vehicle speed and temperature have on PM emission estimates, whereas MOBILE did not. MOVES2010b includes all air toxic pollutants in NATA that are emitted by mobile sources. EPA has incorporated more recent data into MOVES2010b to update and enhance the quality of MSAT emission estimates. These data reflect advanced emission control technology and modern fuels, plus additional data for older technology vehicles.

Based on an FHWA analysis using EPA's MOVES2010b model, even if vehicle-miles traveled (VMT) increases by 102 percent as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same time period (see **Figure 9**).

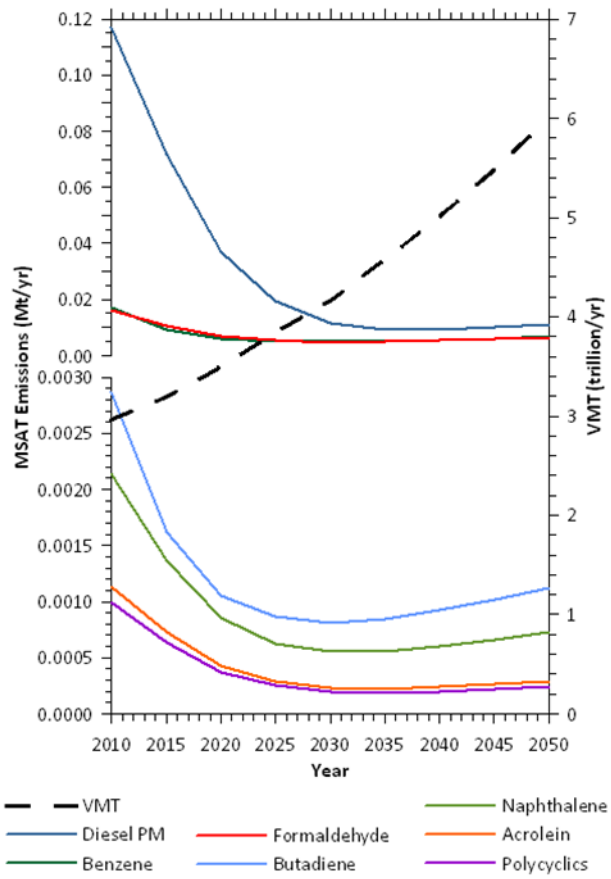


Figure 9 National MSAT Emission Trends 2010-2050 for Vehicles Operating on Roadways Using EPA's MOVES 2010b Model

Source: EPA MOVES2010b model runs conducted during May-June 2012 by FHWA.

Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.

The implications of MOVES on MSAT emissions estimates compared to MOBILE are lower estimates of total MSAT emissions, significantly lower benzene emissions, and significantly higher diesel PM emissions, especially for lower speeds. Consequently, diesel PM is projected to be the dominant component of the emissions total.

4.3.3 MSAT Research

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how potential public health risks posed by MSAT exposure should be factored into project-level decision-making within the context of NEPA.

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, we are duly expected by the public and other agencies to address MSAT impacts in our environmental documents. The FHWA, EPA, the Health Effects Institute, and others have

funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this field.

4.3.4 Project Quantitative MSAT Analysis

A quantitative MSAT analysis was conducted consistent with the latest guidance developed by FHWA. These include the Interim Guidance Update mentioned earlier, and the FHWA preliminary guidance for addressing a quantitative MSAT analysis using MOVES titled "Quick-start Guide for Using MOVES for a NEPA Analysis."

The following describes the approach and methodology used for conducting the quantitative MSAT analysis.

- The affected network for the MSAT analysis was developed using the Hampton Roads Travel Demand Forecast Model. Upon evaluation, the affected network was found to extend well-beyond the study area in order to capture changes in MSAT emissions due to changes in traffic volumes when comparing the No Build to Eight Lane Build Alternative conditions. Traffic volume changes along each link were identified geographically for the entire Hampton Roads Travel Demand Model area including locations where daily traffic volume changes (i.e. increase or decrease) of 5% or more were identified geographically. A review of the traffic links that are predicted to experience an increase or decrease of 5% or more between the No Build and Eight Lane Build Alternative conditions was identified and encompasses roadways where it would be reasonable to expect that traffic volume changes may occur as a result of improvements along the I-64 corridor within the study area. The affected network extends approximately 15 miles in the east and west directions and approximately 15 miles in the north and south directions and covers an approximately 150 square mile area. A map depicting the general location of the affected network is shown in **Figure 10** below. The affected network includes I-264 to the north and west, I-64 to the east, and Route 17 and Route 165 to the south.
- The EPA MOVES2010b model was utilized in order to obtain air toxic emissions for acrolein, benzene, 1,3-butadiene, diesel PM, formaldehyde, naphthalene and polycyclic organic matter.
- The MOVES2010b Runspec and inputs were consistent with FHWA recommendations for conducting a quantitative MSAT analysis, including evaluating all months to obtain average annual emissions for each pollutant.
- Five scenarios were evaluated; the base year, the Interim year Build and No Build conditions, and the Design year Build and No Build conditions.
- <u>Age Distribution</u> - Same for all runs, provided by VDOT/VDEQ.
- <u>Meteorology</u> - Annual meteorological data provided by VDOT/VDEQ for the Hampton Roads area.
- <u>I/M, Fuel Supply and Formulation</u> - Same for all runs, provided by VDOT/VDEQ. No I/M program in region.

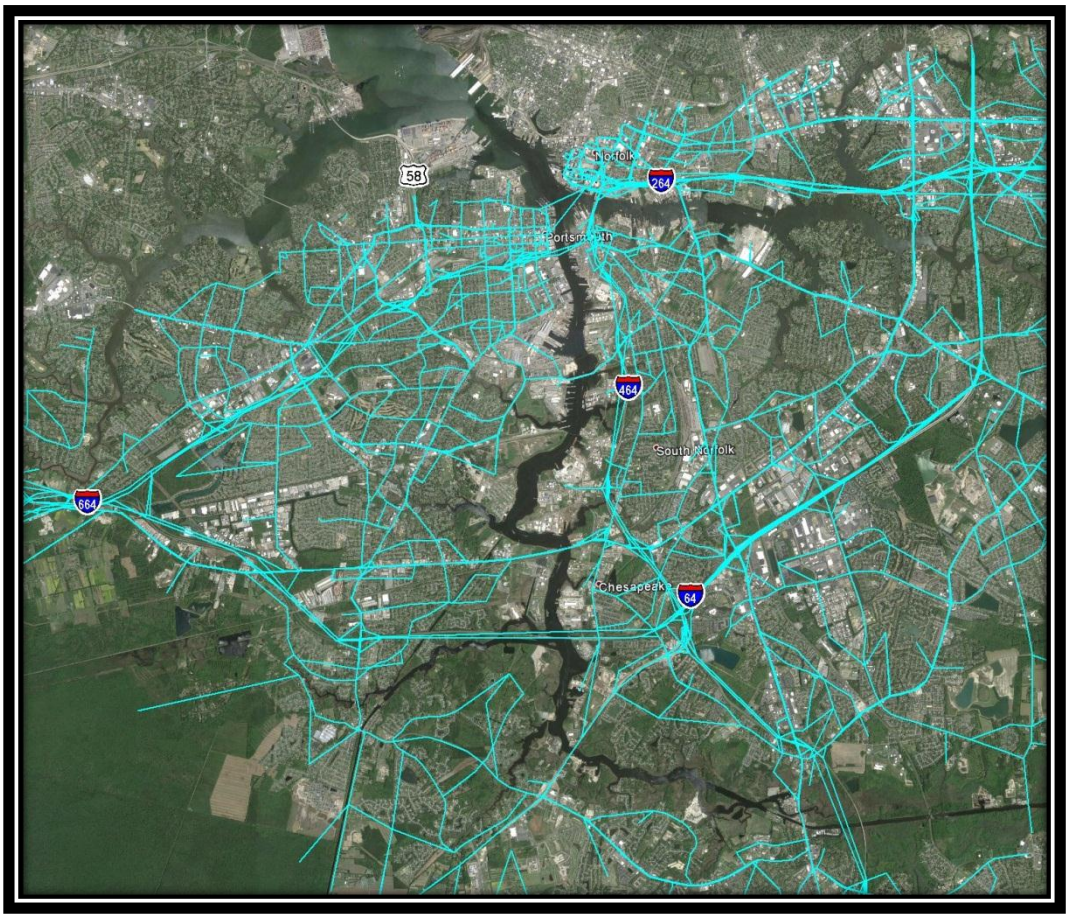


Figure 10 MSAT Affected Network

- Annual VMT - The annual VMT was calculated from the regional traffic demand model output for the No Build and Eight Lane Build Alternative, for all links in the affected network where traffic volumes change by +/- 5% as a result of the Project. The total VMT was apportioned into the six main MOVES source types for passenger cars, other 2-axle/4-axle vehicles, single unit trucks, buses, combination trucks and motorcycles. The 2012 VDOT 1236[13] report, which contains VMT by road type and source type for all Virginia jurisdictions, was used to apportion the VMT to each of the appropriate MOVES source types for the City of Chesapeake. This was done for each Alternative and condition.
- Day, Month, Hour VMT Fractions - Same for all runs, provided by VDOT. Default hourly fractions were used.
- Average Speed Distribution - Project specific for each Alternative and condition. Vehicle speed fraction was estimated from vehicle speeds contained in the regional traffic demand model output for each link included in the affected network and were apportioned using the MOVES AvgSpeedBin Table of bins (i.e., 1 through 16) for each road type.

[13] http://www.virginiadot.org/info/resources/Traffic_2012/VMTReport_1236_2012.pdf

- Road Type Distribution and Ramp Fraction - Project specific, but were the same for all runs. Road type distribution fractions were derived from the 2012 VDOT 1236[14] report for the City of Chesapeake for each MOVES road type and source type, and these were used to apportion the total link VMT to each of the appropriate MOVES source types and road types for Chesapeake. Default ramp fractions were assumed.
- Pollutant summary - Emissions from each of the MOVES runs for the Existing, Build and No Build Interim year and Build and No Build Design year were summarized for the following pollutants:

    1. acrolein;
    2. benzene;
    3. 1,3 butadiene;
    4. diesel particulate matter;
    5. formaldehyde;
    6. naphthalene; and
    7. polycyclic organic matter
- The analysis reflects only running exhaust and crankcase running exhaust, while diesel PM exhaust consists of diesel vehicles only. The polycyclic organic matter (POM) was summarized consistent with the pollutants listed in the FHWA guidance for POM.

The results of the quantitative MSAT analysis are presented in **Table 9** and show that most of the MSAT emissions are expected to increase slightly for the Eight Lane Build Alternative conditions when compared to the No Build condition. Diesel PM was an exception since it showed a slight decrease in the 2025 interim year when compared to the No Build condition. In addition, for all MSAT pollutants, emissions are expected to significantly decline in the Interim and Design years when compared to Existing conditions.

[14] http://www.virginiadot.org/info/resources/Traffic_2012/VMTReport_1236_2012.pdf

Table 9 Projected Annual MSAT Emissions in tons per year (TPY) on "Affected Network"

		Annual Vehicle Millions of Miles Traveled (AVMT)	Acrolein (TPY)	Benzene (TPY)	1,3 Butadiene (TPY)	Diesel PM (TPY)	Formaldehyde (TPY)	Naphthalene (TPY)	Polycyclic Organic Matter (TPY)
2013	Existing	3,709.19	0.70	11.59	2.44	65.68	11.16	1.47	0.62
2025 Interim Year	Build	4,104.25	0.19	4.33	0.91	10.39	3.82	0.47	0.19
	No Build	4,056.98	0.19	4.29	0.90	10.45	3.82	0.47	0.19
	Difference % (Build-No Build)	+1.16	0	+0.93	+0.66	-0.60	+0.05	+0.42	0
	Difference % (Build-Existing)	+10.65	-72.9	-62.6	-62.7	-84.19	-65.74	-67.82	-68.9
2040 Design Year	Build	4,565.23	0.15	4.46	0.93	4.52	3.47	0.43	0.16
	No Build	4,485.26	0.15	4.35	0.91	4.47	3.40	0.42	0.16
	Difference % (Build-No Build)	+1.78	+2.05	+2.53	+2.43	+1.25	+1.91	+1.90	+1.90
	Difference % (Build-Existing)	+23.10	-78.70	-61.50	-61.97	-93.12	-68.90	-70.80	-74.20

Specifically, most MSAT emissions for the Eight Lane Build Alternative condition are expected to slightly increase between 0.05 percent and 0.9 percent in the Interim Year 2025, and between 1.9 percent and 2.5 percent during the Design Year 2040 when compared to the No Build condition. Diesel PM is expected to slightly decrease 0.6 percent for the Interim Build condition when compared to the No Build condition, although in 2040 the Eight Lane Build Alternative condition is expected to result in a slight increase of 1.25 percent when compared to the No Build condition. Emissions of POM and acrolein are expected to remain the same for the Interim Eight Lane Build Alternative condition when compared to the No Build condition. The slight increase for most MSAT emissions is mainly attributed to the small increase in VMT associated with the implementation of the four additional travel lanes under the Eight Lane Build Alternative. The additional capacity attributed to the Eight Lane Build Alternative is expected to attract additional traffic from the region when compared to the No Build alternative however, with more efficient movement of vehicles, the Eight Lane Build Alternative is expected to reduce congestion and improve vehicle speeds which should help offset some of the projected increases in MSAT emissions. The small increases in MSAT emissions are not considered meaningful, especially when compared to regional MSAT emission levels. Of more significance is the Eight Lane Build Alternative conditions are

expected to result in significant reductions in all MSATs compared to the Existing condition in both the Interim and Design years. MSAT emissions for the Interim year Eight Lane Build Alternative condition are expected to decrease between 63 percent and 84 percent compared to the Existing conditions, and MSAT emission for the Design year Eight Lane Build Alternative conditions are expected to decrease between 62 percent and 93 percent compared to the Existing conditions.

