Technical Proposal

Progressive Design-Build (PDB) IS 270 – Innovative Congestion Management Contract

Montgomery and Frederick Counties

Contract No. MO0695172

FAP No. N/A

January 19, 2017

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

Submitted by:

Concrete General, Inc. *in association with* RK&K, ch2m, Bruce & Merrilees

World Class Solutions with Local Leadership

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Submitted to:

State Highway Administration

Maryland Department of Transportation

Section 2

INTERSTATE 270

Mobility

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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2 Mobility

2.1 Proposed Improvement

The CGI Team understands that travelers face significant mobility challenges along I-270, but our proposed best-value solution will address these challenges. Our approach will provide SHA with substantial corridor-wide traffic benefits by maximizing SHA's available $100M project budget. We are proposing a two-pronged approach of **roadway improvements** and **innovative technologies and techniques** in order to **maximize vehicular throughput**, **minimize vehicle travel times**, and **create a more predictable commuter trip** along I-270. While the components address both recurring and non-recurring congestion, the roadway improvements focus on relieving today's recurring congestion, and the innovative technologies and techniques focus on managing today's recurring and non-recurring congestion and extending the lifespan of the roadway improvements into the future.

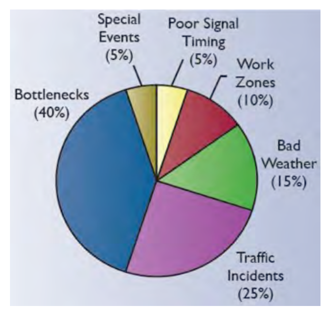
> **The CGI Team's Improvements will:**
> - Reduce SB peak travel time by 30 minutes; reduce delay 43%; increase speeds 23%
> - Reduce NB peak delay 8%
> - Increase SB vehicle throughout 3% during the AM and NB 1% during the PM
> - Improve trip reliability by 9%
> - Combined benefit/cost ratio is nearly 20:1

- 14 **roadway improvements** will increase capacity and vehicle throughput and address safety deficiencies by strategically eliminating existing bottlenecks, the key element limiting vehicular throughput along the corridor, coupled with the impact of crashes and other incidents. Our approach is further based on a "right-sized", practical design approach focused on minimizing impacts to maximize the improvements that can be provided throughout the corridor.
- Innovative technologies and techniques, comprised of **adaptive ramp metering**, **active traffic management** (ATM), and **virtual weigh stations**, will reduce congestion by improving traffic flow and safety.

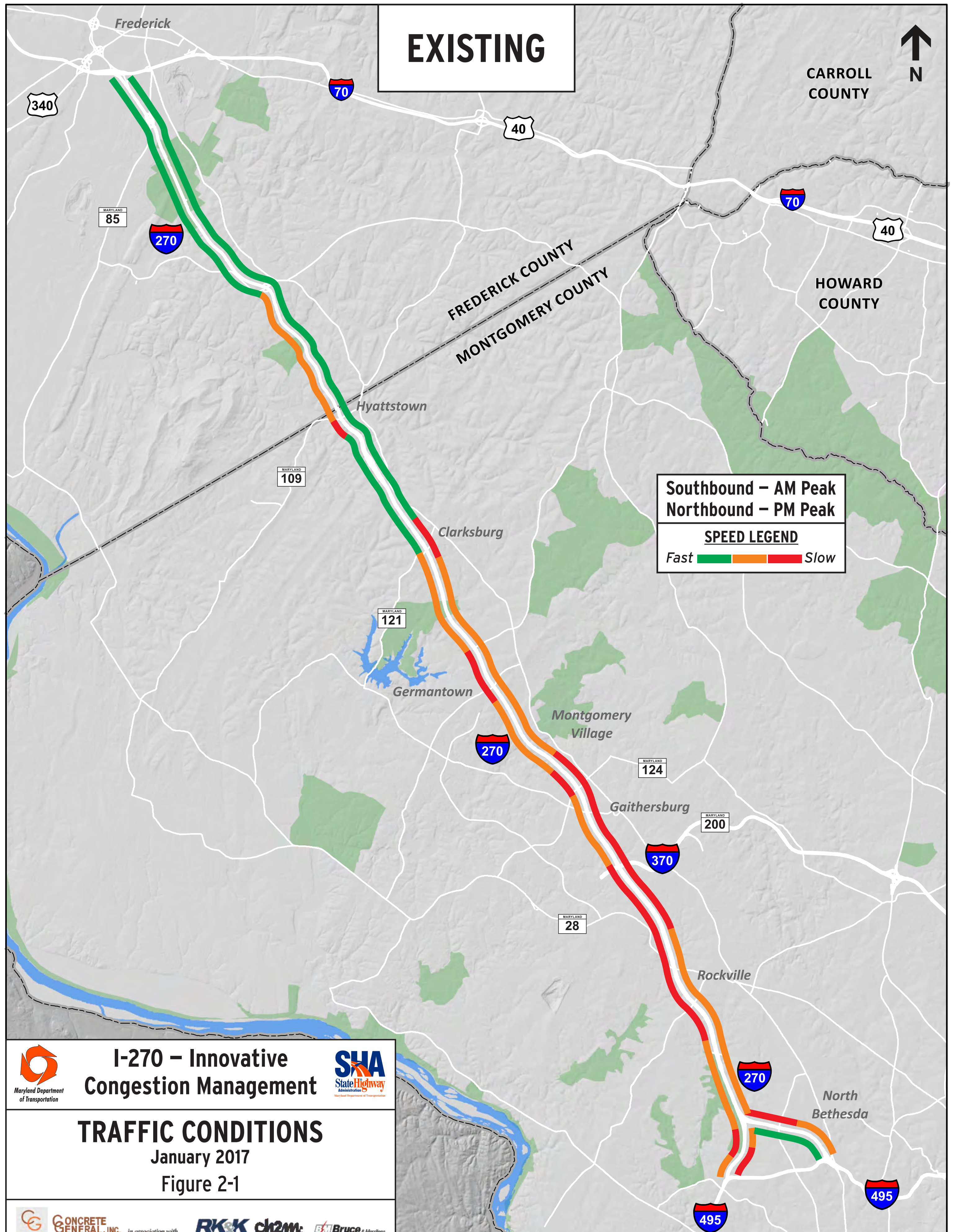
Implementing this approach will provide I-270 motorists with significant congestion relief and provides SHA with a high impact investment. Today's peak period travelers **will save 30 minutes southbound during the AM peak** traveling from I-70 to I-495, **reducing their delay by 43%**. Northbound travelers during the PM peak will see their **delays reduced by 8%**, with most of that savings achieved in the congested area between the Democracy Boulevard and I-370. Our approach addresses recurring congestion by reducing the severity and duration of peak periods, as well as non-recurring congestion by improving safety and providing demand management tools that can help to reduce incident impacts on travel times. As a result, travel time reliability will be improved throughout the corridor. The CGI program of improvements also would prove to be a very cost-effective approach, with a **benefit/cost ratio of nearly 20:1**.

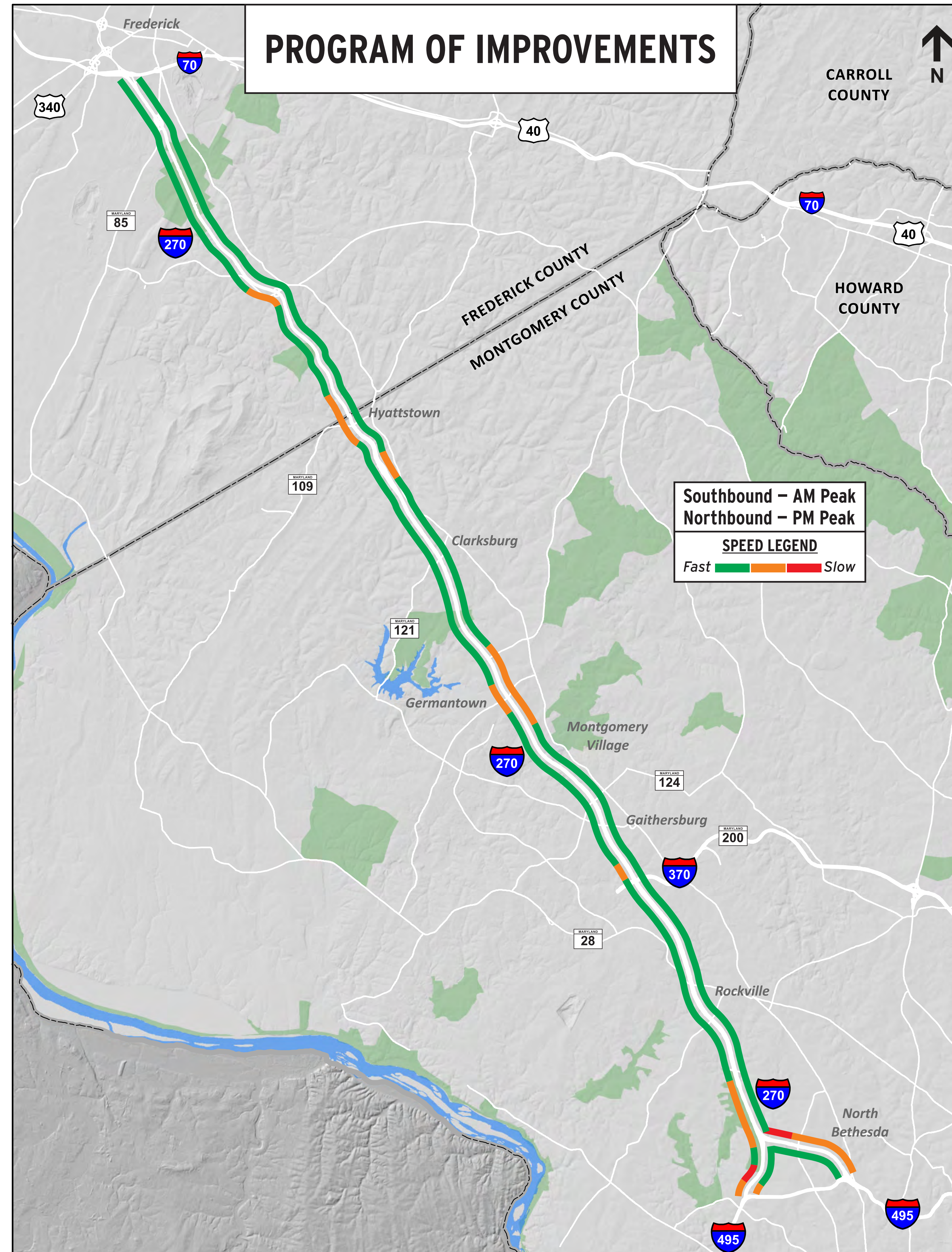
I-270 Today

When discussing mobility and the associated congestion that impacts throughput and travel times along the roadway, it is important to distinguish between recurring and non-recurring congestion. **Recurring** congestion occurs when demand increases beyond the available capacity. It usually is associated with the "typical" morning and afternoon work commutes. **Non-recurring** congestion results from a decrease in capacity, while the demand remains the same. This kind of congestion usually results from a traffic incident, weather event, or work zone. The graph to the right (from FHWA) shows the causes of congestion. Recurring congestion in the form of bottlenecks typically accounts for 40% of mobility problems; and non-recurring accounts for the other 60% of congestion and has a significant impact on travel time reliability due to the unanticipated disruption to a driver's trip.



Recurring Congestion: Recurring congestion along I-270 is fairly typical of an urban/suburban commuter freeway, in this case, generally focused southbound in the AM peak and northbound in the PM peak. I-270 travelers experience recurring delay southbound between 5:30 and 10:00 AM and northbound between 2:30 and 7:00 PM. The CGI Team used a variety of data sources to understand how congestion typically develops and eventually dissipates, including existing traffic counts from SHA; historic traffic data from RITIS; SHA's Mobility Report, I-270 Operational Bottleneck Analysis, I-270 and I-495 Congestion Management Studies, West Side Mobility Study; calibrated VISSIM models from SHA; and historic traffic data from Google Maps and Inrix. Figure 2-1 depicts the typical peak period congestion levels, along with a comparison of the reduced peak period congestion levels with all proposed CGI Team improvements. These improvements and resulting mobility improvements are presented below.


EXISTING
Frederick
CARROLL COUNTY
N
HOWARD COUNTY
FREDERICK COUNTY
MONTGOMERY COUNTY
Hyattstown
Clarksburg
Germantown
Montgomery Village
Gaithersburg
Rockville
North Bethesda
340
70
40
85
270
109
121
124
200
370
28
495
Southbound – AM Peak
Northbound – PM Peak
SPEED LEGEND
Fast
Slow
I-270 – Innovative Congestion Management
TRAFFIC CONDITIONS
January 2017
Figure 2-1


PROGRAM OF IMPROVEMENTS
Frederick
CARROLL COUNTY
N
HOWARD COUNTY
FREDERICK COUNTY
MONTGOMERY COUNTY
Hyattstown
Clarksburg
Germantown
Montgomery Village
Gaithersburg
Rockville
North Bethesda
340
70
40
85
270
109
121
124
200
370
28
495
Southbound – AM Peak
Northbound – PM Peak
SPEED LEGEND
Fast
Slow

2 Mobility

On a typical day, congestion along I-270 first appears at several bottleneck locations before the period of peak traffic demand, sometimes hours earlier. Specifically, these bottleneck locations include:

- AM Southbound: MD 80 to MD 109; Father Hurley Boulevard (MD 27) to MD 124; I-370 to Montrose Road; and River Road (MD 190) along I-495 to the I-270 West Spur.
- PM Northbound: North of MD 121; MD 124 to Father Hurley Boulevard (MD 27); I-270 Y-split interchange to Montrose Road; I-495 to I-270 split (West Spur).

The queue spillback from these bottlenecks increases quickly, and the volume also increases, until the queues from one bottleneck point reach the next bottleneck point. During the peak travel hours, these bottleneck points are the locations of the most severe speed reductions.

Non-recurring Congestion: During a typical week, there is a significant amount of non-recurring congestion throughout the I-270 corridor. Data from RITIS shows that in 2015, there were 211 incidents which resulted in lane closures during the peak periods. Of those incidents, 151 occurred during the peak time and in the peak direction (i.e., southbound in the AM, northbound in the PM). This means the typical commuter will experience congestion due to an incident which resulted in lane closures almost three times per week. Moreover, the peak time/peak direction incidents last an average of 24.6 minutes, leading to an unpredictable commuter trip, and substantially the extending the length and time of congestion.

CGI Team Approach

The CGI Team believes that improving mobility related to daily recurring congestion can be accomplished by improving travel times and speeds during the peak congested periods (severity) and reducing the length of time that the corridor experiences congestion, i.e., "shortening the rush hour" (duration). Improving mobility resulting from non-recurring congestion can be accomplished by improving safety on I-270 and reducing the total number of traffic incidents.

The CGI Team's approach will improve mobility along the I-270 corridor by implementing a program of improvements targeted to solve the identified bottlenecks, while also using innovation and technology to address non-recurring congestion. Our approach is tailored to cost-effectively enhance mobility on I-270 by 1) screening for locations to construct improvements that maximize benefit, 2) developing improvements that can be implemented quickly and easily by utilizing practical design and minimizing impacts, and 3) communicating and collaborating with SHA and other stakeholders to refine the improvement concepts and deliver the best solution. The following paragraphs discuss our approach and outline the details of our improvements, and Section 5 provides more details regarding our Project Management and Work Plan.

Initial Screening: We recognize that simply adding capacity to travel lanes without addressing these bottleneck areas could result in a solution that expends money without meeting the project goals and would not provide any significant additional benefits above and beyond addressing the bottlenecks. The CGI Team completed a high-level analysis of the freeway segments between interchanges using Highway Capacity Manual (HCM) methodology to find the segments where the existing traffic volume exceeded capacity for the base segment, independent of the influence exerted by interchange entrance and exit points along the freeway system. This analysis also allows for a quick understanding of what could happen downstream once upstream bottlenecks are relieved. These calculations were completed for the existing conditions for the primary peak periods. Through this process, we were able to identify several key findings that helped us refine our approach, which are shown in Table 2-1.

Table 2-1. Key Findings for Existing Traffic Congestion.

Segment	Factors that Contribute to Congestion
Southbound	
MD 109 to MD 121	▪ Volumes approach or exceed capacity ▪ Varying roadway grades, which especially impact large truck operations
MD 121 to I-370	▪ Volumes are slightly under capacity, suggesting that merging volumes contribute to bottlenecks through this segment.

Segment	Factors that Contribute to Congestion
I-370 to Montrose Road	▪ Mainline/Express lanes operate at about capacity between a slip ramp from the local lanes and the next downstream locations where traffic can exit to the local lanes. ▪ Local lanes operate at or above capacity between the exit from the express lanes and the downstream entrance to the express lanes.
Montrose Road to I-270 Y-split Interchange	▪ Segment volumes approach capacity, suggesting that the significant weaving approaching the split causes congestion in this area.
I-270 West Spur	▪ Capacity constraints from I-495 to Westlake Terrace
Northbound	
I-270 West Spur	▪ Capacity constraints from I-495 to Westlake Terrace
Montrose Road to I-370	▪ Generally, express lanes operate at or above capacity ▪ Local lanes operate below capacity until the approach to I-370 where a lane reduction causes the demand to exceed the available capacity
I-370 to MD 121	▪ Capacity constraints between MD 124 and Middlebrook Road
MD 121 to I-70	▪ At the end of the HOV lane, capacity constrained on two-lane northbound segment northward to I-70. This suggests that upstream congestion effectively meters traffic from reaching this point, along with the bottleneck that occurs at the end of the HOV lane.

In addition to identifying capacity constraints, our Team completed a demand management screening process, focusing on ramp metering. The ramp metering screening process started with the concept that system-wide (i.e., corridor-wide) metering would be the optimal approach for the I-270 corridor. As noted in the FHWA "Ramp Management and Control Handbook" (FHWA-HOP-06-001), system-wide metering may be preferable where:

- Collision problems extend throughout the corridor.
- Multiple bottlenecks/locations of recurring congestion on the freeway are observed.
- The situation requires the improved ability to address non-recurring congestion problems.

The I-270 corridor meets each of these conditions. Moreover, corridor-wide ramp metering provides more options in optimizing the metered flow rates of traffic entering the freeway, maximizing freeway throughput. This approach also reduces the amount of overall system delay by using nearly all the ramps to control traffic, which promotes equity by balancing any ramp delays for all users of the I-270 corridor.

The screening process for identifying locations to deploy ATM was based on the FHWA "Active Traffic Management Feasibility and Screening Guide" and is discussed in Section 3.

Utilizing Practical Design and Minimizing Impacts: After performing the screening process to understand how congestion forms and spreads along the I-270 corridor, we developed solutions that are innovative, yet practical. Based upon the principles of performance-based practical design (PBPD), our roadway improvements focus on addressing specific bottlenecks, and minimize adverse impacts:

- Environmental and utility impacts will be minimized by utilizing existing pavement, including shoulders, for the majority of the targeted roadway improvements.
- The CGI Team has specifically designed and selected improvements that will not require additional right-of-way.
- Roadways adjacent to I-270 will not be negatively impacted by the recommended improvements.

Performance-Based Practical Design

- Develop solutions that meet the project purpose based on defined goals/objectives/transportation needs,
- Utilize objective data and engineering judgement to inform decisions based on an examination of geometric and operational elements,
- Work within constraints/minimize impacts,
- Consider whether the same investment of money would yield a greater return on investment if applied to other system needs/priorities,
- Evaluate how the preliminary design compares to the applicable design standards, and identify any "design exceptions."

Communication and Collaboration: Many of the improvements were submitted to SHA as Proposed Technical Concepts (PTCs), which SHA reviewed and provided comments (refer to Appendix B for more information on the PTCs). This level of communication and collaboration will continue throughout the project in the form of Design Workshops, Progress Meetings, and SHA's formal Partnering processes. Finally, our

Team will coordinate closely with stakeholders, such as FHWA, Montgomery County, Frederick County, and the public to ensure project goals are achieved within the required timeframe.

Program of Improvements

The CGI Team has developed a program of improvements that address SHA's goal of improved mobility by maximizing vehicle throughput, minimizing vehicle travel times, improving travel time reliability, minimizing queues, and reducing delay. Our proposed concepts are a combination of roadway improvements and innovative technologies and techniques that will combine to substantially improve operations along I-270:

- Roadway improvements that address specific bottlenecks and identified congested locations,
- Adaptive ramp metering to optimize the rate of traffic flows entering southbound I-270 from the 18 interchange ramps between MD 80 and Montrose Road, and improve safety in the vicinity of the entrance ramps,
- Active Traffic Management strategies to improve safety and reduce the level of non-recurring congestion, and
- Virtual weigh stations to improve the operations of commercial vehicles along the northern segments of I-270.

Program of Improvements

- Roadway improvements
- Innovative technologies and techniques
  - Adaptive ramp metering
  - Active traffic management
  - Virtual weigh stations

In total, the CGI Team's concepts provide improvements along both directions of I-270 throughout the project limits. Figure 2-2 shows a map with the location and brief description of each concept, along with isolated congestion relief benefits that each project provides. For additional details about these concepts, including detailed scope and display sheets, refer to Appendix C.

Our improvements constitute a program of including discrete projects, which is beneficial to SHA because several smaller projects will also allow for more straightforward and faster NEPA and permitting approvals. One large project would necessitate a more significant environmental review and documentation process, which would take longer and delay the ability of SHA to get improvements implemented.

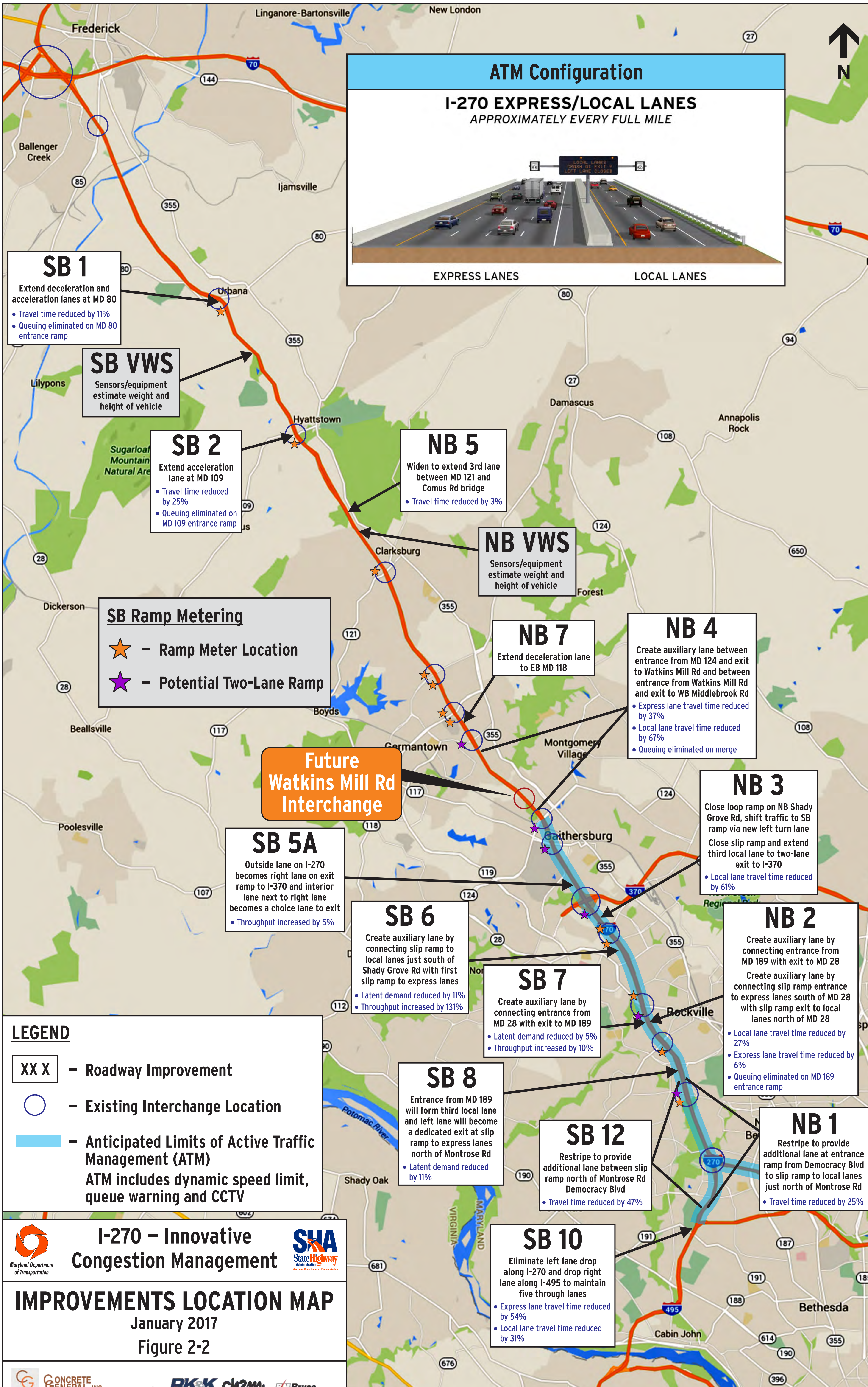
Roadway Improvements

Southbound 1 (SB 1): Extend acceleration and deceleration lanes at MD 80: This improvement consists of two distinct components: extending the length of the deceleration lane for the exit to MD 80 and extending the length of the acceleration lane for the entrance from MD 80. The existing merge location at the MD 80 entrance ramps is an identified bottleneck during the AM peak period. Under this concept, a longer distance for entering traffic to merge is provided. The deceleration lane from southbound I-270 to MD 80 is identified as a frequent crash area. By extending the length of the deceleration lane, vehicles are provided a longer, safer distance to reduce their speeds.

Southbound 2 (SB 2): Extend acceleration lane at MD 109: This improvement involves extending the length of the acceleration lane for the entrance from MD 109 to southbound I-270. The existing acceleration length does not meet AASHTO design guidelines and the reduced speed of entering traffic from MD 109 at the merge with high speed traffic on I-270 contributes to congestion during the AM peak period. This concept provides a longer distance for entering traffic to accelerate and merge.

Southbound 5A (SB 5A): Reconfigure exit lanes to I-370: This improvement involves restriping southbound I-270 approaching the exit to I-370 so the outside lane becomes the right lane on the two-lane exit ramp to I-370. The interior lane next to the right lane on I-270 will become a choice lane for vehicles to exit on the ramp to I-370 or continue south on I-270. In the existing configuration where no choice lane is provided, vehicles in the right lane reduce speed approaching the exit ramp and contribute to congestion on this section of I-270. This concept eliminates the need to develop a deceleration lane for the exit to I-370 and vehicles will not need to slow down on I-270 approaching the exit.

Southbound 6 (SB 6): Create auxiliary lane in local lanes south of Shady Grove Road: This improvement involves creating a third local lane by providing an auxiliary lane between the slip ramps south of Shady Grove Road. The entrance slip ramp from the express lanes will be connected to the first exit slip ramp to the express lanes. AM peak period traffic volumes in the local lanes approach capacity of the existing two lane section, resulting in recurring congestion. Under this concept the auxiliary lane will provide additional capacity at this bottleneck.



I-270 – Innovative Congestion Management

IMPROVEMENTS LOCATION MAP

January 2017

Figure 2-2

Southbound 7 (SB 7): Create auxiliary lane in local lanes between MD 28 and MD 189: This improvement involves creating an auxiliary (third) lane in the local lanes by connecting the entrance from MD 28 to the exit to MD 189. AM peak period traffic volumes in the local lanes approach capacity of the existing two lane section, resulting in recurring congestion. Under this concept, the auxiliary lane will provide additional capacity between the two interchanges.

Southbound 8 (SB 8): Reconfigure local lanes between MD 189 and Montrose Road: This improvement involves developing a third lane in the local lanes by connecting the entrance ramp from MD 189 with the exit ramp to Montrose Road. The existing inside (left) local lane becomes a dedicated exit at the slip ramp to the express lanes north of Montrose Road and two lanes continue to the exit to Montrose Road. AM peak period traffic volumes in the local lanes exceed capacity of the existing two lane section, resulting in reduced speeds and queuing. Under this concept, the third lane provides additional capacity between the two interchanges.

Southbound 10 (SB 10): Maintain three lanes from I-270 and drop right lane on I-495 at I-270/I-495 merge: This improvement involves restriping the I-495 outer loop at the merge with the southbound I-270 west spur. Instead of dropping the inside (left) lane from the I-270 spur, the three lanes from I-270 would continue on I-495 and the right lane on I-495 would drop to maintain five lanes. During the AM peak period, recurring congestion at the I-270/I-495 merge results in queues that spill back onto the I-270 west spur. This improvement maintains capacity in three continuous lanes on the I-270 spur, the heavier traffic movement, and provides an expected merge on the right side of the highway with minimal impacts to I-495 outer loop operations approaching the merge.

Southbound 12 (SB 12): Create additional travel lane between Montrose Road and Democracy Boulevard: This improvement consists of restriping southbound I-270 to provide an additional travel lane within the existing typical section from the slip ramp entrance to the express lanes north of Montrose Road to the interchange at Democracy Boulevard on the west spur, a distance of approximately 3.1 miles. The large volume of weaving movements on the section of southbound I-270 between the express/local lane merge and the Y-split interchange results in substantial friction and reduced speeds during the AM peak period. In addition, the I-270 West Spur operates over capacity during the AM peak. Under this improvement, the added travel lane provides additional capacity on southbound I-270 and the I-270 West Spur. This concept uses PBPD principles to continue to provide a right shoulder throughout the concept area.

Northbound 1 (NB 1): Create additional travel lane between Democracy Boulevard and Montrose Road: This improvement involves restriping northbound I-270 to provide an additional travel lane within the existing typical section between the entrance from Democracy Boulevard on the I-270 West Spur to the slip ramp exit to the local lanes just north of Montrose Road, a distance of approximately 2.7 miles. Traffic volumes on this section of northbound I-270 approach capacity of the existing lanes during the PM peak period. Under this improvement, the added travel lane provides additional capacity on the west spur and on the express lanes on northbound I-270.

Northbound 2 (NB 2): Create auxiliary lane in local lanes between MD 189 and MD 28: This improvement involves creating an auxiliary (third) lane in the local lanes by connecting the entrance from MD 189 to the exit to MD 28. This concept also involves restriping the northbound express lanes within the existing typical section to create an auxiliary lane by connecting the entrance slip ramp from the local lanes south of MD 28 with the exit slip ramp to the local lanes north of MD 28. Traffic volumes approach capacity of the existing two local lanes between MD 189 and MD 28 during the PM peak period. Under this improvement, the auxiliary lane provides additional capacity between the two interchanges. On northbound I-270 within the MD 28 interchange, traffic volumes exceed capacity of the existing three general purpose express lanes during the PM peak period. This improvement provides additional capacity in this section.

Northbound 3 (NB 3): Close loop ramp from NB Shady Grove Road to NB I-270; Close slip ramp to express lanes north of Shady Grove Road: This improvement involves closing the existing loop ramp from northbound Shady Grove Road to northbound I-270. Northbound Shady Grove Road will be reconfigured to provide dual left turn lanes in the median north of the existing bridge over I-270, and a new left turn spur will be constructed at the existing intersection to connect with the existing entrance ramp from southbound Shady Grove Road. The existing configuration of ramp and slip ramp entrances within the Shady Grove Road interchange contributes to considerable friction and recurring traffic congestion during the PM peak period. This improvement eliminates the friction by removing a merge point on northbound I-270.

This improvement also involves closing the slip ramp exit from the local lanes on northbound I-270 to the express lanes south of the I-370 interchange. The left (third) local lane that drops at the slip ramp in the existing configuration will be extended to connect with the exit to I-370. PM peak volumes approach capacity of the existing two local lanes between the exit slip ramp and I-370 and there is a short weaving movement between the Shady Grove Road entrance ramp and the exit to the express lanes. These improvements will eliminate the weave and provide additional capacity.

Northbound 4 (NB 4): Create auxiliary lane between MD 124 and Watkins Mill Road and between Watkins Mill Road and WB Middlebrook Road: This improvement consists of two improvements: an auxiliary lane will be provided in the northbound local lanes by connecting the entrance from MD 124 to the exit at the new Watkins Mill Road interchange and an auxiliary lane will be provided along northbound I-270 by connecting the entrance from Watkins Mill Road with the exit to westbound Middlebrook Road (loop ramp). Traffic volumes on northbound I-270 between MD 124 and Middlebrook Road exceed capacity of the existing three general purpose lanes during the PM peak period. Under this improvement, the added travel lane will provide additional capacity in the general purpose lanes.

Northbound 5 (NB 5): Extend third lane to Comus Road bridge: This improvement extends the right (third) lane drop from its current location north of MD 121 to Comus Road, a distance of approximately 0.8 miles. The additional lane will be provided by widening into the median. The lane drop north of MD 121 is a major source of congestion during the PM peak period. Extending the point of the lane drop, including further separating it from the end of the HOV lane will provide more distance for vehicles to merge into the two lane section.

Northbound 7 (NB 7): Extend deceleration lane at MD 118: This improvement involves extending the length of the deceleration lane for the exit to eastbound MD 118. The existing deceleration length is substandard and the exit is identified as a frequent crash area. Extending the deceleration lane will provide additional length for vehicles to slow down off of the through lanes.

Innovative Technologies and Techniques

In combination with roadway improvements, our Team's proposed solution includes technology-based approaches. The general description of these approaches are provided below; however, the technology approaches are also fundamental to our Team's approach to address safety issues along I-270. This safety discussion is presented in Section 3. The details of operations and maintenance for the technology-based approaches is presented in Section 4.

Adaptive Ramp Metering

The CGI Team is proposing "adaptive ramp metering" along southbound I-270 to automatically set the optimum vehicle rate of release at each ramp based on a variety of parameters including mainline traffic flow conditions in the vicinity of the ramp; mainline traffic flow conditions along other segments along I-270 both upstream and downstream of the ramp; queue length at the ramp; and queue lengths at other metered ramps located within the corridor. Time-of-day / day-of week scheduling can be implemented as necessary. Figure 2-3 shows the elements of adaptive ramp metering and how it will operate on I-270.

By managing the amount of traffic entering I-270 and breaking up platoons that make it difficult to merge, congestion will be reduced and the merging movements will be safer.

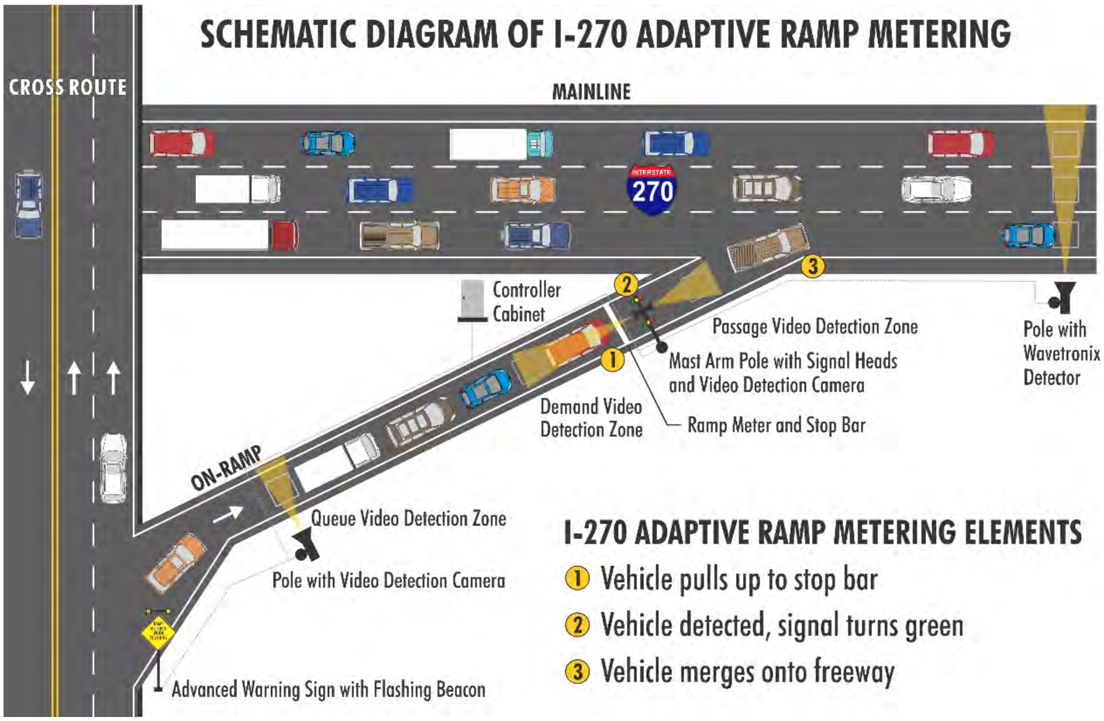
Adaptive ramp meters will be installed at every southbound entrance ramp from the arterials to I-270 from MD 80 to Montrose Road (18 total ramps), including the ramp from I-370 to southbound I-270. Along I-370 approaching the ramp to SB I-270, additional warning signs/signals will be installed to alert freeway motorists to the ramp queuing ahead. Metering the southbound I-270 mainline ramps, including along those segments that generally do not experience recurring congestion, will help alleviate any potential equity-related opposition, because ramp delays will be balanced for all users of the corridor. Our program of improvements does not include ramp meters along northbound entrance ramps for two primary reasons: first, approximately 76% of northbound traffic enters via I-495, two access points that cannot be readily metered. Second, north of the I-270 spurs, northbound traffic exiting I-270 at each interchange exceeds traffic entering; limiting the effectiveness of ramp metering as a demand management strategy.

In order to prevent traffic from backing up onto the arterials, each location will be equipped with queue detection which will increase the release rate of traffic onto I-270 to prevent queues from backing onto and therefore impacting operations on the arterial roadways. Ramp meters would be included on the new Watkins Mill interchange as noted in Section 5.

In addition, the ramps with the highest traffic volumes may be widened as needed to provide adequate storage space for queued vehicles, while still preventing queues from backing onto the arterials. The following ramps onto I-270 southbound may be widened to two lanes (as needed):

- Montrose Road westbound entrance ramp,
- MD 28 eastbound entrance ramp,
- MD 117 entrance ramp,
- MD 124 entrance ramp, and
- Middlebrook Road entrance ramp.

Figure 2-3. Adaptive Ramp Metering Configuration on I-270.



Active Traffic Management: Active Traffic Management (ATM) strategies involve the use of technologies to dynamically manage recurring and non-recurring congestion based on prevailing and predicted traffic conditions. The specific ATM strategies proposed by the CGI Team for I-270 include:

- Dynamic speed limits (DSL), also known as variable speed limits, to adjust speed limit displays based on real-time traffic, roadway, and/or weather conditions. DSL can be speed advisories or regulatory limits, and they will be applied to an entire roadway segment. This "smoothing" process helps minimize the differences between the lowest and highest vehicle speeds.
- Queue warning (QW) to provide real-time displays of warning messages (on DMS) along I-270 to alert motorists that queues or significant slowdowns are ahead. QW is also used to provide additional information to motorists as to why the speed limit is being reduced.

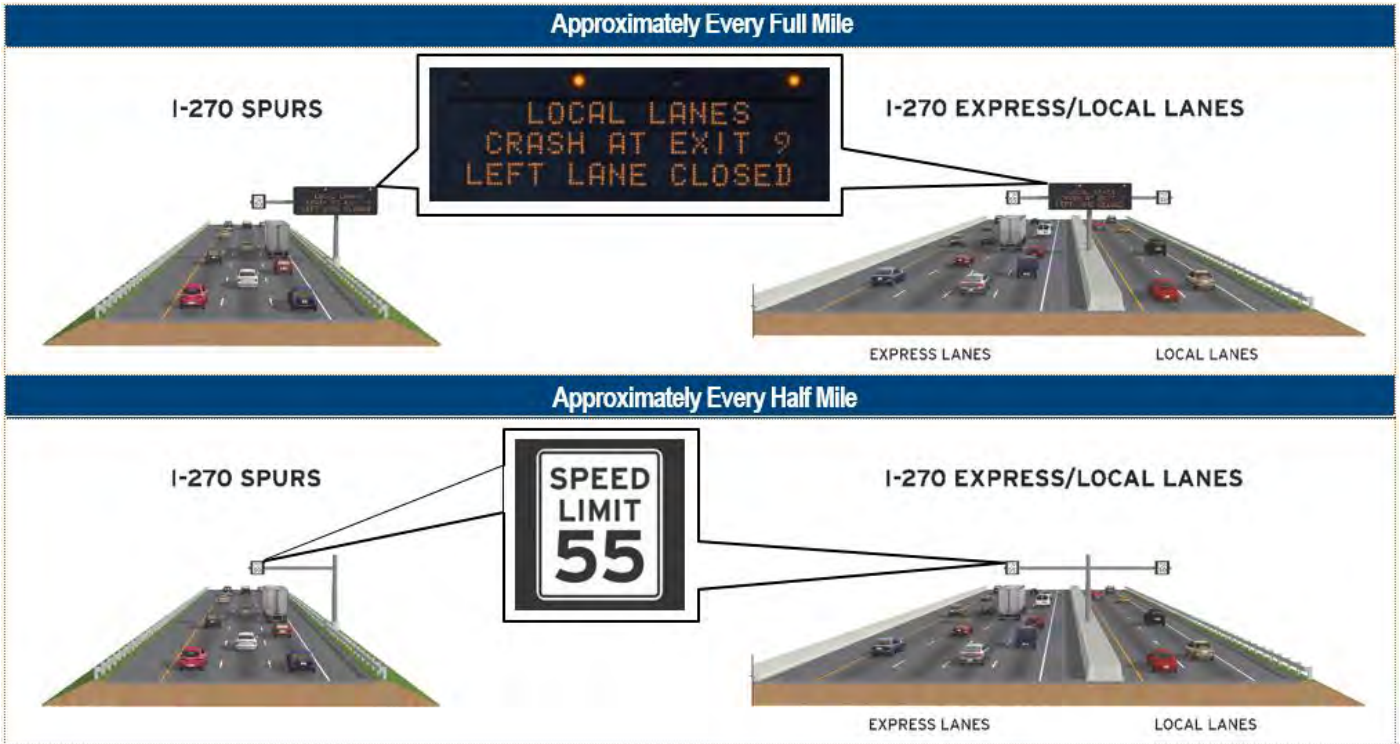
Another component to be included in the ATM concept is CCTV cameras (with pan, tilt, and zoom capabilities) on the DSL/QW support poles. This implementation of full coverage CCTV will support improved incident management and response times along I-270, thereby further reducing non-recurring congestion. According to statistics published for the CHART system, other roadways that have full coverage CCTV and are managed by the CHART system have shown an approximate 20% improvement in incident response times.

The proposed segments for ATM deployment on I-270 are shown on Figure 2-2 and described in Table 2-2, and the preliminary configuration of ATM devices is shown in Figure 2-4.

Table 2-2. Proposed Segments for ATM Deployment.

Road Segment	Anticipated Limits	Configuration
I-270 Spurs (both directions)	I-495 to Y-Split interchange	DSL on mast arms and pole-mount DMS for queue warning. CCTV mounted on each pole.
I-270 Mainline – SB	Y-Split to MD 124	DSL on mast arms, with different speed limit displays for local and express, and pole-mount DMS for queue warning. CCTV mounted on each pole.
I-270 Mainline – NB	Y-Split to Middlebrook Rd	

Figure 2-4. ATM Configurations along I-270.



Within the express-local lanes section, the express lanes and local lanes will be treated as separate roadways, which allows for DSL on both roadways to operate independently based on conditions.

ATM strategies have been proven to significantly reduce rear-end and sideswipe crashes, which are prevalent along the proposed roadway segments, thereby enhancing safety. The safety benefits of ATM are discussed in more detail in Section 3, but by reducing the number of crashes, there is a corresponding reduction in non-recurring congestion. Additionally, these ATM strategies reduce turbulence in freeway traffic flow, reducing the number of traffic shockwaves and helping to prevent flow breakdown from occurring.

Other ATM strategies, such as dynamic shoulder lanes (also known as temporary shoulder lanes or hard shoulder running) and dynamic lane assignment, were also investigated by the CGI Team, but were eliminated from consideration. Dynamic shoulder lanes can reduce recurring congestion by opening the shoulder to traffic during peak periods thereby temporarily increasing roadway capacity. However, our Team determined that this approach would not be appropriate for I-270 because the use of a peak period shoulder lane could actually negatively impact traffic operations and safety by not having a full shoulder available during the heaviest times of travel for incident management and emergency refuge areas; important because over half of congestion is non-recurring. Dynamic lane assignment (DLA) involves the use of overhead lane use control signs to dynamically close or open individual traffic lanes as needed. This strategy was not considered due to large costs associated with installing lane use control signs over each lane. To mount the signs, large gantries spanning the entire width of the roadway would be required about every half mile along the corridor. In addition, proper operation of DLA would require an enhanced decision support system and significant integration with the existing CHART system. Further, the extensive infrastructure that is needed for DLA may become unnecessary with future innovations in transportation such as connected vehicles and autonomous vehicles.

Virtual Weigh Stations

A Virtual Weigh Station (VWS) is a method of pre-screening trucks at highway speeds for weight and height violations. Scaling equipment embedded in the pavement of the travel lanes and adjacent height sensors measure the weight and height of a vehicle and an infrared camera photographs the vehicle and the license plate. Within seconds, a report is transmitted wirelessly to the computer of an enforcement officer located downstream of the VWS so the officer can determine if the vehicle is violating any regulations. If the vehicle is in violation, the officer can choose to pull over the vehicle for inspection and/or static weighing.

When the existing weigh stations south of MD 109 are in operation, the volume of truck traffic entering and exiting the weigh stations results in significant friction and reduced speeds in both directions on I-270. Under this improvement, trucks would no longer be required to stop at the physical weigh stations unless in violation. This in turn would greatly reduce the source of traffic friction from trucks entering and exiting the mainline traffic flow. As a part of the proposed improvements, the VWS will be constructed in the northbound and southbound directions in advance of the existing weigh stations south of MD 109 along relative flat and tangent sections of I-270 as required for proper VWS operations. The locations of the proposed VWS are shown in Figure 2-2. The existing weigh station facilities will serve as a pull-off area for an enforcement officer to pull over, inspect, and weigh a vehicle in violation and portable scales will not be necessary.

Improved Mobility

- SB peak period travel time reduced by 30 minutes; delay reduced by 43%
- SB peak average speeds increased by 23%
- NB peak period travel time reduced by 4 minutes; delay reduced by 8%
- Vehicle throughout increased 3% SB during the AM peak and 1% NB during the PM peak.

Reducing Recurring Congestion

The CGI Team's program of improvements when packaged together would provide substantial system-wide benefits and would significantly reduce recurring congestion. While each individual improvement concept does provide specific benefits (as illustrated in Figure 2-2 and Appendix F), deploying them as a program of improvements results in comprehensive corridor-wide benefits. Most specifically, this will provide measureable improvements in travel time, speed, vehicle throughput, density, intersection operations, queuing and network performance.

The corridor-wide congestion reduction was quantified by modeling the overall program of improvements as one proposed scenario in the SHA-provided VISSIM models for both the existing year (2015) and the horizon year (2040). Most of the improvements were discretely modeled in the VISSIM model, including the roadway improvements and adaptive ramp metering. The smoothing of vehicular speeds resulting from ATM (dynamic speed limits) was not explicitly modeled. The CGI Team's program showed congestion reduction benefits in both the existing year and horizon year, relative to the no-build. The concept evaluation tables in Appendix G demonstrate this.

In particular, the CGI Team's program of improvements would be effective in alleviating today's daily recurring congestion. These improvements are most greatly realized in the peak directions, meaning southbound during the AM peak and northbound during the PM peak. System-wide, the greatest increases in travel speeds and decreases in congestion would occur southbound during the AM peak, with a nearly 30-minute improvement in travel time and a 43% reduction in delay between I-70 and the I-495 / Cabin John Parkway interchange. Northbound during the PM peak, the system-wide improvements are more modest: 4-minute improvements in travel times and 8% reduction in delays. However, in the most severely congested northbound segment, between I-495 and MD 124, travel times would be improved significantly, particularly in the local lanes with a more than 9-minute improvement in travel time. Overall, the CGI program would reduce delay by 42% across the entire I-270 network during the AM peak, and 14% during the PM peak. The average speeds during the AM peak would also increase by 23%. Table 2-3 below illustrates these system-wide benefits. Vehicle throughput would increase by 3% southbound during the AM peak and 1% northbound during the PM peak.

Table 2-3. Total System-Wide Vehicle Network Performance Improvements from Proposed Concepts.

Time Period	Mobility Improvements 2015
AM Peak	▪ Travel Time Reduction: • Southbound: I-70 to I-495 / Cabin John Parkway (via express lanes and West Spur): 30 minutes • Southbound I-270 local lanes: 7.1 minutes ▪ Delay Reduction: • Network-wide: 42% • Southbound I-70 to I-495 / Cabin John Parkway: 43.5 % • Southbound I-270 Local Lanes: 7.1 minutes ▪ Vehicle Throughput Increase: • Network-wide: 3%

Time Period	Mobility Improvements 2015
	• Southbound at I-370 and along the West Spur: 15% • Southbound at Montrose Road: 20% ▪ Vehicular Density: • 32% of I-270 segments operating at LOS E/F improve to LOS D or better ▪ Vehicular Speed: • 23% improvement • Number of I-270 segments > 45 MPH increases by 40% (from 52% to 92%).
PM Peak	▪ Travel Time Reduction: • Northbound: I-495 to I-70 (via express lanes and West Spur): 4 minutes • Northbound I-270 local lanes: 7.1 minutes • West Spur Southbound: 7.5 minutes ▪ Delay Reduction: • Network-wide: 14% • Northbound I-270 local lanes: 45 % • West Spur Southbound: 27% ▪ Vehicle Throughput Increase: • Network-wide: 1% • Bottleneck is eliminated in area of I-370 / MD 124: up to 10% improvement ▪ Vehicular Density: • 7% of I-270 segments operating at LOS E/F improve to LOS D or better ▪ Vehicular Speed: • 5% improvement

Figure 2-4 shows the southbound travel time reductions anticipated from I-70 to I-495 (via the Express Lanes) during today's AM peak, and Figure 2-5 shows expected travel time reductions along the southbound local lanes during the AM peak. Similar graphics illustrative travel times for the CGI program for all locations for both existing and 2040 can be found in Appendix F.

Figure 2-4. AM Peak Hour I-270 Southbound Cumulative Travel Time – Express Lanes

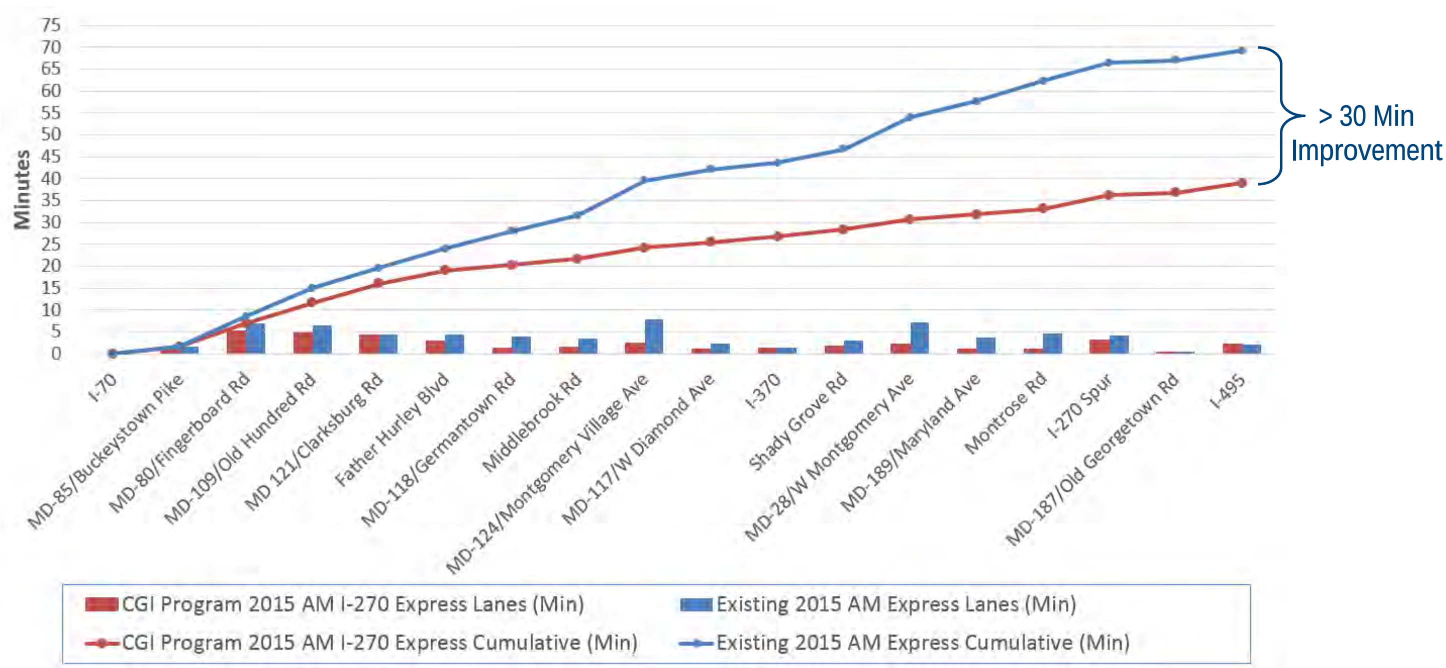
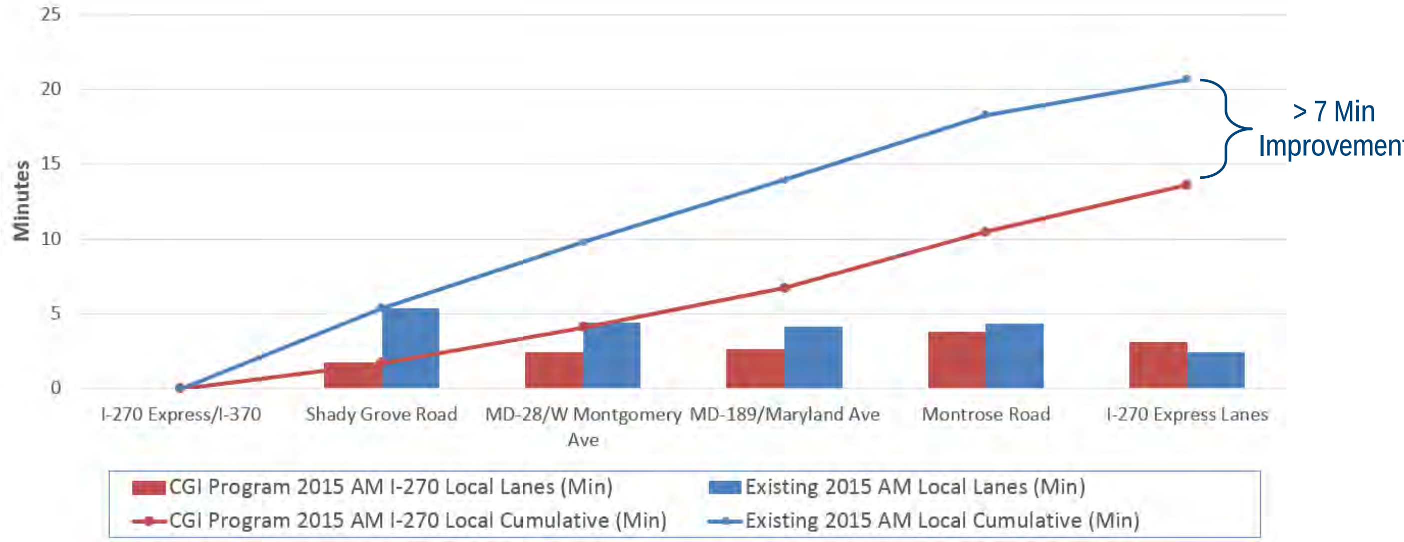


Figure 2-5. AM Peak Hour I-270 Southbound Cumulative Travel Time – Local Lanes



Operational Benefits at Bottleneck Locations: A deeper dive into the CGI Team's program of improvements shows significant operational benefits at the key bottleneck locations. Several operational metrics support this.

Segment Capacity. During the AM peak hour today, 53 of the 85 freeway segments along I-270 southbound operate at or above capacity (LOS E or F); by implementing our program, this would be reduced to 26 segments. Along the I-270 southbound local lanes, of the 31 total segments, there are 26 operating at LOS E or F under existing conditions, this would be reduced to 19 segments. In the PM peak hour, 39 of the 85 total freeway segments along I-270 northbound express including the spurs, operate at LOS E or F. This is would be reduced to 33 segments with the CGI program. In the northbound local lanes in the PM peak, the number of segments operating at LOS E or F would be reduced from 20 under existing conditions to 8.

Bottleneck Reduction. A significant benefit of implementing the CGI Team's program of improvements is the reduction in the number and severity of bottlenecks that the I-270 traveler would encounter. Today, a motorist traveling the length of I-270 southbound during the AM peak encounters four bottleneck areas: MD 80/MD 109, MD 27 to MD 124, the Express-Local lanes section, and the I-270 West Spur / I-495 (outer loop) merge. Our improvements reduce the bottlenecks at all four of these locations, and we are nearly eliminating the bottleneck in between MD 117 to MD 124 and the Express-Local lanes section. Figures 2-6 to 2-8 illustrate expected travel speeds along the corridor in the southbound direction during the AM peak. For each figure, the top graphic shows travel speeds anticipated once our program is implemented, the middle graphic shows existing travel speeds without our program as portrayed in the VISSIM model, and the bottom graphic shows existing travel speeds without our program based on INRIX data.

Similarly, during the PM peak, motorists encounter bottlenecks at three locations: exiting I-495 onto the west spur, the merge between the east and west spurs (Y-split interchange), and the end of the HOV lane section just north of MD 121. Our program eliminates the congestion north of MD 124 and reduce the impact of the congestion at the other two bottleneck areas. Appendix F shows the congestion diagrams that illustrate the travel speeds along the corridor in the northbound direction in the PM peak.

Ramp Queuing and Intersection Operations: The proposed roadway concepts along the I-270 corridor do not directly impact intersection operations. However, the concepts improve the flow and quantity of traffic that is serviced along the express and local lanes of I-270. This relieves spillback from the mainline onto the arterials. In general, implementing the CGI Team's program of improvements would keep the intersection operations at today's level during both the AM and PM peaks with one exception. Roadway improvement NB 3 includes closure of the entrance loop ramp from eastbound/northbound Shady Grove Road to northbound I-270. This movement is replaced by a left turn spur for eastbound/northbound Shady Grove Road to northbound I-270. The existing intersection at this location will be modified to accommodate this new left-turn movement. These improvements are shown on the display sheets in Appendix C. Removing the ramp and reconfiguring the Shady Grove Road interchange provides significant benefits to I-270, however

Figure 2-6. AM Peak Period I-270 Southbound Travel Speeds – Express Lanes

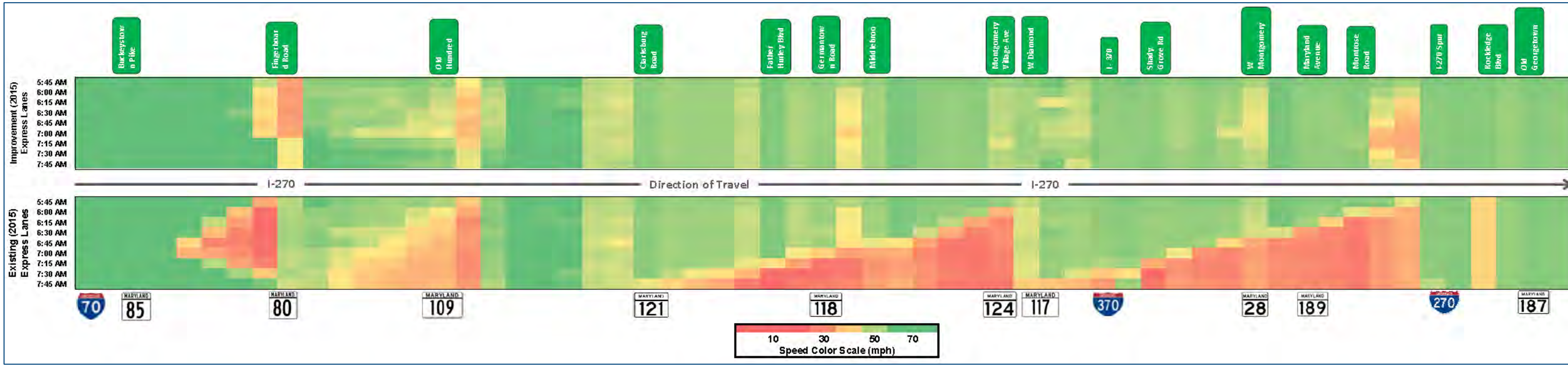


Figure 2-7. AM Peak Period I-270 Southbound Travel Speeds – Local Lanes

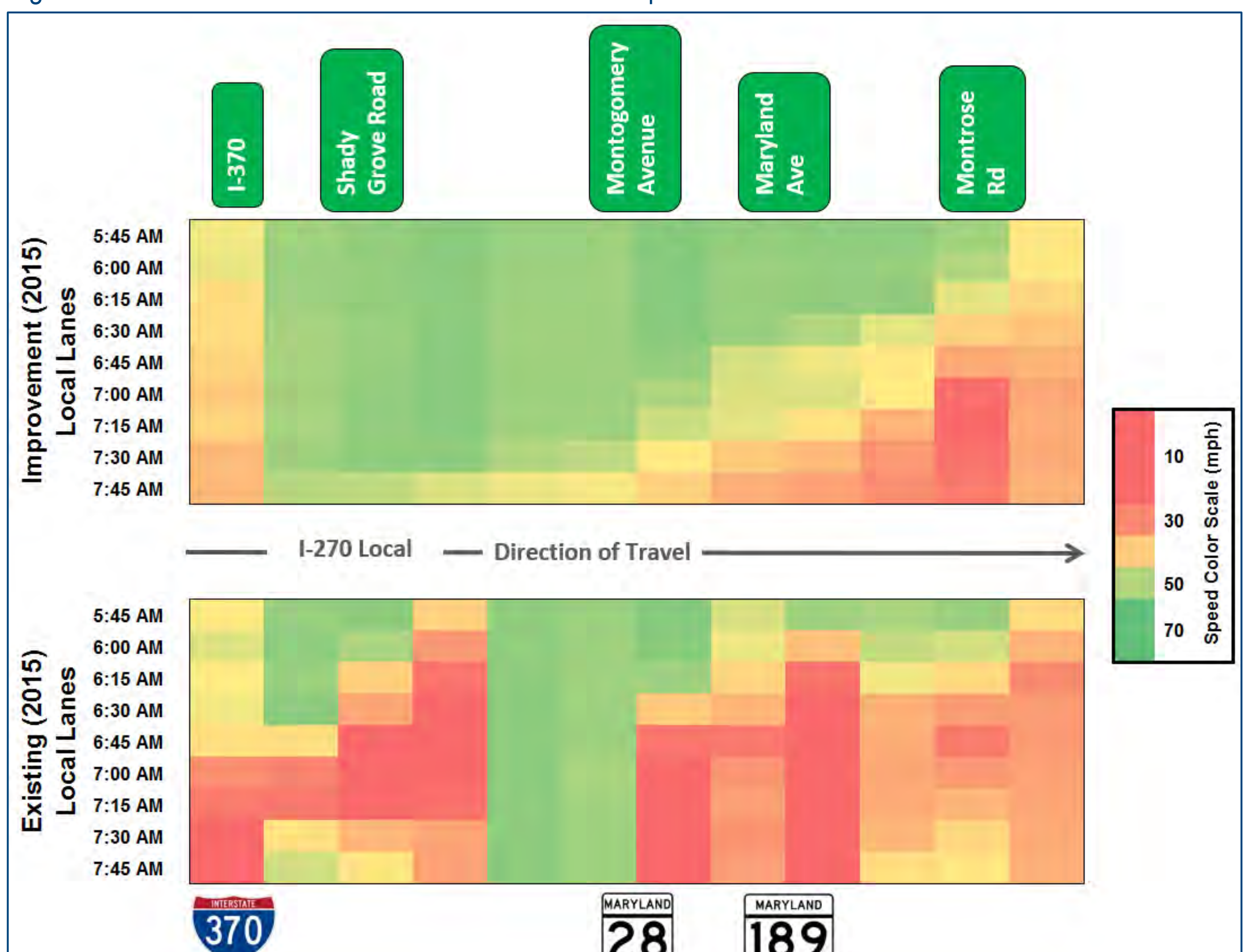
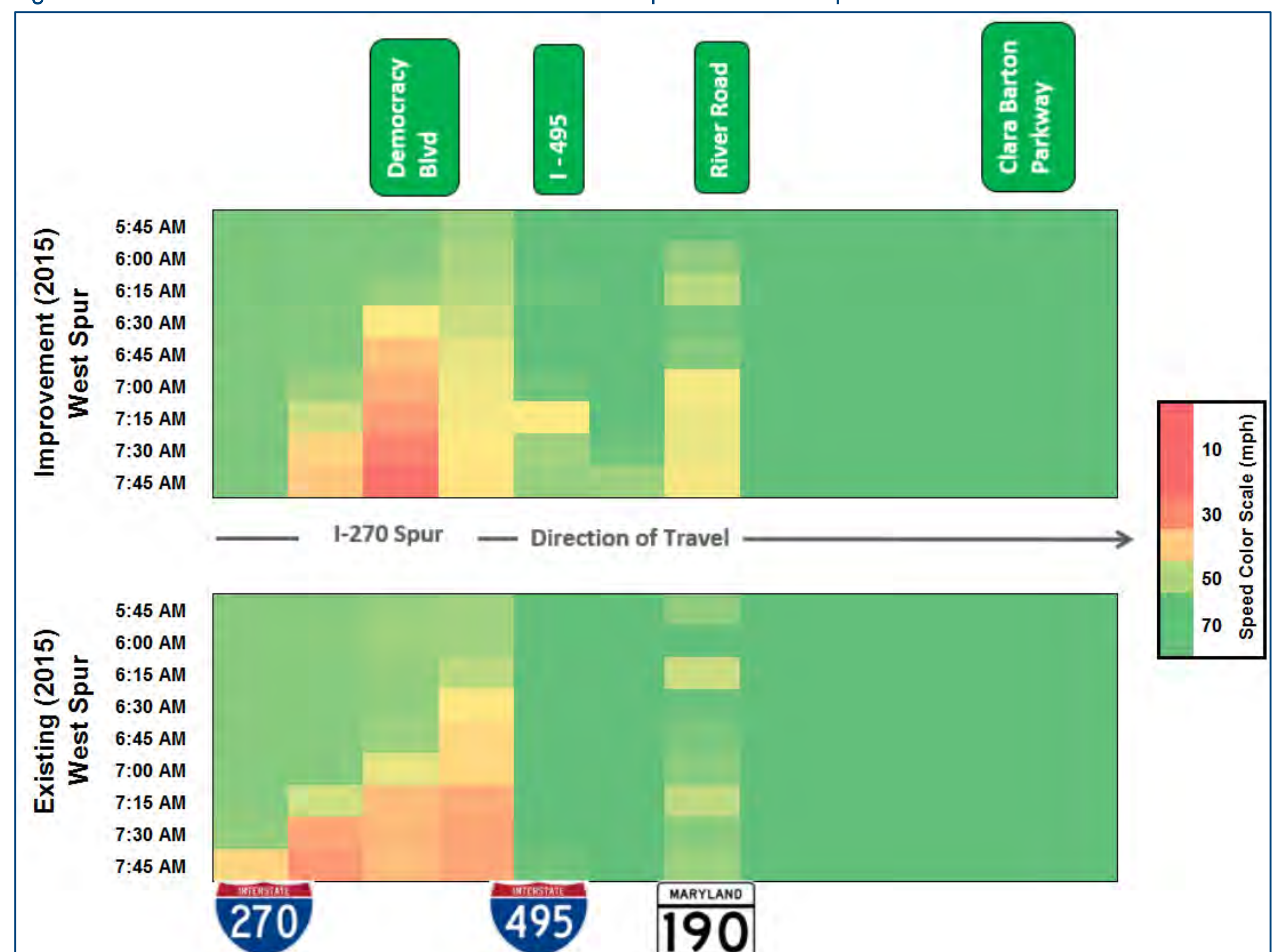


Figure 2-8. AM Peak Period I-270 Southbound Travel Speeds – West Spur



during the PM peak the addition of the extra left turn phase along Shady Grove Road increases delays from 24.6 seconds per vehicle to 34.7 seconds per vehicle, however, the level of service along Shady Grove Road remains LOS C.

Adaptive ramp metering, including widening specific ramps to provide adequate storage area, contains the queues along the ramps as shown in Appendix F. Assuming typical operations along the mainline, the ramp metering algorithm prevents vehicle spillover onto the arterials while maintaining the throughput of the entrance ramp. The algorithm provides an override of the meter signal to clear queuing along the ramp if traffic begins to back up to the arterial. Additional discussion of adaptive ramp metering operation is provided in Section 4. In order to facilitate the effectiveness of the metering on I-270 and limit spillback onto arterials (and associated overrides), five ramps may be widened from one to two lanes as needed to implement ramp metering as shown on Figure 2-2 and Appendix C. By providing both the override functionality and the additional ramp widening, the upstream and downstream intersections along the crossing arterials would not experience any significant impacts. Appendix F includes the intersection delay results and LOS tables.

Innovative Management Techniques: The inclusion of innovative techniques to the CGI Team's program compliments the benefits provided from the roadway concepts. Adaptive ramp metering particularly helps reduce the buildup of recurring congestion in the following locations:

- Metering the southbound entrance ramps provides almost 15 minutes in travel time benefit in the express lanes and 8 minutes in the local lanes,
- Metering the southbound entrance ramps at MD 80 and MD 109 manages congestion near the weigh stations south of MD 109,
- Metering the MD 121 and MD 117 southbound entrance ramps manages congestion that starts just north of I-370,
- Metering the southbound entrance ramps from Shady Grove Road to Montrose Road reduces congestion along the express and local lanes in this section and further downstream to the I-270 spurs, and
- Metering the southbound entrance ramps from I-370 smooths the flow of traffic onto I-270, improving the efficiency of the traffic merging during the peak periods.

Active Traffic Management in the form of DSL and QW provides mobility benefits by reducing the turbulence in freeway traffic flow by reducing the traffic shockwaves and helping to prevent flow breakdown from occurring. Speed harmonization upstream of the queues will reduce the fluctuations in speeds and potentially reduce the duration of the queues along the freeway segments even during recurring congestion periods. It is difficult to quantify the benefits of ATM using the VISSIM models, therefore, we have not include the potential mobility benefits of ATM in our reported mobility improvements. However, as presented in FHWA's *Synthesis of Active Traffic Management Experiences in Europe and the United States (August 2013),* based on assessment of projects where dynamic speed limits and queue warning were implemented, the mobility benefits for the corridor include a modest increase in roadway capacity as well as an increase in throughput of up to five percent.

Trucks entering and exiting I-270 at today's weigh station locations cause friction in the travel lanes along I-270 when they are open, compounding capacity and geometric challenges. Implementing virtual weigh stations (VWS) will aid in reducing this turbulence by cutting down in the number of trucks leaving the normal traffic stream. Various studies, including a 2009 Maryland Virtual Weigh Station Final Report completed by SHA documented that VWS was as or more effective as traditional screening tools, and the MD 32 pilot indicated that VWS was also effective in identifying heavy vehicles with safety concerns. We have not included the potential benefits of VWS in our reported mobility improvements; however, we believe it should contribute to improving mobility in the vicinity of the existing weigh stations.

Real-World Applicability: The benefits of the CGI Team's program of improvements have been estimated using the VISSIM models provided as part of SHA's RFP. While the VISSIM models were developed and calibrated to best reflect travel conditions during the peak periods, there are a few factors to consider when assessing the model results. Our Team assessed each of these factors when evaluating the merits of each concept when developing our program. Specifically, these factors included:

- Existing Weigh Station Operations. The VISSIM models provided in the RFP did not route any truck traffic into and out of the weigh stations during the peak periods. A review of the historic traffic data shows friction near the weigh stations, and as such, we adjusted the existing conditions model to have vehicles entering and exiting the weigh station, essentially treating it as open during peak periods. This caused the model to show peak period operations that were worse than those indicated in the base model from SHA. However, we feel that incorporating this real-world condition into our model will provide SHA with a more accurate picture of how I-270 will operate once our proposed improvements are implemented.

- Impact of I-495 Outer Loop Congestion. The VISSIM models provided in the RFP extends along southbound I-495 (outer loop) to the Clara Barton Parkway interchange and the American Legion Bridge. A review of existing traffic conditions shows that during the AM peak, the southbound I-495 bottleneck stretches across the American Legion Bridge and approximately 1 to 2 miles into Northern Virginia. This bottleneck is not reflected in the VISSIM model. The CGI Team's program of improvements will improve vehicular throughput throughout the I-270 corridor, and would increase throughput to southbound I-495 by approximately 545 vehicles during the AM peak hour. While we anticipate this would add one mile of queuing, today's 3-mile queue along I-270 approaching I-495 is nearly being eliminated by our program of improvements. Similarly, during the PM peak, we are not anticipating significant increases in throughput that would affect downstream operations along I-495. We believe that the overall benefits our program provides outweighs this downstream consideration.
- Metering provided by I-495 Inner Loop Congestion. Congestion approaching and across the American Legion Bridge has the opposite impact for northbound I-495 (inner loop) approaching I-270. This congestion actually meters traffic entering the I-270 system, reducing the number of vehicles entering the I-270 system during the peaks. Our program of improvements is focused on reducing congestion and improving the throughput for those vehicles already entering the I-270 system.
- Proximity of Multiple Entrances to the Freeway System. With many closely spaced interchanges and a densely developed roadway network, motorists entering I-270 have multiple choices on where to enter the I-270 system. The use of adaptive ramp metering for all southbound entrance ramps between MD 80 and Montrose Road allows for the traffic flow demand to be controlled as described under intersection operations. For areas outside of the ramp meter system, such as the Democracy Boulevard entrance, we believe that the downstream congestion along southbound I-495 (outer loop) will not cause a significant shift for traffic volumes entering I-270 southbound at Democracy or entering I-495 westbound (outer loop) at MD 187.

Ultimately, we understand that these real world conditions must be considered by SHA in the evaluation of our proposed improvements. As required, we are reporting our anticipated mobility benefits based on the output of the VISSIM models, including the adjustment for the existing weigh station operations noted in the first bullet above. We did not adjust the VISSIM model to reflect the queuing on the I-495 outer loop that was not reflected in the VISSIM model, since that queuing includes elements beyond the scope of the provided model. However, SHA should consider how the reported southbound I-270 mobility benefits resulting from CGI's proposed solutions should be considered in lieu of the known downstream bottleneck along the outer loop of I-495 at and beyond the American Legion Bridge.

It also must be noted that the above results represent the mobility benefits from our improvements during the peak period. In addition to this, the CGU Team program will have benefits during shoulder peaks and during non-recurring congestion periods. The roadway improvements provide full-time additional capacity at existing bottlenecks. As discussed in Section 4, adaptive ramp metering and ATM can operate during all times, not just the peak periods, which means that benefits from these technology-based improvements can be realized when heavy traffic occurs at unexpected time (weekends, special events, incidents during non-peak times, etc.).

2.II Trip Predictability

A primary indicator of trip predictability is travel time reliability, which is defined by FHWA as the consistency or dependability in travel times, as measured from day-to-day and/or across different times of the day. Two measures of travel time reliability are travel time index (TTI) and planning time index (PTI).

- TTI is the ratio of the average travel time during the peak to the travel time under free flowing (ideal) conditions. The higher the number, the longer the travel times.
- PTI is the ratio of worst case travel time during the peak to the free flow travel time. It is a measure of the amount of time that should be planned for to ensure an on-time arrival and incorporates typical and unexpected delay. The higher the number, the less reliable and longer a trip could take.

If travel times vary greatly it becomes difficult for travelers to plan their trip and an unpredictable trip can frustrate drivers. Such is the case with I-270. Using 2015 data from RITIS, southbound I-270 during the AM peak period has an average weekday TTI of 1.77 and a PTI of 3.37. Using thresholds defined by SHA in the *2015 Maryland State Highway Mobility Report* (December 2015), this means the corridor is heavily congested and extremely unreliable during the AM peak.

Northbound I-270 during the PM peak has a TTI of 1.14 and a PTI of 1.64. Using the SHA thresholds, the overall corridor is uncongested and moderately unreliable, but the West Spur during the PM peak has a TTI of 1.98 and PTI of 3.33. It is heavily congested (borderline severely congested) and extremely unreliable.

Improved Reliability

- Trip reliability will be improved by 9%, saving I-270 users nearly $100,000 each day.
- Improvements at every unreliable location along I-270 identified in the 2015 *SHA Mobility Report.*

These unreliable travel conditions along the I-270 corridor have a direct cost to roadway users. The "Reliability Measurement" module of SHA's "Benefit-Cost Analysis" tool calculates a cost based on variability in network-wide travel time results. The module applies separate values for travel time and reliability (in $ per minute) to the results from multiple VISSIM simulation runs. Models with widely varying results across multiple runs will result in higher costs. The existing I-270 network was analyzed using the reliability measurement module. The network-wide travel time variability results in user costs of over $492,000 during the AM peak hour and over $508,000 during the PM peak hour. The PM peak has a higher user cost due to the excessive and highly variable travel times along both directions of the I-270 West Spur. Together, unreliability during the AM and PM peak hours alone costs users, most of which are commuters, more than $1,000,000 each day.

The program of improvements will improve reliability such that the cost to users due to travel time variability will decrease to $909,000 during the AM and PM peak hours. The unreliability will be reduced by 9%, and while this percentage cannot be directly applied to real-life conditions, it is reasonable to assume that TTI and PTI for the corridor will be reduced considerably.

Predictable Commuter Trip and Reliability

Overall, the CGI Team's improvements will provide a more predictable commuter trip with better travel time reliability. Specifically, the roadway improvements are targeted to address the bottlenecks that contribute to extremely unreliable conditions on I-270.

Roadway Improvements: According to the "*2015 State Highway Mobility Report*," of the Top 30 unreliable highway locations in Maryland, four I-270 locations were on the AM peak list and four were on the PM peak list. As presented in the Section 2.i above, the roadway improvements will address each bottleneck, which contribute to unreliability along I-270, improving overall reliability for the corridor. Table 2-4 shows the unreliable locations and their statewide rankings and the specific improvement concepts that will address each location.

Adaptive Ramp Metering and ATM: Non-recurring congestion contributes to trip unpredictability. Roads like I-270 that have high levels of recurring congestion are more vulnerable to non-recurring congestion. Small incidents can create long backups, delay, and unreliable conditions for hours. If a minor rear-end collision occurred on an uncongested multi-lane roadway, a driver could easily change lanes to avoid the impacts from the incident. During peak periods on I-270, drivers cannot easily change lanes and must slow down approaching the incident, which sends a traffic shockwave of vehicles slowing down throughout the corridor. About 63% of crashes during the peak periods are rear-ends or sideswipe accidents, both indicative of congestion-related accidents. Our proposed adaptive ramp metering and ATM solutions will have a primary purpose of reducing these types of congested-related accidents. Adaptive ramp metering works to smooth the merging operations at interchanges, which will lead to fewer sideswipe accidents. ATM, through DSL and QW, is designed to vary speed limits during congested periods and alert drivers in advance of congested traffic. As presented in detail in Section 3, both approaches have been shown to reduce to number of rear-end accidents. Table 2-4 shows where adaptive ramp metering and ATM will be implemented at the unreliable locations along I-270.