Overall, the results of the MSAT analysis are consistent with the national MSAT emission trends predicted by MOVES and indicate that no meaningful increases in MSATs have been identified and are not expected to cause an adverse effect on human health as a result of the Eight Lane Build Alternative.

4.3.5 Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the CAA and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, http://www.epa.gov/iris/). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents. Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings, cancer in animals, and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling, dispersion modeling, exposure modeling, and then final determination of health impacts, with each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e. 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways to (1) determine the portion of time that people are actually exposed at a specific location; and (2) establish the extent attributable to a proposed action especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the CAA to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities, in addition to improved access for emergency response, that are better suited for a quantitative analysis.

4.3.6 MSAT Conclusions

What we know about mobile source air toxics is still evolving. Information is currently incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with each of the project Alternatives. Under each of the Build Alternatives, there may be slightly higher MSAT emissions in the design year relative to the No Build Alternative due to increased VMT. There could also be increases in MSAT levels in a few localized areas where VMT increases. However, EPA's vehicle and fuel regulations are expected to result in significantly lower MSAT levels in the future than exist today due to cleaner engine standards coupled with fleet turnover. The magnitude of

the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area will be significantly lower in the future than they are today, regardless of the preferred Alternative chosen.

5.0 CONSTRUCTION EMISSION ANALYSIS

The temporary air quality impacts from construction activities are not expected to be significant. Construction activities will be performed in accordance with VDOT's current "Road and Bridge Specifications". The specifications require compliance with all applicable local, state, and federal regulations.

This project is located within an 8-hour Ozone Attainment/Maintenance area, and a volatile organic compounds (VOC) and nitrogen oxides (NOx) Emissions Control Area. As such, all reasonable precautions should be taken to limit the emissions of VOC and NOx. In addition, the following VDEQ air pollution regulations must be adhered to during the construction of this project: 9 VAC 5-130, Open Burning restrictions; 9 VAC 5-45, Article 7, Cutback Asphalt restrictions; and 9 VAC 5-50, Article 1, Fugitive Dust precautions.

6.0 MITIGATION

Mitigation measures will be employed to minimize environmental impacts during construction activities to comply with all federal, state, and local regulations as discussed in **Section 5**.

7.0 CONCLUSIONS

Chesapeake is designated by the EPA as an attainment area for all criteria pollutants, except for the 1997 ozone standard for which the region is designated as an attainment/maintenance area. The traffic analysis conducted by the design team showed that peak AWDT levels in the study area are projected to be above the thresholds contained in the Project-Level CO Air Quality Studies Agreement for the interim and design year conditions. As such, CO impacts were analyzed at the three worst-case intersections/interchanges located in the Study area. The results of the quantitative analysis show that peak CO concentrations are expected to remain well below the CO NAAQS for all conditions.

The Project is located in EPA designated attainment area for PM_{10} and for $PM_{2.5}$; therefore, transportation conformity requirements pertaining to particulate matter do not apply for this project.

The study Alternatives were also evaluated for MSAT impacts following the latest FHWA guidance. The Eight Lane Build Alternative was identified as one with High Potential MSAT Effects; therefore, a quantitative MSAT analysis was conducted consistent with the guidance. While there may be slightly higher MSAT emissions in the design year relative to the No Build Alternative due to increased VMT, and that there could also be small increases in MSAT levels in a few localized areas where VMT increases, EPA's vehicle and fuel regulations are expected to result in significantly lower MSAT levels in the future than exist today due to cleaner engine standards coupled with fleet turnover. The quantitative MSAT analysis demonstrated that there would be no long-term adverse impacts associated with the Build

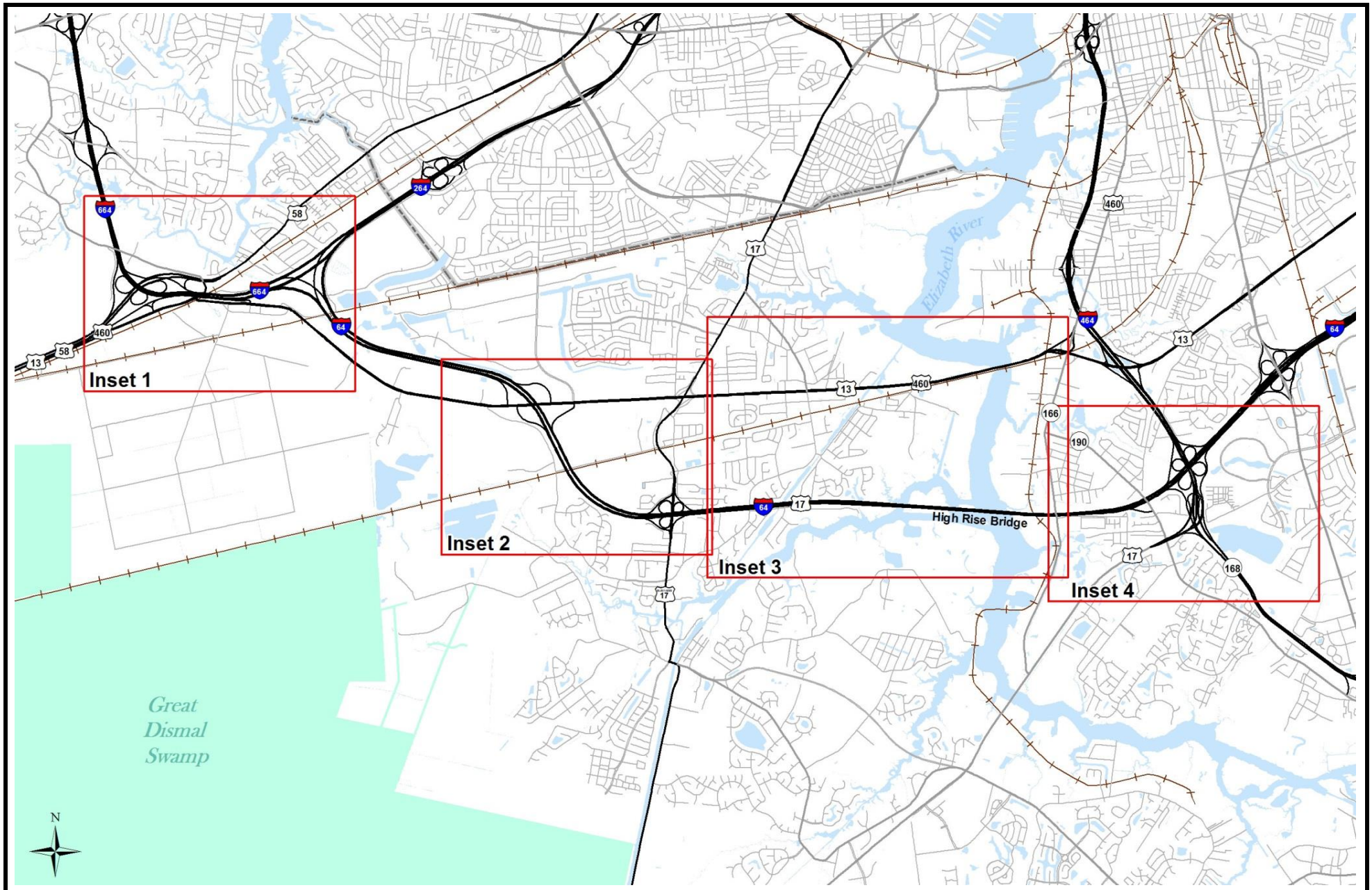
Alternatives, and that future MSAT emissions across the entire study corridor are expected to be significantly below today's levels.

The Project was added to the Hampton Roads Transportation Planning Organization fiscal year (FY) 2012-2015 transportation improvement program (TIP) and the 2034 long range transportation plan (LRTP) as a study-only project on March 21, 2013 by the HRTPO Board; and as such, did not initiate a new regional conformity demonstration. Additionally, the EPA revoked the 1997 8-hour ozone standard for transportation conformity purposes on July 20, 2013, and therefore transportation conformity requirements do not currently apply throughout the study corridor.

Lastly, construction activities will be performed in accordance with VDOT's "Road and Bridge Specifications" as well as any applicable VDEQ regulations. These specifications require compliance with all applicable federal, state, and local regulations.

In conclusion, the air quality analysis has demonstrated that the Project is not expected to cause or contribute to a new violation of any NAAQS, increase the frequency or severity of any violation, or delay timely attainment of any NAAQS.

APPENDIX A - TRAFFIC ANALYSIS (AVAILABLE UPON REQUEST)



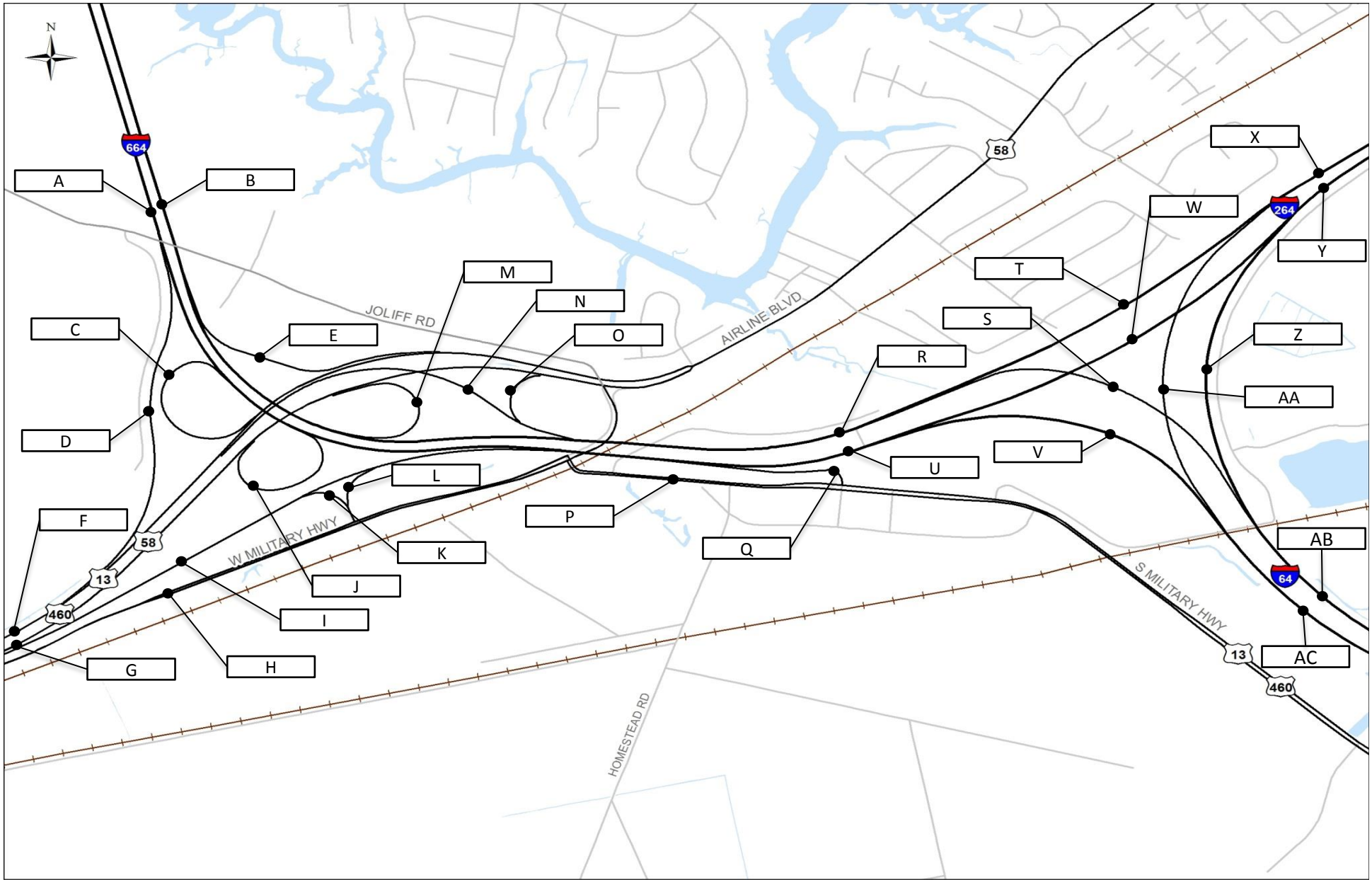
Interstate 64 / High Rise Bridge Corridor Study