As discussed more completely in Section 3, together adaptive ramp metering and ATM are anticipated to reduce the peak period accidents by 18% where both are provided (along southbound I-270 within the express-local lanes), and by 10% where only one approach is provided. This significant reduction in crashes would greatly reduce non-recurring congestion due to crashes, and therefore improve overall trip reliability and predictability. Moreover, adaptive ramp metering and ATM can be operated at all times, not just during peak periods. The ability for full-time operation means that trip reliability and predictability could also be improved during off-peak times.

Table 2-4. Proposed Improvements at Unreliable Locations along I-270.

Unreliable Locations During AM Peak (Direction)	Statewide Rank	Proposed Improvements
Shady Grove Road to MD 28 Local Lanes (Southbound)	17	▪ SB 6: Create auxiliary lane in local lanes south of Shady Grove Road ▪ Adaptive ramp metering ▪ ATM
Shady Grove Road to MD 28 Local Lanes (Southbound)	17	▪ SB 6: Create auxiliary lane in local lanes south of Shady Grove Road ▪ Adaptive ramp metering ▪ ATM
Father Hurley Boulevard (Southbound)	19	▪ Adaptive ramp metering
I-370 to Shady Grove Road (Southbound)	22	▪ SB 5A: Reconfigure exit lanes to I-370 ▪ SB 6: Create auxiliary lane in local lanes south of Shady Grove Road ▪ Adaptive ramp metering ▪ ATM
Father Hurley Boulevard to MD 118 (Southbound)	29	▪ Adaptive ramp metering
Unreliable Locations During PM Peak (Rank)	**Statewide Rank**	**Proposed Improvements**
Democracy Boulevard (Southbound)	1	▪ SB 12: Create additional travel lane between Montrose Road and Democracy Boulevard ▪ ATM
I-495 (Southbound)	3	▪ SB 10: Maintain three lanes from I-270 and drop right lane on I-495 at I-270/I-495 merge
I-270 to Democracy Boulevard (Southbound)	12	▪ SB 12: Create additional travel lane between Montrose Road and Democracy Boulevard ▪ ATM
MD 124 to Middlebrook Road (Northbound)	19	▪ NB 4: Create auxiliary lane between MD 124 and Watkins Mill Road and between Watkins Mill Road and WB Middlebrook Road

The CGI Team's program of improvements will enhance travel time reliability and trip predictability on I-270. The targeted roadway improvements will reduce recurring congestion and increase capacity which will accommodate any disruptions cause by non-recurring congestion. The innovative technologies and techniques will reduce the amount of non-recurring congestion by reducing the number of incidents.

2.III Performance Life of Improvements

The CGI Team's proposed improvements will provide benefits over the No-Build condition to 2040 and beyond. However, it is critical to consider what mobility benefit the proposed improvements will provide relative to existing levels of traffic congestion. We completed an evaluation to understand when peak period congestion will return to existing levels in both the southbound (AM peak) and northbound (PM peak) directions. We have also summarized results for traffic operations during the horizon year (2040).

In addition to relating how our proposed improvements will perform over time, it is important to understand that elements from our solutions have been chosen specifically because of the flexibility they offer SHA to help manage traffic in the decades ahead. Finally, the CGI Team knows that the I-270 project is important not only for the millions of drivers who use that corridor each year, but also for how SHA can best use funding for improvements across the state. We have completed a detailed benefit-cost analysis to help us choose solutions that offer SHA the best value for the investment. Each of these elements are discussed below.

Performance Life of CGI's Proposed Improvements

To understand how the Team's program of improvements will operate in the future, the improvements were modeled using the 2040 No-Build network provided by SHA in the RFP. Taken broadly, during both peak periods, the Team's program of improvements provides considerable mobility improvement when compared to the 2040 No-Build. The 18-22%

reductions in southbound travel times during the AM peak and network-wide 13% increase in vehicle throughput during the PM peak exhibit this. The improvements proposed by the CGI Team are robust and provide benefits for over 20 years.

Moreover, by implementing the CGI program of improvements, I-270 would not be expected to return to the same levels of congestion as today until 2040 or beyond. This would be especially true of the AM peak, as virtually all of the relevant congestion measures indicate that the I-270 network with the CGI improvements performs better than under the existing (2015) conditions. During the PM peak, overall congestion levels would be expected to return to pre-improvement levels by about 2040. While the overall congestion levels near current levels by 2040, I-270 would accommodate upwards of 19% more vehicles in the northern section and 7% more vehicles around I-495 during the peak hour. Table 2-5 illustrates key overall metrics supporting this.

Table 2-5. Total System-Wide Traffic Mobility Improvements between Existing Conditions and 2040 (with CGI Program)

Time Period	Mobility Improvements from Existing to 2040
AM Peak	▪ Travel Times: • Southbound: I-70 to I-495 (via Express lanes and West Spur): 14-minute reduction • Southbound: I-70 to I-495 (via Express lanes and East Spur): 15-minute reduction • Northbound: I-495 to I-70 (via Express lanes and West Spur): Identical (33 minutes) ▪ Delay Reduction: • Network-wide: 1% ▪ Vehicle Throughput Increase: • 16% network-wide • 10% southbound along West Spur ▪ Vehicular Density: • Southbound: I-70 to I-495 (via Express lanes and East Spur): 24% reduction in number of segments LOS E/F ▪ Vehicular Speed: • Network-wide: Nearly identical (32 vs 33 mph average) • Southbound: I-70 to I-495 (via Express lanes and East Spur): 28% improvement
PM Peak	▪ Travel Times: • Northbound: I-495 to I-70 (via express lanes and West Spur): 1 minute longer, 49 min (2015) versus 50 min (2040) • Northbound I-270 local lanes: 1-minute reduction • West Spur SB: 7-minute reduction • West Spur NB: 2-minute reduction ▪ Vehicle Throughput Increase: • 13% network-wide • 39% southbound along West Spur • 4% northbound along I-270 local lanes ▪ Vehicular Density: • Northbound West Spur: 39% reduction in number of segments LOS E/F • Southbound West Spur: 31% reduction in number of segments LOS E/F ▪ Vehicular Speed: • Identical (41 vs 41 mph) • 79% improvement southbound West Spur • 11% improvement northbound local lanes

A review of the localized congestion patterns anticipated in 2040 (included in Appendix F) also shows that where congestion is anticipated in 2040 after the implementation of the CGI program are located in areas that are not targeted by the program. Southbound, generally speaking, the bottlenecks approaching I-370 and within the express-local lanes section would remain alleviated through 2040. However, two key bottleneck points, MD 80/MD 109 in Frederick County and the I-270 West Spur, would return to 2015 pre-improvement levels. Similarly, in the northbound direction, congestion in the local lanes from Montrose Road to I-370, as well as the West Spur north of I-495, would remain alleviated; however, the bottlenecks at MD 124 and MD 121 would re-emerge by 2040. By implementing our program of improvements, the capacity constraints that control the entire system in 2040 would shift from being between Father Hurley Boulevard and the West Spur, including the express-local lanes section, to two separate locations: north of MD 121 (the current four lane section), and along I-495 approaching and across the American Legion Bridge. This latter location currently experiences substantial congestion.

Innovative Technology and Techniques

In addition to reducing non-recurring congestion, the proposed technology improvements will optimize the mobility benefits over the life of the project. As demand grows, the technologies will work together to manage traffic to stabilize flow along the corridor. The use of adaptive ramp metering will act as a demand management technique, and regulating entry flow will help preserve the lifespan of the CGI program. Controlling entry flow at the entrance ramp points would limit the potential for induced demand, potential for demand shifts from the arterials, and potentially even limit changes in travel modes. Since the ability to use this technique relies on the southbound entry ramps providing a location for vehicles to wait to enter I-270, our Team's program of improvements has sized each of the southbound ramps to provide enough capacity to accommodate anticipated 2040 demand.

Benefit-Cost Analysis

In order to directly compare the benefits of the CGI Team's program of improvements to the cost of the project, a benefit-cost (B-C) analysis was performed using SHA's "Benefit-Cost Analysis Tool." The tool monetizes the benefits of the proposed improvements and measures the costs and benefits of the improvements against the "do nothing" scenario over the lifetime of the project. Specifically, the B-C tool compares the total lifetime of benefits of the project in terms of reduced delay, anticipated reduction in crashes, and improved reliability to the total costs of initial construction, ongoing operation and maintenance, and rehabilitation/total replacement of project elements. The analysis calculates a single number, or B-C ratio, which can be used to compare alternatives and justify the cost of projects. The larger the ratio, the more the benefits outweigh the costs.

In general, any B-C ratio greater than 1:1 means the project is providing value. The CGI Team's program of improvements results in a benefit-cost of 19.6. This means that for every $1 spent on the project, $19.60 of benefits are realized in the form of improved mobility, safety, and reliability for travelers throughout the I-270 corridor. Over the life of the project, the improvements will save over $2.5 billion in delay costs and almost $46 million in fuel costs. These estimates can also be considered conservative, as the B-C analysis and VISSIM simulations only captured benefits associated with reducing recurring congestion. Delay reductions realized by reducing nonrecurring congestion were not incorporated into the benefit:cost calculations. The actual savings and B-C ratio that would be realized when the improvements are implemented would be greater than what is shown.

When compared to the projects SHA evaluated in the 2015 *Freeway Congestion Management Studies*, the CGI Team's improvements would rank among the top 10 freeway corridor projects in the state, and with a scope of improvements far larger than any of those projects.

The benefit-cost analysis shows that the CGI Team's approach of targeted roadway improvements combined with innovative technologies and techniques, such as adaptive ramp metering, ATM, and virtual weigh stations, can be applied to other roadways throughout the State to improve mobility by reducing recurring and non-recurring congestion.

A technical memorandum describing the methods and assumptions and full results from the Benefit-Cost Analysis Tool can be found in Appendix J.

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

Section 3

INTERSTATE 270

Safety

Submitted by:

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World Class Solutions with Local Leadership

Proposed Improvements

Although the primary purpose of this project is to reduce recurring and non-recurring congestion and improve travel time reliability along I-270, a second important goal is to provide for a safer I-270 corridor. Within the project area, I-270 is characterized by heavy congestion and is considered one of the most congested interstate corridors in Maryland. This congestion results in safety incidents, especially rear-end and sideswipe crashes, which in turn result in even more congestion of the non-recurrent type. Specifically, a total of 2,133 crashes were reported along I-270 between I-495 (including the I-270 spurs) and I-70 over the three-year period between 2011 and 2013. Of those crashes, nearly half (49%) were rear-end crashes. As shown in Figure 3-1, in some of the segments with the highest crash frequencies, the percentage of rear-end crashes is even higher than 49%. Additionally, fixed object collisions accounted for approximately 23% of crashes and sideswipe collisions accounted for approximately 14% of crashes. This crash pattern is typical of congested conditions.

Safety Benefits from Proposed Improvements

- Total number of annual crashes reduced by 140 in year 2040
- Severity of crashes reduced due to annual reduction of 60 fatal and injury crashes in year 2040
- Duration of crashes reduced due to fewer secondary incidents and reduced response times
- Enhanced incident management due to technology improvements
- Maintains at least one full shoulder for the mainline in the entire I-270 Corridor

The CGI Team recognizes that a safer flow of traffic will increase mobility along I-270 by reducing incidents, thereby avoiding delay and increasing travel time reliability. During the first six months of 2015, there were 152 incidents that closed at least one lane of traffic. Of those, 50% occurred during the AM and PM peak travel periods (weekdays, 6:00–10:00 AM and 2:00–7:00 PM). On average, an incident closed at least one lane in the peak direction of travel during one of the peak periods once every two to three days. The average duration was approximately one-half hour; however, several incidents closed at least one lane for more than 90 minutes. By strategically addressing safety needs along the I-270 corridor, the CGI Team will further improve mobility by addressing a frequent source of non-recurring congestion.

In order to provide a safer flow of traffic in the I-270 Corridor, the CGI Team has developed a two-pronged approach to improve safety (similar to our two-pronged approach to improve mobility), that includes the following:

- Roadway improvements that reduce the number and severity of crashes at specific bottlenecks and high crash locations; and,
- Technology-based improvements that reduce the number and duration of crashes, as well as improve incident management capabilities along the corridor.

Proposed roadway improvements that address specific bottlenecks and high crash locations include extending acceleration and deceleration lanes, re-striping to provide an additional lane where there is an existing lack of capacity, reconfiguring interchange ramps, and limited widening.

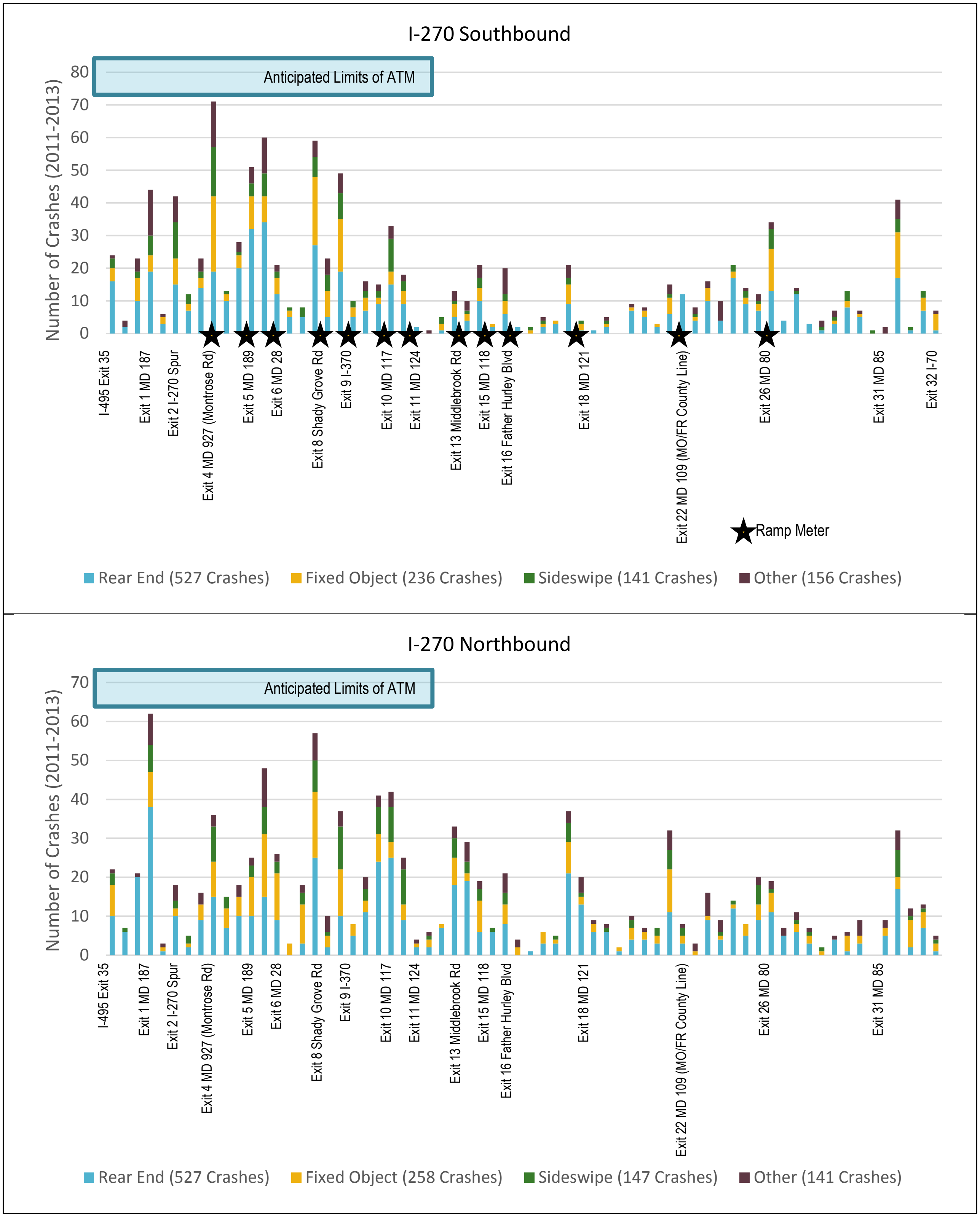
Technology-based improvements proposed for the I-270 corridor include:

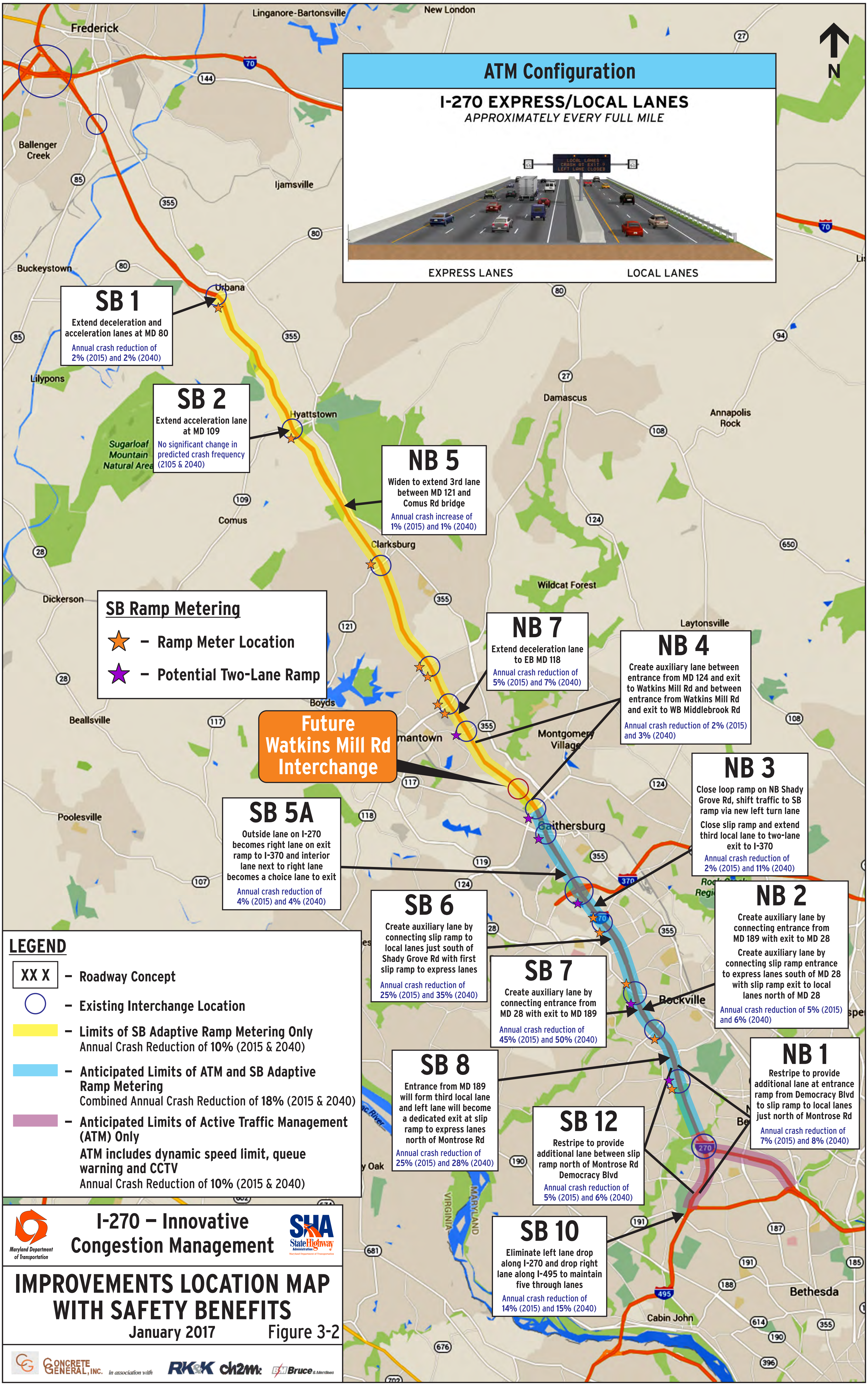
- Adaptive ramp metering along southbound I-270 to optimize the rate of traffic flows entering I-270 and to improve safety along the mainline in the vicinity of entrance ramps;
- Active Traffic Management (ATM) strategies to improve safety and reduce the level of non-recurring congestion by harmonizing speeds and providing advance queue warnings; and
- Virtual weigh stations adjacent to the truck weigh stations to eliminate friction caused by heavy vehicles entering the traffic stream at low speeds, thereby reducing the number and severity of crashes.

Figure 3-2 shows the location of the improvements developed by the CGI Team alongside the quantified safety benefits of each. For additional details about these concepts, including detailed scope and display sheets, please refer to Appendix C.

Implementing this approach will provide motorists with a safer I-270 and increase mobility by reducing the number, severity, and duration of incidents. Under our program of improvements, the number of total predicted crashes along I-270 would be expected to be 105 fewer crashes per year based on 2015 crash frequencies and is estimated to be more than 140 fewer crashes per year by the design year 2040. Severity of crashes will also be reduced with an expected reduction of 40 fatal and injury crashes based on 2015 frequencies and 60 fatal and injury crashes in the design year 2040. The technology-based improvements will directly reduce the number and severity of secondary incidents that occur at the back of queues during non-recurring congestion, as well as indirectly reduce duration by improving incident response capabilities at CHART.

Figure 3-1. Number of Crashes by Crash Type along I-270, 2011 to 2013.





ATM Configuration
I-270 EXPRESS/LOCAL LANES
APPROXIMATELY EVERY FULL MILE
EXPRESS LANES
LOCAL LANES
N
SB 1
Extend deceleration and acceleration lanes at MD 80
Annual crash reduction of 2% (2015) and 2% (2040)
SB 2
Extend acceleration lane at MD 109
No significant change in predicted crash frequency (2105 & 2040)
NB 5
Widen to extend 3rd lane between MD 121 and Comus Rd bridge
Annual crash increase of 1% (2015) and 1% (2040)
SB Ramp Metering
– Ramp Meter Location
– Potential Two-Lane Ramp
NB 7
Extend deceleration lane to EB MD 118
Annual crash reduction of 5% (2015) and 7% (2040)
NB 4
Create auxiliary lane between entrance from MD 124 and exit to Watkins Mill Rd and between entrance from Watkins Mill Rd and exit to WB Middlebrook Rd
Annual crash reduction of 2% (2015) and 3% (2040)
Future Watkins Mill Rd Interchange
NB 3
Close loop ramp on NB Shady Grove Rd, shift traffic to SB ramp via new left turn lane
Close slip ramp and extend third local lane to two-lane exit to I-370
Annual crash reduction of 2% (2015) and 11% (2040)
SB 5A
Outside lane on I-270 becomes right lane on exit ramp to I-370 and interior lane next to right lane becomes a choice lane to exit
Annual crash reduction of 4% (2015) and 4% (2040)
SB 6
Create auxiliary lane by connecting slip ramp to local lanes just south of Shady Grove Rd with first slip ramp to express lanes
Annual crash reduction of 25% (2015) and 35% (2040)
NB 2
Create auxiliary lane by connecting entrance from MD 189 with exit to MD 28
Create auxiliary lane by connecting slip ramp entrance to express lanes south of MD 28 with slip ramp exit to local lanes north of MD 28
Annual crash reduction of 5% (2015) and 6% (2040)
SB 7
Create auxiliary lane by connecting entrance from MD 28 with exit to MD 189
Annual crash reduction of 45% (2015) and 50% (2040)
SB 8
Entrance from MD 189 will form third local lane and left lane will become a dedicated exit at slip ramp to express lanes north of Montrose Rd
Annual crash reduction of 25% (2015) and 28% (2040)
NB 1
Restripe to provide additional lane at entrance ramp from Democracy Blvd to slip ramp to local lanes just north of Montrose Rd
Annual crash reduction of 7% (2015) and 8% (2040)
SB 12
Restripe to provide additional lane between slip ramp north of Montrose Rd Democracy Blvd
Annual crash reduction of 5% (2015) and 6% (2040)
SB 10
Eliminate left lane drop along I-270 and drop right lane along I-495 to maintain five through lanes
Annual crash reduction of 14% (2015) and 15% (2040)
LEGEND
XX X – Roadway Concept
– Existing Interchange Location
– Limits of SB Adaptive Ramp Metering Only
Annual Crash Reduction of 10% (2015 & 2040)
– Anticipated Limits of ATM and SB Adaptive Ramp Metering
Combined Annual Crash Reduction of 18% (2015 & 2040)
– Anticipated Limits of Active Traffic Management (ATM) Only
ATM includes dynamic speed limit, queue warning and CCTV
Annual Crash Reduction of 10% (2015 & 2040)
Frederick
Linganore-Bartonsville
New London
Ballenger Creek
Ijamsville
Buckeystown
Urbana
Lilypons
Hyattstown
Sugarloaf Mountain Natural Area
Comus
Clarksburg
Damascus
Annapolis Rock
Dickerson
Wildcat Forest
Laytonsville
Boyds
Beallsville
Germantown
Montgomery Village
Poolesville
Gaithersburg
Rockville
Cabin John
Bethesda
VIRGINIA
MARYLAND
I-270 – Innovative Congestion Management
Maryland Department of Transportation
SHA State Highway Administration
IMPROVEMENTS LOCATION MAP WITH SAFETY BENEFITS
January 2017
Figure 3-2
CONCRETE GENERAL, INC. in association with RK&K ch2m: Bruce & Merrilees

Defining Improvements to Address Safety Problems

Roadway Improvements: With the exception of the deceleration lane to the exit ramp from southbound I-270 to MD 80 (SB 1), a frequent crash area, the majority of proposed roadway improvements were initially identified to reduce congestion and improve travel time. The collection of roadway improvements was selected based on considerations of safety, mobility, operability/maintainability/adaptability, and cost.

Roadway improvements were evaluated individually using the quantitative methods for estimating change in crash frequency as described in Part C of the AASHTO *Highway Safety Manual* (HSM), using the FHWA approved Enhanced Interchange Safety Analysis Tool (ISATe).

Adaptive Ramp Metering: Ramp metering has been shown to enhance safety by breaking up platoons of vehicles that are entering the freeway and competing for the same limited gaps in traffic. By allowing for smooth merging maneuvers, collisions on the freeway can be reduced.

Adaptive ramp metering will be deployed along southbound I-270, but not along northbound I-270. Metering is most effective when deployed on a corridor-wide basis to reduce overall system delay and promote equity by balancing any ramp delays for all users. Such a system-wide approach is not possible for the northbound direction where much of the traffic entering I-270 comes from the Capital Beltway, an access point that cannot be readily metered.

The HSM does not address ramp metering in the available predictive models in Part C. Instead, the CGI Team applied analysis methods consistent with the guidance and approach to quantitative safety analysis provided in Part D of the HSM to estimate the change in safety performance due to ramp metering.

ATM strategies: The process for identifying limits of ATM strategies was based on the FHWA *Active Traffic Management Feasibility and Screening Guide* (FHWA-HOP-14-019). The CGI Team is proposing to implement the following ATM strategies along I-270 in both directions with anticipated limits between the I-495 and the northern limit of the express/local configuration:

- Dynamic Speed Limits (DSL) – This strategy adjusts speed limit displays based on real-time traffic, roadway, and/or weather conditions. This "smoothing" process helps minimize the differences between the lowest and highest vehicle speeds, thereby improving safety and reliability by reducing the likelihood of rear-end crashes. DSL is aimed at reducing the number and severity of crashes. DSL will provide regulatory or advisory speed limits, based on coordination with SHA and the Maryland State Police (MSP).
- Queue Warning (QW) – This strategy involves real-time displays of warning messages (typically on dynamic message signs, or DMS) along a roadway to alert motorists that queues or significant slowdowns are ahead, thus improving safety by reducing rear-end crashes due to vehicles decelerating quickly. QW will be included as a part of our ATM solution to complement DSL, and is useful in informing drivers as to why the speed limit is being reduced. QW is aimed at reducing the number and severity of secondary crashes, or those that occur in the queues resulting from congestion caused by the initial crash. QW thereby reduces the total incident duration.

> ATM is defined by FHWA as "the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions." Automated and dynamic ATM deployments increase throughput and safety "without delay that occurs when operators must deploy operational strategies manually." Adaptive ramp metering, dynamic speed limit, and queue warning strategies will be deployed in combination to meet system-wide needs of mobility and safety along I-270.

In addition to the DSL and QW strategies selected for I-270, the ATM deployment will be paired with the addition of CCTV cameras (with pan, tilt, and zoom capabilities) on the DSL / QW pedestals, as described in Section 2. As shown in Figure 3-2, there will be pedestal-mount DMS that include the QW, a CCTV camera, speed detectors, and DSL on mast arms approximately every mile. In between, there will be a pedestal-mount CCTV camera, speed detector, and DSL on mast arms. North of the spurs, the DSL will have different speed limit displays for local and express lanes.

Two ATM strategies that were initially considered for I-270 but were eliminated from the proposed solution were dynamic lane assignment (DLA) and dynamic shoulder lanes (also known as hard-shoulder running). DLA was eliminated from consideration and is not included in the CGI Team's proposal for the following reasons:

- Crash types and causes: Nearly half of all crashes along I-270 (49%) are rear-ends, and in some of the highest crash segments, the percentage of rear-end crashes is even higher. Moreover, a large majority of the crashes along I-270 have either "followed too closely" or "too fast for conditions" listed as the probable cause. The combination of DSL and QW strategies is best suited to address such crash types and causes. DLA focuses on safely merging traffic from a lane that is closed ahead to the adjoining open lanes, thereby reducing side-swipe crashes which constitute only 14% of all crashes along I-270.
- Cost: DLA requires lane control signs to be installed over every lane. This would entail large and costly gantries spanning the entire width of the roadway every ½ mile (+/-). While this would likely help to further decrease crashes – particularly sideswipe types – such an approach would not be as cost-effective as our proposed concepts.
- Risk: Proper operation of DLA would require an enhanced decision support system and significant integration with the existing CHART system. The maintenance and operation of DLA would increase the burden on SHA and CHART.

Dynamic shoulder lanes, or hard-shoulder running, was eliminated from consideration and is not included in the CGI Team's proposal for the following reasons:

- Operational Flexibility: Often emergency response vehicles use the shoulder to access the incident scene. Not having the shoulder available would adversely affect the safety of the driver of a vehicle that is disabled and/or in an incident which in turn would adversely affect the mobility of other drivers on the road. If dynamic shoulder lanes were implemented, it would be necessary to implement some form of DLA to close the shoulder to traffic as part of the incident management process, thereby further increasing project costs and system operator responsibilities similar to a full scale DLA deployment. During incident management activities, if the shoulder were to be closed, traffic would need to merge back into the general purpose lanes. During congested periods, when hard-shoulder running would be implemented, the additional merge necessary for incident management activities would introduce additional friction that may lead to additional crashes.
- Cost: Mitigation techniques would be necessary to address the loss of shoulder functions noted above. Typically, this would include constructing supplemental emergency pull-off or refuge areas which would add construction costs.

Virtual Weigh Stations: Virtual weigh stations are a modern approach to commercial motor vehicle weight, height, and safety enforcement. Virtual weigh stations are proposed along northbound and southbound I-270 near the existing location of the weigh station facilities south of MD 109. There is limited data available about the safety benefits for general road users associated with the implementation of virtual weigh stations; however, the virtual weigh stations will reduce the number of trucks that must diverge and merge with I-270 traffic to access traditional weigh stations. This will likely reduce both the number and severity of incidents, although there are no established methods for quantifying the benefit. Additionally, there are several safety guidelines separate from height and weight requirements, such as speed, lights, brakes, steering, tires, suspension, and regulated downtime that do impact the safety of the traveling public. Virtual weigh stations are associated with increased safety on the roads by removing violators from the traffic stream.

The safety improvements of the virtual weigh stations proposed by the CGI Team are not quantified, but will be an added benefit to SHA beyond the predicted crash reductions associated with the other proposed improvements.

3.1 Number/Duration/Severity of Incidents & Incident Management

Number of Incidents

Roadway Improvements: The safety benefits of individual roadway improvements were evaluated by determining the difference between the predicted crash frequencies using the ISATe tool based on existing and proposed conditions. The HSM methodologies predict the long-term crash frequency by crash severity. Table 3-1 summarizes the difference in predicted average annual total crash frequency for both present year (2015) and future year (2040) traffic volumes. Negative values in Table 3-1 indicate a reduction in annual crashes due to the proposed improvements. Detailed analysis results, including the difference in estimated crash frequencies by crash severity for each roadway improvement, are found in Appendix H.

Table 3-1. Proposed to Existing Condition Comparison of Predicted Crash Frequency (2015 and 2040).

Roadway Concept	Difference in average number of crashes per year		Notable Safety Impacts
	2015	2040	
SB 1	-0.44	-0.67	▪ Decrease in total crashes, property damage only (PDO); no anticipated impact to fatal and injury crashes
SB 2	0.04	-0.06	▪ Decrease in PDO
SB 5A	-0.61	-0.66	▪ Decrease in total crashes, injury and PDO; no anticipated impact to fatal
SB 6	-2.39	-4.01	▪ Decrease in total crashes and all severities
SB 7	-11.57	-16.48	▪ Decrease in total crashes and all severities; largest anticipated benefit (total, fatal and injury) SB concept
SB 8	-5.45	-7.94	▪ Decrease in total crashes and all severities; third highest anticipated total crash benefit of the SB roadway concepts; second largest for fatal and injury
SB 10	-2.80	-3.38	▪ Decrease in total crashes, injury and PDO; no anticipated impact to fatal
SB 12	-7.07	-9.16	▪ Decrease in total crashes, PDO; second highest total crash benefit of the SB Concepts; crash benefit primarily PDO
Total SB Improvements	-30.29	-42.34	
NB 1	-8.57	-12.02	▪ Decrease in total crashes, PDO; highest total crash benefit of the NB Concepts; crash benefit primarily PDO
NB 2	-1.49	-2.52	▪ Decrease in total crashes, fatal and injury; second highest total crash benefit of the NB Concepts; decrease in crash severity
NB 3	-0.58	-5.18	▪ Decrease in total crashes, fatal and injury; decrease in crash severity
NB 4	-1.51	-2.49	▪ Decrease in total crashes, PDO
NB 5	0.13	0.12	▪ Decrease in PDO
NB 7	-0.28	-0.45	▪ Decrease in total crashes and all severities
Total NB Improvements	-12.30	-22.54	
Total Improvements – Both Directions	-42.59	-64.90	

As shown in Table 3-1 the expected net impact is a decrease in predicted annual crashes for the build conditions compared to the existing or no build conditions. Additionally, the predicted safety benefit is estimated to increase even as traffic volumes grow between existing and design year 2040. As a whole, the collection of roadway improvements is predicted to reduce the predicted annual number of crashes by more than 9% (65 crashes in 2040) within the localized concept limits, compared to existing or no build conditions.

Concepts SB 1, SB 2, and NB 7 are predicted to reduce the number of incidents because these improvements increase the length of deceleration and acceleration lanes and contribute to a reduction in rear-end and sideswipe crashes from vehicles decelerating quickly or merging within a short distance. Concepts SB 6, SB 7, SB 8, SB 12, NB 1, NB 2, and NB 4 provide an additional travel lane to address recurring congestion and contribute to a reduction in rear-end crashes.

Concept SB 10 is expected to reduce the number of sideswipe crashes associated with the existing left-lane drop by providing the merge on the expected right side of the roadway. Concept NB 3 will eliminate a source of friction by removing a merge point and eliminate a weaving segment, both of which will contribute to a reduction in sideswipe crashes.

It should be noted that not all of the roadway improvements result in reductions in crash frequency. Concept NB 5 is predicted to increase the total number of crashes per year by 0.13 and 0.12 in years 2015 and 2040, respectively. This concept was retained in the proposed program of improvements because the predicted increase in the annual number of crashes is marginal and multiple factors including mobility, operability/maintainability/adaptability, and cost were also considered in selecting the overall program of improvements.

Adaptive Ramp Metering: Crash modification factors (CMFs) were developed based on the experiences in the US locations documented in the FHWA *Ramp Management and Control Handbook*, and applied to estimate the change in crashes as a result of implementing ramp metering. In addition to data in the Ramp Management and Control Handbook, the FHWA CMF Clearinghouse contains a single CMF for ramp metering of 0.64 which, indicates a 36% reduction in total crashes. However, the CMF is based on a single study of nineteen ramp meters in northern California.

> Ramp metering is expected to result in 24 fewer crashes each year.

The CGI Team determined that a 10% reduction in crashes along southbound I-270 is appropriate for those segments where adaptive metering will be deployed. Relative to the crash reductions experienced in other locations in the US, the assumed 10% reduction is a very conservative value; but for the purpose of predicting future crash reductions, the CGI Team believed such a cautious approach was most appropriate. This equates to an annual reduction of 24 crashes along SB I-270 between MD 80 and the Y-split.

Active Traffic Management: Similar to adaptive ramp metering, CMFs were developed based on the experiences in the US locations documented in the FHWA *Active Traffic Management Feasibility and Screening Guide*, and applied to estimate the change in crashes as a result of deploying DSL and QW. In addition to the benefits documented in FHWA's *Active Traffic Management Feasibility and Screening Guide*, the CMF clearinghouse contains a single CMF for variable speed limits of 0.92 which indicates an 8% reduction in total crashes; however, the CMF is based on deployment in St. Louis, Missouri and includes only one year of after data.

> ATM are expected to result in 41 fewer crashes each year.

The experience in Portland, Oregon most closely resembles what is proposed for I-270 for the deployment of ATM strategies (i.e., DSL and QW, with no DLA). Portland has shown the highest reduction in crashes of the US ATM examples at 21%. As was the case for the ramp metering crash reduction prediction, the CGI Team went with a conservative approach, assuming a 10% reduction in crashes along those segments where DSL and QW strategies will be deployed. Using a 10% CMF, while much less than the Portland experience, is closer to the results from ATM in the US. This equates to an annual reduction of 41 crashes along the I-270 segments identified for the implementation of ATM.

Combined Impacts: The previous discussions have addressed the predicted reduction in crashes from roadway improvements, adaptive ramp metering, and ATM on an individual strategy basis. Figure 3-2 shows the predicted reduction in crashes for the entire I-270 corridor incorporating all of the proposed strategies.

There is always the potential situation of double counting some of these crash reductions when multiple strategies are deployed in the same locations. Therefore, these numbers do not reflect a simple summation of the individual strategy results. Recognizing this possibility, the CGI Team continued its conservative approach to crash reduction and estimated the total reduction in crashes from the recommended strategies as follows:

> The total predicted reduction in crashes as a result of our improvements along I-270 is more than 105 total crashes in 2015 and more than 140 crashes in the design year 2040.

- Roadway improvements: The specific roadway conditions are taken into consideration and only the relative difference between the existing and proposed, or expected change in crash frequency, was taken into consideration when estimating the predicted reduction in crashes. These estimates are also limited specifically to the area in which the roadway improvements are focused and do not take into consideration other indirect impacts to safety, thereby producing a conservative estimate of benefit and limiting the risk of double counting.

- Segments with both ATM and ramp metering (i.e., SB I-270 from around MD 124 to the Y-split) are assumed to have a net 18% reduction in crashes. This is slightly less than the 10% + 10% = 20% reduction that would occur from a simple summation of the assumed crash reduction values presented above. It is important to recognize that ramp metering and ATM target different types of crashes. ATM-related crash reduction will tend to focus more on rear-end crashes and those incidents where the primary cause is excessive speed for the conditions (DSL) or following too close for the conditions (QW); whereas ramp metering, providing a smoother merge process, focuses more on side-swipe crashes during peak period conditions when congestion is at its greatest. Both strategies complement one another. Moreover, in developing the crash reduction factors for ATM along I-270, the CGI Team focused on ATM deployments in the US where ramp metering was already operational. As such, the CGI Team believes any overlap or double counting is minimal.