Key Map

Forecasting Locations Maps

Not to Scale

May 2014



VDOT

Interstate 64 / High Rise Bridge Corridor Study

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Forecasting Locations Maps

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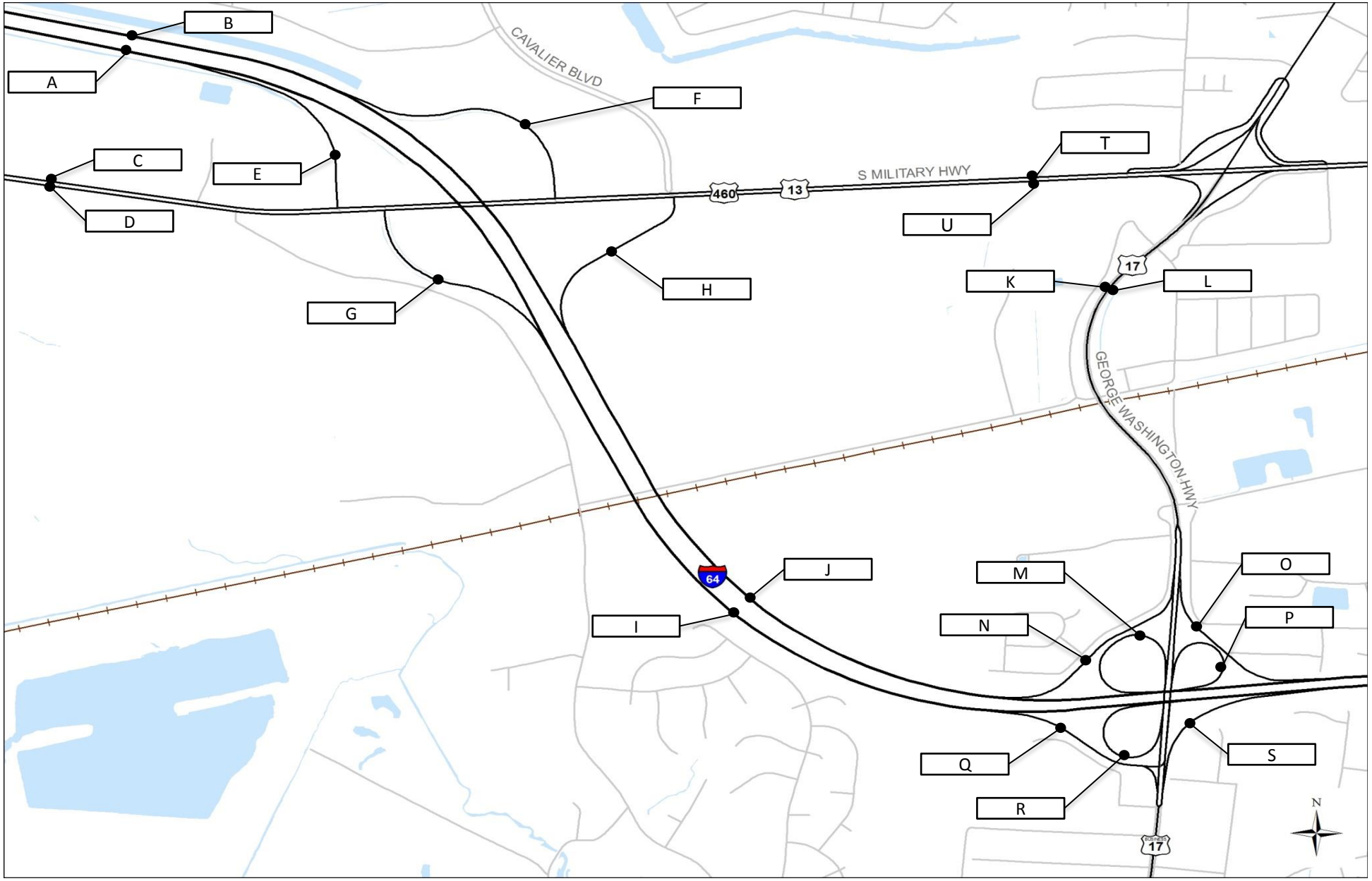

Interstate 64 / High Rise Bridge Corridor Study

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Forecasting Locations Maps

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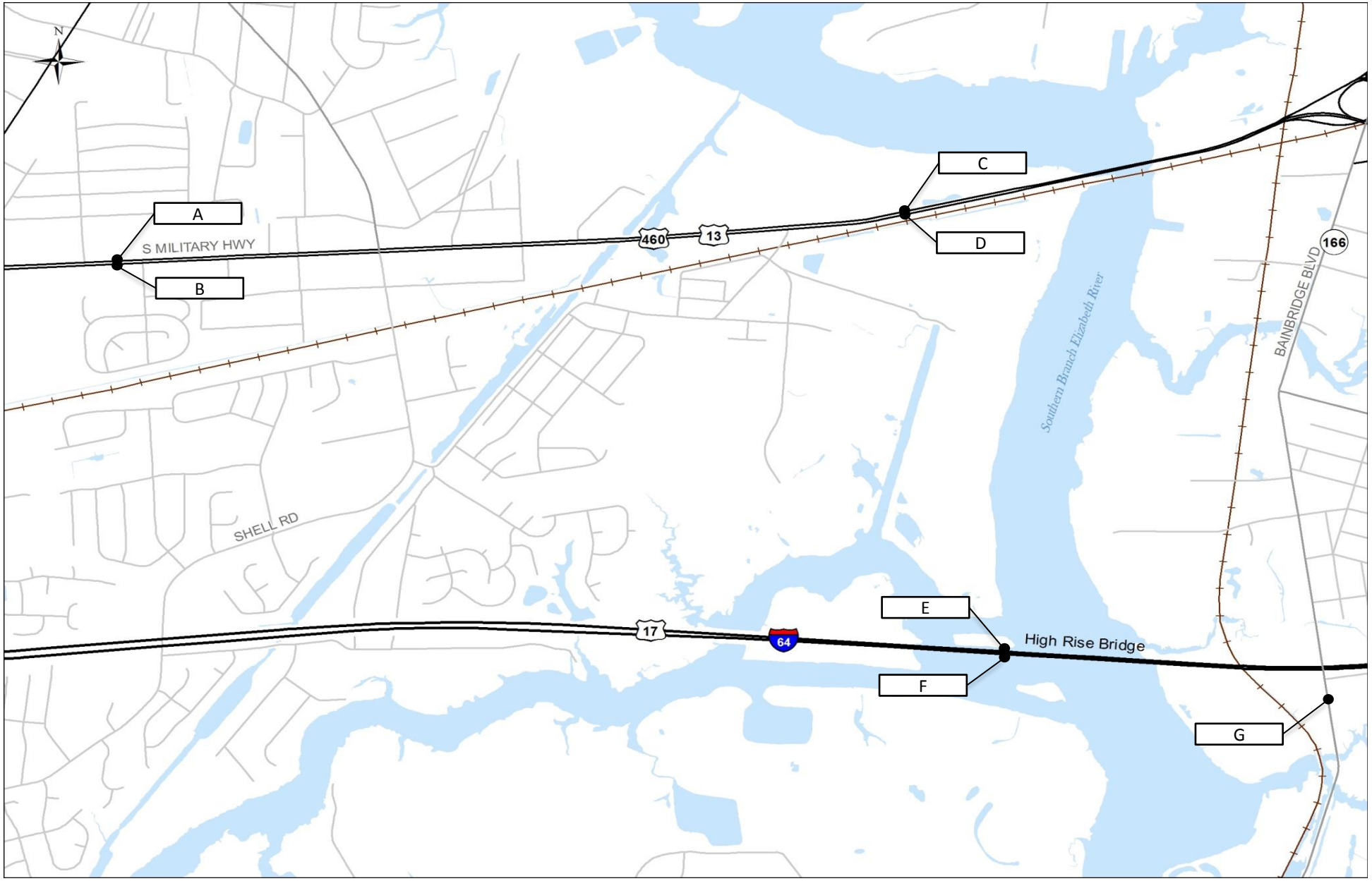

Interstate 64 / High Rise Bridge Corridor Study

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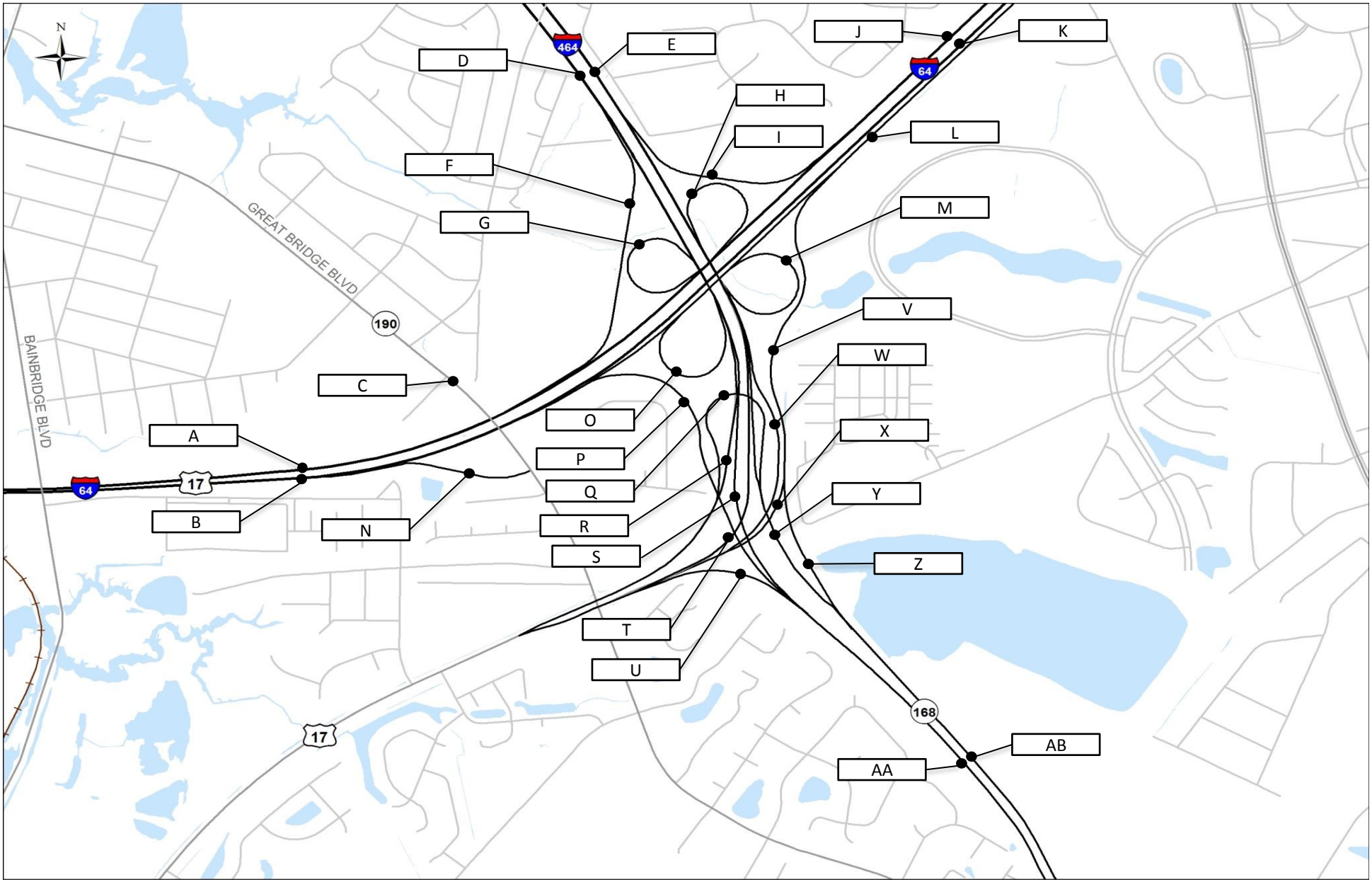