Duration of Incidents

The reduction in the duration of incidents has been qualitatively included in our analyses, but there are limited tools and data available to quantify the reduction. The targeted roadway improvements are not expected to impact the duration of incidents; however, the technology-based improvements are included specifically to address incident duration.

Although ramp metering will likely not directly impact the duration of incidents, it will be very beneficial in managing traffic upstream of a crash site. By being an adaptive approach, the rate of release of entering traffic along I-270 will automatically adjust in response to congestion and delays caused by crashes and other incidents.

DSL and QW strategies will reduce the duration of incidents along I-270, primarily by reducing the number of secondary incidents that occur within proximity to a primary incident when roadways are at less than capacity. In many respects, they can be viewed as an extension of the primary incidents' duration. No statistics were available to quantify the impact, but based on the results from Europe, it is envisioned that the use of DSL and QW, coupled with adaptive ramp metering to reduce the flow rate into the congested area resulting from a primary crash, will result in a reduction of secondary crashes and a reduction in the duration of issues associated with the primary incident.

The addition of CCTV on DSL / QW pedestal poles is expected to improve incident management and response times along these I-270 segments to be more comparable to other SHA roadways that have full coverage CCTV. Incident response is one aspect of incident duration. In 2014 CHART's average response time was 11 minutes, and the average incident took 23 minutes to clear. In 2013, the last year for which crash data was collected, the average incident duration in Maryland was approximately 22 minutes while the average incident duration on I-270 was more than 25 minutes.

Severity of Incidents

Our program of improvements includes an emphasis on reducing some of the most impactive crashes to I-270 – those that result in fatalities or injuries. These crashes have an outsized cost to society at large and reducing them falls into the goals of FHWA's Vision Zero initiatives. Additionally, these types of crashes have an outsized impact on the operations of I-270, typically requiring longer response and clearance times, compromising mobility for hours. A key finding of our predictive safety analysis of the roadway improvements is that in some locations, while the change in the number of total crashes is expected to be small, the number of fatal and injury crashes is expected to be reduced at a rate greater than the total number of crashes. Specifically, for roadway improvement concepts NB 2 and NB 3, the predicted crash frequency for fatal and injury crashes are predicted to decrease, while the predicted number of property PDO crashes increases slightly. See Appendix H for a detailed summary of the estimated difference in crash frequencies for 2015 and 2040.

There is limited data regarding the impact of ramp metering on crash severity; however, as reported in the FHWA *Ramp Management and Control Handbook*, Detroit experienced a greater decrease in injury crashes relative to the overall total decrease in crashes. In other locations, a single crash reduction for all crash severities was reported.

Similarly, there is limited data regarding the impact of ATM strategies on crash severity; however, the speed harmonization benefits of DSL and QW are likely to result in reduced crash severity.

Impact on Incident Management

The addition of CCTV cameras along the 12 (+/-) miles on I-270 between I-495 and the end of the local/express roadway configuration to the north is expected to improve overall incident management response by CHART. Following deployment, the average incident response times along this I-270 segment will more closely match the lower response times along other freeway segments in Maryland that do have full CCTV coverage.

In 2015, the CHART response times for incidents on I-270 were greater than 12 minutes during the AM peak, greater than 11 minutes during the PM peak, and greater than 13 minutes during off-peak periods. In contrast, the response time for incidents along I-95 were approximately 8 minutes during both peak and off-peak periods. With the exception of incident response along the Capital Beltway during the AM peak, which also experienced incident response times greater than 12 minutes, the I-270 Corridor experienced the longest durations of incidents for major roads in the state of Maryland. Additional CCTV cameras will reduce response times by providing a way to identify and confirm incidents in locations that do not currently have video coverage. Faster identification and confirmation of incidents will lead to faster notification of emergency responders.

It should also be noted that the potential negative incident management impact was one of the reasons that the CGI Team did not include hard shoulder running as part of the recommended strategies. One of the key functions of a shoulder is to provide first responder access and a means to bypass congestion to quickly reach an incident scene. Opening the shoulder for traffic flow during peak periods essentially takes away this shoulder function. DLA would be necessary as a mitigation technique to maintain access to incidents during hard-shoulder running operations. During incident management activities, operations staff would also need to determine which segments of the shoulder should be closed to traffic to improve emergency access, followed by the actual tasks necessary to close the shoulder—changing lane control signs and changing DMS messages to warn vehicles that the shoulder is closed and that traffic needs to merge back into the general purpose lanes.

3.II Innovative Technologies or Techniques

By definition, ATM strategies and adaptive ramp metering are innovative in that they are relatively new and have not been widely adopted and implemented in the US. In contrast to emerging technologies that have not been tested, have a higher risk of failure, and/or would not be compatible with the existing CHART infrastructure, the solutions proposed by the CGI Team are more leading edge in nature with proven success in initial deployments. The adaptive ramp metering and ATM strategies proposed for I-270 have been successfully deployed to provide significant safety and mobility benefits in Europe plus a few (and growing number of) implementations within the US. Moreover, several vendors have ATM and adaptive ramp metering software packages available, thereby helping to minimize costs and risks.

> Innovative strategies and technologies, such as active traffic management and adaptive ramp metering, are the primary approaches for achieving the safety goal along I-270.

A potential issue with deploying these innovative approaches is that the technologies and the associated operational concepts will be very new to the drivers of I-270. Accordingly, the CGI Team is committed to supporting SHA with education and outreach activities. Such efforts will be important for the corridor stakeholders to understand how ATM and adaptive ramp metering work, thereby helping to achieve the maximum possible benefits.

The recommended innovative strategies can also set the stage for even further innovation and new technologies in the future as discussed in Section 4.

3.III Mitigation for Non-Standard Designs

The CGI Team's approach is based upon getting the most benefit out of SHA's $100M project budget. As such, the foundation of our proposed improvements, both roadway and technology-based, uses a performance-based practical design (PBPD) philosophy and approach. This "design up" approach allows designers and decision makers to develop solutions that meet the project purpose based on explicitly defined goals, objectives, and transportation performance needs, in contrast to the traditional "top down, standards first" approach. As such, the CGI Team has explored mitigation strategies for locations along the I-270 Corridor that do not meet typical design standards in order to provide for a safer I-270 corridor while maximizing the use of available budget.

3 Safety

Roadway Improvements: While there are several important elements to practical design, we have developed our improvements based upon a careful engineering evaluation of the existing conditions, site constraints, and engineering judgement to identify locations where typical design standards can be modified to address the project goals. Using these approaches, we are able to propose more roadway improvements over a greater portion of the project limits than would be possible using traditional roadway improvement techniques. Our proposed improvements include restriping the mainline, reconfiguring the local lanes in several locations, and extending acceleration and deceleration lanes within existing shoulders. Each of these approaches addresses an identified mobility or safety issue, but does so in a manner that does not fully follow established design guidelines for lane width and/or shoulder width.

> **Attributes of Performance-Based Practical Design**
>
> - Develop alternative solutions that meet the project purpose based on explicitly defined goals, objectives, and transportation performance needs,
> - Utilize relevant, objective data to inform decisions, along with engineering judgement,
> - Base project decisions on critical examination of geometric and operational elements,
> - Work within constraints and minimize potential impacts,
> - Consider whether the same investment of money would yield a greater return on investment if applied to other system needs and/or priorities, and
> - Evaluate how the preliminary design compares to the applicable design standards, and identify any design exceptions.

Utilizing FHWA's ten controlling criteria for design, the proposed roadway improvements will fall below the minimum AASHTO standards for lane width and/or shoulder width and, therefore, will require design exceptions. The CGI Team will collaborate closely with SHA to document the design exceptions in accordance with FHWA's *Mitigation Strategies for Design Exceptions*. Members of the CGI Team have extensive experience evaluating, documenting, and receiving approval for design exceptions. We are confident that the design exceptions required for this project will be approved based on the safety analysis we have completed as part of this proposal effort, mitigation approaches we have taken while developing the proposed improvements to offset the potential negative effects of the proposed design, and engineering judgment about the operational realities of the existing and proposed configurations. As documented above, we have completed a safety analysis of all proposed roadway improvements, and all would either have marginal effects on safety or improve safety.

The proposed improvements already include elements that attempt to mitigate the effects of reduced lane and shoulder width. For example, along the I-270 mainline we are proposing that, where reasonable, at least one full shoulder be provided. Typically, this would be the right shoulder. This approach necessitates limited widening in locations where there is insufficient roadway width to accommodate restriping to provide an additional lane and at least one full shoulder. For improvement SB 12, which involves restriping the mainline of I-270 from just north of Montrose Road to south of Democracy Boulevard, widening is proposed from south of Tuckerman Lane to south of the Y-split interchange. This approach ensures that there is a full shoulder to accommodate stopped vehicles and emergency response vehicles in this segment. For the improvements along the local lanes, such as SB 6, widening is impractical in many locations because of roadside retaining walls or noise walls. However, in these locations the proposed reconfigured roadway segments where shoulders would be reduced would be limited in extent to at most one-half mile (typically much less). This limited distance with no full shoulders is mitigated by the fact that at least one full shoulder would be provided before and after these segments.

Technology-based Improvements: The proposed technology-based improvements were chosen to meet typical design standards in a cost effective manner. Thus, mitigation strategies are not necessary for deployment of adaptive ramp metering, ATM strategies, CCTVs, or virtual weigh stations. Instead, these techniques help to mitigate existing conditions where I-270 does not meet typical design standards by improving operations and safety.

In closing, the CGI Team believes the proposed improvements offer SHA the best value and meet the safety goal of the project. We are committed to working closely with SHA to further refine the proposed improvements to maximize the ultimate safety benefits.

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

Section 4

INTERSTATE 270

Operability/ Maintainability/ Adaptability

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

The CGI Team understands SHA values solutions which will provide for ease of operations and maintenance while still addressing the mobility and safety goals now and in the future. The CGI Team improvements along I-270 will provide tangible improvements to mobility, safety, and trip predictability without significantly increasing the cost or complexity of SHA operations and maintenance needs and activities. Further, our improvements are adaptable to future transportation technological advancements. Compatibility and integration of the proposed solutions with SHA's existing infrastructure, including CHART, are key considerations in developing these proposed improvements as these are technologies SHA staff is familiar with operating and maintaining. The innovative strategies proposed by the CGI Team are not only adaptable to future advancements, but set the stage for the future of transportation.

The CGI Team has developed improvements addressing SHA's goals of improved mobility and safety while considering operations and maintenance needs. Our proposed improvements are a combination of pavement (roadway) and non-pavement improvements (technology-based) which will combine to substantially improve mobility and safety along I-270:

- Roadway improvements to address bottlenecks and congestion at 14 locations by widening ramps, lengthening acceleration or deceleration lanes, creating auxiliary lanes and reconfiguring exit lanes. Refer to Section 2 for details of the roadway improvements.
- Adaptive Ramp Metering to optimize the rate of traffic entering I-270 and to improve safety in the vicinity of entrance ramps,
- Active Traffic Management (ATM) strategies to improve safety and reduce the level of non-recurring congestion, and
- Virtual Weigh Stations to improve the operations of commercial vehicles along the northern segments of I-270.

CGI Team Program of Improvements
- Roadway Improvements
- Technology-based Improvements
  - Adaptive Ramp Metering
  - Active Traffic Management
  - Virtual Weigh Stations

Each of these proposed improvements has associated operations and maintenance requirements. This section focuses on those requirements and how the proposed improvements are adaptable to future technological advancements.

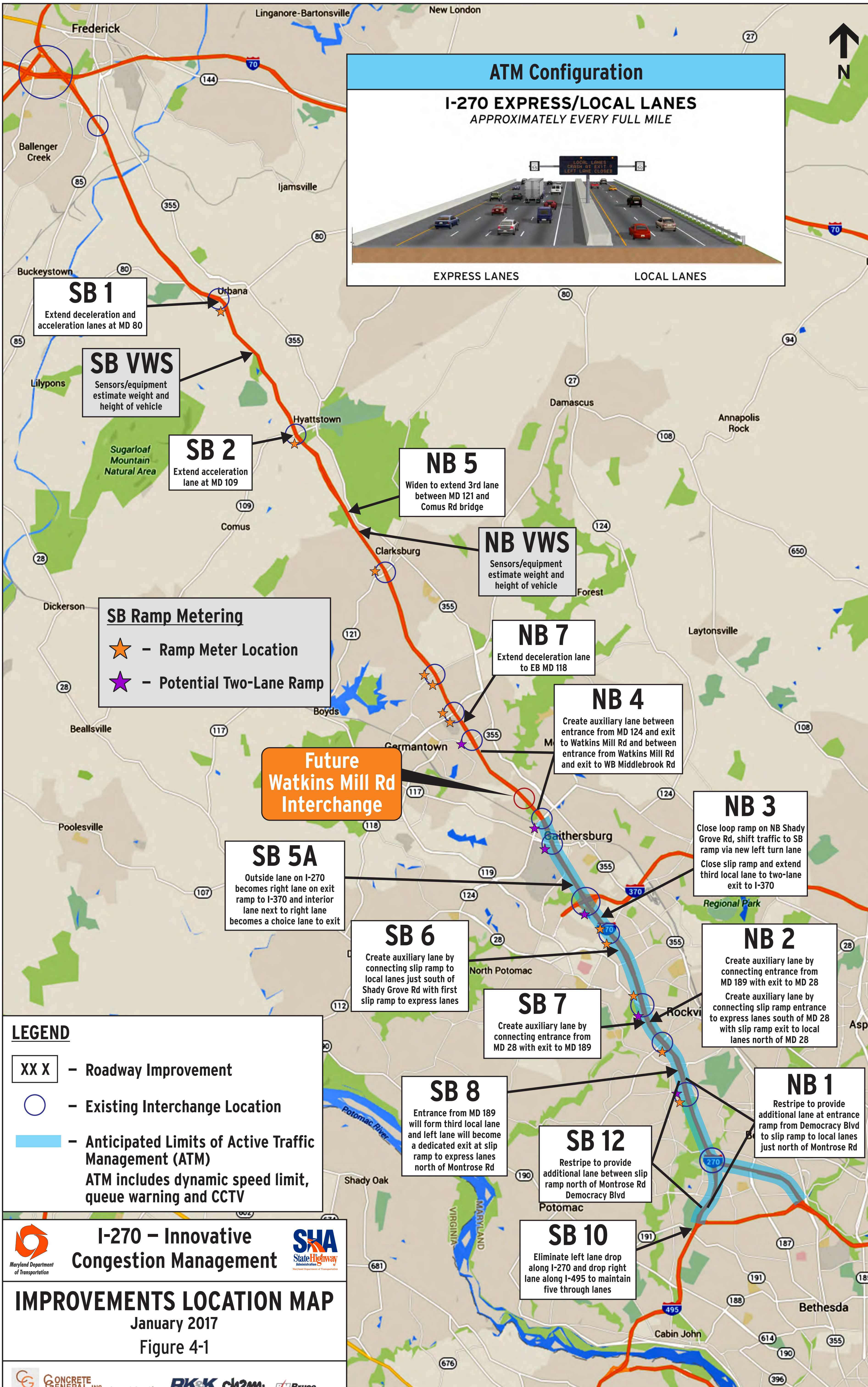
Figure 4-1 shows a map with the location and brief description of each improvement. For additional details about these improvements, including detailed scope and display sheets, please refer to Appendix C.

Functionality of Technology-Based Improvements

In order to properly discuss operability, maintainability, and adaptability, it is important to provide a summary of the proposed operations and functionality of our non-pavement technology-based improvements:

Ramp Metering: The CGI Team will deploy ramp meters at 18 of the southbound entrance ramps along the corridor (all ramps from MD 80 to Montrose Road). The ramp meters will regulate the flow of vehicles onto the southbound I-270 mainline by using traffic signal displays on each of these ramps to hold vehicles for a short period of time (e.g., 4 to 9 seconds) before they are released onto southbound I-270. With adaptive operations, metering rates will be optimized based on real-time mainline flows and ramp demands on a corridor-wide basis. It is envisioned ramp metering will operate primarily during the AM peak period, but will be triggered when volume thresholds are reached (such as when a major incident or special event occurs).

The ramp metering software proposed utilizes queue, demand, passage and mainline detectors to determine the metering rate (i.e., the rate at which vehicles are released, which translates into the number of vehicles allowed to enter the freeway each hour) at each ramp. The system will include queue detectors near ramp entrances to detect backups, allowing metering rate modifications to avoid spillback onto the arterial and local roadways. The ramp metering locations will have communications connections, similar to SHA's standard for new traffic signal systems (Ethernet network using cellular modems). The peer-to-peer technology employed by the proposed system promotes an adaptive metering approach, allowing mainline detectors at any ramp meter location to control the metering rate at a single ramp meter location or many ramp meter locations, without requiring a central management software. This feature is important because it allows the system to address major bottleneck locations by adjusting the metering rate at multiple upstream ramp locations, subject to override by the queue detectors, thereby providing traffic responsive (adaptive) control on a system-wide, equitable basis. The system has the functionality to operate with pre-determined ramp metering rates based on time of day plans (TOD); however, it is expected this mode of operation will be the exception, and the ramp meters will typically operate in adaptive mode. Our Team will configure the ramp meter locations to operate in adaptive mode with minimal oversight from SHA personnel including alarm notifications if issues arise.



IMPROVEMENTS LOCATION MAP
January 2017
Figure 4-1

Active Traffic Management: The CGI Team proposes ATM approximately between I-495 and the northern limit of the local / express lane configurations on the I-270 mainline. The ATM system will consist of dynamic speed limits (DSL) displayed on small full-color Dynamic Message Signs (DMS) installed on mast arms over the roadway (with separate signs over the local and express lanes) at nominal ½-mile intervals. Our Team evaluated lane-by-lane dynamic lane control as part of the ATM system but determined the additional cost and sign clutter associated with gantries spanning the entire roadway did not provide the best value to SHA, particularly since our solution maintains minimum shoulder widths at almost all locations and does not include part-time travel lanes The CGI Team will work with SHA and the State Police to determine if the speeds displayed should be regulatory (speed limit) or advisory. During the concept of operations phase, we will define operational considerations such as compliance, enforcement, judicial implications, operability, and record keeping. Generally, dynamic regulatory speed limits will provide the tools to achieve better compliance, however will require additional reporting and record keeping considerations which may require third party intervention. Another key consideration will be balancing the desire to keep the operating speed for the HOV lane as close to free flow as possible, while using DSL to smooth travel speeds on the adjacent lanes. The Code of Maryland does allow for DSL under Section 21-802(c). Our proposed system will be adaptable to either approach in the future. Queue warning messages will be displayed on larger pedestal mounted DMS co-located with the DSL at nominal 1-mile intervals. The queue warning messages will indicate where queues exist and reinforce the need to reduce speeds (e.g., "Congested Traffic 2 Miles Ahead; Reduce Speeds). Detectors (located on ATM supports) will provide real-time data for the dynamic speed limit and queue warning software algorithms. CCTV cameras will be installed on the poles to support and enhance incident management activities. The ATM system will operate on a 24/7 basis. Appendix I shows potential operational scenarios along a segment of I-270.

Our Team is familiar with several turnkey ATM software packages we can deliver within our project budget and will accommodate the system's functional needs. The exact vendor will be selected during the design phase to ensure the best functionality and latest features for SHA for automated operation of the speed limit and queue warning displays. The logic is not applied independently to each location, but takes into account the flow conditions and displays at adjacent signs to ensure no rules, such as maximum decrease in speed between signs, are violated. The CGI Team will continue our discussions with these vendors, and working with SHA, will develop detailed requirements for a compliance matrix, followed by system demonstrations and final costing. The selected vendor will be the one providing the greatest functionality and least maintenance and operations requirements to SHA, for the most reasonable cost.

The CGI Improvements will:

- Minimize Operations Costs
- Minimize Maintenance Costs
- Function well today but be adaptable and set the stage for the future.
- Minimize new equipment and personnel after construction is complete.
- Minimize integration with CHART and existing signal systems, while still allowing for it in the future.
- Minimize Life-cycle Cost
- Be Deployed Quickly
- Maintain shoulders in the entire I-270 corridor.

The ATM devices (DMS, controllers, detectors) will be connected to a central server (where the ATM software will reside) via the existing MDOT Shared Resource fiber network. The specific location of the server has not yet been finalized; it will not be integrated into the CHART system as part of this project, in order to allow the solution to be deployed quickly and more cost effectively. SHA staff will have access to the ATM system enabling review of the operation, identification of any failures, and manual override of the automated operation if deemed necessary. The proposed DMS for queue warning can be setup to allow overrides from the CHART system, if desired by SHA, in order to aid with dissemination of information to motorists during emergencies. The CCTV will be connected and integrated into CHART's video management system via the aforementioned fiber network.

Virtual Weigh Station: The CGI Team proposed to install Virtual Weigh Stations (VWS) at both truck weigh stations in the northern part of the corridor. It is anticipated VWS will be utilized during weekday peak hours to allow the weigh station along I-270 to be closed to eliminate turbulence associated with trucks entering I-270 mainline. During enforcement periods, a Maryland State Police (MSP) vehicle may be positioned downstream of the VWS location and when a violation is detected by the VWS site, the MSP officer is notified. The MSP officer will then pursue the offending vehicle and direct them to an area (most likely the existing weigh stations south of MD 109) for a secondary inspection. The VWS allows enforcement of truck regulations without needing to force all trucks to exit to a truck weigh station and later re-enter the freeway facility. The use of VWS could reduce personnel and equipment requirements, in order to enforce truck weight restrictions, since only violators will be pursued by MSP instead of all trucks being screened, as under the current weigh station operation along I-270. The proposed VWS locations will utilize the software, policies, and procedures already in place for existing VWS locations. Our sites will utilize the same exact equipment as existing VWS sites to ensure operability, maintainability, and adaptability consistent with existing VWS sites. Refer to Section 5 for additional information on third party coordination.

Additional details for non-pavement improvements will be provided in the Concept of Operations which will be developed by the CGI Team at the onset of design.

4.1 Maintenance, Operations, Personnel and Equipment Requirements

The CGI Team's solution includes a plan for maintenance for both pavement and non-pavement elements.

> **The CGI Team Anticipates No New Personnel or Equipment will be Necessary to Operate and Maintain Proposed Improvements**
>
> - Devices similar or identical to existing SHA assets.
> - Maintenance Skills and Procedures Similar to Existing
> - Technology Improvements are Automated Systems
> - Field devices remotely accessible through proposed Central Management Software.

Pavement: Part of our Team's approach is to implement roadway improvements addressing mobility and safety issues in as many locations as possible, maximizing the benefit to I-270 users and the scope of improvements within SHA's available budget. One cost-effective method to achieve this goal is the use of existing shoulders in locations where our Team proposes to reconfigure the existing roadway to provide additional capacity. The highway would be reconfigured to utilize a portion of the existing shoulders as travel lanes while still maintaining minimum width shoulders throughout the corridor. This would include through lanes, auxiliary lanes, and extended acceleration and deceleration lanes. The improvements which include use of existing shoulders are SB 1, 2, 6, 7, 8, and 12; NB 1, 2, 3, 4, 5, and 7; and at the ramp metering locations where existing ramps would be reconfigured to be two-lanes wide to increase storage and to minimize the likelihood of excessive ramp queues. This shoulder use is targeted at spot locations, and does not constitute hard shoulder running for several contiguous miles along I-270. The specific locations for the use of existing shoulders are shown in the detailed improvement descriptions and display sheets provided in Appendix C.

The CGI Team conducted a pavement analysis of existing shoulders based upon the pavement core and as-built information provided by SHA. This analysis revealed that in all locations where we are proposing to reconfigure the roadway, the existing shoulders are sufficient to support full-time traffic loading. However, in the locations of these improvements the existing shoulder pavement sections would not be considered "full-depth" and as such would not be expected to perform as well as the existing mainline pavement. Once under full-time traffic loading, these existing shoulders are anticipated to have a design life of approximately 15 years before major rehabilitation would be needed. This is approximately 10 years less than the anticipated life of the adjacent mainline pavement. The supporting documentation for our pavement analysis is provided in Appendix D. The CGI Team proposes a straightforward method to address this long-term maintenance issue. Instead of performing a full-depth reconstruction of the shoulder pavement when shoulder condition deteriorates after years of traffic use, we propose SHA complete an intermediate grinding and resurfacing operation. This pavement work would be in addition to the normally programmed pavement maintenance that SHA would complete along I-270. Ultimately, this would result in a more expensive pavement maintenance program, but an approach far less expensive and impactful than full depth reconstruction of the shoulder as part of the initial construction. Avoiding full depth reconstruction of the shoulder will avoid the need to construct and maintain new storm water management facilities. The CGI Team approach to roadway improvements maximizes benefit and minimizes cost by augmenting existing SHA resurfacing efforts.

Beyond the need to resurface the shoulders, SHA would only need to provide normal programmed pavement grinding and resurfacing for the remainder of the project design period (2020-2040). Utilizing this proposed approach, the existing shoulder could support full-time traffic loading until SHA needs to complete more extensive pavement rehabilitation for the full highway. The future maintenance costs of the intermediate pavement resurfacing are included in our benefit-cost analysis provided in Appendix J.

Non-Pavement: The proposed ATM and adaptive ramp metering systems consist of electronic equipment, including DMS for dynamic speed limit displays and queue warning messages, ramp metering signals, controllers, detectors, and virtual weigh station equipment, which will need to be maintained by SHA. This will entail both preventative maintenance, performed at regularly scheduled intervals for the upkeep of equipment, and corrective maintenance to repair or replace failed equipment and restore normal operations. Such maintenance is necessary to ensure the associated mobility and safety benefits continue to accrue (the life-cycle costs were included in the benefit-cost analysis in Appendix J). While the non-pavement strategies of ATM and adaptive ramp metering are innovative and new to SHA and Maryland drivers, the SHA maintenance staff will be very familiar with the associated hardware. The proposed hardware for detectors, cameras, controllers, signals (for ramp metering) and DMS (for dynamic speed limits and queue warning) are essentially the same as currently used by SHA. While the maintenance effort will increase as a result of additional devices, the knowledge base required by SHA staff to properly maintain the hardware will remain essentially unchanged. Our Team believes maintenance staff will not be required to learn or implement a new maintenance regimen or procedures for the proposed improvements.

The CGI Team Improvements are Designed with Ease of Maintenance in Mind

- No new maintenance regiments or procedures.
- Limited lane closures to access ATM devices.
- ATM and ramp metering can be remotely monitored.

The proposed system will be designed with maintenance and ease of expansion in mind. For example, the ITS-based field devices, such as DMS, ramp signals, controllers, and detectors can be monitored remotely. The CGI Team proposes central management software to perform real-time monitoring of the field devices and detection of any abnormal conditions, such as loss of communications, DMS and meter display malfunctions, automatic comparison of current operating parameters with expected values, etc. This functional status information is continuously reported back to the server and can be displayed to operators through the central software, including any alarms identifying a malfunction. The system will log such occurrences. Moreover, the proposed device placement and configuration was developed with ease of maintenance in mind, such as locating DMS on center-mount sign structures such that they will be readily accessible by bucket truck, and no more than one travel lane will need to be closed for maintenance/replacement activities.

Maintenance of the adaptive ramp meter system will be very similar to maintenance SHA already performs for traffic signals throughout Maryland. The only new ramp metering components SHA does not already maintain and stock within existing SHA assets is the Econolite/Safetran 2070 controller with Intelight MaxTime ramp meter software. Since Econolite already holds a contract with SHA for traffic signal controllers and associated equipment, acquiring spare parts and maintenance equipment for the 2070 controller will cause no additional procurement to take place during the long-term maintenance of the system. SHA's skilled traffic signal technicians should be able to quickly learn the programming elements associated with the ramp meter software due to the similarities in menu systems with their current traffic signal controllers. The CGI Team will train SHA signal shop personnel on the MaxTime ramp meter software and MaxView central management software.

Similarly, the maintenance of the ATM system components should be familiar to SHA staff. The DMS for DSL may be a bit different in terms of their design, but the basic maintenance principles SHA currently applies will still be mostly relevant. The detectors and CCTV cameras will be the same as currently used for CHART.

Maintenance for the proposed Virtual Weigh Stations will be completed by the Motor Carrier Division and associated support divisions and contractors. Since the proposed VWS sites will be identical in design to existing sites, the CGI

Team expects no new equipment, spare parts, or personnel will be necessary to maintain and operate the new locations.

In addition to the field hardware, there will be additional software (and the associated servers) and firmware requiring "maintenance", which in this context means being able to call the software vendor whenever a potential "bug" is discovered, ensuring the latest software version is in place an operating, and being able to readily expand the system in the future throughout Maryland. Our Team will address these needs with the selected software vendors in terms of warranty provisions, a statewide software license, and a maintenance agreement which covers on-call support when needed and version updates when they come out (which may be an annual expense to SHA).

As part of the preliminary design and implementation activities, the CGI Team will finalize the following:

- Maintenance program plan, including an assessment of any additional resources required and the associated costs to SHA.
- Training and instruction of SHA staff in the maintenance of the hardware and software associated with the ATM, adaptive ramp metering equipment and infrastructure. It will not be necessary for this training to focus on all devices since most of the equipment is not new to SHA, but should focus on the software elements which will be new to SHA.
- Documentation and other manuals on the maintenance of all equipment.

Development of the Maintenance Concept will parallel the development of the system Concept of Operations, so that as the system is defined the maintenance requirements can be defined in greater detail.

Personnel and Equipment Requirements

Once the ATM and ramp metering solutions are installed and become active, and the system has been turned over to SHA, personnel will be needed to support system operations and maintenance. The proposed roadway improvements will have no new personnel or equipment requirements for maintenance or operations. For the purpose of the alternatives analyses, the CGI Team has assumed an additional annual maintenance and operations cost of approximately 5-10% of the capital costs associated with the new ITS field devices. This conservative estimate will be further refined during the Concept of Operations preparation at the onset of the project.

- Operations. A key objective during the CGI Team's analyses of innovative technologies was to minimize the need for active and continuous operator involvement with the associated system software. Dynamic speed limits, queue warning, and adaptive ramp metering operations will be automated to the greatest extent possible, with the software and the controller firmware calculating (in real time, subject to appropriate rules and constraints) the optimum metering rates and speed limits at each location, and displaying the speed limits and any queue warning messages without operator involvement. The automation will be similar to existing SHA systems within CHART including automatic deployment of travel time or weather messages on DMS without operator involvement. Operator involvement will be the exception rather than the rule. Accordingly, our Team anticipates no additional operations staff will be required for the proposed innovative systems. Operations staff will receive training such that they can override the automated system when deemed appropriate, fine tune the various parameters on which automated operation is based, and expand the system sometime in the future.
- Maintenance. Maintenance is expected to be undertaken by SHA's Traffic Operations Division for adaptive ramp metering and SHA's Office of Maintenance Communication Division for ATM via State forces and contractors, therefore incremental maintenance costs for the proposed solutions would be absorbed as part of the regular maintenance budget. Additional spare part inventories may be required as the result of additional field devices. Regardless, new skills will not be required, as all of the proposed equipment is already familiar to SHA maintenance staff. Software maintenance and updates will not require any additional SHA staff, as this will be provided via a software maintenance agreement with the vendors, renewed on a regular basis. Our Team anticipates no new SHA personnel and maintenance equipment will be required for the proposed improvements as part of this project.

Maintenance and operations assumptions, such as no new personnel and maintenance equipment, along with other information on system functions, field hardware and operational scenarios will be confirmed and documented in the

Concept of Operations to be developed at the onset of the project. The American National Standards Institute (ANSI) document, *Guide for the Preparation of Operational Concept Documents* will be used as the basis for developing the Concept of Operations for the I-270 project. As noted in the ANSI Guidance, a good Concept of Operations should tell a story; that is, it should be a narrative, pictorial description of the system's intended use.

4.II Compatibility and Integration

The CGI Team will perform all the project activities, particularly as they relate to innovative technologies and strategies, in accordance with the principles of systems engineering (as shown in Figure 4-2). This process has already commenced with the "feasibility study/concept exploration" and the associated analyses of various improvements as part of the proposal preparation. Systems engineering is frequently described as a "requirements-driven process" where the system requirements are traced back to operational concepts, which in turn are traced back to the overall project goals and objectives. In addition to the goals of improved mobility and safety, and minimal impact on SHA on-going operations and maintenance activities, the CGI Team has been cognizant of the need for our improvements and technologies to be compatible with the current transportation infrastructure, including potential integration into the CHART system.

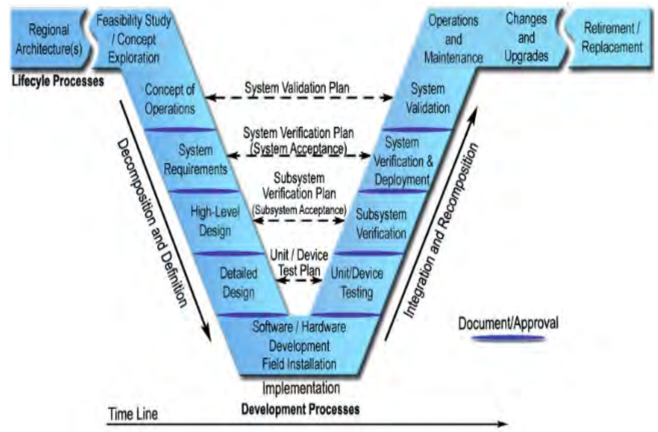


Figure 4-2. Systems Engineering "V" Diagram

Compatibility

The CGI Team's solution combines a series of roadway improvements with the deployment of Intelligent Transportation System (ITS) elements including adaptive ramp metering, Active Traffic Management (ATM), and virtual weigh stations. Our Team is proposing to utilize equipment, materials, systems, and procedures currently used by SHA, **minimizing the addition of new elements to SHA's current transportation assets and maximizing compatibility.** Our solution maximizes compatibility with current infrastructure, meeting SHA's operability/maintainability/adaptability goal for this project. Our solutions have the **ability to function independently of the existing CHART system to expedite project delivery and reduce project cost and risk.** The systems will be designed so as not to preclude integration into the CHART system at a later date.

CGI Improvements will Maximize Compatibility by:

- Using equipment and vendors SHA is familiar with.
- Minimizing the addition of new elements to assets.
- Allowing future integration into CHART.
- Allowing future expansion of the system.
- Completing a systems engineering process as part of the Concept of Operations.
- Following SHA Standards and Specifications.
- Using web browser based Thin applications for Central Management Software.

Current Transportation Infrastructure: In developing a solution, the CGI Team specifically sought to include roadway, civil, and ITS hardware elements which are compatible with current SHA standards, practices, and operations, as described below. This approach offers SHA the ability to use products which are currently stocked, are part of the Qualified Products List, are readily available from suppliers, and have familiarity with operations and maintenance personnel.

Roadway Improvements: The roadway improvements proposed by the CGI Team will be designed where possible to meet AASHTO criteria, but modified as necessary based upon sound practical design approaches. The improvements will be constructed based on SHA's *Standard Specifications for Construction and Materials,* the *Book of Standards*, and other applicable SHA references/standards. These solutions will be compatible with the current infrastructure in the I-270 corridor.

Adaptive Ramp Metering: Adaptive ramp metering is a new form of traffic management for SHA. The CGI Team has defined a ramp metering system to minimize equipment new to SHA and to maximize compatibility. Many of the system components are the exact models SHA currently uses for other applications including the SHA-standard cellular modem and antenna, the Wavetronix Smartsensor HD Radar detector, the Econolite Autoscope video detection camera, and Econolite Size S controller cabinet. However, the system will require some additional components not currently used by SHA including an Econolite 2070 controller and an Inteligt 1C Module in the cabinet. For these elements, our Team has selected a vendor SHA is familiar with so there will be compatibility between the old and new equipment.

ATM: ATM is a new form of traffic management for SHA. However, this can be accomplished using many hardware components already used by SHA including dynamic message signs, the Wavetronix Smartsensor HD Radar detector, standard pedestal-mounted sign structures, and standard traffic signal mast arms. The dynamic speed limit signs (DSL) are not standard and since there are many vendors fabricating these devices, the CGI Team would coordinate with SHA during the design phase to select a DSL model acceptable to SHA and would be as compatible with existing DMS models as possible. CCTV cameras and DMS for queue warning will be compatible to those already in use allowing the devices to be integrated into CHART through normal procedures, if desired.

> **CGI Team's Proposed Software for ATM and Adaptive Ramp Metering will:**
>
> - Successfully operate outside of CHART software.
> - Integrate into CHART software at a later date, if desired.
> - Minimize cost and schedule risks.
> - Minimize operations and maintenance costs.

Virtual Weigh Station: Virtual weigh stations are not new to SHA. The CGI Team is proposing a virtual weigh station installation compatible with SHA's current system including weigh-in-motion sensor equipment, loop detectors, CCTV camera equipment, piezo sensors, over height vehicle detector equipment, and communication equipment to include a cellular modem. Our proposal to add virtual weigh stations will require no software enhancements. The new location can simply be added to the existing software operated using web based Thin Clients by the SHA Motor Carrier Division (MCD), Cardinal Scale Manufacturing, and Maryland State Police (MSP). Our Team will coordinate with MCD, Cardinal, MSP, and Xerox/Conduent (the current vendor) to provide information and input needed to help make the new virtual weigh station locations operable. It is anticipated new sites will be integrated by working with Cardinal, MCD and the SHA Radio Shop.

Proposed Software and CHART System: The CGI Team recognizes software is a crucial aspect of this project. Software is needed to operate the adaptive ramp metering, the dynamic speed limits and queue warning strategies, and the virtual weigh stations. We recognize CHART's software cannot be modified unless the Maryland Department of Information Technology (DoIT) approves of the modification and administers the work under a DoIT contract. Moreover, it is the Team's understanding any work or enhancements to the CHART system need to be performed by others. As such, the CGI solution is to provide and implement strategies and software that can successfully operate outside of the CHART software. At the same time, the software will be configured such that it can be readily integrated into the CHART software at a later date. This approach allows SHA to implement a solution which can be tailored to this corridor, while avoiding large expenditures and risks due to modifying the existing CHART software and avoiding disruption to existing CHART activities. Additionally, our approach is to provide software which is essentially "off the shelf" so as to minimize cost and schedule risks.

Adaptive Ramp Metering Software: The adaptive ramp metering system will be developed and setup to function independently of SHA CHART, SHA Signal Shop and Montgomery County traffic signal system networks. The CGI Team proposes to use the Intelight MaxTime ramp metering software on the controllers in the field and use MaxView software to view, monitor and operate the adaptive ramp metering system from remote locations. MaxView is a web-deployed system which does not require software to be installed on SHA's operator or service technician computers. The use of MaxTime allows the ramp metering components to be very compatible with SHA systems. MaxTime is adaptable to being integrated into the CHART software or SHA Signal system should SHA desire.

Integration

ATM Software: The CGI Team has already commenced discussions with vendors known to have operational ATM software, including the vendors listed in the text box below (listed in alphabetical order). We did not select a vendor to maximize flexibility during design. The ATM software will reside on a separate server independent of the CHART system, with a workstation or web deployed application provided for SHA to monitor the ATM system and override its automatic operations when and if required. The CGI Team will work through the systems engineering process to define the needs and requirements of the ATM system relative to what these vendors can provide with their existing products. During the preliminary design phase, the Team will work with SHA to define the ATM software package which best meets the project requirements (in terms of functionality and costs). While this ATM system will not be integrated into CHART as part of this project, compatibility of the ATM system with CHART for future integration will be considerations into the selection of the software package. The CGI Team will work with SHA and DoIT to define the necessary data and command interfaces, protocols, and methods for integrating the ATM software into the CHART system at a later date such that all I-270 data can combined with other CHART data, and ATM monitoring and control can be accommodated from the CHART workstations including following all guidelines defined by DoIT.

ATM Software Providers

- Coval
- Cubic
- Kapsch
- Q-Free
- Southwest Research
- Siemens
- TransCore

Activities during the software design and implementation phases will include:

- Defining and installing the necessary hardware to operate the ATM software. This includes identifying the location of the hardware (e.g., the CHART facility in Hanover or SHA's Satellite Traffic Operations Center);
- Identifying the placement and communications needs for infrastructure to allow remote access of the ATM and ramp metering software, thereby allowing CHART or SHA Signal Operations operators to interact with the ATM (and ramp metering) system, including override of automated operation when deemed necessary;
- Development of software test plans;
- Development of operating parameters (e.g., rules) to ensure optimum automated operation;
- Testing of the software prior to implementation in the field, and then additional testing (e.g., acceptance test period) following installation of the field devices and integration of the devices with the ATM software;
- Documentation, including a user's manual; and
- Training of SHA staff on the operation of the ATM and adaptive ramp meter software.

The CGI Team recognizes the current CHART software does not currently support ATM or ramp metering technologies, however, by using the devices we have chosen for this project, if and when SHA is ready to add those features to the CHART software, our hardware will be adaptable to that change. We will work with SHA to obtain the hardware needed to operate the ATM software. In addition, we will assist in the configuration of the software when implementing the system and arrange for any needed training.

4.III Maintenance, Operations and Adaptability of Innovative Technologies

The CGI Team's approach for maintaining and operating the proposed innovative technologies and strategies have been discussed earlier in this Section. Our Team recognizes it is important our proposed improvements are adaptable to future transportation technological advancements, while being compatible with existing transportation infrastructure and represent the latest state of the art technology when deployed.

The CGI Team's Improvements Are Adaptable by:

- Setting the stage for future CV and AV deployments.
- Using Ethernet networking for communication, similar to the Internet of Things.
- Not forcing SHA to make a policy decision for future deployments in order to construct our improvements.
- Bridging the gap between current technologies and future transportation technologies.
- Installing supports and communication feeds which can be utilized for future DSRC deployments.

Technology and operational strategies are continually evolving and advancing, and what is relatively new and leading edge today may be obsolete a decade from now. Beyond the near-term future of integrated systems lies a world of Connected Vehicles (CV) and Autonomous Vehicles (AV). Connected vehicle technology will enable vehicles, roads and other infrastructure, and smartphones, to all communicate and share vital transportation information, promoting a 360-degree awareness of nearby vehicles and the transportation network itself. These evolving technologies are not yet ready for widespread implementation, but as Connected Vehicles (CVs) become more ubiquitous along the nation's roadways, including I-270, the design and implementation of ITS-based transportation systems management and operations (TSMO) systems will change. The data rich environment provided by CVs will permit the development of more proactive and predictive algorithms for ATM and other operational strategies. Our Team recognizes CV and AV is the future of transportation technology but exactly what the future will look like is uncertain today. Our innovative improvement strategies represent the "next steps" for SHA and CHART to "bridge the gap" between today's technology and CV/AV. Moreover, once deployed, our "smart systems" will set the stage for the next future steps (refer to Figure 4-3).

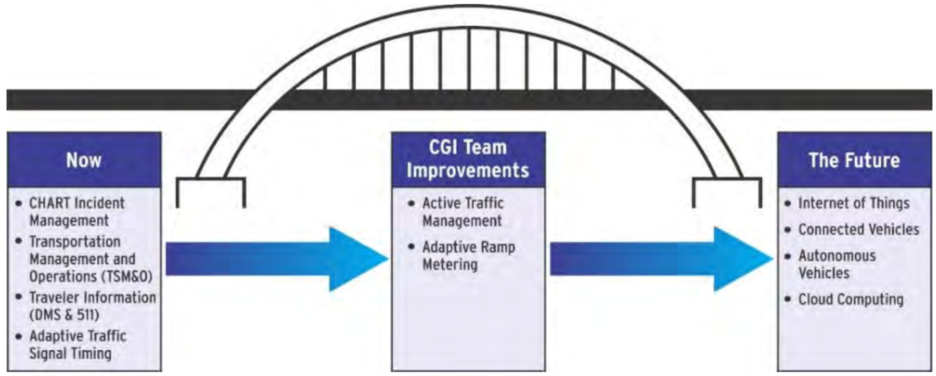


Figure 4-3. Future Transportation Technologies

While our solutions will be adaptive to future transportation technology, they will not force or commit SHA to a specific approach for the future of CV and AV. Our improvements are flexible enough to allow SHA to choose a policy direction for future solutions such as Integrated Corridor Management, the Internet of Things and CV/AV technologies, at a later date. We are avoiding large scale (and expensive) investments in gantries which will span the entire roadway with DMS signs for each lane which will likely be antiquated in a few years when CV technology gains market saturation. By using "off-the-shelf" software products and equipment SHA is already familiar with using, we intend to reduce the risk for high future costs for replacements or upgrades. Our technology based solutions of dynamic speed limits, queue warning, CCTV cameras, and ramp meters will be useful as part of a connected transportation system well into the future.

When the percentage of CVs and AVs will reach this tipping point is a matter of debate, but when it happens, the ITS infrastructure, communication network connections, and supports installed as part of our project can be used for future Dedicated Short Range Communications (DSRC) or other CV technology, perhaps making I-270 a future CV test bed. DSRC is a technology which is expected to be critical for vehicle-to-infrastructure communication as CV and AV vehicles begin to be widely deployed. It is our plan to design the ATM and ramp metering infrastructure (e.g., including spare space in the field cabinets) to accommodate and adapt to CV and AV technology in the future.

The CGI Team improvements will utilize Ethernet based communication networks for all proposed technology based solutions. Transportation and technology industry experts agree Ethernet based networks, working towards the Internet of Things architecture, will ensure our improvements are ready for the future and will not be obsolete in 10 years.

The CGI Team will ensure the newest innovations are incorporated into the design prior to agreement of a Construction Agreed Price (CAP) for constriction to avoid additional costs or change orders. Our Team has not yet selected a software vendor for the ATM system. Since several vendors provide turnkey software features meeting our project needs within the project budget, waiting to make this decision until the design phase allows us to select the package that is the latest, greatest, and most advanced at the time in terms of functionality, while balancing cost and risk concerns. Moreover, our Team recognizes the importance of security for all software products and will ensure SHA is provided the latest version of each software package with a plan for future security patches. Our Team will ensure the newest innovations for technology elements are included in the Construction Agreed Price (CAP), including all necessary integration, software, licenses and training by executing the systems engineering process and working with software vendors and SHA stakeholders through the project process. Our Team will attempt to reduce future costs to SHA by negotiating with software vendors to include the cost of future software releases in the initial implementation cost.

The CGI Team proposes to provide SHA a project which includes roadway improvements and technology-based improvements, is adaptable to the future, and minimizes new maintenance and operations costs after deployment, all while still providing significant improvements for mobility and safety which will last into the future.

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

Section 5

INTERSTATE 270

Well-Managed Project

Submitted by:

CONCRETE GENERAL, INC. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

The CGI Solution

The CGI Team is proposing a two-pronged approach of roadway improvements and innovative technologies and techniques to maximize vehicular throughput, minimize vehicle travel times, and create a more predictable commuter trip along I-270. While the components address both recurring and non-recurring congestion, the roadway improvements focus on relieving today's recurring congestion, and the innovative technologies and techniques focus on managing today's recurring and non-recurring congestion and extending the lifespan of the roadway improvements.

Figure 5.1 summarizes the 14 roadway improvements, and three innovative technologies that comprise our Team's program of improvements, including their implementation schedule. The CGI Team will utilize a Project Management Plan to address communications, coordination, and risk management through a collaborative approach with all stakeholders. This plan will support the project goals and ensure timely implementation of the program of improvements.

5.I. Key Elements of the D-B Project Management Plan

Past experience proves that a cohesive and collaborative Project Management Plan (PMP) that includes owner, design and construction professionals is critical to a successful D-B project. We will use our national and international experience to finalize the design of our programmed improvements and leverage our extensive regional construction experience to implement the solutions successfully.

Communications

Communication and collaboration are fundamental elements of the CGI Team. We will use a task force approach to administering the project, whereby individual design disciplines are grouped into related Task Forces and responsible parties are identified for facilitating coordination and communication both inside and outside the task force.

Task Force Meetings: Task Force meetings will be held on a regular basis to review progress, verify schedule, identify coordination needs, and resolve issues. To enhance communication and collaboration, each task force will include members of the CGI Team, SHA, and reviewing/permitting agencies as applicable. Additional stakeholder and third party representatives may be added as necessary.

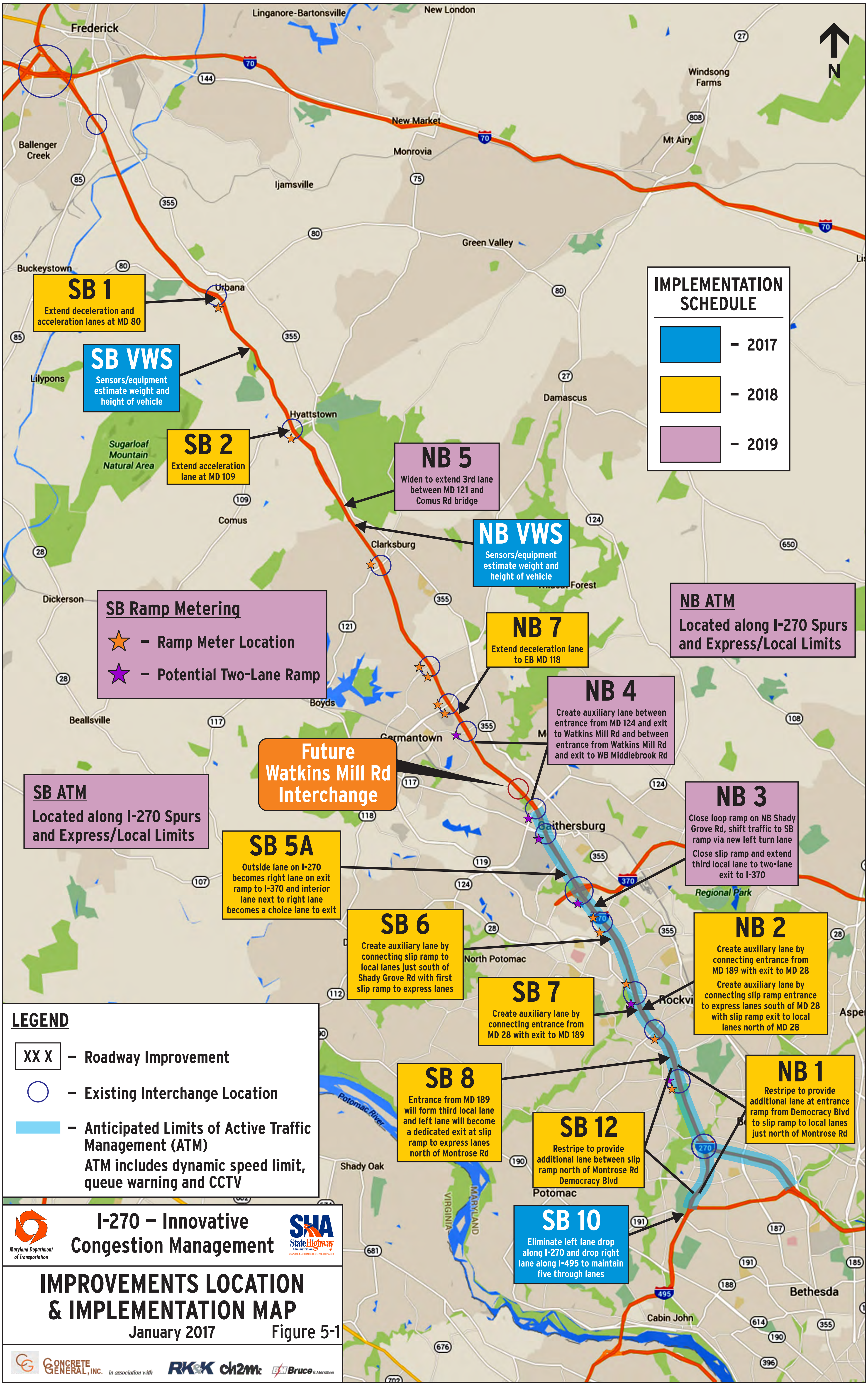
Progress Meetings: Regular Progress meetings will focus on ensuring that the project is meeting or exceeding project goals and expectations, including schedule and cost. The focus of these meetings will be on both design and construction, with topics to be determined as required for each meeting. Typical attendance will include CGI Team design and construction management, task force leaders, SHA Project Management, and others such as utilities, review/permitting agencies, and stakeholders as necessary.

Partnering: SHA's formal Partnering processes for design and construction will be used by the CGI Team to enhance the collaborative nature of the project and to facilitate effective and timely issue resolution. Our Team members are regular participants in the process and recognize the significant value it brings to the project. We will encourage participation by Montgomery and Frederick counties.

Action Logs: All meetings will include action logs, identifying action items, responsible parties, and resolution timeframes. The action logs will be used as the basis for documenting communication needs and issue resolutions. The Task Force Leaders and CGI Team project management will be responsible for ensuring that all action items are addressed.

> **Partnering with Stakeholders**
>
> D-B Manager Michael Higgins and Design Manager Eric Mellor will ensure that SHA and all stakeholders are active, collaborative participants during all phases of the Project, including weekly progress meetings and Task Force meetings. We will identify desired stakeholder contacts, notification requirements, and use a stakeholder interaction log to regularly report all concerns, findings, commitments, and approvals.

Document Control: We will use the Aconex file sharing and collaboration tool to ensure that our Team, SHA, permitting agencies, and stakeholders have access to the latest plan information during design to facilitate reviews and comments resolution. During construction, the document control system will ensure that all parties have the latest plans, including all revisions, and that materials certifications are received and working drawings are approved.


SB 1
Extend deceleration and acceleration lanes at MD 80
SB VWS
Sensors/equipment estimate weight and height of vehicle
SB 2
Extend acceleration lane at MD 109
NB 5
Widen to extend 3rd lane between MD 121 and Comus Rd bridge
NB VWS
Sensors/equipment estimate weight and height of vehicle
SB Ramp Metering
– Ramp Meter Location
– Potential Two-Lane Ramp
NB 7
Extend deceleration lane to EB MD 118
NB ATM
Located along I-270 Spurs and Express/Local Limits
NB 4
Create auxiliary lane between entrance from MD 124 and exit to Watkins Mill Rd and between entrance from Watkins Mill Rd and exit to WB Middlebrook Rd
Future Watkins Mill Rd Interchange
SB ATM
Located along I-270 Spurs and Express/Local Limits
SB 5A
Outside lane on I-270 becomes right lane on exit ramp to I-370 and interior lane next to right lane becomes a choice lane to exit
NB 3
Close loop ramp on NB Shady Grove Rd, shift traffic to SB ramp via new left turn lane
Close slip ramp and extend third local lane to two-lane exit to I-370
SB 6
Create auxiliary lane by connecting slip ramp to local lanes just south of Shady Grove Rd with first slip ramp to express lanes
NB 2
Create auxiliary lane by connecting entrance from MD 189 with exit to MD 28
Create auxiliary lane by connecting slip ramp entrance to express lanes south of MD 28 with slip ramp exit to local lanes north of MD 28
SB 7
Create auxiliary lane by connecting entrance from MD 28 with exit to MD 189
SB 8
Entrance from MD 189 will form third local lane and left lane will become a dedicated exit at slip ramp to express lanes north of Montrose Rd
NB 1
Restripe to provide additional lane at entrance ramp from Democracy Blvd to slip ramp to local lanes just north of Montrose Rd
SB 12
Restripe to provide additional lane between slip ramp north of Montrose Rd Democracy Blvd
SB 10
Eliminate left lane drop along I-270 and drop right lane along I-495 to maintain five through lanes
IMPLEMENTATION SCHEDULE
– 2017
– 2018
– 2019
N
LEGEND
XX X – Roadway Improvement
– Existing Interchange Location
– Anticipated Limits of Active Traffic Management (ATM)
ATM includes dynamic speed limit, queue warning and CCTV
Frederick
Linganore-Bartonsville
New London
Windsong Farms
New Market
Monrovia
Mt Airy
Ballenger Creek
Ijamsville
Green Valley
Buckeystown
Urbana
Lilypons
Hyattstown
Damascus
Sugarloaf Mountain Natural Area
Comus
Clarksburg
Dickerson
Boyds
Beallsville
Germantown
Gaithersburg
Regional Park
North Potomac
Potomac River
Shady Oak
Potomac
VIRGINIA
MARYLAND
Bethesda
Cabin John
Maryland Department of Transportation
I-270 – Innovative Congestion Management
SHA State Highway Administration
IMPROVEMENTS LOCATION & IMPLEMENTATION MAP
January 2017
Figure 5-1
CONCRETE GENERAL, INC. in association with RK&K ch2m: Bruce

Communication with SHA, Permitting and Regulatory Agencies, Utilities and Third Parties: The CGI Team's goal is to include all parties in our normal work process, communications, and meetings. However, we recognize that this may not work for all parties, and will make necessary accommodations to ensure that all parties remain informed as necessary for the project to proceed and the project goals to be met.

Communications with the Public: The CGI Team recognizes that SHA would take the lead in communication with the public regarding the project. We are prepared to support the SHA as necessary by providing progress updates, displays, website material, and written responses to inquiries to SHA. We will attend and make presentations at public meetings set up by SHA, and develop marketing style materials to explain the improvements being made to I-270.

The CGI Team has implemented similar communication strategies on major projects in the region, including the Intercounty Connector, MD210 D-B, and the Purple Line LRT. We understand the local sensitivities and we will build upon existing relationships to make the I-270 Innovative Congestion Management project a success.

Coordination

The CGI Team will focus on proactively identifying those parties to be coordinated with and ensuring that their feedback is addressed and incorporated into the project. We will use a Task Force approach to project development and coordination, with individual Task Force leaders being responsible for identifying and facilitating all necessary coordination activities. With all parties being welcome at the regular Task Force meetings, most coordination will take place at these meetings. We will also offer the SHA and other stakeholders the ability to co-locate with the CGI Team to encourage an active role in the project development. To accommodate specific issues, stakeholders, or requirements, the CGI Team will hold specific meetings or attend meetings held by others to achieve appropriate levels of coordination.

Coordination with SHA: SHA will be an integral partner in the continued development and construction of the improvements by participating in Task Force meetings. We expect that representatives from all interested offices within SHA will be active participants in the Project Development process. This involvement is further detailed in our Work Plan.

Coordination between Construction and Design Teams: Our design and construction Teams have been sitting side by side throughout the procurement process developing the CGI Team solution. This collaborative atmosphere will be carried forward once the contract is awarded, with the construction and design teams collaborating daily to develop the most efficient and effective final design.

Interdisciplinary Coordination: The Task Force leaders be responsible for coordination and collaboration between disciplines, including software vendor/integrator. In addition to the collaboration at the Task Force meetings, weekly progress meetings will include all Task Force leaders to ensure that designs address and are compatible with all disciplines. Task force leaders will be empowered to resolve issues quickly and to involve SHA/ stakeholders as required.

Early Stakeholder Communication

The CGI Team met with Montgomery County early during our concept development process. We have taken in account their concerns and are prepared to demonstrate how our program of improvements will address potential issues and minimize impacts.

Coordination with Other Projects: SHA delayed planned interchange improvements at I-270 / Watkins Mill Road to ensure compatibility with the innovative congestion management solutions. Improvements are also planned at I-270 / I-85. The CGI Team will coordinate our improvements with these and other planned improvements to ensure mutual compatibility and minimize impacts to these other projects. In addition, we recognize that our improvements must be coordinated with SHA's existing infrastructure, including CHART, and other adjacent local systems. Significant collaboration between technical experts from the CGI Team, SHA, and stakeholders will be necessary to ensure the entire system will function properly.

Utilities, Permits and Third Party Coordination: The CGI Team will use a tracking log to identify and track all potential utility relocations and permits, environmental permits and approvals, and third party coordination elements. Each item will include a schedule and party responsible for the coordination.

Emergency Services Coordination: Our Team will meet with Montgomery and Frederick County fire, police, and rescue services to identify impacts and mitigation strategies for emergency services for both temporary and permanent conditions. We will coordinate with the Maryland State Police regarding implementation of the virtual weigh stations.

Our Team has the demonstrated ability to successfully implement similar coordination strategies on significant projects in the region including US 29 at MD 198, MD 216, MD 355 at Montrose/Randolph Road, I-95/I-895 Interchange, and I-695 Inner Loop.

Risk Management

The CGI Team has developed robust risk management identification and mitigation processes to enable successful delivery of this project for SHA. The CGI Team's risk management plan will:

- Identify, and log on a risk register, the potential risks and issues for the program and for each improvement;
- Identify the party (CGI Team, SHA, Stakeholder) most appropriate to manage the risk;
- Develop approaches to minimize or eliminate the risk;
- Develop the necessary mitigation and contingency plans for risks that cannot be eliminated; and
- Review the risk register at each progress meeting.

While our selected improvements have, by their nature, minimized projects risks, our Team will further minimize project risks through our demonstrated experience, ability to manage complex projects, collaboration and communication with SHA and the stakeholders. A sample of project issues and risks, together with proposed mitigation, are provided below:

Software and Integration: Software identification, selection and integration is required for the ATM and Adaptive Ramp Metering aspects of our program of improvements. To mitigate risk inherent in these systems, the CGI Team will utilize FHWA's Systems Engineering Process to guide and document the process. This proven, progressive process will ensure accomplishment of the key activities that ensure the improvements achieve the project goals and address SHA and stakeholder concerns. Additionally, rather than being limited by a specific vendor's capabilities, the CGI Team will select a software vendor based on specific needs of the selected improvements.

NEPA/MEPA: Our program will be implemented as a series of distinct and separate projects with minimal NEPA/MEPA documentation expected for each. This approach, combined with our experience working with SHA OPPE preparing similar documents, allows us to streamline the process ensuring swift approvals. We will support SHA by recommending an appropriate purpose and need addressing logical termini, addressing critical elements such as noise analysis and Section 4(f)/park land coordination, and will ensure that all stakeholders are involved throughout the process.

Environmental / Right-of-Way Impacts: The CGI Team has selected improvements that will remain within the existing right-of-way. If unexpected right-of-way impacts arise, our Team is prepared to (and experienced in) assisting SHA with the acquisition of property. We will seek to minimize or avoid impacts to environmental resources to the extent practical and as required by law. Similar to our experience on the Intercounty Connector, our Team will partner with SHA and agencies early in the design process to obtain necessary permits, perform mitigation, and verify compliance during construction.

Minimize Utility Impacts and Relocations: The CGI Team has designed improvements with the goal of avoiding and/or minimizing utility impacts. Based on our history of work along I-270, we have a good understanding of the potential utility conflicts and the requirements to make new connections to existing systems. Our Team will coordinate with utilities to ensure the information we are using is accurate, impacts are minimized, and necessary connections can be made in accordance with the project schedule.

Coordination with Other Projects: The CGI Team will coordinate our improvements with Watkins Mill and other planned improvements to ensure mutual compatibility and minimize impacts to these other projects. In addition, we will coordinate our selected improvements with SHA's existing infrastructure, including CHART, and other adjacent local systems.

Additional Issues and Risks: Additional issues and risks identified by the CGI Team are summarized below.

RISK	SUMMARY OF RISK	MITIGATION MEASURES
ITS/Communications	▪ Availability of data sources ▪ Limitation & condition of existing infrastructure	▪ CGI Team understands SHA's approach. B&M has installed & maintained SHA infrastructure ▪ CHART / Radio Shop involvement, systems/devices development
SWM/Drainage Issues	▪ Pavement reconstruction requires SWM ▪ Limited right-of-way ▪ Drainage in narrow shoulder	▪ Experts in MD process & requirements, PRD & MDE ▪ Drainage analysis of existing structures & spreads/revised drainage design
Incident Management/ Enforcement space	▪ System in place relying on communication ▪ Limited shoulders	▪ Understand existing system ▪ CHART field staff involvement - concept development & MOT
Third Party Systems	▪ Mont. County maintains signals in County ▪ Impacts to adjacent arterial systems	▪ Third Party involvement/who maintains ▪ Communicate system goals
Stakeholder Outreach (i.e., external groups)	▪ Opposition from federal, state & local agencies, communities, businesses, etc.	▪ Proactive & specific outreach
Scope Growth after CAP	▪ Ensuring proper scope as CAP is developed	▪ Stakeholder involvement ▪ Vet scope questions/issues guarantee
Federal/State Standard Changes	▪ Upgrade issues/costs impacts ▪ Aged facility needs standards upgrades	▪ SHA policies/agency standards knowledge ▪ Upgraded CAP requirements
Noise	▪ Analysis and requirements based on improvements	▪ CGI Team Understands the requirements & will work to minimize need for barriers.

5.II. Design-Builder's Work Plan

Task Forces, focused around groupings of traditional design and construction disciplines, will progress the design. Designated Task Force leaders will be responsible for coordination and collaboration between disciplines, including software vendor/integrator, and will be empowered to resolve issues quickly and to involve stakeholders as required.

Project Development

Scope Validation: During the 120-day Scope Validation Period we will verify any scope of work which could not be reasonably determined during procurement. We will document scope issues and meet with SHA to resolve.

Work Package Development: Each of our proposed improvements will stand alone on its own merits and be designed/constructed as an individual project, with an individual CAP, and individual NEPA/MEPA evaluation and permitting. The work packages may include traditional plan sets, performance specifications for final design and construction, and technology/systems development and implementation.

Design QA/QC: The CGI Team will use proven Design and Construction Quality Management Plans, which includes cross-discipline coordination, checks, construction staff input, and reporting to the Executive Committee.

NEPA/MEPA: Our Team will develop NEPA/MEPA documentation for each improvement as an individual project. We will seek to avoid or minimize impacts to environmental and cultural resources. We will provide all plans, analysis, details, background information and findings necessary, and collaborate with all stakeholders to allow SHA to obtain expedient approvals. Our schedule will include necessary time for this process.

Design Reviews: The project schedule will include time for both formal and over-the-shoulder design reviews by SHA and stakeholders. Our Team will also integrate the reviewing parties into the weekly Task Force and progress meetings.

Early Procurement or Construction Work: The CGI Team, together with SHA and the stakeholders, will identify long lead time materials, phased construction, or ROW needs for which early procurement would benefit the project. Early work will be independent and severable. If desired by SHA, the CGI Team will provide ROW acquisition services.

Utilities/Permitting: The CGI Team will use utility and permit tracking logs to identify and track all potential utility relocations and environmental permits, including schedule, for each work package.

Schedule: The CGI Team will maintain a master CPM schedule using Primavera P6 showing design, review, stakeholder coordination and construction activities for our improvements/CAPs. We will also maintain a 4 Week Look Ahead Schedule, allowing easy identification of upcoming tasks, meetings, review responsibilities, and construction activities.

Risk: We will use a risk register to track and manage allocation of risks through all phases of the project. We will collaborate with SHA and the stakeholders to develop a risk sharing pool for items that are anticipated at the time of submitting the CAP but cannot be priced.

Construction Agreed Price (CAP): We will use a cost tracking log to continuously track and update the cost of individual PTCs and CAPs from inception through construction. The CGI Team proposes to prepare CAPs at approximately 65% design completion. If the CGI Team, SHA and the Independent Cost Estimator cannot agree to a Reconciled CAP price within three attempts, SHA may choose to deliver the work by other means.

Construction: The final construction value is reduced by the sum of the Design and Preconstruction services fee, D-B Construction Management Fee, and Construction Services (which includes CAPs, ROW acquisition and utility relocations). Once a CAP is approved, SHA will issue NTP for Phase Two Construction Services and construction work may proceed for the approved CAP.

Systems: Systems installation, integration and testing will be completed with functionality traced back to requirements through the Systems Engineering Process.

Safety and Maintenance of Traffic: Maintaining a safe environment for our Team's workers and the traveling public on I-270 is a commitment we take seriously. During the design phase our traffic control approach will include close collaboration with SHA and the stakeholders. As a series of smaller projects, construction impacts to traffic will be localized, but corridor wide coordination will still be necessary. Public outreach and coordination with local officials will be necessary to minimize inconvenience to the traveling public. We will implement our TMP and will continue collaboration during construction, making adjustments as necessary to accommodate changing conditions.

Services Provided by the CGI Team

The CGI Team will provide the preconstruction services necessary to negotiate the CAP (typically at 65% plan completion) for the selected improvements in accordance with the contract requirements and, specifically, as further defined by Section I.F. of the RFP. These services include:

- Coordinate with SHA, Stakeholders and 3rd Parties using meetings, partnering and design meetings, conference calls, and workshops. Preparing agendas, meeting minutes and action item lists for that coordination.
- Site visits and inspections
- OPCC and reconciliation meetings at Milestones
- Develop & update design & construction schedules
- Risk Management Plan including risk register with risk identification, assessments, mitigation and risk register
- QA/QC including design, construction, material sourcing
- Worker and Public Safety Plan
- Develop construction cost models & calculate quantities
- Data Collection (including MOT) for topographic surveys, utility designations, right-of-way mosaics, metes & bounds surveys, soil borings, test pits, environmental features delineations, ambient noise, and traffic counts
- Develop DBE and Subcontractor plan
- Prepare and submit CAP proposal, cost model & assumptions at designated completion. Reconcile.
- Identify advanced procurement of materials
- Evaluate and provide life-cycle costs
- Develop plans, specifications and other deliverables
- Develop roadway design, IAPA, and design exceptions.
- Develop Right-of-way needs & plats
- Design and permit surface drainage, stormwater management, and erosion and sediment control, including NPDES and MDE Approvals
- Perform H&H, Drainage, and SWM design & approvals.
- Obtain CCTV inspections of existing drainage pipes

- Perform subsurface geotechnical investigations & determine existing soil, rock, and groundwater conditions
- Analyze pavement performance data & existing material conditions. Select pavement types, design, rehabilitation design, and materials.
- Structural design of bridges, culverts, walls and incidental structures
- Traffic engineering design of temporary and permanent signing, lighting, traffic signals, markings, and ITS
- Traffic Operations Analyses and Report
- Traffic Management Plan (TMP), red flag summary, Maintenance of Traffic Alternatives Analysis (MOTAA).
- HOV equivalency analysis
- Safety analysis using the HSM
- Landscape Architecture & Forest Impact Analysis, significant tree identification, forest impact plans, tree preservation plan, reforestation design and approvals
- Prepare and coordinate the JPA including applications, location map, impact plates, trilogy request, responses to MDE comments, MDE and USACE approvals
- Avoidance, minimization and Mitigation report for the JPA
- Design and approval of compensatory mitigation
- Wetland mitigation, supplemental delineation reports and stream restoration as required for permit conditions
- Utility Coordination and conflict matrix
- Support SHA public outreach including attending outreach forums, providing displays, printed materials, photos, renderings and other materials.
- Provide Aconex project management software

Quality Assurance / Quality Control

The CGI Team will develop and use a project specific Design Quality Control Plan (DQCP) to achieve design excellence. This plan is based on implementing best practices identified through our vast variety of experiences and applying those best practices with the project goals and key issues in mind. In addition to the checks, balances and certifications typically used for design-build projects, we will implement the following specific features.

Selecting the Right Team: The firms and key staff for the CGI Team have been selected specifically for their proven ability to produce design excellence on similar projects. Our key staff have current design-build experience with SHA, including obtaining the full range of environmental approvals and permits. Our sub consultants will be active members of our Team and will be fully engaged in our QA/QC program.

Design Coordination: Regular meetings will be a key element of our approach to design excellence. Disciplines will meet on a weekly basis to discuss the details of the design and coordinate with other disciplines to advance the design. Weekly progress meetings will include all key staff, critical discipline leaders, construction leadership, SHA, stakeholders and third parties as necessary to complete the work. All meetings will include agendas and meeting minutes including issue tracking/resolution, risk tracking/mitigation, stakeholder concerns/resolutions, permit log/tracking, and four-week look ahead schedules. These meetings will also be used as an opportunity to conduct over-the-shoulder reviews.

Design Document Management: During design we will use file sharing and collaboration tools to ensure that our Team, SHA, permitting agencies, and stakeholders have access to the latest design information. Our approach to design excellence will continue into the construction phase by ensuring that the latest plans are easily identifiable; readily available to construction staff; and any revisions are clearly logged.

Independent Over the Shoulder Reviews: In additional to formal QA/QC plan reviews, we will use frequent over the shoulder reviews to verify contract conformance and design quality. These reviews will be performed by independent staff who were not actively engaged in performing the work. SHA, reviewing agencies, utilities, and other impacted third parties will be included in the over the shoulder review process.

Constructability and Environmental Reviews: As a D-B project, we recognize that a major component of design excellence includes providing plans that are easily constructed with minimal impacts to mobility, the environment, and stakeholders. Our leadership will exercise good judgment and sound decision-making to ensure that the design supports the construction means and methods, phasing/work sequencing, and environmental restrictions. During construction, our design staff will remain engaged to confirm design assumptions and oversee field changes.

MDE/SHA-PRD/Permitting Agency Reviews: The CGI Team will schedule sufficient time in the design process to allow for required MDE, SHA-PRD, and Permitting Agencies to review and approve plans and issue permits. Our experience has shown that up to three review cycles are typically necessary. The CGI Team will actively engage these agencies in the design QA/QC process in order to facilitate more effective incorporation of their requirements and concerns.

DQCP Certifications: Design packages will not be released for construction without a DQCP Certification. This certification will ensure that all elements to be constructed have been designed in conformance with the DQCP and meet the expectations of the SHA.

Review of Materials/Working Drawings: Due to the unique nature of materials and working drawing approvals that are necessary during construction, specific procedures will be developed for their approvals. These procedures will clearly outline the areas of responsibility (Contractor, Designer, SHA, Third Party) and timeframes for approvals.

5.III. Minimization of Impacts

As shown by Table 5-1, below, our program of improvements minimizes environmental, right-of-way, and utility impacts.

Table 5-1. Preliminary Assessment of Impacts for CGI Proposed Improvements.

Concept	Preliminary Impact				
	Waters/Wetlands	Tree/Forest	Right-of-Way	Utilities	Noise
SB 1	None	Low	None	Low	None
SB 2	None	Low	None	Low	None
SB 5A	None	None	None	None	None
SB 6	None	None	None	None	Study Required
SB 7	None	None	None	None	Study Required
SB 8	None	Low	None	Low	Study Required
SB 10	None	None	None	None	None
SB 12	Low	Low	None	Low	Study Required
NB 1	Low	Low	None	Low	Barrier Likely
NB 2	None	Low	None	Low	Barrier Likely
NB 3	Low	Medium	None	Low	Barrier Likely
NB 4	None	Low	None	Low	Study Required
NB 5	None	None	None	Low	Study Required
NB 7	None	None	None	None	None
Virtual Weigh Stations	None	None	None	Low	None
Adaptive Ramp Metering	None	None	None	None	None
ATM	None	None	None	None	None

Environmental Impacts

Waters/Wetlands: The CGI Team expects little or no impact to waters and/or wetlands primarily because the majority of our improvements impact only the existing pavement, or a very small area outside of the existing pavement.

Trees/Forests: Impacts to trees and forests is expected to be low, with any impacts minimized through the use of steepened slopes or barrier walls. The CGI Team will make reasonable efforts to perform on-site mitigation for any tree or forest impacts as required by the regulatory agencies.

Noise: We understand that the CGI Team will be responsible for providing a noise study assessing the reasonableness and feasibleness of noise abatement in accordance with applicable regulations. SHA will be responsible for the final design and construction of noise abatement. Based on our initial assessment and current SHA/FHWA policy, we suggest that the locations noted in Table 5.1 as “Study Required” will require a full noise study but are unlikely to meet warrants for a barrier. Locations noted in Table 5.1 as "Barrier likely" will require a full noise study and are likely to meet warrants for a barrier. Of the three locations likely to require a noise barrier, NB1 may be a modification to the existing noise barrier whereas NB2 and NB3 would be new barriers.

Right-of-Way Impacts

The CGI Team has specifically designed and selected improvements that are not expected to require additional right-of-way. All roadway improvements are within the existing right-of-way. Ancillary improvements such as SWM are expected to be minimal and can be accommodated within the existing right-of-way. Should the need for additional right-of-way be unavoidable, we will prepare plats and assist SHA with the acquisition of the right-of-way, recognizing that this cost will be deducted from the final contract value. Time will be included within the project schedule for any acquisitions that become necessary, and work that can be completed without the required right-of-way will be prioritized.

Utility Impacts

Based on our concept designs, the CGI Team expects only minor conflicts with existing facilities. Our process to identify and minimize utility impacts consists of the following:

Creation of Utility Mosaic. Immediately upon award, the CGI Team will undertake a program to locate and identify all utilities within the limits of work for our improvements. Initially, this effort will consist of utility research and requesting of records plans from the various utilities present in the work areas and from SHA. Using this information, a utility mosaic will be assembled covering each of the improvements. Utilities will be designated and test pits performed where utilities exist in close proximity to planned work.

Meeting with Utility Companies. Individual or group meetings will be held with the utility companies to confirm the findings of our utility investigations. The utility mosaics and concept design plans will be shared with the utility companies, and feedback will be solicited regarding the accuracy of the utility information. These meetings will also be used to establish criteria for working near or adjacent to existing facilities, as well as criteria to be used if impacts are unavoidable.

Conflict Identification. After ensuring the accuracy of the utility mosaics, potential conflicts between the existing utilities and the proposed improvements will be identified. Methods of avoiding or minimizing any conflict identified will be studied. Follow up meetings will be held with the utility companies to confirm any impacts and determine responsibilities for design and construction of any unavoidable relocations. Schedules will be developed to ensure that the utility work is accommodated within the improvement deployment schedule.

Protection of Utilities. During construction, utilities will be located and protected in accordance with the utility company requirements to ensure a safe working environment and to avoid accident utility outages.

5.IV. Implementation Approach

TIMELY IMPLEMENTATION

Figure 5.1 shows the aggressive implementation schedule proposed by the CGI Team. We will implement three of the improvements in 2017 to provide immediate benefit to I-270. Ten additional improvements will be implemented in 2017, with the remaining improvements to be implemented and complete by fall of 2018. Our Team members have local experience with all aspects of planning, permitting, design, material acquisition, construction and systems integration that are necessary for this project. In addition, our Team members have recent implementation experience for similar projects including I-66 (VDOT) and I-76 (Pennsylvania Turnpike Commission), current SHA design build experience, and decades of experience completing projects in the I-270 corridor. We will utilize a detailed design and construction schedule to ensure that all time commitments are met. We have identified several items that are critical to timely implementation of this project:

- We will initiate design on the anticipated notice to proceed date in March 2017. We expect initial coordination with SHA can begin immediately after selection in February of 2017.
- Improvements with no environmental, right-of-way or utility impacts are generally scheduled for design completion within 6 to 12 months from NTP, with construction in accordance with Figure 5-1.

- Improvements requiring more rigorous regulatory agency review, or with utility impacts, are scheduled for design completion within 12 to 18 months from NTP, with construction in accordance with Figure 5-1.
- Coordination with impacted stakeholders such as Montgomery County, Frederick County and FHWA must begin immediately after NTP and will be necessary for completion of the Concept of Operations for I-270. Active involvement by SHA in this coordination will be necessary to achieve timely implementation.
- Timely and comprehensive design reviews together with participation in task forces by SHA and stakeholders will be critical to maintaining schedule. We will use a design-build style approach to design and permitting reviews, with 14-day review periods, comment resolution, limited review cycles, and partnering to resolve issues.
- We recognize the likely need to participate in Montgomery County's mandatory referral process. Similar to how our Team approached this process for the Intercounty Connector, we have scheduled this activity to be performed concurrently with our ongoing design activities.