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Interstate 64 / High Rise Bridge Corridor Study

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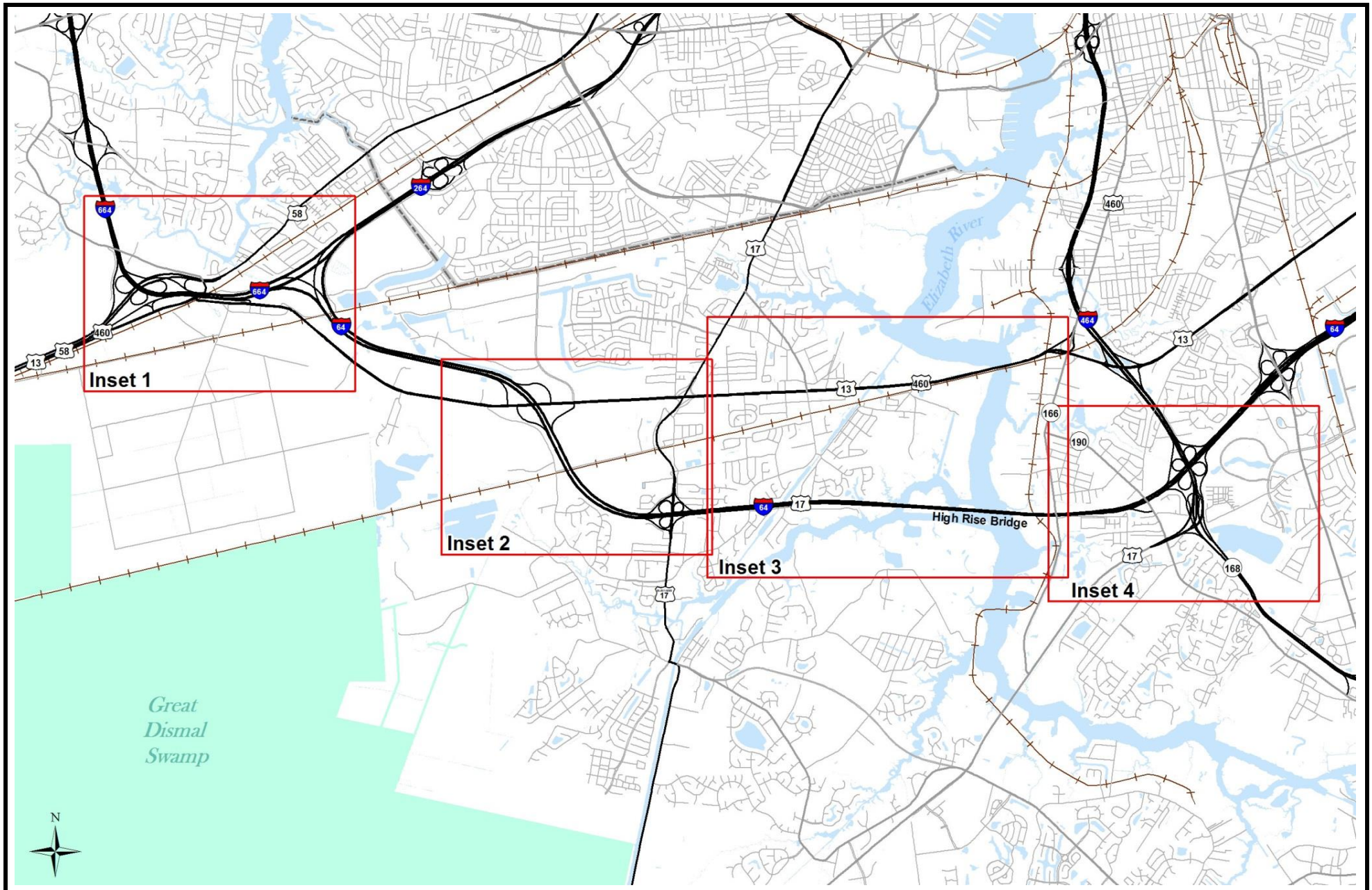


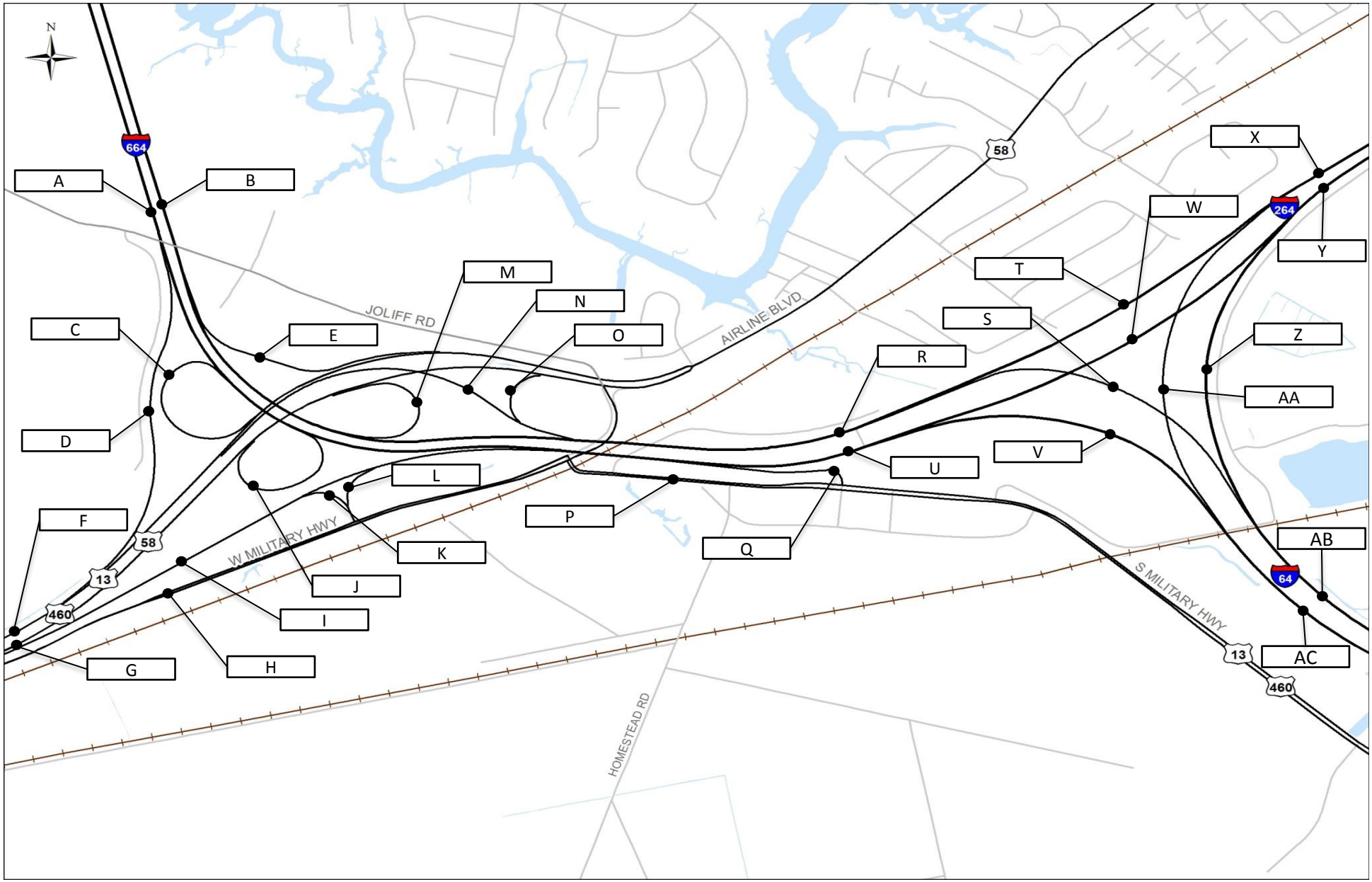
Interstate 64 / High Rise Bridge Corridor Study

Key Map

Forecasting Locations Maps - Build Alternatives

Not to Scale

June/July 2014



VDOT

Interstate 64 / High Rise Bridge Corridor Study

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Forecasting Locations Maps - Build Alternatives

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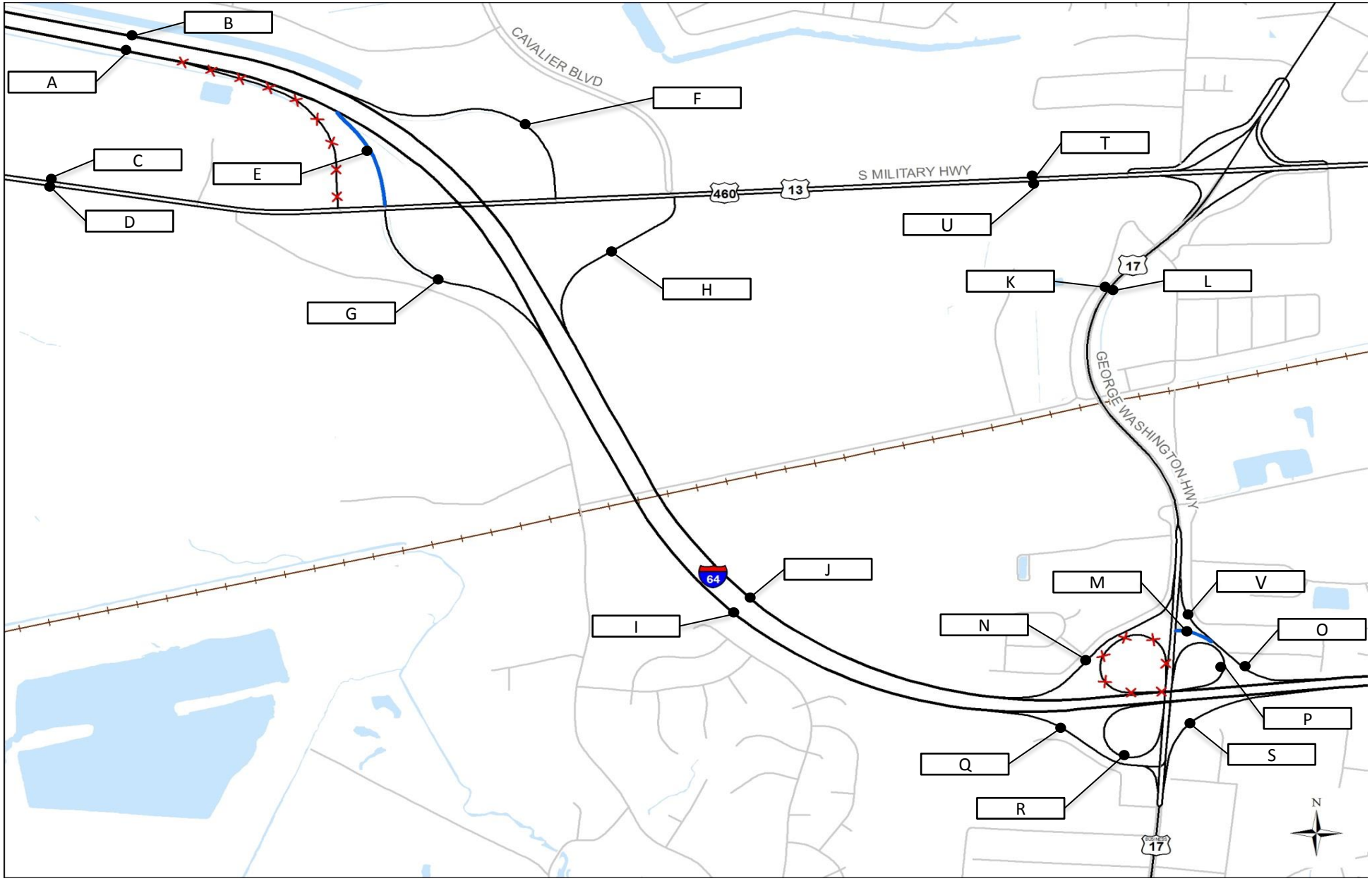
June/July 2014



VDOT

Interstate 64 / High Rise Bridge Corridor Study

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Forecasting Locations Maps - Build Alternatives