Design and Construction Packages

As shown at the beginning of this section, the CGI Team's selected improvements are individual and distinct projects. We anticipate developing, permitting, and implementing each of these improvements as individual, yet coordinated, projects. Where appropriate, we may elect to combine multiple improvements into a single project or CAP, but we expect this to be in select circumstances only.

To support preparation of the individual design packages, we will begin field reconnaissance (including supplemental surveys, geotechnical investigations, and utility research/designation) immediately after notice to proceed. To increase efficiency, these activities will be performed at one time for all concepts, though they will be prioritized to support the early implementation packages.

Additional activities that apply to many or all improvements, such as our I-270 Concept of Operations will also proceed immediately such that they are complete and available to support final design efforts.

For each improvement we anticipate conducting plan reviews at 30%, 65% and 100% design completion. In accordance with the RFP, we will initiate CAP negotiation at 65% for all packages, unless by mutual agreement between the CGI Team and SHA it is apparent that CAP negotiation would be more appropriate at a different design completion level.

Throughout the design process our Team will be identifying early work items (such as utility relocations) or material acquisition (such as sign gantries) that should be considered for SHA's early procurement process.

5.v. Watkins Mill Interchange

Compatibility of Proposed Watkins Mills Interchange

The Proposed Watkins Mill Interchange is fully compatible with the improvements selected by the CGI Team and our program of improvements (see specifically roadway improvement NB 4). Our program of improvements will perform as expected regardless of when, or if, the Watkins Mill Interchange is constructed.

Along southbound I-270 our Team is not proposing any modifications to I-270 in the vicinity of the Watkins Mill Interchange. No coordination between the projects would be required, although the addition of ramp metering to the proposed Watkins Mill Interchange would be beneficial to the I-270 corridor (see below).

Along northbound I-270, the CGI Team will be constructing an auxiliary lane between MD124 and Middlebrook Road (improvement NB 4). Some of this pavement will overlap pavement to be constructed as part of the future Watkins Mill Interchange. It will be necessary to coordinate construction schedules between the two projects to determine the most effective manner to complete the construction.

Modifications to Proposed Watkins Mill Interchange

In order to maximize the benefit provided by the Adaptive Ramp Metering proposed by the CGI Team, SHA should consider adding ramp metering equipment including signing, signals, and detection equipment to the proposed Watkins Mill Project for ramps entering I-270 southbound. We do not expect that this equipment would change the Watkins Mill Interchange Limits of Disturbance.

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

INTERSTATE 270

Appendices

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

Submitted to:

Appendix A

Addenda Letters and Responses to RFIs

Submitted by:

CONCRETE GENERAL, INC. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF HIGHWAY DEVELOPMENT
707 NORTH CALVERT STREET
BALTIMORE, MARYLAND 21202

September 1, 2016

Contract No.: MO0695172
F.A.P. No.: Not Applicable
Description: IS 270 Innovative Congestion Management Contract – Progressive Design-Build: Request for Proposals (RFP)

ADDENDUM NO. 1

To All Prospective Proposers:

Please be advised that the Technical and Price Proposal Submittal Date for this contract is still scheduled for **January 5, 2017**.

The attention of prospective proposers is directed to the following revisions, additions and/or deletions to the Request for Proposals (RFP).

REQUEST FOR PROPOSALS

Page No.	Description
18	ADDED "ITS Information" to the Additional Material.
Appendix	Stipend Agreement, page 2 of 6: REVISED "Alternative Technical Concept" and "ATC" to "Proposed Technical Concept" and "PTC." Also, REVISED stipend amount in section 2.2 (a) to $750,000.

NOTICE TO PROSPECTIVE PROPOSERS

The attention of prospective proposers is directed to the following revisions, additions, and/or deletions to the Additional Information on ProjectWise:

ADDED "I-270 ITS Devices.xlsx" and "ITS_I270.kmz" and "I270_FiberLine.kmz" and "I270_MH_FM.kmz" at the following location on ProjectWise:
pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\06 - ITS Information\

Questions relating to this Addendum No. 1 may be directed in writing to:

Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
e-mail address: MO069_IS_270@sha.state.md.us

During the Technical Proposal Phase, only e-mailed inquires will be accepted. No requests for additional information or clarification to any other Department or Administration office, consultant, or employee will be considered.

GREGORY I. SLATER, DEPUTY ADMINSTRATOR FOR PLANNING, ENGINEERING, REAL ESTATE, AND ENVIRONMENT.

THIS ADDENDUM IS ISSUED TO CLARIFY, ADD TO, DELETE FROM, CORRECT AND/OR CHANGE THE CONTRACT DOCUMENTS TO THE EXTENT INDICATED AND IS HEREBY MADE PART OF THE SAID CONTRACT DOCUMENTS. COMAR 21.05.02.08 REQUIRES THAT ALL ADDENDA ISSUED BE ACKNOWLEDGED; THEREFORE, PRIOR TO SUBMITTING YOUR PRICE PROPOSAL, ATTACH THE ADDENDUM RECEIPT VERIFICATION FORM TO THE FRONT OF THE PRICE PROPOSAL FORM PACKET. FAILURE TO DO SO MAY RESULT IN THE PRICE PROPOSAL BEING DECLARED NON-RESPONSIVE.

- Watkins Mill IAPA and Permits

F. Watkins Mill Interchange Plans

G. Watkins Mill Interchange Design Files

The following materials are being provided in electronic format on Projectwise. The Administration makes no representation regarding its accuracy.

H. Additional Material

- 100-Scale Mapping
- Existing Right-of-Way mosaic file
- Inventory of Existing Structures
- Utility plans and/or as-builts
- As-builts
- ITS Information

The following materials are being provided in electronic format on Projectwise, unless otherwise noted. This material is considered necessary for the Design-Build Team to submit a technical proposal and prepare a bid.

I. I-270 Concept Evaluation Templates

J. Manuals and Guidance

- VISSIM Modeling Techniques
- Manual for the Inspection of Highway Right of Way in Karst Areas

In general, the Microstation files included on the ProjectWise are in conformance with the MDSHA Microstation V8 CAD Standards Manual.

It is likely that most Proposers will use plot drivers that differ from the drivers used to produce the provided plans. Some of the drawings screen existing features through level symbology color 250. The manipulation of the drawing files to produce any requirements (as found elsewhere in the RFP) for as-built plans will be the responsibility of the selected Design-Builder.

Proposers are also provided with a file index provided on ProjectWise. The file is a Word Document describing all the files and files names as outlined above.

III. RULES OF CONTACT

The Procurement Officer is the Administration's single contact and source of information for this procurement.

The following rules of contact will apply during the Contract procurement process, which begins upon the submittal of the SOQ, and will be completed with the execution of the Contract. These rules are designed to promote a fair, unbiased, and legally defensible

1.5 shall not be entitled to use information submitted by Proposer to the SHA in which the SHA determines is exempt from disclosure under the Maryland Public Information Act ("PIA"), Title 10, Subtitle 6, Part III of the State Government Article of the Annotated Code of Maryland, unless the RFP otherwise provides.

1.6 The SHA acknowledges that the use of any of the Work Product by the SHA or the Design-Builder is at the sole risk and discretion of the SHA and the Design-Builder, and shall in no way be deemed to confer liability on the unsuccessful Proposer.

2. **<u>Compensation And Payment.</u>**

2.1 Compensation payable to Proposer for the Work Product described herein shall be $750,000.00 if any of the following conditions are met:

(a) The Proposer was in the competitive range and was not the most advantageous to the State or was not selected for award;

(b) The Proposer was selected for award, but the Contract was not executed or it was terminated by SHA for its convenience prior to issuance of a notice to proceed for events outside the control of the Design-Builder and the Design-Builder is not seeking reimbursement for design activities undertaken after notice of selection;

(c) The Proposer was not in the competitive range, but it submitted an Proposed Technical Concept (PTC) approved by the Administration and that the Administration wishes to utilize the PTC in the final design.

2.2 In its sole discretion, the SHA may pay compensation to Proposer, in an amount to be determined by the SHA, for the Work Product described herein under the following conditions:

(a) For any Proposer meeting the criteria identified in Section 2.1, above.

Any amount paid under this subparagraph (a) will not exceed $750,000.00 and will be subject to audit of the costs incurred by the Proposer in preparing its Technical Proposal and Price Proposal. Auditors shall have access to all books, records, documents and other evidence and accounting principles and practices sufficient to reflect properly all direct and indirect costs of whatever nature claimed to have been incurred. Failure of the Proposer or its team members to maintain and retain sufficient records to allow the auditors to verify all or a portion of the claim or to permit the auditors access to the books and records of Proposer and its team members shall constitute a waiver of the right to be paid a stipend and shall bar any recovery hereunder.

Any Proposer wishing to apply for a stipend under this subparagraph (a) shall submit the completed Agreement to the SHA concurrently with the price proposals being submitted. Eligibility of receipt of a stipend is dependent upon

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF HIGHWAY DEVELOPMENT
707 NORTH CALVERT STREET
BALTIMORE, MARYLAND 21202

October 7, 2016

Contract No.: MO0695172
F.A.P. No.: Not Applicable
Description: IS 270 Innovative Congestion Management Contract – Progressive Design-Build: Request for Proposals (RFP)

ADDENDUM NO. 2

To All Prospective Proposers:

Please be advised that the Technical and Price Proposal Submittal Date for this contract has been POSTPONED from January 5, 2017 to **January 19, 2017**.

The attention of prospective proposers is directed to the following revisions, additions and/or deletions to the Request for Proposals (RFP).

REQUEST FOR PROPOSALS

Page No.	Description
38	REVISED the submittal deadline for Proposed Technical Concepts to November 17, 2016.
41	REVISED the submittal deadline for the Technical and Price Proposals to January 19, 2017.
57	REVISED the submittal deadline for Proposed Technical Concepts to November 17, 2016.
57	REVISED the submittal deadline for the Technical and Price Proposals to January 19, 2017.
Appendix	Price Proposal, Page 1 of 43: REVISED the submittal deadline for the Technical and Price Proposals to January 19, 2017.

Questions relating to this Addendum No. 2 may be directed in writing to:

Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
e-mail address: MO069_IS_270@sha.state.md.us

During the Technical Proposal Phase, only e-mailed inquires will be accepted. No requests for additional information or clarification to any other Department or Administration office, consultant, or employee will be considered.

GREGORY I. SLATER, DEPUTY ADMINSTRATOR FOR PLANNING, ENGINEERING, REAL ESTATE, AND ENVIRONMENT.

THIS ADDENDUM IS ISSUED TO CLARIFY, ADD TO, DELETE FROM, CORRECT AND/OR CHANGE THE CONTRACT DOCUMENTS TO THE EXTENT INDICATED AND IS HEREBY MADE PART OF THE SAID CONTRACT DOCUMENTS. COMAR 21.05.02.08 REQUIRES THAT ALL ADDENDA ISSUED BE ACKNOWLEDGED; THEREFORE, PRIOR TO SUBMITTING YOUR PRICE PROPOSAL, ATTACH THE ADDENDUM RECEIPT VERIFICATION FORM TO THE FRONT OF THE PRICE PROPOSAL FORM PACKET. FAILURE TO DO SO MAY RESULT IN THE PRICE PROPOSAL BEING DECLARED NON-RESPONSIVE.

A Letter of Interest (LOI), on official letterhead of the Design-Builder, notifying the Administration whether or not the Design-Builder intends to submit a Technical and Price Proposal must be delivered no later than **December 15, 2016 prior to 12 noon** (EST). The LOI must be delivered to the following email address:

MO069_IS_270@sha.state.md.us

The LOI must be signed by individual(s) authorized to represent the Major Participant firm(s) and the lead Constructor firm(s). A Major Participant is defined as the legal entity, firm or company, individually or as a party in a joint venture or limited liability company or some other legal entity, that will be signatory to the Design–Build Contract with the Administration. Major Participant(s) will be expected to accept joint and several liability for performance of the Design–Build Contract. Major Participants are not design subconsultants, construction subcontractors or any other subcontractors to the legal entity that signs the Design–Build Contract.

If the Design–Build contracting entity will be a joint venture, or some other entity involving multiple firms, all Major Participant firms involved must have an authorized representative sign the LOI.

iii. Proposed Technical Concepts Submittal and Review

Section iii through section vii sets the process for the submittal and review of Proposed Technical Concepts (PTC). The process is intended to:

- Allow Proposers to incorporate innovation and creativity into the Proposals.
- Allow the Administration to consider Proposer PTCs in making the selection decision.
- Avoid delays and potential conflicts in the design associated with deferring of reviews of PTCs to the post-award period.
- Obtain the best-value for the public.

The Proposer is also encouraged to submit standards or specifications that are approved for usage by other state Departments of Transportation as PTCs.

The Proposer may submit PTCs for review by the Administration on or before
2 **November 17, 2016 prior to 12 noon.** (prevailing local time). Inquiries received after that date and time will not be accepted.

All PTCs shall be submitted in writing via email only to the project email address, with a cover letter clearly identifying the submittal as a request for review of a PTC. If the Proposer does not clearly designate its submittal as a PTC, the submission will not be treated as a PTC by the Administration

The Administration will review each PTC submitted to assess the implementation potential of the technical aspects of the concept and its compatibility with the project goals. The Administration will not approve PTCs but will return comments on the PTC on its implementation potential and its compatibility with the project goals. If the Administration needs more information, the Administration will submit written questions to the Proposer and/or request a one-on-one meeting in order to better understand the details of the PTC.

Proposer's Name

<u>Price Proposal</u>

Contract No. MO0695172

Container ____of____

d. Location and deadline for submittal of Technical and Price Proposals

2 Technical Proposals and Price Proposals must be delivered no later than **January 19, 2017 prior to 12 noon** (prevailing local time). The proposal must be delivered to the following location:

Office of Procurement and Contract Management
Fourth Floor, C-405
707 N. Calvert Street
Baltimore, Maryland 21202

e. Number of Copies

One original and eleven (11) copies of the complete Technical Proposal shall be submitted along with one (1) electronic copy PDF file on a CD or flash drive. A single original of the Price Proposal shall also be submitted.

f. Proposal Guaranty

The Proposal Guaranty shall be delivered with the Price Proposal in a sealed business-sized envelope clearly marked as follows:

Prospective Proposer's Name

Proposal Guaranty

IS 270 – Innovative Congestion Management Project

Contract No. MO0695172

4. Effect of Submitting Proposal

Signing of the Design-Build Proposal Submission Form and Price Proposal Form, and delivery of the Proposal represents (a) an offer by the proposer to perform the Work for the Price submitted within the time(s) specified in accordance with all provisions of this RFP and (b) the Prospective proposer's agreement to all the provisions of the RFP and Contract governing requirements and procedures applicable through execution of the Design – Build Contract. **The Technical Proposal will become part of the Design – Build Contract.**

By so signing the above referenced terms and by delivering the Proposals, the Prospective Proposer makes the following affirmative representations.

XVII. PROPOSED PROCUREMENT SCHEDULE

	Issue RFQ/RFP	June 7, 2016
	Final Date for RFQ Questions	July 11, 2016
	SOQ submittal to MSHA	July 25, 2016
	Reduced Candidate List (RCL) Notified	August 11, 2016
	One-on-One Meetings	August 24-25, 2016
	One-on-One Meetings	September 28-29, 2016
	One-on-One Meetings	October 26-27, 2016
△2	Last Day to submit PTCs	November 17, 2016
	Final Date for RFP Questions	December 8, 2016
	Letter or Interest	December 15, 2016
△2	Technical and Price Proposal Submittal	January 19, 2017
	Selection of Successful Proposer	February 2017
	Notice to Proceed (Anticipated)	March 2017

This is the proposed procurement schedule for this project as of the date of the issuance of this RFQ/RFP.

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
PROPOSAL FORM

Proposal by____

Name

____

Address (Street and/or P.O. Box)

____

City	State	Zip

(   ) ________________ (   ) ________________________

A.C.	Phone No.	A.C.	Fax No.

to furnish and deliver all materials and to do and perform all work, in conformance with the Standard Specifications, revisions thereto, General Provisions and the Special Provisions in this contract to IS 270 Innovative Congestion Management located in, Frederick and Montgomery Counties, Maryland, for which Technical and Price Proposals will be received until 12:00 o'clock
2 noon on January 19, 2017. Technical and Price Proposals shall be submitted to:

State Highway Administration
Office of Procurement and Contract Management
Fourth Floor, C-405
707 N. Calvert Street
Baltimore, MD 21202

In response to the advertisement by the Administration, requesting proposals for the work in conformance with the Contract Documents, now on file in the office of the Administration. I/We hereby certify that I/we am/are the only person, or persons, interested in this proposal as principals, and that an examination has been made of the work site, the Specifications, and Request for Proposals, including the Special Provisions contained herein. I/We propose to furnish all necessary machinery, equipment, tools, labor and other means of construction, and to furnish all materials required to complete the project at the following unit price or lump sum price.

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF HIGHWAY DEVELOPMENT
707 NORTH CALVERT STREET
BALTIMORE, MARYLAND 21202

November 9, 2016

Contract No.: MO0695172
F.A.P. No.: Not Applicable
Description: IS 270 Innovative Congestion Management Contract – Progressive Design-Build: Request for Proposals (RFP)

ADDENDUM NO. 3

To All Prospective Proposers:

Please be advised that the Technical and Price Proposal Submittal Date for this contract is still scheduled for **January 19, 2017**.

The attention of prospective proposers is directed to the following revisions, additions and/or deletions to the Request for Proposals (RFP).

REQUEST FOR PROPOSALS

Page No.	Description
9	REVISED the 3rd bullet to shift the responsibility of constructing noise barriers required for the project from the Design-Builder to the Administration.
14	ADDED noise studies to the Design-Builder's services.
16	ADDED construction of any required noise abatement to the Administration's services.
45	REVISED the page limit for the Mobility goal from 16 pages to 20 pages.
Appendix	Contract Provisions: REPLACED TC-5.01.

Questions relating to this Addendum No. 3 may be directed in writing to:

Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
e-mail address: MO069_IS_270@sha.state.md.us

During the Technical Proposal Phase, only e-mailed inquires will be accepted. No requests for additional information or clarification to any other Department or Administration office, consultant, or employee will be considered.

For/

GREGORY I. SLATER, DEPUTY ADMINSTRATOR FOR PLANNING, ENGINEERING, REAL ESTATE, AND ENVIRONMENT

THIS ADDENDUM IS ISSUED TO CLARIFY, ADD TO, DELETE FROM, CORRECT AND/OR CHANGE THE CONTRACT DOCUMENTS TO THE EXTENT INDICATED AND IS HEREBY MADE PART OF THE SAID CONTRACT DOCUMENTS. COMAR 21.05.02.08 REQUIRES THAT ALL ADDENDA ISSUED BE ACKNOWLEDGED; THEREFORE, PRIOR TO SUBMITTING YOUR PRICE PROPOSAL, ATTACH THE ADDENDUM RECEIPT VERIFICATION FORM TO THE FRONT OF THE PRICE PROPOSAL FORM PACKET. FAILURE TO DO SO MAY RESULT IN THE PRICE PROPOSAL BEING DECLARED NON-RESPONSIVE.

Act (MEPA)

- Project(s) will require NEPA approval from the Federal Highway Administration (FHWA) when federal actions will be required (e.g. design exceptions, Interstate Access Point Approval [IAPA]). If no federal action is required, then MEPA approval will be needed. Multiple environmental documents may be developed for the contract. Each separate project for an environmental document must be a standalone construction project that connects logical termini and be of sufficient length, have independent utility, and not restrict consideration of alternatives for other reasonably foreseeable transportation improvements. Any NEPA/MEPA document will be prepared by SHA. The Design-Builder will have no decision making responsibility with respect to the NEPA/MEPA process but will provide information needed about the project and possible mitigation actions.
- Public Involvement will be needed as part of NEPA/MEPA and should ensure travel shed is covered, not just the immediate project area.
- 3 The requirements of the SHA Noise Policy must be met for the Design-Builder's improvements. However, noise barriers, if required, will be excluded from any work package or CAP, and will not be paid for from the contract budget. The Administration will be responsible for the costs associated with noise barriers and the additional impacts or requirements they incur, including additional right-of-way, utility relocations, grading, drainage, stormwater management, retaining walls, etc.
- DNR managed land (Seneca Creek State Park) is within the contract limits.

5. Minimize Environmental Impacts

- No permits have been obtained. Agency coordination will be required to secure necessary permits for any environmental impacts.
- The Design-Builder will prepare permit applications for submittal by the Administration.
- Environmental impacts due to Design-Builder's project should be minimized to the extent practical.
- Mitigation may be required by permitting agencies depending on impacts to environmental features as a result of Design-Builder's project.

6. Minimize utility and property impacts and relocations

- Utility and property impacts due to Design-Builder's project should be minimized to the extent practical.
- All costs for third party utility relocations and property impacts will be subtracted from the fixed value contract.

E. **Project Status**

The current status of aspects of the project is as follows:

<u>Mapping and Survey</u>

- Develop any Right-of-way needs for the project(s)
- Preparation of any Design Exceptions as required for the project(s)
- Design of any surface drainage conveyances, stormwater management, and erosion and sediment control and obtain any related environmental agency approvals required for the project(s) (including NPDES and MDE Approvals).
- Hydrologic and Hydraulic analyses, Drainage and Storm Water Management (SWM) Analyses, Design, and Approvals.
- Closed-Circuit Television (CCTV) inspections of existing drainage pipes as needed.
- The pavement engineering for the Project shall include, but is not limited to, the pavement investigation, pavement type selection, new pavement design, pavement rehabilitation design, and material selection.
- Perform pavement and subsurface geotechnical investigations needed to determine subsurface features and characteristics, and properties to support pavement and geotechnical engineering functions.
- Analyze pavement performance data and existing material conditions to determine the structural and functional conditions for the development of pavement engineering recommendations;
- Analyze subsurface geotechnical field and laboratory test data to determine existing soil, rock, and groundwater conditions etc. for the development of geotechnical engineering recommendations;
- Structural design for all bridges, culverts, walls and any and all other incidental structures required for the project(s).
- Traffic engineering design of any temporary and permanent signing, lighting, traffic signals, pavement markings, and Intelligent transportation systems (ITS) required for the project(s)
- Traffic Operations Analyses including the preparation of a Traffic Operations Analysis Report
- Temporary Traffic Control Design and Implementation including the preparation of a Traffic Management Plan (TMP), red flag summary, Maintenance of Traffic Alternatives Analysis (MOTAA). Additionally, attending and running TMP meetings.
- HOV equivalency analysis and submit to FHWA for approval, if required
- Safety analysis using the Highway Safety Manual (HSM) and submit to FHWA for approval, if required
- Landscape Architecture design of any roadside landscaping and stormwater management landscaping required for the project(s)
- Forest Impact Analysis, Significant tree identification, development of forest impact plans, tree preservation plan and design of any reforestation mitigation required for the project(s)
- Preparation of any necessary documents to obtain final reforestation site review approval from the Maryland Department of Natural Resources
- Prepare and coordinate the Joint Permit Application(s) (JPA) including but not limited to preparation and submittal of the JPA application(s) to SHA with attachments including location map, impact plates, trilogy request and

3

- Complete all work related to providing a noise study(ies) that makes a final determination on reasonableness and feasibleness related to noise abatement.

- Acquisition of Environmental Permits
- Acquisition of Right-of-Way
- Review Construction CAP proposals and compare to ICE
- Reconcile Final CAP for each phase
- Construction Management and Inspection Services
- Design and construct required noise abatement, including additional impacts or requirements they incur, such as additional utility relocations, grading, drainage, stormwater management, retaining walls, etc.

3

Scope Validation and Identification of Scope Issues

A Scope Validation Period of 120 days from the date of the Notice to Proceed for Design and Preconstruction Services will be provided on this contract. During the Scope Validation Period, the Design-Builder shall thoroughly verify and validate that the Design-Builder's understanding of the scope of work and its ability to complete it within the Design and Preconstruction Services Fee. Any Scope Issues determined during this period shall not be deemed to include items that the Design-Builder should have reasonably discovered prior to submission of its Technical Proposal.

If the Design-Builder intends to seek an adjustment to the Design and Preconstruction Fee due to a Scope Issue, it shall promptly, but in no event later than the expiration of the Scope Validation Period, provide the Administration in writing with a notice of the existence of such Scope Issue and basis for such Scope Issue. Within 30 days of the notice, the Design-Builder shall provide documentation that specifically explains its support for the Scope Issue, which shall include among other things: (a) the assumptions the Design-Builder made during the preparation of its Proposal that form the basis of its allegation, along with documentation verifying it made such assumptions in developing its Proposal; (b) explanation of the Scope Issue that the Design-Builder could not have reasonably identified prior to submission of the Technical Proposal; (c) specific impact on the Design and Preconstruction Services. For the avoidance of doubt: (1) The Design-Builder shall not be entitled to raise any Scope Issues that were not previously addressed with a notice; and (2) Design-Builder shall have no right to seek any relief for any Scope Issues not identified in a notice provided to the Administration during the Scope Validation Period.

Within a reasonable time after the Administration's receipt of the documentation, the parties shall meet and confer to discuss the resolution of such Scope Issues. If the Administration agrees that the Design-Builder has identified a valid Scope Issue, a change order will be executed to increase the value of the Design and Preconstruction Fee; however, the Construction Services will be adjusted to retain the overall fixed value of the contract. Notwithstanding anything to the contrary in the Contract Documents or a matter of law, the Design-Builder shall have the burden of proving that the alleged Scope Issue could not have reasonably been identified prior to the submission of the Technical Proposal and such Scope Issue materially impacts its Design and Preconstruction Services Fee.

The parties acknowledge that the purpose of the Scope Validation Period is to enable the Design-Builder to identify those Scope Issues that could not have reasonably been identified prior to the submission of the Technical Proposal. By submission of the Technical Proposal, the Design-Builder acknowledges that the Scope Validation Period is a reasonable time to enable the Design-Builder to identify Scope Issues that materially impacts its Design and Preconstruction Fee. The Design-Builder will assume and accept all risks to complete the Design and

Proposer is alerted to their responsibility to confirm that all team members have received addenda. The Proposer is solely responsible to ensure that their team has the correct information.

i. Statement including the proposed legal structure of the Design–Builder.

j. Include a general authorization for the Administration to confirm all information contained in the Technical Proposal submittal with third parties, and indicate limitations, if any, to such authorization.

As an attachment to the cover letter and excluded from the page limitation for this section, provide documentation that the Design Team has Professional Liability Insurance.

3 **2. Mobility (20 Pages Maximum) – CRITICAL**

Goal: Provide improvements that maximize vehicle throughput, minimize vehicle travel times and create a more predictable commuter trip along I-270.

Value Statement: Effective and reliable traffic flow along I-270 is necessary for its function as a primary commuter route and for the vitality of economic development. Describe the improvements you will provide to address and manage congestion along I-270 while reducing delay and increasing reliability.

i. Provide the Design-Builder's improvements for maximizing vehicle throughput and minimizing vehicle travel times. Specifically, discuss how the Design-Builder's improvements will reduce recurring congestion in terms of travel time, vehicle throughput, density, intersection operations, queues and vehicle network performance, both along I-270 and on the connecting ramps and arterial roadways. – **CRITICAL**

ii. Discuss how the Design-Builder's improvements will provide a more predictable commuter trip, including innovative technologies or techniques that will be provided. – **SIGNIFICANT**

iii. Discuss the performance life of the improvements; that is, the time it will take for congestion levels to return to pre-construction levels and the basis for the Design-Builder's assessment of performance. – **IMPORTANT**

3. Safety (10 Pages Maximum) – IMPORTANT

Goal: Provide for a safer I-270 corridor.

Value Statement: Safer flow of traffic will increase mobility along I-270 by reducing incidents that increase delay and reduce travel time reliability. Discuss how your improvements will increase safety along I-270.

TERMS AND CONDITIONS

TC SECTION 5
LEGAL RELATIONS AND PROGRESS

TC-5.01 INSURANCE

100 **DELETE:** In its entirety.

INSERT: The following.

TC-5.01 INSURANCE FOR DESIGN-BUILD

In addition to the provisions of GP-7.14 (Liability Insurance), the following shall apply on Administration Contracts.

The Contractor shall maintain in full force and effect third party legal liability insurance necessary to cover claims arising from the Contractor's operations under this agreement that cause damage to the person or property of third parties. The insurance shall be under a standard commercial general liability (CGL) form endorsed as necessary to comply with the above requirements and the other requirements of this Section. The State of Maryland shall be listed as an additional insured on the policy. The limit of liability shall be no less than $1 000 000 per occurrence/$2 000 000 general aggregate. The insurance shall be kept in full force and effect until all work has been satisfactorily completed and accepted.

When specified in the Contract Documents or otherwise required by law, the Contractor shall carry the type and amounts of insurance in addition to any other forms of insurance or bonds required under the terms of the Contract and these Specifications.

All insurance policies required by this Section, elsewhere in the Contract Documents, or otherwise required by law, shall be kept in full force and effect until all work has been satisfactorily completed and accepted. The Contractor shall be responsible for the payment of all deductibles or self-insured retentions.

All insurance policies required by this Section, elsewhere in the Contract Documents, or otherwise required by law, (other than Workers' Compensation Policies) shall include endorsements:

(a) Stating that the State of Maryland is additional insured with respect to liability arising from the Contractor's operations under this agreement that cause damage to the person or property of third parties.

(b) Stating that such coverage as is provided by the policies for the benefit of the additional insureds is primary and any other coverage maintained by such additional insureds (including self-insurance pursuant to the Maryland Tort Claims Act) shall be non-contributing with the coverage provided under the policies.

(c) Containing waivers of subrogation with respect to all named insureds and additional insureds.

(d) Stating that the insurer has the duty to adjust claims and provide a defense with regard to such claims made against the additional insured.

All insurance policies required by this Section, elsewhere in the Contract Documents, or otherwise required by law, (including Workers' Compensation Policies) shall be endorsed to state that the insurer shall provide at least 7 days notice of cancellation or nonrenewal to:

Maryland State Highway Administration
Director, Office of Construction
7450 Traffic Drive
Hanover MD 21076

Evidence of insurance shall be provided to the Administration at the address listed above prior to the award of the Contract by means of a Certificate of Insurance with copies of all endorsements attached.

Any policy exclusions shall be shown on the face of the Certificate of Insurance or provided with the Certificate of Insurance.

Certificates of Insurance shall comply with all requirements of the Maryland Annotated Code, Insurance Article, § 19-116. Certificates of Insurance shall be on a form approved by the Maryland Insurance Commissioner (Commissioner). Standard Certificate of Insurance forms currently adopted for use by the Association for Cooperative Operations Research (ACORD) or the Insurance Services Office (ISO) are deemed approved by the Commissioner and are acceptable. Outdated ACORD or ISO forms (those with a revision date prior to the date of the form currently adopted for current use by ACORD or ISO) are not acceptable. The Contractor shall ensure that all required Certificates of Insurance satisfy all requirements of §19-116 of the Insurance Article, including the prohibition against the issuance of any certificate of insurance that contains false or misleading information or that purports to amend, alter, or extend the coverage provided by the policies referenced in the certificate.

The Certificate of Insurance shall be accompanied by a document (a copy of State License or letter from insurer) that indicates that the agent signing the certificate is an authorized agent of the insurer.

No acceptance and/or approval of any Certificate of Insurance or insurance by the Administration shall be construed as relieving or excusing the Contractor, or the Contractor's Surety from any liability or obligation imposed upon either or both of them by the provisions of this Contract or elsewhere in the Contract Documents.

The cost of the insurance will not be measured but the cost will be incidental to the Contract lump sum price.

Contractor and Railroad Public Liability and Property Damage Insurance shall be provided as specified in TC-6.05.

.01 Indemnification

The Design-Build Team shall indemnify, defend and hold the Administration and its officers, directors, employees, agents and consultants from and against all claims, actions, torts, costs, losses, and damages for bodily injury (including sickness, disease or death) and/or tangible property damage (other than to the Work itself) arising out of or resulting from the performance of the Work by the Design-Build Team, any subcontractor, subconsultant, engineer, supplier, any individual or entity directly or indirectly employed by any of them or anyone for whose acts any of them may be liable. Damages covered by the preceding sentence include, but are not limited to, all fees and charges of engineers, attorneys and all other professionals and all mediation, arbitration, court or other dispute resolution costs.

The indemnity obligation set forth in the preceding paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Design-Build Team or any subcontractor, subconsultant, engineer, supplier, or other individual or entity under Workers' Compensation acts, disability benefit acts, or other employee benefit acts.

.02 Additional Insurance Requirements

.02.1 Professional Liability Insurance

Professional Liability Insurance Policy, which covers the Indemnification Clause of this contract (paragraph .02 above), as it relates to errors, omissions, negligent acts or negligent performance in the work performance under this contract by the Designer, its subcontractors, employees and agents. The limitation of the Courts and Judical Proceedings Article states Annotated Code of Maryland Section 5-108(b) shall apply.

.02.2 Workers' Compensation Insurance

Workers' compensation, as required by the laws of the State of Maryland, including Employer's Liability Coverage and coverage for the benefits set forth under the U.S. Longshoremen and Harbor Workers' Compensation Act, the Jones Act, and other federal laws where applicable.

.02.3 Comprehensive Automobile Liability Insurance

Comprehensive Business Automobile Liability covering use of any motor vehicle to be used in conjunction with this contract, including hired automobiles and non-owned automobiles. Loading and unloading of any motor vehicle must be covered by endorsement to the automobile liability policy or policies.

.02.4 Administrative & General Provisions

a. Each policy, with the exception of Workers' Compensation and Professional Liability Insurance, shall name the State Highway Administration.

b. Defense of Claims

Each insurance policy shall include a provision requiring the carrier to investigate and defend all named insured against any and all claims for death, bodily injury or property damage, even if groundless.

c. Compliance

The Design-Build Team shall be in compliance with this Section provided it procures either one policy or insurance covering all work under the contract or separate insurance policies for all segments constituting the entire project. In either case, a certificate of insurance must be filed for each policy with the Administration indicating that all required insurance has been obtained.

The Design-Build Team is responsible for assuring that insurance policies required by this Contract comply with all the requirements. The Design-Build Team is also responsible to determine that all subconsultants, subcontractors, suppliers, and all other individuals or entities performing Work for the Project carry all applicable insurance coverages set forth in this section, including, in all cases, Workers' Compensation, Automobile, and Commercial General Liability Insurance. The Design-Build Team shall indemnify and hold harmless the Administration from any claims arising from the failure to fulfill said responsibilities.

d. Reporting Provisions

Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the Administration, its officers, agents and employees.

e. Separate Application

The insurance provided by the Design-Build Team shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

.02.5 Notice of Cancellation or Modification

All policies of insurance provided in this Section shall be endorsed to provide that the insurance company shall notify the Administration, the Design-Build Team, and each named insured at least thirty (30) days prior to the effective date of any cancellation or modification of such policies.

TC-5.03 SUBCONTRACTING AND SUBCONTRACTORS

102 **INSERT**: The following before the paragraph titled '**Subcontractors Prompt Payment.**'

Percentage of Own Workforce Required. The Design-Build Team must perform at least fifty percent of the value of the on-site construction work with its own workforce, not including the percent goal required in the contract proposal to be performed by DBE's. The Designer must perform at least fifty percent (50%) of the value of the design work with its own workforce, not including the work required by DBE's.

106 **ADD**: The following sections at the end of section '**TC-5.05 DETERMINATION AND EXTENSION OF CONTRACT TIME.**'

TC-5.06 OWNERSHIP OF DOCUMENTS

All plans, specifications, inspection records, or other documents ("Documents") generated by the Design-Build Team and all consultants, subcontractors, suppliers, manufacturers performing Work on the Project are the property of the Administration. Upon request by the Administration, the Design-Build Team or any other person or entity performing Work will produce and deliver such Documents as requested, both in hard copy and electronic format.

TC-5.07 ACCESS TO AND RETENTION OF RECORDS

The Design-Build Team and its employees and Subcontractors shall make all project records available for inspection by the Project Manager and all other persons authorized by the Administration, and shall permit such representatives to interview employees during working hours. Project records include daily time reports, records of force account work, quality control or assurance documentation, inspectors reports, employment records, payrolls, equal opportunity records, construction conference records, partnering records, and any other documents in any way related to the Project substantiating payment. These records shall be retained at least three years after final acceptance of the project.

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF HIGHWAY DEVELOPMENT
707 NORTH CALVERT STREET
BALTIMORE, MARYLAND 21202

December 19, 2016

Contract No.: MO0695172
F.A.P. No.: Not Applicable
Description: IS 270 Innovative Congestion Management Contract – Progressive Design-Build: Request for Proposals (RFP)

ADDENDUM NO. 4

To All Prospective Proposers:

Please be advised that the Technical and Price Proposal Submittal Date for this contract is still scheduled for **January 19, 2017**.

The attention of prospective proposers is directed to the following revisions, additions and/or deletions to the Request for Proposals (RFP).

REQUEST FOR PROPOSALS

Page No.	Description
14	REVISED the order of the last two bullets at the bottom of the page so the language for the JPA services, which flows onto the next page, is continuous.
16	REVISED the last bullet of the Administration's Services to exclude construction, as the construction will not occur during the preconstruction phase.

Questions relating to this Addendum No. 4 may be directed in writing to:

Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
e-mail address: MO069_IS_270@sha.state.md.us

During the Technical Proposal Phase, only e-mailed inquires will be accepted. No requests for additional information or clarification to any other Department or Administration office, consultant, or employee will be considered.

For/

GREGORY I. SLATER, DEPUTY ADMINSTRATOR FOR PLANNING, ENGINEERING, REAL ESTATE, AND ENVIRONMENT.

THIS ADDENDUM IS ISSUED TO CLARIFY, ADD TO, DELETE FROM, CORRECT AND/OR CHANGE THE CONTRACT DOCUMENTS TO THE EXTENT INDICATED AND IS HEREBY MADE PART OF THE SAID CONTRACT DOCUMENTS. COMAR 21.05.02.08 REQUIRES THAT ALL ADDENDA ISSUED BE ACKNOWLEDGED; THEREFORE, PRIOR TO SUBMITTING YOUR PRICE PROPOSAL, ATTACH THE ADDENDUM RECEIPT VERIFICATION FORM TO THE FRONT OF THE PRICE PROPOSAL FORM PACKET. FAILURE TO DO SO MAY RESULT IN THE PRICE PROPOSAL BEING DECLARED NON-RESPONSIVE.

- Develop any Right-of-way needs for the project(s)
- Preparation of any Design Exceptions as required for the project(s)
- Design of any surface drainage conveyances, stormwater management, and erosion and sediment control and obtain any related environmental agency approvals required for the project(s) (including NPDES and MDE Approvals).
- Hydrologic and Hydraulic analyses, Drainage and Storm Water Management (SWM) Analyses, Design, and Approvals.
- Closed-Circuit Television (CCTV) inspections of existing drainage pipes as needed.
- The pavement engineering for the Project shall include, but is not limited to, the pavement investigation, pavement type selection, new pavement design, pavement rehabilitation design, and material selection.
- Perform pavement and subsurface geotechnical investigations needed to determine subsurface features and characteristics, and properties to support pavement and geotechnical engineering functions.
- Analyze pavement performance data and existing material conditions to determine the structural and functional conditions for the development of pavement engineering recommendations;
- Analyze subsurface geotechnical field and laboratory test data to determine existing soil, rock, and groundwater conditions etc. for the development of geotechnical engineering recommendations;
- Structural design for all bridges, culverts, walls and any and all other incidental structures required for the project(s).
- Traffic engineering design of any temporary and permanent signing, lighting, traffic signals, pavement markings, and Intelligent transportation systems (ITS) required for the project(s)
- Traffic Operations Analyses including the preparation of a Traffic Operations Analysis Report
- Temporary Traffic Control Design and Implementation including the preparation of a Traffic Management Plan (TMP), red flag summary, Maintenance of Traffic Alternatives Analysis (MOTAA). Additionally, attending and running TMP meetings.
- HOV equivalency analysis and submit to FHWA for approval, if required
- Safety analysis using the Highway Safety Manual (HSM) and submit to FHWA for approval, if required
- Landscape Architecture design of any roadside landscaping and stormwater management landscaping required for the project(s)
- Forest Impact Analysis, Significant tree identification, development of forest impact plans, tree preservation plan and design of any reforestation mitigation required for the project(s)
- Preparation of any necessary documents to obtain final reforestation site review approval from the Maryland Department of Natural Resources

△4 △3

- Complete all work related to providing a noise study(ies) that makes a final determination on reasonableness and feasibleness related to noise abatement.
- Prepare and coordinate the Joint Permit Application(s) (JPA) including but not limited to preparation and submittal of the JPA application(s) to SHA with attachments including location map, impact plates, trilogy request and

- Acquisition of Environmental Permits
- Acquisition of Right-of-Way
- Review Construction CAP proposals and compare to ICE
- Reconcile Final CAP for each phase
- Construction Management and Inspection Services
- 4 3 Design required noise abatement

Scope Validation and Identification of Scope Issues

A Scope Validation Period of 120 days from the date of the Notice to Proceed for Design and Preconstruction Services will be provided on this contract. During the Scope Validation Period, the Design-Builder shall thoroughly verify and validate that the Design-Builder's understanding of the scope of work and its ability to complete it within the Design and Preconstruction Services Fee. Any Scope Issues determined during this period shall not be deemed to include items that the Design-Builder should have reasonably discovered prior to submission of its Technical Proposal.

If the Design-Builder intends to seek an adjustment to the Design and Preconstruction Fee due to a Scope Issue, it shall promptly, but in no event later than the expiration of the Scope Validation Period, provide the Administration in writing with a notice of the existence of such Scope Issue and basis for such Scope Issue. Within 30 days of the notice, the Design-Builder shall provide documentation that specifically explains its support for the Scope Issue, which shall include among other things: (a) the assumptions the Design-Builder made during the preparation of its Proposal that form the basis of its allegation, along with documentation verifying it made such assumptions in developing its Proposal; (b) explanation of the Scope Issue that the Design-Builder could not have reasonably identified prior to submission of the Technical Proposal; (c) specific impact on the Design and Preconstruction Services. For the avoidance of doubt: (1) The Design-Builder shall not be entitled to raise any Scope Issues that were not previously addressed with a notice; and (2) Design-Builder shall have no right to seek any relief for any Scope Issues not identified in a notice provided to the Administration during the Scope Validation Period.

Within a reasonable time after the Administration's receipt of the documentation, the parties shall meet and confer to discuss the resolution of such Scope Issues. If the Administration agrees that the Design-Builder has identified a valid Scope Issue, a change order will be executed to increase the value of the Design and Preconstruction Fee; however, the Construction Services will be adjusted to retain the overall fixed value of the contract. Notwithstanding anything to the contrary in the Contract Documents or a matter of law, the Design-Builder shall have the burden of proving that the alleged Scope Issue could not have reasonably been identified prior to the submission of the Technical Proposal and such Scope Issue materially impacts its Design and Preconstruction Services Fee.

The parties acknowledge that the purpose of the Scope Validation Period is to enable the Design-Builder to identify those Scope Issues that could not have reasonably been identified prior to the submission of the Technical Proposal. By submission of the Technical Proposal, the Design-Builder acknowledges that the Scope Validation Period is a reasonable time to enable the Design-Builder to identify Scope Issues that materially impacts its Design and Preconstruction Fee. The Design-Builder will assume and accept all risks to complete the Design and

Request for Proposals – Questions and Responses

The following questions were received on September 2, 2016.

Question 1:
Please provide the SHA I-270 accident data in Excel Spreadsheet format from SHA OOTS TDSD's ACRES system to aid with the expedited review and analysis of data during the Technical Proposal phase of the I-270 project.

Response 1:
Crash data in Excel format has been posted on ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\04 - Existing Crash Data\Accident Data\

Question 2:
Please provide Synchro files which were used to develop signal timing for signalized intersections in the VISSIM network to aid with the review and analysis of solutions during the Technical Proposal phase of the I-270 project.

Response 2:
Synchro files are not available. The existing signal timing sheets were used for 2015 design year and minor signal timing adjustments were made to traffic signals with excessive delays and queues for 2040 no-build design year.

Question 3:
Will SHA provide consistent parameters such as number of runs, seeds, seeding time for the VISSIM runs so that all teams provide comparable results for SHA to evaluate?

Response 3:
As stated on Page 48 of the Request for Proposals (RFP), "The Proposer shall use VISSIM version 7.00-13, shall follow SHA's VISSIM Modeling Techniques, shall not modify calibration parameters, such as vehicle inputs, vehicle routes, driving behavior, link behavior type, lane change distance, speed distributions and decisions without providing justification to the SHA and must use the simulation parameters and random seeds as provided in the VISSIM files when reporting results."

The following questions were received on September 7, 2016.

Question 4:
Please provide the following: schedule and plans for MD 85 at I-270 project, MD 121 at I-270 project, and schedule for I-270 at Watkins Mill project.

Response 4:
The Watkins Mill Interchange is planned to be re-advertised in 2017; however, a precise schedule is undetermined and will depend on the magnitude of the design changes (if any) that will be required to accommodate the I-270 Innovative Congestion Management (ICM) Contract.

The I-270/MD 121 Interchange Improvements Project is in the planning phase. Information can be found at the following project website:

http://apps.roads.maryland.gov/WebProjectLifeCycle/ProjectInformation.aspx?projectno=MO4261115

Final review plans for the I-270/MD 85 (Phase 1) Interchange Reconstruction Project (Contract No. FR3885171) have been posted to ProjectWise at the location below. Additionally, Plans, Specifications, & Estimate (PS&E) plans for a stream stabilization project (Contract No. MO1605174) have been posted to ProjectWise at the location below:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\11 - Other Projects\

The latest advertisement, bid, and notice to proceed (NTP) dates for these projects can be found in the Contractor's Ad Schedule on SHA's website:

http://www.roads.maryland.gov/pages/contractadschedule.aspx

Question 5:
Please provide the following: 100 scale mapping north of the Watkins Mill project.

Response 5:
The SHA will not provide additional 100 scale mapping. A planimetrics file for the area north of the 100 scale mapping has been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\07 - Planimetrics\mTO_planimetrics_I270.dgn

Question 6:
Please provide the following: crash data in MS Excel format.

Response 6:
See question 1.

Question 7:
Please provide the following: traffic counts in 15 minute increments and in MS Excel format.

Response 7:
Two MS Access databases have been posted to the ProjectWise location below, one for I-270 and one for Montgomery and Frederick Counties. A data dictionary has been included to explain

the columns in the tables. Also, the locations of the counts have been included in shape and KMZ formats.

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\02 - Existing Traffic Counts\15 minute counts\

Question 8:
Please provide the following: speed data in 15 minute increments (collected at the same time as the traffic counts).

Response 8:
Speed, Travel Time Index (TTI), and Planning Time Index (PTI) data for the I-270 mainline (from the spurs to I-70), the I-270 collector distributor (CD) lanes, and I-495 (from American Legion Bridge to the spurs) has been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\10 - 2015 Avg Weekday INRIX Data\

Question 9:
Please provide the following: Excel sheet for I-270 Concept Evaluation 042516 Final.pdf.

Response 9:
The Excel files used to generate said document had been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\I_I-270 Concept Evaluation Templates\files\

Question 10:
Please provide the following: origin-destination data and 5 year interval traffic projections through 2040.

Response 10:
Origin-destination data and land use information in 5 year increments have been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\09 - MWCOG Travel Demand Model Outputs\

Question 11:
Please provide the following: small structure inventory for Frederick County.

Response 11:
The following file on ProjectWise has been updated to include the maps for Frederick County:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\03 - Inventory of Existing Structures\Inventory Maps\Small Structures.pdf

Three additional small structures (10182X0, 10358X0, and 10359X0) have been added to the following ProjectWise folder:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\03 - Inventory of Existing Structures\Other Structures\

Question 12:
Please provide the following: utility designation north of the Watkins Mill Project, right-of-way (ROW) mosaic north of the Watkins Mill Project, pavement borings/geotech info north of the Watkins Mill Project, and wetland delineation and environmental features north of Game Preserve Road.

Response 12:
The extent of additional base information required to complete design will be highly dependent on the concept; therefore, the additional data collection needed to complete the project is included in the pre-construction services to be provided by the Design-Builder.

Question 13:
Please provide the following: pavement structure numbers of all shoulders.

Response 13:
The SHA has not performed any design to date. Pavement design is included in the pre-construction services to be provided by the Design-Builder. Prospective proposers may, at their will and discretion, perform preliminary calculations during the procurement phase.

Question 14:
Please provide the following: noise model north of Watkins Mill.

Response 14:
The SHA will not provide additional noise models. Should the project require noise analyses, the Design-Builder shall develop the required noise models, analyses and reports as part of the pre-construction services.

The following questions were received on September 12, 2016.

Question 15:
Our Team is requesting access to view and use the "Explore and Visualize Crashes" tool within the RITIS (Regional Integrated Transportation Information System). This tool will be beneficial to the project by allowing our team to view more detailed crash data to better identify the deficiencies along I-270.

Response 15:
Proposers may request one team member to be provided RITIS access. If access is desired, please submit a request to the project email address along with the name and email address of the user to whom RITIS access will be given.

Question 16:
In reference to RFQ/RFQ Article XII.B.7, is it acceptable to use VISSIM Version 8.00-10 in lieu of Version 7.00-13?

Response 16:
VISSIM version 7.00-13 shall be used. However, additional supporting information related to the technical proposal may be included in the Appendix.

The following questions were received on September 27, 2016.

Question 17:
Please provide clarification on the schedule of prices as shown in the RFP. All three bid items are shown as lump sum, but the RFP describes a design development process involving SHA, the DB team and public/stakeholders as required by SHA design development policies. Throughout the design process, it is likely that the construction scope will evolve with stakeholder and SHA input. For clarity, will the lump sum prices also evolve as the scope becomes better defined in the design period?

Response 17:
The contract budget is $100,000,000 and this budget is fixed. As noted in the question, the proposed concept and final construction scope shall continue to evolve during design, as is usual for all design processes and projects, prior to reconciliation of a Construction Agreed Price (CAP). However, the Design and Preconstruction Services Fee should be considered to be a "Guaranteed Maximum Price" or upset limit. It shall include all design and preconstruction services needed to deliver the scope of improvement proposed by the Design-Builder.

The Construction Management Fee shall include all profit, general and administrative costs, regional and home office overhead, and other indirect costs, as specified in Article XII.C.2 beginning on page 48 of the RFP.

The Construction Services Fee is determined by subtracting the Design and Preconstruction Services Fee and Construction Management Fee from the total contract budget. Regardless of what the final construction scope becomes, each construction package price will be reconciled and have its own agreed upon CAP. The sum of all the CAPs, any necessary right-of-way acquisition costs, and utility relocations costs will not exceed the Construction Services Fee, which is a "Guaranteed Maximum Price" or upset limit.

If there is a scope change during the design and preconstruction services, then it will be handled by the appropriate contract specifications. However, the Administration does not intend to increase the value of the contract and the Design-Builder will need to propose modifications to stay within budget.

Question 18:
What level of design and plans related to PTCs are required for the Technical Proposal submittal?

Response 18:
Per General paragraph of Article XII.B (Technical Proposal) in the RFP (page 42), "The Technical Proposal submittal shall contain concise narrative descriptions and graphic illustrations, drawings, charts, plans and specifications that will enable the Administration to clearly understand and evaluate the capabilities of the Design - Builder and the characteristics and benefits of the proposed solutions." Proposers are responsible for determining the necessary level of detail that will enable the Administration to clearly understand and evaluate the capabilities of the Design - Builder and the characteristics and benefits of the proposed solutions.

Question 19:
Since each PTC is being evaluated on its own merits, and with its own VISSIM analysis, please clarify what should be submitted with the final Technical Proposal? Is a VISSIM model for each PTC required, or one model that combines each of the PTCs selected by the DB for inclusion in their Technical Proposal?

Response 19:
One VISSIM model that combines each of the PTCs selected by the Design-Builder for inclusion in the Technical Proposal shall be submitted. Please refer to Article XII.B.7 in the RFP (page 48).

Question 20:
We request that SHA consider revising the Technical Proposal due date to either December 21st or January 18th.

Response 20:
In Addendum No. 2 the Technical Proposal due date was revised to January 19, 2017.

Question 21:
Is there any VISSIM calibration report available? If so, please provide.

Response 21:
A VISSIM calibration memorandum has been posted on ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\ 03 - VISSIM Traffic Models\I-270 Modeling Calibration Methodologies Memorandum.pdf

Question 22:
Can SHA provide any origin-destination traffic data for the GP and HOV lanes within the corridor used to develop existing and 2040 traffic volumes for the corridor?

Response 22:
See response to question 10.

Question 23:
We have been unable to locate any CAD files on PW that support the TNM validation that has been done, including Microstation files with the NSA shapes, the measured receptors and the TNM validation model layouts. Will SHA provide these files to all proposers?

Response 23:
MicroStation files with the NSA shapes, the measured receptors and the TNM validation model layouts will not be provided.

Question 24:
Special Provision Insert, TC-5.01 Insurance, page 2, 6th paragraph requires "*Any policy exclusions shall be shown on the face of the Certificate of Insurance or provided with the Certificate of Insurance.*" All policies have numerous standard exclusions which are usual and customary in the industry. Listing all these exclusions in or attached to the certificate of insurance would be an unnecessary administrative burden. Please consider the following amendment, which we believe is the true intent of this requirement, "~~*Any policy*~~ *Policy exclusions applicable to the requirements herein shall be shown on the face of the Certificate of Insurance or provided with the Certificate of Insurance.*"

Response 24:
This is a standard Special Provision for all Administration contracts and will not be modified.

The following questions were received on October 6, 2016.

Question 25:
If our proposed solution requires additional staff to operate, beyond the existing MDOT / CHART manpower capabilities, is the additional staffing to be included in the current $100M budget? If yes, for what period of time (years) would the staff need to be provided? Will additional staffing (temporary or permanent) be SHA employees, contract employees, or staff provided by the Design Builder? Will staff be located in an existing MDOT / CHART facility. If yes, which existing facility?

Response 25:
No, the contract budget does not include long-term Operations and Maintenance (O&M) costs. The budget does include design, construction, integration, testing, system documentation, training and anything else needed to turn over to the State a fully functional & operational system.

Though long-term O&M costs are not included in the budget, as part of their Technical Proposal Submittal, Proposers are responsible for evaluating impacts to O&M, and justifying and documenting anticipated O&M requirements. Please refer to the Operability/Maintainability/Adaptability goal in the RFP. The SHA needs to clearly understand the impacts the project will have on its O&M programs.

Question 26:
If our proposed solution requires "back-office" computers and other equipment, shall they be housed in an existing MDOT / CHART facility. If yes which one? If no, would the Design Builder be required to provide such facilities and would the cost be included in the current $100 Million budget?

Response 26:
Housing back-office computers and equipment in MDOT, SHA and/or CHART facilities is potentially feasible, but not required. Proposers would need to confirm that the proposed location would be implementable, assuring basic system support such as telecommunication connectivity, a reliable power supply, accessibility for maintenance and system redundancy.

Proposers will design the system and should propose where the best location would be. There are numerous alternatives – e.g. the Statewide Operations Center, the Hanover Traffic Signal Shop, the Glen Burnie Data Center, District 3, etc. Proposers shall determine the most practical solution that meets the goals of the project. As noted above, using a State facility is feasible.

Regardless of where the equipment is housed, the Design-Builder shall provide all required equipment and facilities to turn over to the State a fully functional & operational system, as noted in response 25, the cost for which must be paid for from the contract budget.

Question 27:
If existing MDOT / CHART facilities are being utilized for proposed operational activities, is the Design Builder responsible for any improvements to the facility (physical improvements or new equipment/connectivity) as part of the $100 Million budget? Please provide any existing plans or requirements for where equipment or staffing might be housed at the proposed MDOT / CHART facility including IT and computer facilities so we can estimate the cost of any improvements. Please arrange for access to the proposed facility for the Design Builders designers and estimators.

Response 27:
The cost of improvements to MDOT facilities shall be paid for from the project budget if the improvements are required for the Design-Builder to provide a fully functional system at project completion. The Design-Builder is not responsible for facility improvements unrelated to the project.

Your request for existing plans/information is too broad. Also, SHA does not know the equipment/staffing requirements for your proposed solutions and would be unable to determine potential housing locations. However, to help Proposers conceptualize potential housing locations, Proposers may visit SHA facilities. To make an appointment, Proposers may send an email request to the project email address, specifying which facility and potential dates.

Question 28:
Will maintenance of any new field ITS devices need to be covered in our $100 Million budget? If so, for what time period and to what extent is expected?

Response 28:
No. See response to question 25.

The following questions were received on October 10, 2016.

Question 29:
The RFP allows for resubmittal of PTC's after receiving initial feedback from SHA, but it does not specify a due date. Can a PTC be resubmitted after the 11/17 Last Day to submit PTC's, if the initial submittal was made prior to 11/17?

Response 29:
Yes.

Question 30:
We request permission to engage in joint discussions with FHWA and the SHA noise barrier team on proper implementation of Federal Highway Noise Regulations and Guidance. If you concur with this request, please provide appropriate point of contact.

Response 30:
Proposers may meet with the SHA Noise Team by sending a request to the project email address. If additional guidance from FHWA is needed, SHA will follow up and report back to the Proposer(s).

Question 31:
A fiber optic exists along I-270. Can this fiber optic be utilized for the project?

Response 31:
The Administration has determined that up to 4 fibers may be dedicated to this project.

The following question was received on October 13, 2016.

Question 32:
The RFP requests us to "*Discuss what modifications would be needed to the proposed Watkins Mill Interchange project to be compatible in a safe and efficient manner with your Innovative Congestion Management improvements.*" In order to properly reply to that question may we please have the latest Watkins Mill Interchange plans to review so the proper analysis can be made.

Response 32:
The Watkins Mill Interchange plans were previously posted on ProjectWise on June 7, 2016. The Proposer shall discuss what modifications would be needed to the proposed Watkins Mill Interchange as shown in that information.

The following questions were received on October 15, 2016.

Question 33:
Please furnish the 2015 Calibration Report for the I-270 Vissim models.

Response 33:
See response to question 21.

Question 34:
Please furnish contact information for Network Maryland.

Response 34:
Contact information for Network Maryland can be found on the Maryland Department of Information Technology's (DoITs) website.

Question 35:
Page 2 of the RFQ/RFP indicates that all costs for ROW acquisition will be subtracted from the established cost for Construction Services, and that ROW acquisition will be completed by the Administration. Please specify and generally describe applicable SHA costs related to ROW acquisition, e.g. purchase cost, legal fees, assessment fees, GEC fees, SHA staff, etc.

Response 35:
Only the final negotiated purchase cost of the ROW will be subtracted from the Construction Services Fee. All SHA labor and overhead—including that of our ROW specialists who will make first offers, negotiate, prepare documentation, etc.—will not be subtracted from the contract budget. Please note, development of ROW needs and plats are included in the Design & Preconstruction Services, and, therefore, will be subtracted from the contract budget.

The following questions were received on October 17, 2016.

Question 36:
As indicated in the RFQ/RFP, the Mobility Section in our Technical Proposal is of Critical Importance is 16 pages and will represent 50% of our Technical score The other sections representing the remaining 50% are 30 pages are rated only Important. We request that the page count for the Mobility Section be increased to accurately represent the relative level of importance and scoring of our proposal. A suggested page count for the Mobility Section is 25-30 pages.

Response 36:
The Administration will increase the page count to 20 pages for the Mobility section with a future addendum.

Question 37:
We request that full page explanatory graphics not count against the total page count of a specific section when included in the Technical Proposal (and not the appendix).

Response 37:
The specified page limits shall include full page explanatory graphics.

The following questions were received on October 18, 2016.

Question 38:
Can SHA provide GIS information for existing stormwater management BMPs, drainage areas and storm drains along the I-270 corridor in Montgomery County and Frederick County?

Response 38:
Available GIS information has been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\08 - SWM GIS maps\

Question 39:
Please confirm the IS 270 Congestion Management contract shall be all-inclusive and not rely on any follow-up SHA or County contracts, such as future overlays to repair any stripping eradication efforts, to meet SHA or RFP requirements.

Response 39:
No resurfacing projects on I-270 are funded or programmed in the near future. Proposed improvements for the I-270 Innovative Congestion Management contract shall be all-inclusive and not rely on improvements provided in other projects.

The following questions were received on October 31, 2016.

Question 40:
Please confirm that since this is not a capacity addition project, but a congestion management and reduction project of existing roadway traffic that noise analysis and potentially new noise walls, or modifications to existing noise walls or other mitigation efforts, will NOT be required.

Response 40:
Per the RFP Contract Provisions, General Provisions, Terms and Conditions and Technical Requirements, the Design-Builder shall comply with all Federal, State and local laws, ordinances and regulations applicable to the activities and obligations associated with this project. The Design-Builder is responsible for determining whether noise mitigation will be required to implement the Design-Builder's proposed improvements. Please note that noise analysis and mitigation may be required if, based on the scope of improvements, the NEPA defined project is considered Type I. Refer to the MDOT SHA Highway Noise Policy and 23 CFR 772 for additional information related to the definition of Type I projects.

<u>Question 41:</u>
Please confirm that if no new full time mainline or CD lanes are added to the existing I-270 typical section, noise analysis and potentially new noise walls or modifications to existing noise walls or other mitigation efforts will NOT be required.

<u>Response 41:</u>
See response to question 40. Full-time use is not a consideration for the determination of a Type I project. Part-time shoulder use would fall under the definition of a Type I project. Refer to FHWA's Use of Freeway Shoulder for Travel for additional information.

<u>Question 42:</u>
Please confirm that if revisions to current entrances and exit ramp configurations along the I-270 corridor are proposed, noise analysis and potentially new noise walls, or modifications to existing noise walls or other mitigation efforts will NOT be required.

<u>Response 42:</u>
See response to question 40.

<u>Question 43:</u>
If a noise analysis is performed utilizing current criteria on the existing I-270 configuration and traffic, (without any or with only minor improvement such as the installation of gantry's, detection or ramp metering made by the Design Builder) and the results indicate additional noise mitigation is required, will the design builder be required to provide such mitigation as part of the $100 Million dollar budget? If so what would be the limit of the mitigation – the entire corridor from the I-495 juncture to the I-70 interchange - or other limits.

<u>Response 43:</u>
All costs for noise mitigation required by the Design-Builder's project(s) to comply with all applicable Federal, State and local laws, ordinances and regulations, shall be a part of the contract budget. This includes any required Right-of-way and or Utility Relocations needed as a result.

Multiple environmental documents may be developed for the contract. Each separate project for an environmental document must be a standalone construction project that connects logical termini and be of sufficient length, have independent utility, and not restrict consideration of alternatives for other reasonably foreseeable transportation improvements. If the project is determined to be a Type I project, the level of mitigation required and the limits of that mitigation would be determined based on any noise analysis done for the environmental document(s) to meet applicable Federal, State and local laws, ordinances and regulations.

The following questions were received on November 2, 2016.

<u>Question 44:</u>
It was noted that the wetlands and waterways shapes and delineation report were a draft. Have they been finalized?

Response 44:
The wetland delineation report has been finalized and posted to ProjectWise at the location below:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\06 - Wetland Delineations\

Also, the shape files have been updated and replaced at the location below. Included is a CAD file of the wetlands and waterways (mEF_I270_16.1019.dgn).

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\B_Survey and Topographic Files\02 - Environmental Features Files\

Question 45:
Since noise mitigation does not contribute directly to meeting the project goals, would MDOT consider utilizing a separate funding mechanism for noise barriers?

Response 45:
Yes. The Administration has decided to use another funding source(s) for the construction of noise barriers. This will be reflected in Addendum No. 3.

The Design-Builder shall identify in its proposal where noise barriers may be required, including approximate locations and areas. As part of its design and preconstruction services, the Design-Builder will be responsible to complete all work related to providing a noise study to make a final determination on reasonableness and feasibleness related to noise abatement for the Design-Builder's project(s) to comply with all applicable Federal, State and local laws, ordinances and regulations.

The SHA will be responsible for final design and construction of any required noise abatement and the additional impacts or requirements they incur, including additional utility relocations, grading, drainage, SWM, retaining walls, etc.

Please note, responses to questions 40, 41, and 42 still apply. Also note, this response (45) supersedes the first paragraph of response 43.

The following questions were received on November 14, 2016.

Question 46:
Please provide a copy of the SHA application for Federal funding under the Integrated Corridor Management (ICM) program.

Response 46:
The requested document has been posted to ProjectWise at the location below:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\09 - Integrated Corridor Management\

Question 47:
With regard to communications for ITS field devices such as CCTV cameras, message signs, and ramp meters, we understand there are four (4) existing dark fibers on the corridor that are available for use by the design-builder. If so:

a) How do we obtain the exact locations of existing fiber conduits, pull boxes, and splice vaults?
b) Are we able to break into the fiber duct at any point to add additional pull boxes and splice vaults?
c) Can we splice into existing fibers at any new/existing pull box or splice vault?
d) Can we add additional fiber within the existing conduits?
e) Are there spare conduits in the existing ITS duct bank?
f) Does SHA have any mandatory standards on communication architecture or equipment? For instance, is there a requirement for Cisco-supplied switches or for GB Ethernet?

Response 47:
There are four (4) existing dark fiber strands on the corridor that are available for use by the Design-Builder. The locations of these strands were previously posted to ProjectWise and can be found at the following location:
pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\06 - ITS Information\

These four (4) fibers are a part of the MDOT's Resource Share Agreement (RSA) with Level 3. Only these four dark fiber strands are available for the Design-Builder to use. There are no other existing strands or conduits available for the Design-Builder's use. Level 3 owns the strands and requires that any splicing of the strands be performed by Level 3's certified splicers. Any associated cost for that splicing shall be part of the project budget. The RSA does allow for the ability to add new pull boxes and/or splice vaults but does not allow adding fiber to the existing conduits. Any new pull boxes and/or splice vaults must be coordinated with Level 3, and locations must be approved by Level 3. If the Design-Builder's solutions require additional conduit/fiber, the Design-Builder will be required to construct these new resources as part of their project.

SHA does not have any mandatory standards on communication architecture or equipment. However, the Administration values a project which will provide for ease of operations and maintenance. It is the Design-Builder's responsibility, per the RFP, to describe how its approach, including communication architecture or equipment, will ensure the SHA will have a fully functional system that is easily maintainable.

Question 48:
We request the SHA re-evaluate the DBE participation goal of 25% for the Design and Preconstruction phase of the project.

The Construction portion of this phase involves only Estimating and Project Management (no construction). It is unrealistic to ask the Construction firm selected to subcontract out ¼ of its estimating and or management functions. Those two key functions are never subcontracted out by any Construction firms as no firm would allow these two key functions to be performed outside of their organizations from both a propriety and leadership standpoint. This fact is recognized in the DBE requirements included in SHA's CMAR program where DBE participation is not required for this phase of the project. The following is taken from one of the recent CMAR RFQ's. *"The overall DBE participation goal will be 0% of the total Contract price for the Preconstruction Services. Due to the nature of the Contractor's role in the Preconstruction Design phase, the Administration has determined that there are insufficient subcontracting opportunities to justify a DBE goal on the Preconstruction Design phase."*

The above will therefore require that the full 25% of Design and Preconstruction services be shifted to the Engineering portion of the fee putting a DBE component of approx. 35% to 40% on the designer. As an innovative project requiring "World Class" expertise to identify and implement new innovative solutions specialize senior staff will be required from the firms other national or international offices. That staff is generally only found in large multinational engineering and planning firms - not local small DBE organizations. There are specific areas where DBE firms can be utilized (e.g. Outreach, Survey, Subsurface investigations, etc.) but these tasks do not come close to equaling 25% of the total Design and Preconstruction fee.

We respectfully request the Design and Preconstruction DBE requirement be lowered to no more than 5% to 10% of the total Design and Preconstruction fee. If desired by SHA, the resulting decrease in DBE dollars can be shifted to the Construction portion of the project so as to provide the same total DBE participation for the full $100 million dollar project budget as previously desired.

Response 48:
On Design-Build projects, typically 30% of the portion of the contract price allocable to professional services requires good faith effort to achieving DBE/MBE participation. Understanding that, in addition to the professional services, that the Contractor's preconstruction services are included in the Design and Preconstruction Services Fee, the Administration determined that overall 25% was a realistic MBE goal contract to be in line with 30% of professional services allocable to MBE participation. This would allow all preconstruction services to be completed the Contractor with a similar level of MBE for professional services to other Design-Build contracts. We believe there are other areas for DBE participation above those identified such as highway, traffic, drainage, stormwater management, erosion and sediment control, permitting, noise analysis, etc.

Question 49:
On normal DB and CMAR projects the different sections of the technical proposal are divided between several different groups to review and score totally independently. Will that be same on this project. Will the Technical Proposal be reviewed by three independent groups, do the individual groups see the other sections, and are the given the appendix?

On this project, that is so non typical and innovative, we request SHA review the above assumed procedures and have one team review and score the entire document. As a minimum we believe, if independently scored, the teams should have access to the entire document, including the appendix.

Response 49:
Yes, the technical proposal will be broken down into individual Evaluation Factors and evaluated independently by different evaluation teams as described in the RFP beginning on page 50. This is SHA's standard evaluation process that serves the organization well, regardless of the nature of the project.

The following question was received on November 27, 2016.

Question 50:
On page 41 Item 4 of the RFP "Effect of Submitting a Proposal" it states we are to "*perform the work for the price submitted within the time(s) specified*". We have found no time to be specified in the RFP for completion and Section B on pages 42 thru 47, which details what is to be included in our technical proposal, does not request a schedule or completion date. We therefore assume individual completion dates will be assigned to each construction package at the time the CAP's are determined. Please confirm our assumption or inform us where the completion date is specified or requested.

Response 50:
The schedule for design and completion of construction for each CAP will be determined by the Design-Builder as part of the submittal of its Technical and Price Proposal. See Response 2 (R2) in the Notice to Prospective Proposers dated June 17, 2016. The completion date shall be provided on Page 41 of 43 of the Price Proposal Form Packet.

The following question was received on December 1, 2016.

Question 51:
As a follow up to question number 49: Will the reviewers of the individual sections have access to the full technical proposal, including the appendix?

Response 51:
As stated in the RFP on page 51, "Each Evaluation Team will only be given the section or sections for each specific Evaluation Factor or Factors they are rating and not the Technical Proposals in its entirety. Evaluations will be limited to the information provided in the specific Evaluation Factor section and will not consider information provided in other sections." Each Evaluation Team will have access to the appendix, which is not rated. It should be noted the Evaluation Teams determine the initial technical ratings. The Evaluation Committee, which determines the overall technical ratings, will have access to the entire Technical Proposal and appendix.

The following questions were received on December 5, 2016.

Question 52:
RFQ Article XII.B.5.ii (Page 47) requires the proposer to "Discuss the services to be provided by the Design-Builder." Please clarify what services are to be addressed in this section of the Technical Proposal.

Response 52:
Discuss the Design and Preconstruction Services, and any other services the Design-Builder will provide that will best meet or exceed the goals of the project.

Question 53:
In the definition of Construction Agreed Price on pages 3 and 4 of the RFP, it states that a CAP "shall include all final design…" Please define "final design".

- Is this the design effort required to progress the design to 100% from the 65% state used for negotiation of the CAP?
- If the cost to progress the design from 65% to 100% is included in the CAP, what further design effort, if any, is required if SHA elects to bid a package competitively?

Response 53:
Final design for a work package, the cost of which is included in the CAP, is the design effort required to complete design for that work package. For example, if the CAP is initiated at 65% design, final design is the effort required to progress design from 65% to 100% release for construction drawings, including revisions/redlines. If the CAP is initiated at 90% design, final design is the effort required to progress design from 90% to 100% release for construction drawings, including revisions/redlines. Proposers shall identify in their proposals at what percent design completion (e.g. 65%, 90%, 100%, etc.) CAPs will be initiated. If SHA rejects the Design-Builder's price and bids the package competitively, no further design effort will be required by the Design-Builder. The Administration will terminate the process and complete design by some other means for that work package.

Question 54:
In the second paragraph addressing Construction Agree Price on page 4, it is noted that, "A proportionate amount of the Construction Management Fee will be included in the CAP." Is it the intent of the PDB process for the total amount of all executed CAPs to equal the sum of the Construction Management Fee bid item and the Construction Services Fee bid item, less any amount paid to third parties for ROW acquisition and utility relocation? If so, this seems inconsistent with the paragraph's first sentence that says, "A zero-dollar change order will be executed to subtract the amount of the CAP, and any associated right-of-way and utility relocation costs, from the Construction services costs..." (Emphasis added.)

Response 54:
Assuming the entire budget were to be spent and there were multiple independent projects, then the sum of the CAPs and amount paid to third parties for ROW acquisition and utility relocation for each project would add up to the Construction Services Fee submitted as part of the Price Proposal. Likewise the Construction Management Fee for each project would add up to the Construction Management Fee submitted as part of the Price Proposal.

Page 4 of the RFP goes on to state, "For example, if the Construction Management Fee was five percent when compared to the Construction services costs, this amount will be added to the CAP and subtracted from the original Construction Management Fee as part of the change order. Payment for the Construction of the project will be paid through an agreed upon work breakdown structure." Thus the change order pulls the CAP, ROW costs, and utility relocation costs from the Proposal Construction Services Fee, and pulls a proportionate amount from the Proposal Construction Management Fee. The purpose of the net zero dollar change order is to approve the CAP and create a pay item for it.

Question 55:
In the event that SHA executes its right to competitively bid a PS&E package, will there be any further obligation under this contract to provide design, preconstruction, or construction management services?

Response 55:
All Design and Preconstruction Services in the contract shall be provided until the Administration terminates the contract.

There is no obligation to perform Construction Management (CM) services until a CAP is accepted. If a CAP is not accepted, then the Design-Builder is not obligated to provide CM services for that work package. If a CAP is not accepted, this does not release the Design-Builder from its obligation to perform CM services for other CAPs that have been accepted.

Question 56:
On the bottom of Page 4 of the RFP in Section I.A, there is the subtitle **Design and Preconstruction Services**. The ensuing paragraph seems to be addressing the contract as a whole, including the Construction Management Fee and Construction Services Fee. Is there an inconsistency here?

Response 56:
The SHA is entering into a contract with the Design-Builder to complete the Design and Pre-Construction Services as required in the Technical Proposal. If SHA is agreeable to the CAP(s), then a net zero dollar change order will be executed for a CAP to include the PS&E package of that CAP. The Design-Builder cannot proceed with any Construction Services until SHA has approved a CAP and issued Notice to Proceed for the CAP.

Question 57:
At the bottom of RFQ page 48 in Section XII.C.2, it is noted that regional and home office overhead costs are to be included in the Construction Management Fee. No further guidance on overhead cost is provided in the ensuing table. Please clarify where to allocate the cost for establishing and maintaining a project office on the jobsite.

Response 57:
An engineer's office would be included in a CAP.

Question 58:
At the bottom of RFQ page 48 in Section XII.C.2, it is noted that general and administrative costs are to be included in the Construction Management Fee. Does this include all costs for indirect items such as Bond, insurance premiums, permits, licenses, and success fees? Might not

a separate mobilization bid item for a fixed amount of say $1,500,000.00 be appropriate for such one-time expenses?

Response 58:
If a separate mobilization item were included in the Schedule of Prices (SOP), it would apply to all work packages; however, each work package must be independent and severable. Like all other work items necessary for construction (e.g. construction stakeout, maintenance of traffic, class 1 excavation, etc.), mobilization for each work package will be included the CAP for that specific package. Permits and licenses are also included in the CAP(s). Any cost associated with providing requirements to submit a proposal, such as Proposal Guaranty for the overall $100 M contract, may be included in the Design and Preconstruction item.

Regarding Success Fees, refer to Response 4 (R4) in the Notice to Prospective Proposers dated June 17, 2016.

Question 59:
Please confirm that the “Traffic Control Plan Certification” is not relevant to this contract.

Response 59:
The Traffic Control Plan Certification Contract Provision should be completed with Option 3 checked as it is the Design-Builder’s responsibility to provide any traffic control plan.

Question 60:
TC-4-02 Failure to Maintain Traffic indicates a $1,000 per day deduction for failure to maintain the project. Please clarify if this is only applicable to active work zones or if it is applicable to the entire length of I-270.

Response 60:
TC-4.02, Failure to Maintain Project, is applicable to the work as defined in GP-5.11, Maintenance of Work During Construction.

Question 61:
TC-7.05 addresses retainage on Progress Payments. Is it the intention of the Authority to hold retainage on the Design and Preconstruction Services Fee? Is this necessary when the Authority is only paying for “services actually provided and invoiced” as stated on in XII.C on page 48?

Response 61:
Retainage applies to all work under the contract.

Question 62:
Should execution of the Buy American Steel Form (Page 3 of 43 of the Contract) be deferred until CAP negotiation?

Response 62:
The Price Proposal form needs to be completed in its entirety and no portion of it can be deferred to a CAP.

Question 63:
The standard MDOT MBE Form A on Page 15 of 43 includes a certification referencing the "total dollar amount of the Contract" although the goal at the time of submission is only applicable to design work. Please clarify how this form is to be completed.

Response 63:
The form should be completed for the Design and Preconstruction Services. See response 56.

The following question was received on December 6, 2016.

Question 64:
We have had difficulty reproducing some of the results in the evaluation templates provided by SHA. We would like to be able to replicate the results to ensure the validity and comparability of all team's results.

Response 64:
The model must be run in **32-bit mode** to replicate the VISSIM model results that SHA has provided for every MOE.

The following question was received on December 7, 2016.

Question 65:
Does the Watkins Mill Interchange Project impact Level 3?

Response 65:
Yes. Design plans for the proposed relocation of Level 3 have been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\F_Watkins Mill Interchange Plans\Level 3 Relocation\

The following questions were received on December 8, 2016.

Question 66:
In the *General Requirements* on page 2 of Section I.A, it states that the Design-Builder shall complete all design and construction work in two phases, Phase IV - Final Design and Phase V – Partnering during design and construction, Review Shop Drawings, Revisions, Redesign Under Construction, As-Built Plans and provisions for expert court testimony. Please clarify the intent or significance of Phase IV and Phase V in the context of either this two-phase procurement or the two-phase contract.

Response 66:
The intent is to ensure that the consulting services provided and tasks performed by the Design-Builder during both phases of the contract comply with the Administration's policies and

procedures and the requirements set forth in "Volume II -Specifications for Consulting Engineers' Services," dated 1986.

Question 67:
A definition of *Opinion on Probable Construction Cost* (OPCC) is provided on page 3 in Section I.A. Please confirm that the OPCC is simply the aggregate construction cost of anticipated improvements and that these costs are expected to be incorporated into CAPs as the "Construction, labor, equipment, and materials and all incidentals necessary to complete the Construction of the package."

Response 67:
The OPCC is the actual Construction cost the Design-Builder estimates to build all aspects of a Construction package.

Question 68:
On page 4 as part of the definition of a CAP, it states that SHA will consider establishing a risk sharing pool with the Design-Builder during the Design and Preconstruction phase. Please clarify whether the funding for this risk sharing pool is from within or outside of the $100 million fixed value of the contract.