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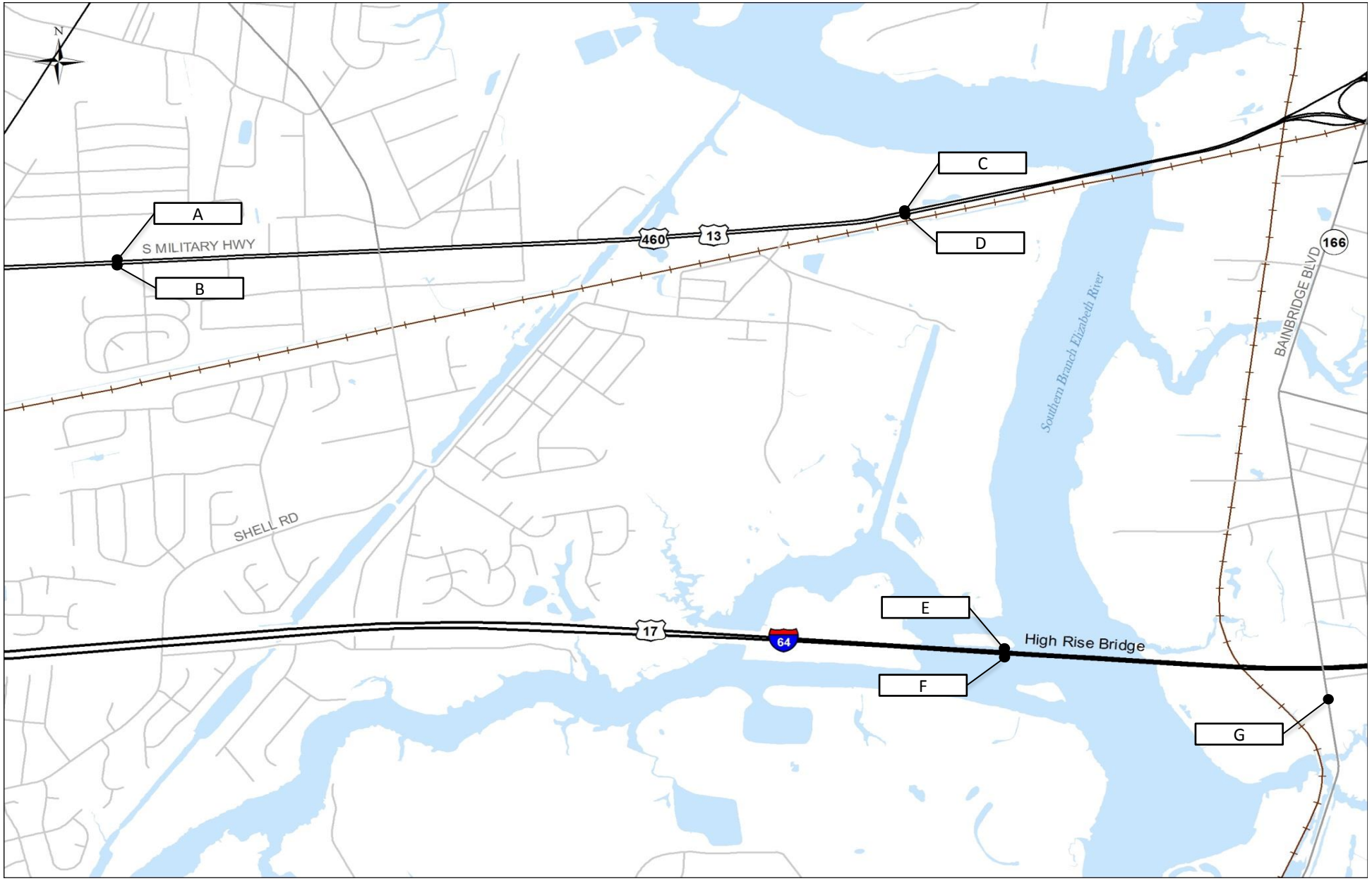

Interstate 64 / High Rise Bridge Corridor Study

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Forecasting Locations Maps - Build Alternatives

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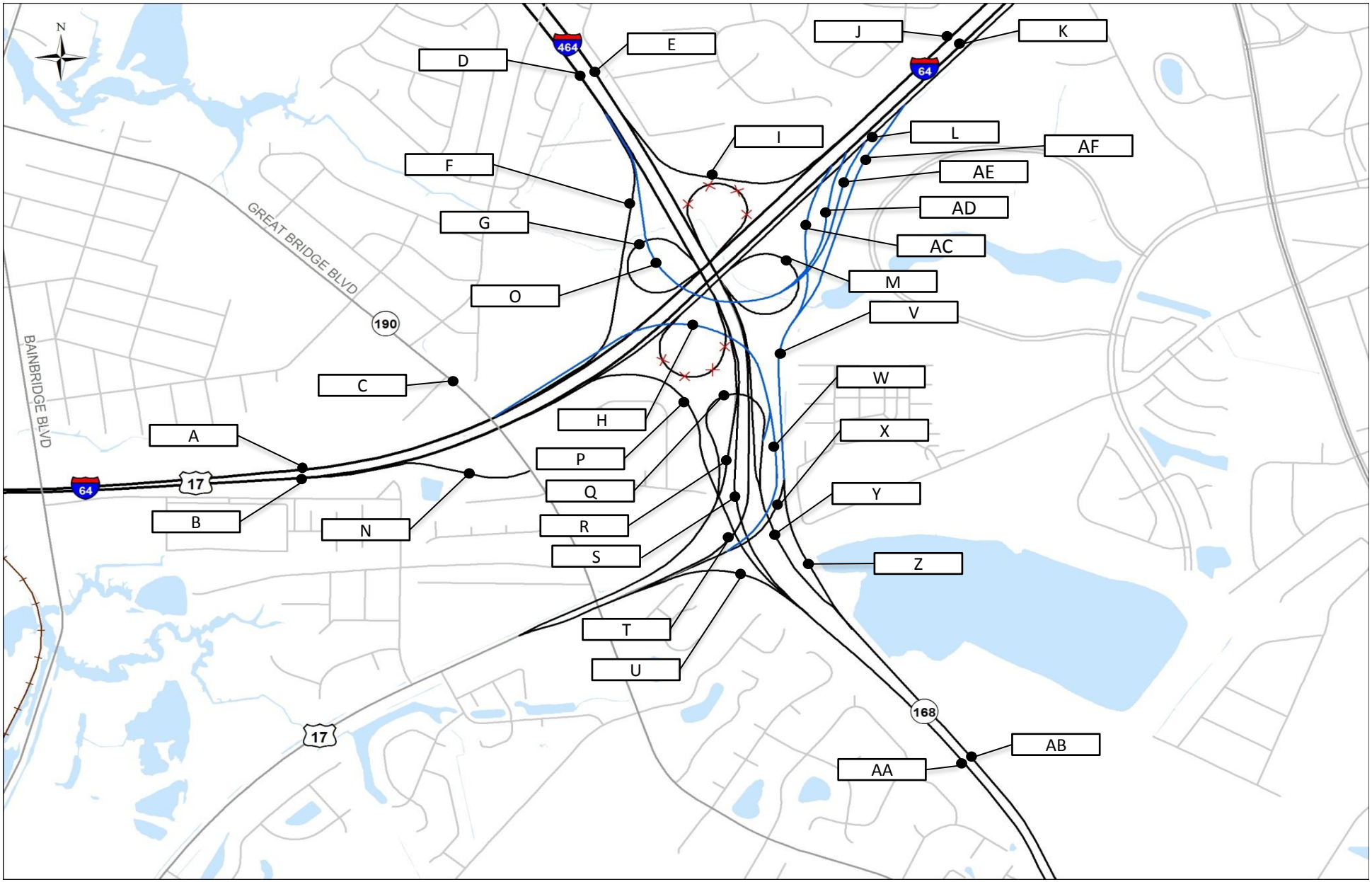
June/July 2014



Interstate 64 / High Rise Bridge Corridor Study

Inset 4

Forecasting Locations Maps - Build Alternatives

Not to Scale

June/July 2014

APPENDIX B - SAMPLE MOVES INPUT AND OUTPUT FILES (COMPLETE SET OF FILES AVAILABLE UPON REQUEST)

MOVES Run Input File I-64 and I-464 North Interchange 2025 Eight Lane Build Condition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MOVES Run Output File I-64 and I-464 North Interchange 2025 Eight Lane Build Condition

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1	**2025**	**1**	**5**	**8**	**46**	**CO**	**4.61**	**NULL**
1	**2025**	**1**	**5**	**8**	**47**	**CO**	**4.61**	**NULL**
1	**2025**	**1**	**5**	**8**	**48**	**CO**	**4.61**	**NULL**

1	2025	1	5	8	49	CO	4.61	NULL
1	2025	1	5	8	50	CO	4.61	NULL
1	2025	1	5	8	51	CO	4.61	NULL
1	2025	1	5	8	52	CO	4.607946	NULL
1	2025	1	5	8	53	CO	4.607946	NULL
1	2025	1	5	8	54	CO	4.607946	NULL
1	2025	1	5	8	55	CO	4.607946	NULL
1	2025	1	5	8	56	CO	4.607946	NULL
1	2025	1	5	8	57	CO	4.607963	NULL
1	2025	1	5	8	58	CO	4.607963	NULL
1	2025	1	5	8	59	CO	4.607963	NULL
1	2025	1	5	8	60	CO	4.607963	NULL
1	2025	1	5	8	61	CO	4.607963	NULL
1	2025	1	5	8	62	CO	2.980371	NULL
1	2025	1	5	8	63	CO	2.980371	NULL
1	2025	1	5	8	64	CO	2.980373	NULL
1	2025	1	5	8	65	CO	2.980373	NULL
1	2025	1	5	8	66	CO	2.980371	NULL
1	2025	1	5	8	67	CO	2.980371	NULL
1	2025	1	5	8	68	CO	2.980371	NULL
1	2025	1	5	8	69	CO	2.980377	NULL
1	2025	1	5	8	70	CO	5.551719	NULL
1	2025	1	5	8	71	CO	5.551719	NULL
1	2025	1	5	8	72	CO	5.551719	NULL
1	2025	1	5	8	73	CO	3.975692	NULL

1	**2025**	**1**	**5**	**8**	**74**	**CO**	**4.607957**	**NULL**
1	**2025**	**1**	**5**	**8**	**75**	**CO**	**4.607957**	**NULL**
1	**2025**	**1**	**5**	**8**	**76**	**CO**	**4.607957**	**NULL**
1	**2025**	**1**	**5**	**8**	**77**	**CO**	**4.607957**	**NULL**
1	**2025**	**1**	**5**	**8**	**78**	**CO**	**4.607957**	**NULL**
1	**2025**	**1**	**5**	**8**	**79**	**CO**	**4.607957**	**NULL**
1	**2025**	**1**	**5**	**8**	**80**	**CO**	**4.607957**	**NULL**

APPENDIX C – SAMPLE CAL3QHC INPUT AND OUTPUT FILES (COMPLETE SET OF FILES AVAILABLE UPON REQUEST)

CAL3QHC Input I-64&I-460 Interchange 2025 Eight Lane Build

```
'I-64 and I-464 Highway Interchange North',60,175,0.0,0.0,52,0.3048,1,0

'1',25697.573,6240.22614,5.9

'2',25859.0314,5604.80948,5.9

'3',25760.073,4925.12198,5.9

'4',25671.5314,4419.91364,5.9

'5',25306.948,4050.12198,5.9

'6',24869.448,3755.85114,5.9

'7',25064.7605,3432.93448,5.9

'8',25413.7189,3633.45531,5.9

'9',25674.1355,3794.91364,5.9

'10',25952.7814,3841.78864,5.9

'11',26388.5453,3661.23309,5.9

'12',26419.7953,3458.10809,5.9

'13',26416.323,3194.2192,5.9

'14',26421.5314,3008.45531,5.9

'15',26551.7397,2935.53864,5.9

'16',25975.3508,2173.38587,5.9

'17',26114.2397,1647.3442,5.9

'18',26414.5869,1867.83031,5.9

'19',26852.0869,1939.01087,5.9

'20',27336.4619,1680.33031,5.9

'21',27621.1842,1426.85809,5.9

'22',27874.6564,1175.12198,5.9

'23',28285.999,787.80716,5.9

'24',28620.0267,807.25161,5.9

'25',27836.6934,1767.66827,5.9

'26',27574.1934,2478.77939,5.9

'27',27485.999,2607.94605,5.9

'28',27430.4434,3182.94605,5.9

'29',27425.5823,3385.02939,5.9

'30',27415.1656,3581.55716,5.9

'31',27363.4107,3855.10413,5.9
```

'32',27363.0823,4153.77939,5.9

'33',27465.1656,4408.6405,5.9

'34',27785.999,4562.11272,5.9

'35',27774.8879,4848.22383,5.9

'36',27963.7767,5170.88008,5.9

'37',28118.9417,5687.37314,5.9

'38',28099.4104,6061.72209,5.9

'39',28226.3636,6226.65265,5.9

'40',28419.5059,6452.34709,5.9

'41',28584.4365,6625.9582,5.9

'42',28870.8948,6918.92695,5.9

'43',28453.1431,7204.30022,5.9

'44',28238.2993,6938.4582,5.9

'45',28065.7733,6760.50682,5.9

'46',27657.7872,6308.03286,5.9

'47',27389.775,6068.23251,5.9

'48',27002.4052,5946.70473,5.9

'49',26510.8688,6074.74293,5.9

'50',26165.8167,6265.71515,5.9

'51',26242.8566,6380.73251,5.9

'52',25963.9938,6578.21515,5.9

'2025 Build AM',98,1,0,'CO'

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'I64EB_1','AG',24904.17,3508.4,25286.12,3727.85,3080,2.95,0,68

1

'I64EB_2','AG',25286.12,3727.85,25773.62,4068.12,3080,2.95,0,68

1

'I64EB_3','AG',25773.62,4068.12,26152.78,4392.43,3080,2.95,0,68

1

'I64EB_4','AG',26152.78,4392.43,27485.42,5815.35,3080,2.95,0,68

1

'I64EB_5','AG',27485.42,5815.35,28599.31,6955.62,3080,2.95,0,68

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'I64WB_1','AG',28540.3,7006.96,27761.86,6210.94,4480,2.95,0,68

1

'I64WB_2','AG',27761.86,6210.94,26863.2,5256.32,3470,2.95,0,68

1

'I64WB_3','AG',26863.2,5256.32,26510.42,4878.54,3470,2.95,0,80

1

'I64WB_4','AG',26510.42,4878.54,26118.06,4468.82,2480,2.95,0,68

1

'I64WB_5','AG',26118.06,4468.82,25731.26,4134.79,2480,2.95,0,68

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'I64WB_6','AG',25731.26,4134.79,25461.81,3945.21,2480,2.95,0,68

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'I64WB_7','AG',25461.81,3945.21,24853.48,3576.46,2850,2.95,0,80

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'I464SB_1','AG',25753.33,6508.81,25962.97,6149.87,600,3.87,0,56

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'I464SB_2','AG',25962.97,6149.87,26555.42,5003.61,600,3.87,0,56

1

'I464SB_3','AG',26555.42,5003.61,26750.29,4608.21,2670,3.87,0,68

1

'I464SB_4','AG',26750.29,4608.21,26884.22,4204.92,2670,3.87,0,56

1

'I464SB_5','AG',26884.22,4204.92,26916.51,3958.79,2670,3.87,0,56

1

'I464NB_9','AG',26992.77,3987.04,26981.27,4272.88,2850,3.87,0,44

1

'I464NB_10','AG',26981.27,4272.88,26912.91,4527.87,2850,3.87,0,44

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'I464NB_11','AG',26912.91,4527.87,26777.64,4848.78,2850,3.87,0,56

1

'I464NB_12','AG',26777.64,4848.78,26498.56,5385.23,3470,3.87,0,44

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'I464NB_13','AG',26498.56,5385.23,26059.32,6201.21,3470,3.87,0,56

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'I464NB_14','AG',26059.32,6201.21,25864.44,6564.05,4480,3.87,0,56

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'RAMPC_1','AG',27499.31,5002.41,27635.6,5224.63,450,6.06,0,35

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'RAMPC_2','AG',27635.6,5224.63,27815.28,5903.45,450,6.06,0,35

1

'RAMPC_3','AG',27815.28,5903.45,27955.74,6130.19,450,6.06,0,35

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'RAMPB_1','AG',26804.43,4954.32,27033.18,5118.63,620,4.61,0,35

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'RAMPB_2','AG',27033.18,5118.63,27256.62,5112.38,620,4.61,0,35

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'RAMPB_3','AG',27256.62,5112.38,27407.66,4959.25,620,4.61,0,35

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'RAMPB_4','AG',27407.66,4959.25,27418.99,4772.34,620,4.61,0,35

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'RAMPB_5','AG',27418.99,4772.34,27330.05,4616.55,620,4.61,0,35

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'RAMPB_6','AG',27330.05,4616.55,27158.18,4548.84,620,4.61,0,35

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'RAMPB_7','AG',27158.18,4548.84,26959.74,4611.34,620,4.61,0,35

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'RAMPB_8','AG',26959.74,4611.34,26777.64,4848.78,620,4.61,0,35

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'RAMPA_1','AG',25887.33,6205.36,25983.17,6039.39,710,6.06,0,35

1

'RAMPA_2','AG',25983.17,6039.39,26022.75,5819.25,710,6.06,0,35

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'RAMPA_3','AG',26022.75,5819.25,26090.81,5290.09,710,6.06,0,35

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'RAMPA_4','AG',26090.81,5290.09,26169.28,5062.31,710,6.06,0,35

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'RAMPA_5','AG',26169.28,5062.31,26338.72,4855.71,710,6.06,0,35

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'RAMPA_6','AG',26338.72,4855.71,26543.58,4725.5,710,6.06,0,35

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'RAMPA_7','AG',26543.58,4725.5,26788.38,4667.34,710,6.06,0,35

1

'RAMPA_8','AG',26788.38,4667.34,27040.11,4682.1,710,6.06,0,35

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'RAMPA_9','AG',27040.11,4682.1,27245.84,4762.83,710,6.06,0,35

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'RAMPA_10','AG',27245.84,4762.83,27499.31,5002.41,710,6.06,0,44

1

'RAMPA_11','AG',27499.31,5002.41,27593.06,5249.81,260,6.06,0,35

1

'RAMPA_12','AG',27593.06,5249.81,27700.7,5829.67,260,6.06,0,35

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'RAMPA_13','AG',27700.7,5829.67,27784.04,6003.28,260,6.06,0,35

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'RAMPA_14','AG',27784.04,6003.28,27921.19,6176.89,260,6.06,0,35

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'RAMPA_15','AG',27921.19,6176.89,28644.87,6916.46,260,6.06,0,44

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'RAMPD_1','AG',26510.42,4878.54,26262.56,4758.97,990,4.61,0,35

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'RAMPD_2','AG',26262.56,4758.97,26078.19,4787.62,990,4.61,0,35

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'RAMPD_3','AG',26078.19,4787.62,25960.48,4938.66,990,4.61,0,35

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'RAMPD_4','AG',25960.48,4938.66,25978.71,5132.93,990,4.61,0,35

1

'RAMPD_5','AG',25978.71,5132.93,26126.63,5267.31,990,4.61,0,35

1

'RAMPD_6','AG',26126.63,5267.31,26327.67,5256.37,990,4.61,0,35

1

'RAMPD_7','AG',26327.67,5256.37,26555.42,5003.61,990,4.61,0,35

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'RAMPE_1','AG',27761.86,6210.94,27527.45,6016.69,1010,4.78,0,35

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'RAMPE_2','AG',27527.45,6016.69,27262.52,5853.32,1010,4.78,0,35

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'RAMPE_3','AG',27262.52,5853.32,26974.67,5811.13,1010,4.78,0,35

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'RAMPE_4','AG',26974.67,5811.13,26475.25,5892,1010,4.78,0,35

1

'RAMPE_5','AG',26475.25,5892,26245.51,6023.81,1010,4.78,0,35

1

'RAMPE_6','AG',26245.51,6023.81,26059.32,6201.21,1010,4.78,0,35

1

'RAMPF_1','AG',25724.14,6490.78,25887.33,6205.36,1080,4.78,0,35

1

'RAMPF_2','AG',25887.33,6205.36,25979,5879.67,370,4.78,0,35

1

'RAMPF_3','AG',25979,5879.67,25985.94,5579.67,370,4.78,0,35

1

'RAMPF_4','AG',25985.94,5579.67,25815.28,4445.96,370,4.78,0,35

1

'RAMPF_5','AG',25815.28,4445.96,25731.79,4223.43,370,4.78,0,35

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'RAMPF_6','AG',25731.79,4223.43,25461.81,3945.21,370,4.78,0,35

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'RAMPG_1','AG',24904.17,3508.4,25303.51,3692.9,1980,2.98,0,44

1

'RAMPG_2','AG',25303.51,3692.9,25636.03,3912.22,1980,2.98,0,44

1

'RAMPG_3','AG',25636.03,3912.22,26057.65,4227.44,1380,2.98,0,35

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'RAMPG_4','AG',26057.65,4227.44,26365.45,4511.02,1380,2.98,0,35

1

'RAMPG_5','AG',26365.45,4511.02,26804.43,4954.32,1380,2.98,0,44

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'RAMPG_6','AG',26804.43,4954.32,27175.96,5341.04,760,2.98,0,35

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'RAMPG_7','AG',27175.96,5341.04,27652.96,5829.32,760,2.98,0,35

1

'RAMPG_8','AG',27652.96,5829.32,27955.74,6130.19,760,2.98,0,35

1

'RAMPG_9','AG',27955.74,6130.19,28524.49,6699.98,1210,2.98,0,44

1

'RAMPG_10','AG',28524.49,6699.98,28688.11,6868.82,3230,2.98,0,56

1

'RAMPH_1','AG',25636.03,3912.22,25921.23,3987.64,600,5.55,0,35

1

'RAMPH_2','AG',25921.23,3987.64,26177.49,3947.8,600,5.55,0,35

1

'RAMPH_3','AG',26177.49,3947.8,26425.7,3776.99,600,5.55,0,35

1

'RAMPL_10','AG',27079.9,4019.31,26903.54,4271.89,1480,6.58,0,44

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'RAMPL_11','AG',26903.54,4271.89,26537.05,4446.99,1480,6.58,0,44

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'RAMPL_12','AG',26537.05,4446.99,26152.33,4433.8,1480,6.58,0,44

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'RAMPL_13','AG',26152.33,4433.8,25905.11,4340.05,1480,6.58,0,44

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'RAMPL_14','AG',25905.11,4340.05,24826.64,3619.91,1480,6.58,0,35

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'RAMPO_6','AG',27227.58,4074.01,27292.07,4361.21,3180,2.98,0,44

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'RAMPO_7','AG',27292.07,4361.21,27395.62,4536.96,3180,2.98,0,44

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'RAMPP_1','AG',27395.62,4536.96,27472.03,4799.08,1160,6.06,0,35

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'RAMPP_2','AG',27472.03,4799.08,27441.81,5423.51,1160,6.06,0,35

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'RAMPP_3','AG',27441.81,5423.51,27486.26,5632.7,1160,6.06,0,35

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'RAMPP_4','AG',27486.26,5632.7,27576.14,5826.28,1160,6.06,0,35

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'RAMPP_5','AG',27576.14,5826.28,27757.56,6022.03,1160,6.06,0,35

1

'RAMPP_6','AG',27757.56,6022.03,27920.51,6176.03,1160,6.06,0,35

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'RAMPR_1','AG',27395.62,4536.96,27566.68,4783.42,2020,6.06,0,35

1

'RAMPR_2','AG',27566.68,4783.42,27926.99,5917.56,2020,6.06,0,35

1

'RAMPR_3','AG',27926.99,5917.56,28099.78,6198.84,2020,6.06,0,35

1

'RAMPR_4','AG',28099.78,6198.84,28524.49,6699.98,2020,6.06,0,35

1.0,0,4,1000,0.0,'Y',5,1,72

CAL3QHC Output I-64&I-460 Interchange 2025 Eight Lane Build

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CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 95221                PAGE  1


JOB: I-64 and I-464 Highway Interchange North          RUN: 2025 Build AM


DATE : 10/16/14

TIME : 17: 8:26


  The MODE flag has been set for calculating concentrations for POLLUTANT:  CO


SITE & METEOROLOGICAL VARIABLES

------------------------------

VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM

 U =  1.0 M/S        CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0 PPM


LINK VARIABLES

--------------

  LINK DESCRIPTION     *        LINK COORDINATES (FT)         *    LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE

                     *  X1        Y1        X2        Y2     *     (FT)  (DEG)           (G/MI)  (FT) (FT)       (VEH)

------------------------*----------------------------------------*-------------------------------------------------------
```

PAGE 2

JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

DATE : 10/16/14

TIME : 17: 8:26

LINK VARIABLES

LINK DESCRIPTION	*	LINK COORDINATES (FT)				*	LENGTH	BRG	TYPE	VPH	EF	H	W	V/C	QUEUE
	*	X1	Y1	X2	Y2	*	(FT)	(DEG)		(G/MI)	(FT)	(FT)			(VEH)
1. I64EB_1	*	24904.2	3508.4	25286.1	3727.9	*	441.	60.	AG	3080.	3.0	0.0	68.0		
2. I64EB_2	*	25286.1	3727.9	25773.6	4068.1	*	595.	55.	AG	3080.	3.0	0.0	68.0		
3. I64EB_3	*	25773.6	4068.1	26152.8	4392.4	*	499.	49.	AG	3080.	3.0	0.0	68.0		
4. I64EB_4	*	26152.8	4392.4	27485.4	5815.4	*	1950.	43.	AG	3080.	3.0	0.0	68.0		
5. I64EB_5	*	27485.4	5815.4	28599.3	6955.6	*	1594.	44.	AG	3080.	3.0	0.0	68.0		
6. I64WB_1	*	28540.3	7007.0	27761.9	6210.9	*	1113.	224.	AG	4480.	3.0	0.0	68.0		
7. I64WB_2	*	27761.9	6210.9	26863.2	5256.3	*	1311.	223.	AG	3470.	3.0	0.0	68.0		
8. I64WB_3	*	26863.2	5256.3	26510.4	4878.5	*	517.	223.	AG	3470.	3.0	0.0	80.0		
9. I64WB_4	*	26510.4	4878.5	26118.1	4468.8	*	567.	224.	AG	2480.	3.0	0.0	68.0		
10. I64WB_5	*	26118.1	4468.8	25731.3	4134.8	*	511.	229.	AG	2480.	3.0	0.0	68.0		
11. I64WB_6	*	25731.3	4134.8	25461.8	3945.2	*	329.	235.	AG	2480.	3.0	0.0	68.0		
12. I64WB_7	*	25461.8	3945.2	24853.5	3576.5	*	711.	239.	AG	2850.	3.0	0.0	80.0		
13. I464SB_1	*	25753.3	6508.8	25963.0	6149.9	*	416.	150.	AG	600.	3.9	0.0	56.0		
14. I464SB_2	*	25963.0	6149.9	26555.4	5003.6	*	1290.	153.	AG	600.	3.9	0.0	56.0		
15. I464SB_3	*	26555.4	5003.6	26750.3	4608.2	*	441.	154.	AG	2670.	3.9	0.0	68.0		
16. I464SB_4	*	26750.3	4608.2	26884.2	4204.9	*	425.	162.	AG	2670.	3.9	0.0	56.0		
17. I464SB_5	*	26884.2	4204.9	26916.5	3958.8	*	248.	173.	AG	2670.	3.9	0.0	56.0		
18. I464NB_9	*	26992.8	3987.0	26981.3	4272.9	*	286.	358.	AG	2850.	3.9	0.0	44.0		
19. I464NB_10	*	26981.3	4272.9	26912.9	4527.9	*	264.	345.	AG	2850.	3.9	0.0	44.0		
20. I464NB_11	*	26912.9	4527.9	26777.6	4848.8	*	348.	337.	AG	2850.	3.9	0.0	56.0		
21. I464NB_12	*	26777.6	4848.8	26498.6	5385.2	*	605.	333.	AG	3470.	3.9	0.0	44.0		
22. I464NB_13	*	26498.6	5385.2	26059.3	6201.2	*	927.	332.	AG	3470.	3.9	0.0	56.0		
23. I464NB_14	*	26059.3	6201.2	25864.4	6564.0	*	412.	332.	AG	4480.	3.9	0.0	56.0		
24. RAMPC_1	*	27499.3	5002.4	27635.6	5224.6	*	261.	32.	AG	450.	6.1	0.0	35.0		
25. RAMPC_2	*	27635.6	5224.6	27815.3	5903.5	*	702.	15.	AG	450.	6.1	0.0	35.0		

26. RAMPC_3	*	27815.3	5903.5	27955.7	6130.2	*	267.	32.	AG	450.	6.1	0.0 35.0
27. RAMPB_1	*	26804.4	4954.3	27033.2	5118.6	*	282.	54.	AG	620.	4.6	0.0 35.0
28. RAMPB_2	*	27033.2	5118.6	27256.6	5112.4	*	224.	92.	AG	620.	4.6	0.0 35.0
29. RAMPB_3	*	27256.6	5112.4	27407.7	4959.3	*	215.	135.	AG	620.	4.6	0.0 35.0
30. RAMPB_4	*	27407.7	4959.3	27419.0	4772.3	*	187.	177.	AG	620.	4.6	0.0 35.0
31. RAMPB_5	*	27419.0	4772.3	27330.1	4616.5	*	179.	210.	AG	620.	4.6	0.0 35.0
32. RAMPB_6	*	27330.1	4616.5	27158.2	4548.8	*	185.	248.	AG	620.	4.6	0.0 35.0
33. RAMPB_7	*	27158.2	4548.8	26959.7	4611.3	*	208.	287.	AG	620.	4.6	0.0 35.0
34. RAMPB_8	*	26959.7	4611.3	26777.6	4848.8	*	299.	323.	AG	620.	4.6	0.0 35.0
35. RAMPA_1	*	25887.3	6205.4	25983.2	6039.4	*	192.	150.	AG	710.	6.1	0.0 35.0
36. RAMPA_2	*	25983.2	6039.4	26022.8	5819.2	*	224.	170.	AG	710.	6.1	0.0 35.0
37. RAMPA_3	*	26022.8	5819.2	26090.8	5290.1	*	534.	173.	AG	710.	6.1	0.0 35.0
38. RAMPA_4	*	26090.8	5290.1	26169.3	5062.3	*	241.	161.	AG	710.	6.1	0.0 35.0
39. RAMPA_5	*	26169.3	5062.3	26338.7	4855.7	*	267.	141.	AG	710.	6.1	0.0 35.0
40. RAMPA_6	*	26338.7	4855.7	26543.6	4725.5	*	243.	122.	AG	710.	6.1	0.0 35.0
41. RAMPA_7	*	26543.6	4725.5	26788.4	4667.3	*	252.	103.	AG	710.	6.1	0.0 35.0
42. RAMPA_8	*	26788.4	4667.3	27040.1	4682.1	*	252.	87.	AG	710.	6.1	0.0 35.0
43. RAMPA_9	*	27040.1	4682.1	27245.8	4762.8	*	221.	69.	AG	710.	6.1	0.0 35.0
44. RAMPA_10	*	27245.8	4762.8	27499.3	5002.4	*	349.	47.	AG	710.	6.1	0.0 44.0
45. RAMPA_11	*	27499.3	5002.4	27593.1	5249.8	*	265.	21.	AG	260.	6.1	0.0 35.0
46. RAMPA_12	*	27593.1	5249.8	27700.7	5829.7	*	590.	11.	AG	260.	6.1	0.0 35.0
47. RAMPA_13	*	27700.7	5829.7	27784.0	6003.3	*	193.	26.	AG	260.	6.1	0.0 35.0
48. RAMPA_14	*	27784.0	6003.3	27921.2	6176.9	*	221.	38.	AG	260.	6.1	0.0 35.0
49. RAMPA_15	*	27921.2	6176.9	28644.9	6916.5	*	1035.	44.	AG	260.	6.1	0.0 44.0
50. RAMPD_1	*	26510.4	4878.5	26262.6	4759.0	*	275.	244.	AG	990.	4.6	0.0 35.0
51. RAMPD_2	*	26262.6	4759.0	26078.2	4787.6	*	187.	279.	AG	990.	4.6	0.0 35.0

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LINK VARIABLES

LINK DESCRIPTION	*	LINK COORDINATES (FT)				*	LENGTH	BRG	TYPE	VPH	EF	H	W	V/C	QUEUE
	*	X1	Y1	X2	Y2	*	(FT)	(DEG)		(G/MI)	(FT)	(FT)			(VEH)
52. RAMPD_3	*	26078.2	4787.6	25960.5	4938.7	*	191.	322.	AG	990.	4.6	0.0	35.0		
53. RAMPD_4	*	25960.5	4938.7	25978.7	5132.9	*	195.	5.	AG	990.	4.6	0.0	35.0		
54. RAMPD_5	*	25978.7	5132.9	26126.6	5267.3	*	200.	48.	AG	990.	4.6	0.0	35.0		
55. RAMPD_6	*	26126.6	5267.3	26327.7	5256.4	*	201.	93.	AG	990.	4.6	0.0	35.0		
56. RAMPD_7	*	26327.7	5256.4	26555.4	5003.6	*	340.	138.	AG	990.	4.6	0.0	35.0		
57. RAMPE_1	*	27761.9	6210.9	27527.4	6016.7	*	304.	230.	AG	1010.	4.8	0.0	35.0		
58. RAMPE_2	*	27527.4	6016.7	27262.5	5853.3	*	311.	238.	AG	1010.	4.8	0.0	35.0		
59. RAMPE_3	*	27262.5	5853.3	26974.7	5811.1	*	291.	262.	AG	1010.	4.8	0.0	35.0		
60. RAMPE_4	*	26974.7	5811.1	26475.2	5892.0	*	506.	279.	AG	1010.	4.8	0.0	35.0		
61. RAMPE_5	*	26475.2	5892.0	26245.5	6023.8	*	265.	300.	AG	1010.	4.8	0.0	35.0		
62. RAMPE_6	*	26245.5	6023.8	26059.3	6201.2	*	257.	314.	AG	1010.	4.8	0.0	35.0		
63. RAMPF_1	*	25724.1	6490.8	25887.3	6205.4	*	329.	150.	AG	1080.	4.8	0.0	35.0		
64. RAMPF_2	*	25887.3	6205.4	25979.0	5879.7	*	338.	164.	AG	370.	4.8	0.0	35.0		
65. RAMPF_3	*	25979.0	5879.7	25985.9	5579.7	*	300.	179.	AG	370.	4.8	0.0	35.0		
66. RAMPF_4	*	25985.9	5579.7	25815.3	4446.0	*	1146.	189.	AG	370.	4.8	0.0	35.0		
67. RAMPF_5	*	25815.3	4446.0	25731.8	4223.4	*	238.	201.	AG	370.	4.8	0.0	35.0		
68. RAMPF_6	*	25731.8	4223.4	25461.8	3945.2	*	388.	224.	AG	370.	4.8	0.0	35.0		
69. RAMPG_1	*	24904.2	3508.4	25303.5	3692.9	*	440.	65.	AG	1980.	3.0	0.0	44.0		
70. RAMPG_2	*	25303.5	3692.9	25636.0	3912.2	*	398.	57.	AG	1980.	3.0	0.0	44.0		
71. RAMPG_3	*	25636.0	3912.2	26057.7	4227.4	*	526.	53.	AG	1380.	3.0	0.0	35.0		
72. RAMPG_4	*	26057.7	4227.4	26365.4	4511.0	*	419.	47.	AG	1380.	3.0	0.0	35.0		
73. RAMPG_5	*	26365.4	4511.0	26804.4	4954.3	*	624.	45.	AG	1380.	3.0	0.0	44.0		
74. RAMPG_6	*	26804.4	4954.3	27176.0	5341.0	*	536.	44.	AG	760.	3.0	0.0	35.0		
75. RAMPG_7	*	27176.0	5341.0	27653.0	5829.3	*	683.	44.	AG	760.	3.0	0.0	35.0		
76. RAMPG_8	*	27653.0	5829.3	27955.7	6130.2	*	427.	45.	AG	760.	3.0	0.0	35.0		

77. RAMPG_9	*	27955.7	6130.2	28524.5	6700.0	*	805.	45.	AG	1210.	3.0	0.0 44.0
78. RAMPG_10	*	28524.5	6700.0	28688.1	6868.8	*	235.	44.	AG	3230.	3.0	0.0 56.0
79. RAMPH_1	*	25636.0	3912.2	25921.2	3987.6	*	295.	75.	AG	600.	5.6	0.0 35.0
80. RAMPH_2	*	25921.2	3987.6	26177.5	3947.8	*	259.	99.	AG	600.	5.6	0.0 35.0
81. RAMPH_3	*	26177.5	3947.8	26425.7	3777.0	*	301.	125.	AG	600.	5.6	0.0 35.0
82. RAMPL_10	*	27079.9	4019.3	26903.5	4271.9	*	308.	325.	AG	1480.	6.6	0.0 44.0
83. RAMPL_11	*	26903.5	4271.9	26537.1	4447.0	*	406.	296.	AG	1480.	6.6	0.0 44.0
84. RAMPL_12	*	26537.1	4447.0	26152.3	4433.8	*	385.	268.	AG	1480.	6.6	0.0 44.0
85. RAMPL_13	*	26152.3	4433.8	25905.1	4340.0	*	264.	249.	AG	1480.	6.6	0.0 44.0
86. RAMPL_14	*	25905.1	4340.0	24826.6	3619.9	*	1297.	236.	AG	1480.	6.6	0.0 35.0
87. RAMPO_6	*	27227.6	4074.0	27292.1	4361.2	*	294.	13.	AG	3180.	3.0	0.0 44.0
88. RAMPO_7	*	27292.1	4361.2	27395.6	4537.0	*	204.	31.	AG	3180.	3.0	0.0 44.0
89. RAMPP_1	*	27395.6	4537.0	27472.0	4799.1	*	273.	16.	AG	1160.	6.1	0.0 35.0
90. RAMPP_2	*	27472.0	4799.1	27441.8	5423.5	*	625.	357.	AG	1160.	6.1	0.0 35.0
91. RAMPP_3	*	27441.8	5423.5	27486.3	5632.7	*	214.	12.	AG	1160.	6.1	0.0 35.0
92. RAMPP_4	*	27486.3	5632.7	27576.1	5826.3	*	213.	25.	AG	1160.	6.1	0.0 35.0
93. RAMPP_5	*	27576.1	5826.3	27757.6	6022.0	*	267.	43.	AG	1160.	6.1	0.0 35.0
94. RAMPP_6	*	27757.6	6022.0	27920.5	6176.0	*	224.	47.	AG	1160.	6.1	0.0 35.0
95. RAMPR_1	*	27395.6	4537.0	27566.7	4783.4	*	300.	35.	AG	2020.	6.1	0.0 35.0
96. RAMPR_2	*	27566.7	4783.4	27927.0	5917.6	*	1190.	18.	AG	2020.	6.1	0.0 35.0
97. RAMPR_3	*	27927.0	5917.6	28099.8	6198.8	*	330.	32.	AG	2020.	6.1	0.0 35.0
98. RAMPR_4	*	28099.8	6198.8	28524.5	6700.0	*	657.	40.	AG	2020.	6.1	0.0 35.0

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ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. 1	*	25697.6	6240.2	5.9	*
2. 2	*	25859.0	5604.8	5.9	*
3. 3	*	25760.1	4925.1	5.9	*
4. 4	*	25671.5	4419.9	5.9	*
5. 5	*	25306.9	4050.1	5.9	*
6. 6	*	24869.4	3755.9	5.9	*
7. 7	*	25064.8	3432.9	5.9	*
8. 8	*	25413.7	3633.5	5.9	*
9. 9	*	25674.1	3794.9	5.9	*
10. 10	*	25952.8	3841.8	5.9	*
11. 11	*	26388.5	3661.2	5.9	*
12. 12	*	26419.8	3458.1	5.9	*
13. 13	*	26416.3	3194.2	5.9	*
14. 14	*	26421.5	3008.5	5.9	*
15. 15	*	26551.7	2935.5	5.9	*
16. 16	*	25975.4	2173.4	5.9	*
17. 17	*	26114.2	1647.3	5.9	*
18. 18	*	26414.6	1867.8	5.9	*

19. 19	*	26852.1	1939.0	5.9	*
20. 20	*	27336.5	1680.3	5.9	*
21. 21	*	27621.2	1426.9	5.9	*
22. 22	*	27874.7	1175.1	5.9	*
23. 23	*	28286.0	787.8	5.9	*
24. 24	*	28620.0	807.3	5.9	*
25. 25	*	27836.7	1767.7	5.9	*
26. 26	*	27574.2	2478.8	5.9	*
27. 27	*	27486.0	2607.9	5.9	*
28. 28	*	27430.4	3182.9	5.9	*
29. 29	*	27425.6	3385.0	5.9	*
30. 30	*	27415.2	3581.6	5.9	*
31. 31	*	27363.4	3855.1	5.9	*
32. 32	*	27363.1	4153.8	5.9	*
33. 33	*	27465.2	4408.6	5.9	*
34. 34	*	27786.0	4562.1	5.9	*
35. 35	*	27774.9	4848.2	5.9	*
36. 36	*	27963.8	5170.9	5.9	*
37. 37	*	28118.9	5687.4	5.9	*
38. 38	*	28099.4	6061.7	5.9	*
39. 39	*	28226.4	6226.7	5.9	*
40. 40	*	28419.5	6452.3	5.9	*
41. 41	*	28584.4	6626.0	5.9	*
42. 42	*	28870.9	6918.9	5.9	*
43. 43	*	28453.1	7204.3	5.9	*
44. 44	*	28238.3	6938.5	5.9	*
45. 45	*	28065.8	6760.5	5.9	*

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RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
46. 46	27657.8	6308.0	5.9
47. 47	27389.8	6068.2	5.9
48. 48	27002.4	5946.7	5.9
49. 49	26510.9	6074.7	5.9
50. 50	26165.8	6265.7	5.9
51. 51	26242.9	6380.7	5.9
52. 52	25964.0	6578.2	5.9

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JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
5.	0.0	0.1	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.	0.0	0.1	0.0	0.0	0.0	0.0	0.4	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.	0.0	0.1	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20.	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30.	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.	0.2	0.1	0.0	0.0	0.0	0.0	0.5	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50.	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60.	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65.	0.2	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.	0.2	0.1	0.0	0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75.	0.1	0.1	0.0	0.1	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80.	0.1	0.1	0.0	0.1	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85.	0.1	0.1	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90.	0.1	0.1	0.0	0.1	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95.	0.1	0.1	0.0	0.2	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

100.	*	0.1	0.1	0.0	0.2	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
105.	*	0.1	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
110.	*	0.1	0.0	0.0	0.2	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
115.	*	0.1	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
120.	*	0.1	0.1	0.0	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
125.	*	0.1	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
130.	*	0.1	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
135.	*	0.1	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
140.	*	0.1	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
145.	*	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
150.	*	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
155.	*	0.0	0.0	0.0	0.2	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
160.	*	0.0	0.0	0.0	0.1	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
165.	*	0.0	0.0	0.0	0.1	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
170.	*	0.0	0.0	0.0	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
175.	*	0.0	0.0	0.0	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
180.	*	0.0	0.0	0.0	0.2	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
185.	*	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
190.	*	0.0	0.0	0.0	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
195.	*	0.0	0.0	0.0	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
200.	*	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
205.	*	0.0	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
210.	*	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

WIND * CONCENTRATION

ANGLE * (PPM)

(DEGR)* 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

41 42 43 44 45 46 47 48 49 50 51 52

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215. *	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
220. *	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
225. *	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
230. *	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
235. *	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
240. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
245. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
250. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
255. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
260. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
265. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
270. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
275. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
280. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
285. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
290. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
295. *	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
300. *	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
305. *	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
310. *	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
315. *	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
320. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
325. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
330. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
335. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

340. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
345. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
350. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
355. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
360. *	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
------*																				
MAX *	0.2	0.1	0.0	0.3	0.4	0.4	0.5	0.5	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEGR. *	25	5	5	105	90	75	35	305	20	265	5	5	5	5	5	5	5	5	5	5

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JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.0	0.2	0.4	0.4	0.5
10.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.0	0.2	0.5	0.5	0.5
15.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.1	0.4	0.5	0.3
20.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.4	0.4	0.3
25.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.4	0.3	0.2
30.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.2
35.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2
40.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
45.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
50.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

100. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
105. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
110. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
115. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
120. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
125. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
130. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
135. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
140. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
145. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
150. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
155. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
160. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
165. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
170. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
175. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
180. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
185. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
190. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
195. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
200. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
205. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
210. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1

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JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
215.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.1
220.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.3
225.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.2	0.2	0.2
230.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.3	0.3	0.2
235.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.4
240.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.4	0.3	0.4
245.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.5
250.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.5
255.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.2	0.1	0.1	0.4	0.4	0.5
260.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.5
265.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.1	0.1	0.4	0.3	0.5
270.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.5
275.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5
280.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.4	0.5
285.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5
290.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.5
295.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4
300.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5
305.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5
310.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.5
315.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.4	0.4	0.5
320.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.4	0.4	0.5
325.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5
330.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.4	0.4	0.5
335.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.4	0.4	0.5
340.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.4	0.4	0.5
345.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.4	0.4	0.5

```
350. *  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.1  0.1  0.2  0.1  0.1  0.1  0.2  0.4  0.4  0.5
355. *  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.1  0.2  0.1  0.1  0.1  0.2  0.5  0.4  0.5
360. *  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.1  0.3  0.1  0.1  0.0  0.1  0.4  0.4  0.5
------*-------------------------------------------------------------------------------------------------------
MAX  *  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.2  0.3  0.3  0.1  0.2  0.1  0.2  0.5  0.5  0.5
DEGR. *  5    5    5    5    5    5    5    5    5    5  305  260  360    5  255  230    5   10   10    5
```

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JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 41	42	43	44	45	46	47	48	49	50	51	52
5.	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
50.	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
55.	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0
60.	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0
65.	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.2	0.0	0.0	0.0	0.0
70.	0.0	0.0	0.0	0.1	0.1	0.4	0.3	0.1	0.0	0.0	0.0	0.0
75.	0.0	0.0	0.0	0.1	0.3	0.4	0.3	0.2	0.0	0.0	0.0	0.0
80.	0.0	0.0	0.0	0.1	0.3	0.4	0.3	0.2	0.0	0.0	0.0	0.0
85.	0.0	0.0	0.0	0.1	0.3	0.4	0.3	0.2	0.0	0.0	0.0	0.0
90.	0.0	0.0	0.0	0.1	0.3	0.4	0.3	0.1	0.0	0.0	0.0	0.0
95.	0.0	0.0	0.0	0.2	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0

100.	*	0.0	0.0	0.0	0.2	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0
105.	*	0.0	0.0	0.0	0.2	0.2	0.3	0.2	0.1	0.0	0.0	0.0	0.0
110.	*	0.0	0.0	0.0	0.2	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0
115.	*	0.0	0.0	0.0	0.2	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0
120.	*	0.0	0.0	0.0	0.2	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0
125.	*	0.0	0.0	0.0	0.2	0.3	0.3	0.2	0.2	0.0	0.0	0.0	0.0
130.	*	0.0	0.0	0.0	0.2	0.3	0.4	0.3	0.2	0.0	0.0	0.0	0.0
135.	*	0.0	0.0	0.0	0.2	0.3	0.3	0.4	0.3	0.0	0.0	0.0	0.0
140.	*	0.0	0.0	0.0	0.3	0.3	0.3	0.4	0.3	0.0	0.0	0.0	0.0
145.	*	0.0	0.0	0.0	0.3	0.3	0.2	0.4	0.2	0.0	0.0	0.0	0.1
150.	*	0.0	0.0	0.0	0.3	0.3	0.2	0.4	0.3	0.0	0.1	0.0	0.1
155.	*	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.1	0.0	0.2
160.	*	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.0	0.1	0.0	0.2
165.	*	0.0	0.0	0.2	0.3	0.3	0.4	0.3	0.3	0.0	0.2	0.1	0.3
170.	*	0.0	0.0	0.2	0.4	0.3	0.4	0.3	0.2	0.0	0.2	0.1	0.3
175.	*	0.0	0.0	0.2	0.4	0.3	0.4	0.3	0.2	0.1	0.3	0.1	0.4
180.	*	0.0	0.0	0.3	0.4	0.3	0.4	0.3	0.2	0.0	0.3	0.1	0.3
185.	*	0.0	0.0	0.3	0.4	0.3	0.3	0.3	0.2	0.1	0.3	0.1	0.3
190.	*	0.0	0.0	0.3	0.3	0.4	0.2	0.3	0.1	0.1	0.3	0.1	0.3
195.	*	0.0	0.0	0.4	0.3	0.4	0.3	0.3	0.1	0.1	0.3	0.1	0.3
200.	*	0.0	0.0	0.3	0.3	0.2	0.4	0.3	0.1	0.1	0.3	0.1	0.3
205.	*	0.0	0.0	0.2	0.3	0.3	0.3	0.2	0.0	0.1	0.3	0.1	0.3
210.	*	0.0	0.0	0.2	0.2	0.3	0.2	0.2	0.0	0.1	0.3	0.1	0.3

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JOB: I-64 and I-464 Highway Interchange North RUN: 2025 Build AM

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 41	42	43	44	45	46	47	48	49	50	51	52
215.	0.0	0.0	0.2	0.3	0.2	0.2	0.2	0.0	0.1	0.3	0.1	0.3
220.	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.3	0.1	0.3
225.	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.3
230.	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.3
235.	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.3
240.	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.3
245.	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.3	0.1	0.2
250.	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.1	0.2
255.	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.1	0.2
260.	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.2
265.	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1
270.	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1
275.	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1
280.	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0
285.	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0
290.	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0
295.	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0
300.	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0
305.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0
310.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0
315.	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
320.	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
325.	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
330.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
335.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
340.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
345.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

```
350. *  0.3  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0

355. *  0.3  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0

360. *  0.3  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0

------*-------------------------------------------------------------------------

MAX  *  0.5  0.4  0.4  0.4  0.4  0.4  0.4  0.3  0.1  0.3  0.2  0.4

DEGR. * 240  235  195  170  190   70  135  135  175  175  225  175


THE HIGHEST CONCENTRATION OF    0.50 PPM OCCURRED AT RECEPTOR  (   .
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