Response 68:
Risk sharing pools must come from the contract's fixed budget.

Question 69:
In the *General Requirements* in Section I.A and again in Section I.F *Scope of Services / Description of Work*, there are multiple references to "milestones". Please define these milestones.

Response 69:
Proposers shall determine what milestones are needed to deliver a well-managed project.

Question 70:
Section XII.C.1 defines the *Design-Builder Design and Preconstruction Services Fee*, noting that payment will be based on services actually provided and invoiced.

a. Subsequent language requires the Design-Builder to provide a fee breakdown. Is this Design-Builder requirement relevant to Proposal content or is this just guidance on how the successful proposer (the Design-Builder) is to bill for post-Award design services?
b. The final sentence of this segment indicates the Design-Builder shall provide a breakdown for each firm showing the estimated direct labor breakdown, estimated direct expenses, approved audited overhead, and profit. Is this also guidance on how the successful proposer (the Design-Builder) is to bill for post-Award design services for work performed by the Lead Designer and any subconsultants?

Response 70:
The fee breakdowns are not merely guidance. They are required of all Proposers in their Price Proposals.

Question 71:
Section XII.C.2 indicates that the Proposer will provide a breakdown of all components used in establishing the fee. Is this Proposer requirement relevant to Proposal content? If so, where in the Proposal should this information be provided?

Response 71:
This requirement shall be provided with the Price Proposal.

Question 72:
In response to Question #48, it was noted that "the Contractor's preconstruction services are included in the Design and Preconstruction Services Fee." Assuming that the table provided at the top of page 49 is applicable to the entire contract and not just to the Construction Phase, please provide guidance or examples for other types of Contractor costs that can be included in the fee for design and preconstruction services. Alternately, please confirm that the table on page 49 is only applicable to the Construction Phase thereby allowing Contractor project costs to be classified as preconstruction services during the Design Phase.

Response 72:
The table on page 49 is applicable to the Design-Builder's Construction Management services, which support the Construction Services and are not needed for nor applicable to the Design & Preconstruction Services.

Question 73:
Regarding ground mounted signs along the corridor: If a sign is proposed to be relocated without changing the content of the sign, does the sign material need to be upgraded to MUTCD standards?

Response 73:
Upgrading existing facilities to current standards when no safety or operational issues exist is not a contract goal. Existing signs that are not impacted and will remain in place do not necessarily need to be upgraded to MUTCD standards. However, once the Design-Builder changes the conditions in which that sign exists, including the sign's location or message, the sign should be upgraded to current MUTCD standards.

Question 74:
For signs mounted on cantilever or sign bridges: If a sign must be relocated to a different location without changing the content of the sign, does the sign material need to be upgraded to MUTCD standards?

Response 74:
Yes. See response 73.

Question 75:
If a sign remains in place with a different message, does the sign material need to be upgraded to MUTCD standards?

Response 75:
Yes. See response 73.

Question 76:
If a sign with the same message must be temporarily removed and replaced on a new structure in the same location without changing the message, or a different location on the same structure without changing the message, does the sign material need to be upgraded to MUTCD standards?

Response 76:
Yes. See response 73.

Question 77:
Are there any restrictions for including discussion of costs in the technical proposal?

Response 77:
No.

Question 78:
For the final proposal, can the PTC's and other Appendix data be presented in only electronic format and provide the required copies for the technical and cost proposal only?

Response 78:
Proposals shall include hard copies of the Concept Evaluation Templates. All other appendix materials may be saved onto a flash drive.

Question 79:
We would like to request the following data for six scenario years including the years 2015, 2020, 2025, 2030, 2035, and 2040:

A. Four OD trip tables for all scenarios, which are inputs to the 4th iteration highway assignment. These OD trip table names are i4_AM.VTT, i4_MD.VTT, i4_PM.VTT and i4_NT.VTT.
B. Two highway assignment loaded networks for all scenarios, which are outputs from the 4th iteration highway assignment. These loaded network names are i4_HWY.NET and i4_HWYMOD.NET.
C. The full MWCOG model transmittal folder with input files, scripts and all the supporting input data.

Response 79:
The MWCOG model input files and the documentation necessary to run the model successfully have been posted to ProjectWise at the following location:

pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\10 - MWCOG model\

Proposers can use these files to run the interim year models and generate loaded networks and time of day trip tables. This model set represents version 2.3.57a, the 2015 CLRP and Round 8.4 land use assumptions.

The following question was received on December 11, 2016.

Question 80:
We understand this is past the due date for questions and apologize for this late clarification request; however, we believe it may be in the Administration's best interest to provide additional information to the proposers on formatting of the Technical Proposal and Appendix. The only guidance provided is that the Technical Proposal (including appendix) shall be in a 3-ring binder and any "*Charts, exhibits, and other illustrative and graphical information may be on 11"-by-17" paper, but must be folded to 8.5"-by-11", with the title block showing. An 11"-by-17" sheet will be considered only one page*."

It may be inconvenient to unfold and then refold each sheet individually as your team reviews the material and we may not be able to fit, in a reasonably sized single 3-ring binder, if tri-folded. We respectfully request the appendix be allowed in its own 11"x17" binder with unfolded sheets.

Response 80:
The appendix can be in its own 11"x17" binder with unfolded sheets. Also, see Response 78.

The following question was received on December 16, 2016.

Question 81:
Question 70 addressed a cost breakdown that must be provided by the Design-Builder. Question 71 addressed a cost breakdown that must be provided by the Proposer. In both cases, the SHA response indicates that the required breakdown must be provided with the Price Proposal. It is mandated on RFP page 40 that the "Price Proposal shall be submitted on the Price Proposal Form supplied by the Administration…" Would the aforementioned Article XII.C breakdowns be a supplement to the 43-page Price Proposal Form since there does not seem to be an appropriate place for inclusion within those 43 pages.

Response 81:
Yes, the cost breakdown should be a supplement submitted with the Price Proposal Form.

The following question was received on December 19, 2016.

Question 82:
We have been unsuccessful in exporting the document "Ver2.3.57a_Conformity_2015CLRP_Rnd8_4_Xmittal.zip" located in the following folder on ProjectWise:
pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\10 – MWCOG model\

We believe this is due to the zip folders size (25.48 GB). Would you please consider breaking this folder into smaller zip files, or extracting the files into the 10-MWCOG model folder so that we can download the information and put it to use on this project?

Response 82:
The files that were in the zip file “Ver2.3.57a_Conformity_2015CLRP_Rnd8_4_Xmittal.zip” have been extracted and placed at the following location on PW:
pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\H_Additional Material\10 - MWCOG model\Ver2.3.57a_Conformity_2015CLRP_Rnd8_4_Xmittal\

The following questions were received on December 23, 2016.

Question 83:
The fifth paragraph of TC-5.01 indicates that Workers’ Compensation policies are the only exceptions to an endorsement requirement. Please note that such endorsements are not commercially available on a Professional Liability insurance policy because of the nature of the coverage. Accordingly, we request listing of Professional Liability insurance as an exception.

Response 83:
Professional Liability insurance may be an exception.

Question 84:
TC Section 5 Article .02.1 is an additional requirement for the Professional Liability Insurance Policy to provide various indemnifications. Please note that such indemnifications are not commercially available because of the nature of the coverage. Accordingly, we request deletion of this requirement.

Response 84:
This is a standard Special Provision for all Administration contracts and will not be modified.

Question 85:
TC Section 5 Article 02.4a establishes a requirement to name the State Highway Administration in various insurance policies, presumably meaning that the Administration must be named as an Additional Insured. Consistent with the questions addressing endorsements and indemnifications and with the nature of errors and omissions coverage, we request that Professional Liability Insurance be listed with Workers’ Compensation as an exception to this requirement.

Response 85:
The said article states, “Each policy, with the exception of Workers’ Compensation and Professional Liability Insurance, shall name the State Highway Administration.”

Question 86:
TC Section 5 Article 02.4b uses “named insured” as an identifier, as was the case in 02.4a. Please consider revising the reference to Additional Insureds, assuming this is the intent of the requirement.

Response 86:
The said language, "named insured," is consistent with other provisions in SHA's Standard Specifications for Construction and Materials, 2008.

Question 87:
TC Section 5 Article 02.5 requires the insurance company to notify the Administration, the Design-Build Team, and each insured about policy cancellation or modification. The industry-standard Notice of Cancellation to Others will trigger appropriate notifications if a policy is cancelled, but it will not react to modifications. We suggest that the obligation for notification of policy modifications be eliminated or assigned to the design-builder. Alternately, could the Administration provide an example Notice of Cancellations to Others endorsement that they have accepted in the past?

Response 87:
This is a standard Special Provision for all Administration contracts and will not be modified.

The following question was received on December 24, 2016.

Question 88:
A safety and resurfacing project (Contract No. MO1865177) has appeared on the contractor's advertisement schedule. It appears to be located on I-495 near the southern end of the I-270 contract. The advertisement date is 2/14/17 and the NTP date is 5/22/17. Are plans available?

Response 88:
Yes. Plans have been posted to ProjectWise at the following location:
pw:\\SHAVMPWX.shacadd.ad.mdot.mdstate:SHAEDMS01\Documents\Design-Build\MO0695172\E_Appendices\11 - Other Projects\MO1865177 - IFB_PS&E- Design Plans.pdf

The following question was received on January 4, 2017.

Question 89:
Article VIII.B on page 23 of the RFP mandates meeting or exceeding the DBE Participation Goal for work performed under the Design and Preconstruction Fee bid item. Please clarify this requirement. Does the reference to a goal only pull in the goal for 25% DBE participation, or does this reference also pull in the subgoals for 9% female participation and 6% African-American participation?

Response 89:
The Design-Builder shall meet or exceed the DBE goals, including sub-goals, required by the Contract Provision AFFIRMATIVE ACTION REQUIREMENTS UTILIZATION OF MINORITY BUSINESS ENTERPRISES FOR STRAIGHT STATE CONTRACTS (page 3 of 10).

The following question was received on January 9, 2017.

Question 90:
The RFP states that the Contract MBE goal as shown in the Appendix is only applicable to the Design and Preconstruction item in the Price Proposal. The Design and Preconstruction item includes significant cost for items such as 'costs associated with providing requirements to submit a proposal, such as the Proposal Guaranty' (per Response 58) and the contractually required ACONEX project management software. There is no ability to provide MBE participation for these items or to help meet the MBE goal via the considerable construction to be performed under the CAPS, forcing the entire MBE participation for the Design and Preconstruction to be achieved via professional services participation. Is it SHA's intent that the MBE goal be achieved on the entire value of the Design and Preconstruction item, or may the MBE goal be interpreted to apply only to those professional services being provided by the Lead Design Firm and its subconsultants?

Response 90:
25 percent of the Design & Preconstruction Services Fee provided with the Price Proposal must be MBE. As mentioned in Response 48, the MBE goal has been adjusted down from what a typical design-build project would require to account for Preconstruction Services and Aconex costs. Also note, the Design-Builder is not required to include the Proposal Guaranty in the Design & Preconstruction Services Fee. The Design-Builder may elect to include the Proposal Guaranty in the Construction Services Fee.

The following questions were received on January 10, 2017.

Question 91:
Has the Maryland State Highway Administration issued a wage determination for the project based upon the (Anticipated) Notice to Proceed Date of March 2017?

Response 91:
Prevailing wage rates will be established with the CAP.

Question 92:
Will the Maryland State Highway Administration consider establishing indexed base cost for petroleum based products (diesel fuel, hot mixed asphalt pavements and slurry seal) and structural steel?

Response 92:
Any adjustments will be included in the CAP. Depending on the scope of the CAP, typical SHA adjustments for asphalt binder, pavement density, asphalt mixture, pavement surface profile, and diesel fuel will be included. While SHA does not have a standard structural steel adjustment, this can be discussed with the CAP and potentially included in a risk sharing pool.

The following question was received on January 11, 2017.

Question 93:

Please confirm the design builder must provide Aconex project management software for this project. The cost of providing that software from March 2017 thru March 2020 is almost 1/4 of a million dollars. In addition after that date access to the data base to retrieve the project records would not be available unless additional payments are made by SHA on a yearly basis. Several members of our team have existing service agreement with other software firms for similar Project Management tools that could be made available for use on this project for no cost and would provide the SHA the availability to recover their Project Records at no cost after March 2020.

Response 93:

Confirmed. The Design-Builder is to provide Aconex project management software per the RFP.

Submitted to:

State Highway Administration

Maryland Department of Transportation

Appendix B

INTERSTATE 270

CGI Team PTCs and SHA Responses

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

PROPOSED TECHNICAL CONCEPT 1

ROADWAY MODIFICATIONS TO SOUTHBOUND I-270 AT I-370

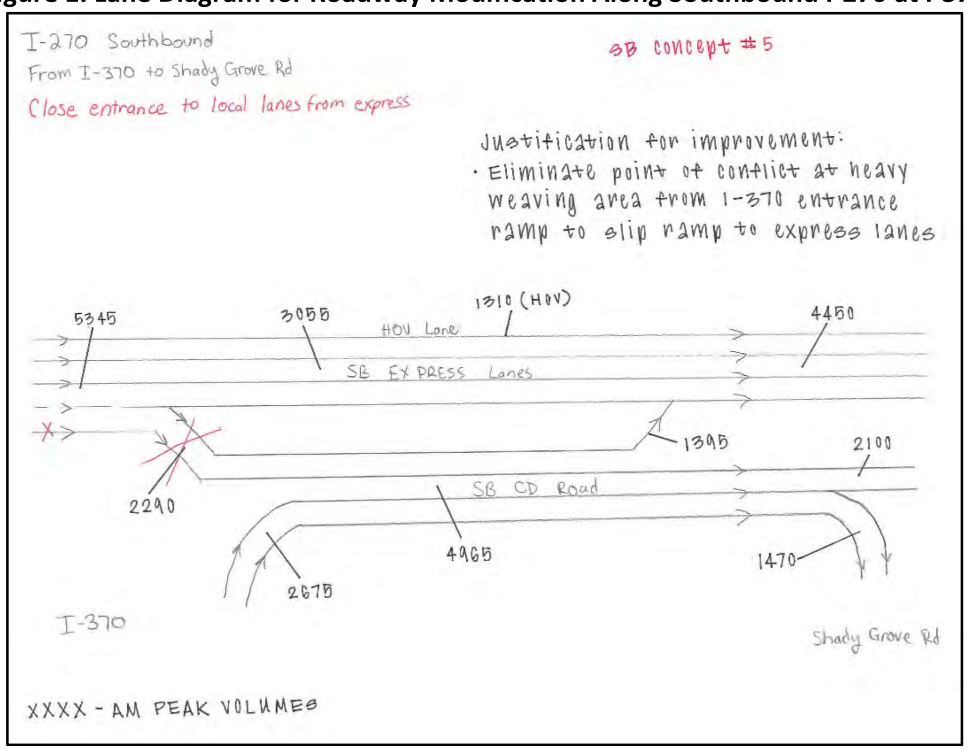
A. DESCRIPTION

Just north of I-370, southbound I-270 widens from four lanes to five lanes. Approximately one-quarter mile south, within the I-270/I-370 interchange, two lanes diverge from the right to form the barrier-separated collector-distributor/local lanes. The four leftmost lanes continue south as the I-270 mainline/express lanes (the second lane from the right is a choice lane). 2,290 vehicles diverge to the two local lanes and 4,365 vehicles continue on the four express lanes (including the HOV lane).

Approximately one-quarter mile south of the diverge (approximately 750 feet after the barrier separation begins), the two-lane entrance ramp from I-370 merges with the two local lanes. Approximately one-quarter mile south of this merge, a slip ramp diverges from the local lanes to the express lanes. During the AM peak hour 2,675 vehicles enter from the I-370 ramp, and 1,395 of those vehicles weave across the local lanes to access the slip ramp to the express lanes. This dense, short weave section causes recurring peak period congestion that spills back onto the mainline of I-270.

Under this PTC, access to the local lanes from southbound I-270 would be closed. This would eliminate the weave conflict between the I-370 entrance ramp and downstream slip ramp, eliminating congestion from the local lanes spilling back onto southbound I-270. The existing lane configuration, proposed modifications, and existing traffic volumes are shown in **Figure 1**.

Figure 1. Lane Diagram for Roadway Modification Along Southbound I-270 at I-370



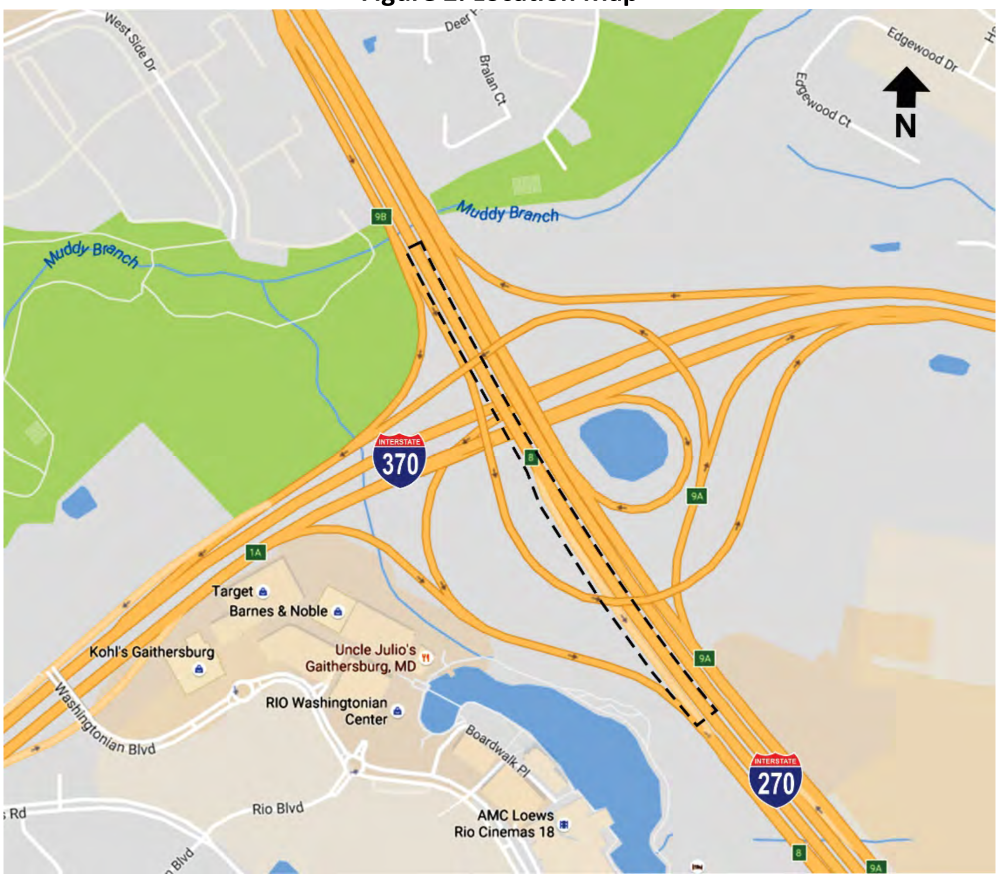
Under this PTC, traffic on southbound I-270 would access the local lanes using the slip ramp between

Shady Grove Road and Gude Drive. Southbound I-270 traffic that currently uses the local lanes to exit at Shady Grove Road would have to divert to new routes, with most vehicles likely to exit I-270 at I-370 and use other routes to arrive at their destination.

B. LOCATION

This PTC is located along southbound I-270 at the diverge of the local lanes from the mainline within the I-370 interchange. The location of this improvement is shown in **Figure 2**.

Figure 2. Location Map



C. ANALYSIS

This PTC advances the project goals of increased mobility and safety. In addition, the PTC could be implemented in a configuration that would require no long-term operations or maintenance cost.

1. Mobility

Closing the entrance to the local lanes and therefore eliminating the weave conflict between the I-370 entrance ramp traffic and existing traffic in the local lanes will eliminate a recurring congestion point. This congestion spills back onto I-270 and results in congestion along the southbound I-270 mainline. Closing the access to the local lanes will result in more traffic in the express lanes; however, the additional volume would be less than the capacity of the four-lane express lanes section (including the HOV lane). The existing and proposed traffic volumes are shown in **Table 1**. Note that the proposed volumes assume that approximately 1,100 vehicles that would have accessed the local lanes to exit at Shady Grove Road would exit from southbound I-270 prior to this point (likely at the I-370 interchange).

Table 1. Existing and Proposed AM Peak Hour Volumes Along Southbound I-270 through the I-370 and Shady Grove Road Interchanges

Location	Existing Condition				Proposed Condition			
	Ramp	Local Lanes	Slip Ramp	Express Lanes[1]	Ramp	Local Lanes	Slip Ramp	Express Lanes[1]
I-370 Bridge	N/A	N/A	N/A	6,655	N/A	N/A	N/A	5,555
Local Lanes Entrance		2,290		4,365		0		
I-370 Entrance	2,675				2,675	0		
Between I-370 Entrance and Slip Ramp	N/A	4,965			N/A	2,675		
Slip Ramp to Express		3,570	1,395	5,760		1,280	1,395	6,950
Between Slip Ramp and Shady Grove Road Exit			N/A				N/A	
Shady Grove Road Exit	1,470	2,100			370[2]	910		
Between Shady Grove Road Exit and EB Entrance	N/A				N/A			
Shady Grove Road EB Entrance	610				610			
Between Shady Grove Road EB and WB Entrances	N/A	2,710			N/A	1,520		
Shady Grove Road WB Entrance	380				380			
Slip Ramp from Express	N/A	3,090	780	4,980	N/A	1,900	1,880[3]	5,070

[1] Includes 1,310 vehicles in HOV lane. All other express lanes volume is in three general-purpose lanes.
[2] Assumes 1,100 vehicles who currently use this ramp will exit I-270 north of this location. Actual diverting volume to be determined during detailed traffic analysis.
[3] Assumes SB I-270 traffic that previously exits at start of local lanes will use this slip ramp (minus volumes that diverted north of the start of the local lanes).

2. Safety

The weave section along the southbound I-270 local lanes between the I-370 entrance ramp and slip ramp is a high accident location. Removing the weave will eliminate the major source of conflicts along this section of I-270. In addition, eliminating the congestion that spills back from the entrance to the local lanes would reduce congestion-related accidents along southbound I-270 approaching this location.

D. POTENTIAL IMPACTS

There would be no roadway, right-of-way, infrastructure, or environmental impacts from this PTC. The work to close the access to the local lanes could include a permanent or temporary barrier. This could be implemented without impacting the existing infrastructure. No other work would be needed outside of the existing roadway section.

As noted above, traffic that currently uses the local lanes to access the exit at Shady Grove Road would have to divert to another exit from I-270. Considering that all traffic wanting to make this movement would be coming from the north, with the proximity of the I-370 interchange and the existing roadway network, it is likely that most of these vehicles would use the I-370 interchange and other surface streets to reach their destination. Additional traffic analysis is needed to identify the potential impacts to the overall system from the influx of these diverting vehicles.

E. OTHER PROJECTS

TBD.

F. ADMINISTRATION RISK

This PTC would divert some southbound I-270 traffic from the Shady Grove Road exit ramp to other exits along I-270. Additional analysis is needed to determine if any signal modifications would be needed to accommodate the diverted traffic. If so, SHA would have to coordinate with Montgomery County on the changes.

G. DESIGN-BUILDER RISK

TBD.

H. COST/SCHEDULE BENEFITS

TBD.

I. RELATED PTCs

The following PTCs could be implemented in conjunction with this PTC to improve overall operations:

- None. This PTC does not require other PTCs though it would preclude the implementation of other technology-based management or roadway PTCs.

J. MISCELLANEOUS

TBD.

October 6, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 1 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Please determine if there are any operational impacts to the existing infrastructure (e.g. I-370 ramps, the slip ramp between Shady Grove Road and Gude Drive, etc.) due to the closure proposed in this PTC.
3. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
4. Please clarify if the intention is to make this a permanent or temporary closure. If temporary, please clarify how the closure would be implemented and when it would operate. If permanent, please provide more details regarding how the access would be closed and what would become of the existing infrastructure, such as the existing pavement.
5. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 2

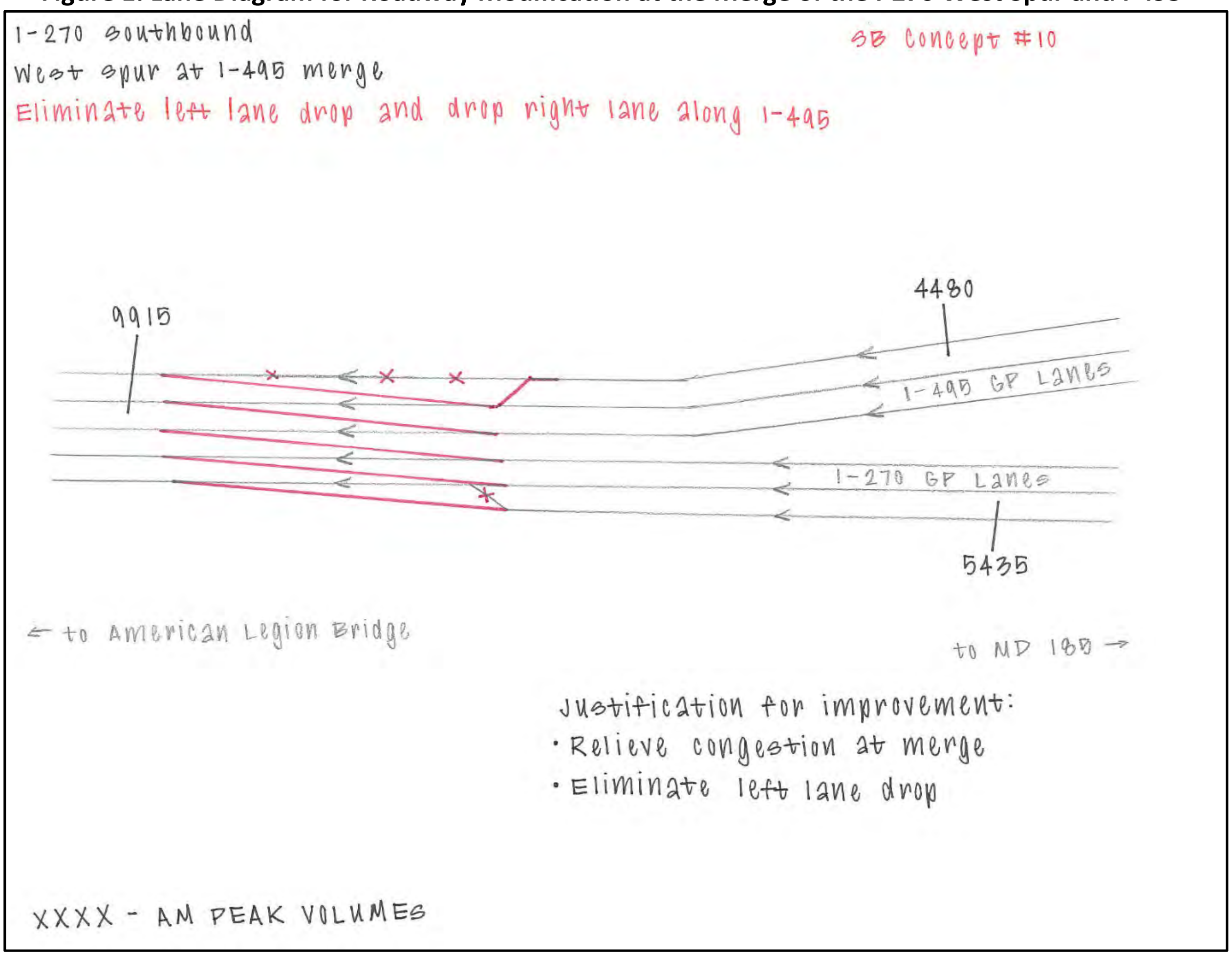
ROADWAY MODIFICATIONS TO THE MERGE OF THE I-270 WEST SPUR AND I-495

A. DESCRIPTION

Currently at the merge of the southbound I-270 West Spur with the outer loop of I-495, each roadway carries three lanes. The I-495 outer loop flies over the I-270 West Spur and merges on the right side. At the point of the merge, the left lane on the I-270 West Spur drops. This lane operates as an HOV lane during the AM peak period. The three lanes of the outer loop continue, creating a five-lane section. The AM peak hour volume from the I-270 West Spur is 5,435 vehicles. The AM peak hour volume from the I-495 outer loop is 4,480 vehicles. During the AM peak period, recurring congestion at the merge backs up onto the I-270 West Spur.

Under this PTC, the three lanes from the southbound I-270 West Spur would be maintained and the right lane from the I-495 outer loop would drop at the merge. The existing lane configuration, proposed modifications, and existing traffic volumes are shown in **Figure 1**.

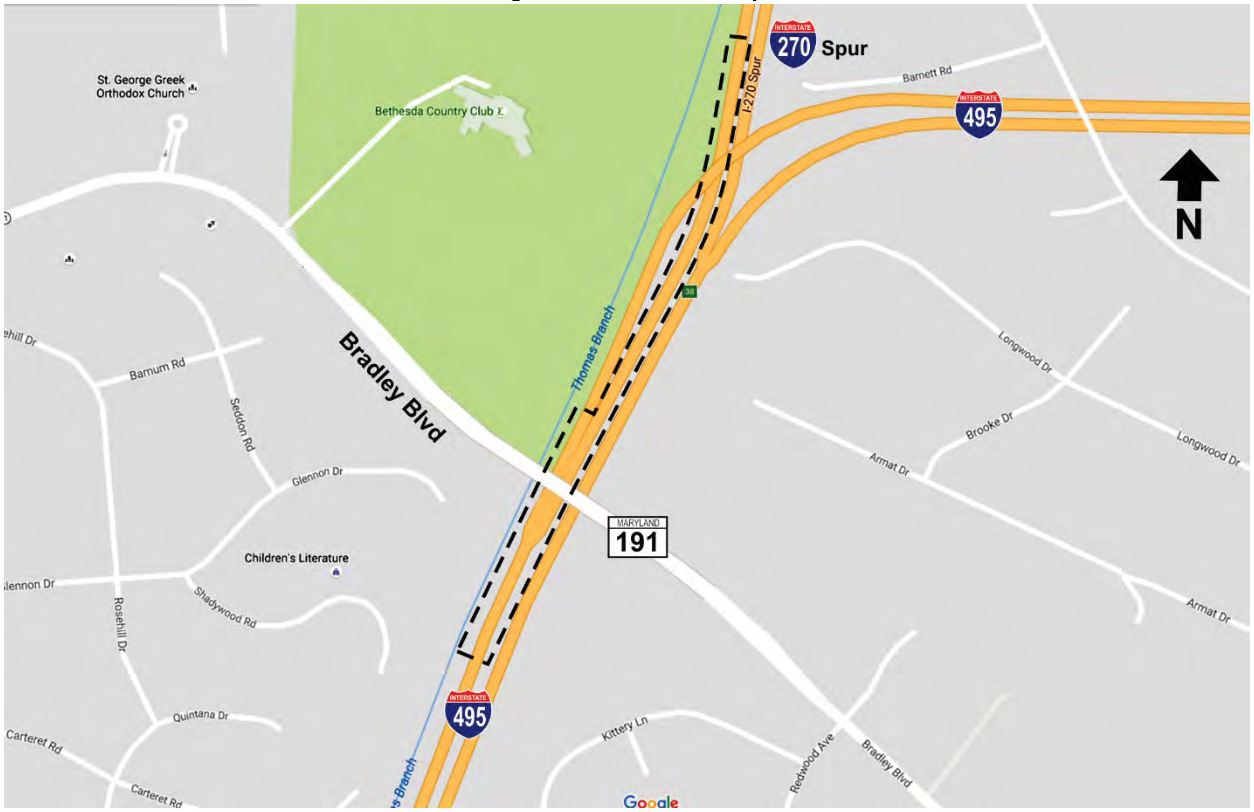
Figure 1. Lane Diagram for Roadway Modification at the Merge of the I-270 West Spur and I-495



B. LOCATION

This PTC is located at the merge of the southbound I-270 West Spur and the I-495 outer loop. The location of this improvement is shown in **Figure 2**.

Figure 2. Location Map



C. ANALYSIS

This PTC advances the project goals of increased mobility and safety. In addition, the PTC could be implemented in a configuration that would require no long-term operations or maintenance cost.

1. Mobility

Reconfiguring the merge to maintain the I-270 West Spur lanes and drop the right I-495 outer loop lane better accommodates the existing traffic volumes. The existing I-495 outer loop traffic volumes during the AM peak hour is 4,480 vehicles, which could be accommodated in two travel lanes. In contrast, the existing southbound I-270 West Spur traffic volumes during the AM peak hour is 5,435 vehicles, which requires three travel lanes. Reconfiguring the merge will eliminate the merging from the HOV lane into the more heavily utilized lanes from the I-270 West Spur. This will be replaced by merging from the right I-495 outer loop lane into the less heavily utilized lanes from I-495. This change should reduce congestion and improve mobility along the southbound I-270 West Spur.

2. Safety

Reconfiguring the merge should reduce congestion along the southbound I-270 West Spur, reducing congestion-related accidents.

D. POTENTIAL IMPACTS

There would be no roadway, right-of-way, infrastructure, or environmental impacts from this PTC. The work to reconfigure the merge could be accomplished through resurfacing, restriping, and minor signing changes.

E. OTHER PROJECTS

TBD.

F. ADMINISTRATION RISK

None.

G. DESIGN-BUILDER RISK

None.

H. COST/SCHEDULE BENEFITS

TBD.

I. RELATED PTCs

The following PTCs could be implemented in conjunction with this PTC to improve overall operations:

- None. This PTC does not require other PTCs though it would preclude the implementation of other technology-based management or roadway PTCs.

J. MISCELLANEOUS

TBD.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 2 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Please document any degradation of traffic operations on I-495.
3. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
4. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

My telephone number/toll-free number is 410-545-8800 or 1-888-228-6971
Maryland Relay Service for Impaired Hearing or Speech 1.800.735.2258 Statewide Toll Free

Street Address: 707 North Calvert Street • Baltimore, Maryland 21202 • *Phone* 410.545.0300 • www.roads.maryland.gov

PROPOSED TECHNICAL CONCEPT 3

ROADWAY MODIFICATIONS TO NORTHBOUND I-270 AT SHADY GROVE ROAD AND I-370

A. DESCRIPTION

Along the northbound I-270 CD Road/local lanes through the Shady Grove Road interchange, there is a complex mix of lane drops, merges, weaves, and diverges. From south to north, the local lanes configuration varies as follows:

- Two lanes widen to three lanes approaching the Shady Grove Road exit ramp,
- The right two lanes drop at the exit ramp; one local lane continues,
- There are simultaneous merges on the left, from two slip ramp lanes from the express lanes, and from the right from the loop entrance ramp from northbound Shady Grove Road,
- The loop ramp merges and three local lanes continue; the left lane is striped as an auxiliary lane,
- The lane from the entrance ramp from southbound Shady Grove Road merges on the right; three local lanes continue,
- The left lane becomes a slip ramp to the express lanes; two local lanes continue,
- A lane is added on the right approaching the I-370 exit ramp, and
- The three lanes split to four lanes (with a center choice lane), with two lanes going to I-370 and two local lanes continuing north.

This complex configuration results in recurring congestion along the local lanes. In addition, the location of the simultaneous merges (slip ramp and loop ramp) is a noted high crash location.

Under this PTC, multiple roadway improvements are proposed:

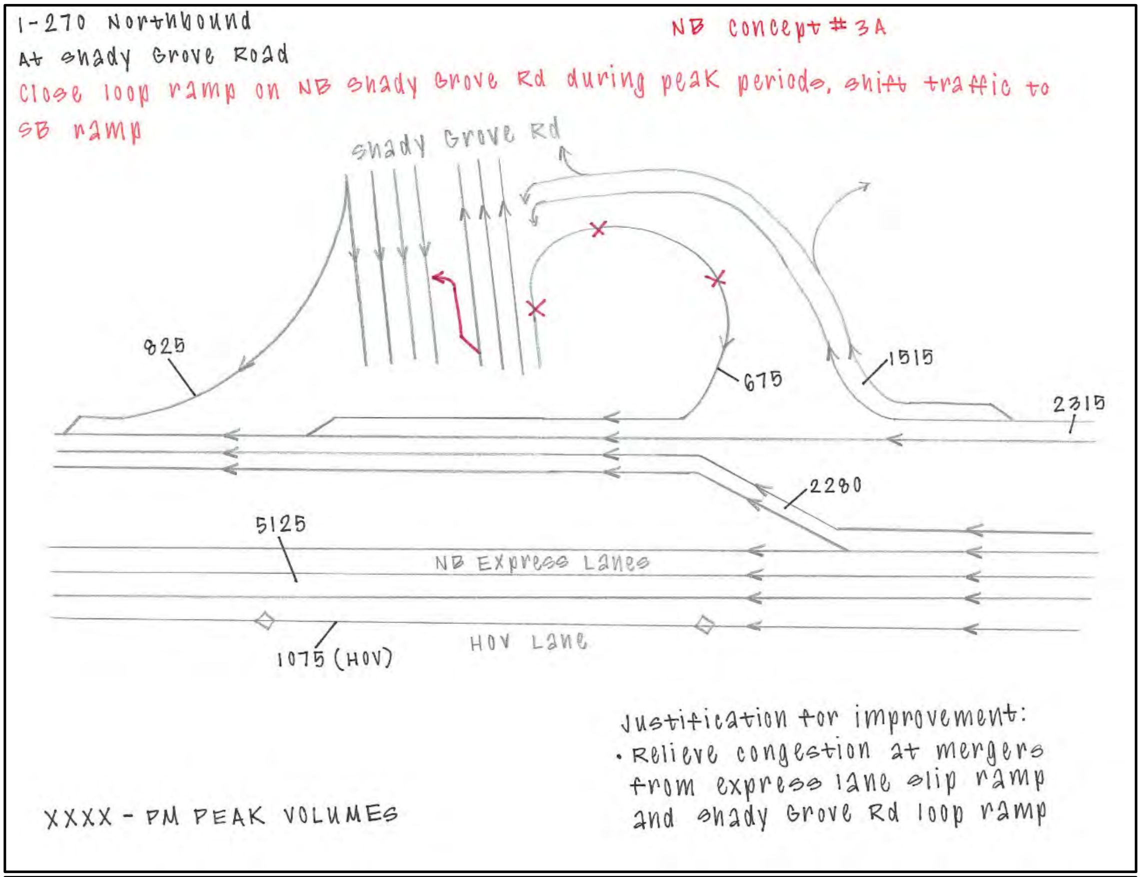
1. Eliminate the simultaneous merge by closing the loop entrance ramp from northbound Shady Grove Road to the local lanes (the ramp could be removed or access to it closed). The ramp movement to the northbound local lanes would be accommodated by providing a left turn spur for northbound traffic to the existing southbound Shady Grove Road entrance ramp. The Shady Grove Road lane configuration and existing traffic signal would be modified to accommodate left turn storage and a left turn phase for the spur ramp.
2. Eliminate weaving in the I-270 local lanes between Shady Grove Road and I-370 by closing the slip ramp from the local lanes to the express lanes between Shady Grove Road and I-370.
3. Provide additional capacity between Shady Grove Road and I-370 by maintaining three local lanes from the existing local to express slip ramp drop to the I-370 exit ramp.

The existing lane configuration, proposed modifications, and existing traffic volumes are shown in **Figure 1** and **Figure 2**.

B. LOCATION

This PTC is located along the northbound I-270 local lanes through the Shady Grove Road interchange to the I-370 interchange. The location of this improvement is shown in **Figure 3**.

Figures 1 and 2. Lane Diagrams for Roadway Modification Along NB I-270 at Shady Grove Road and I-370



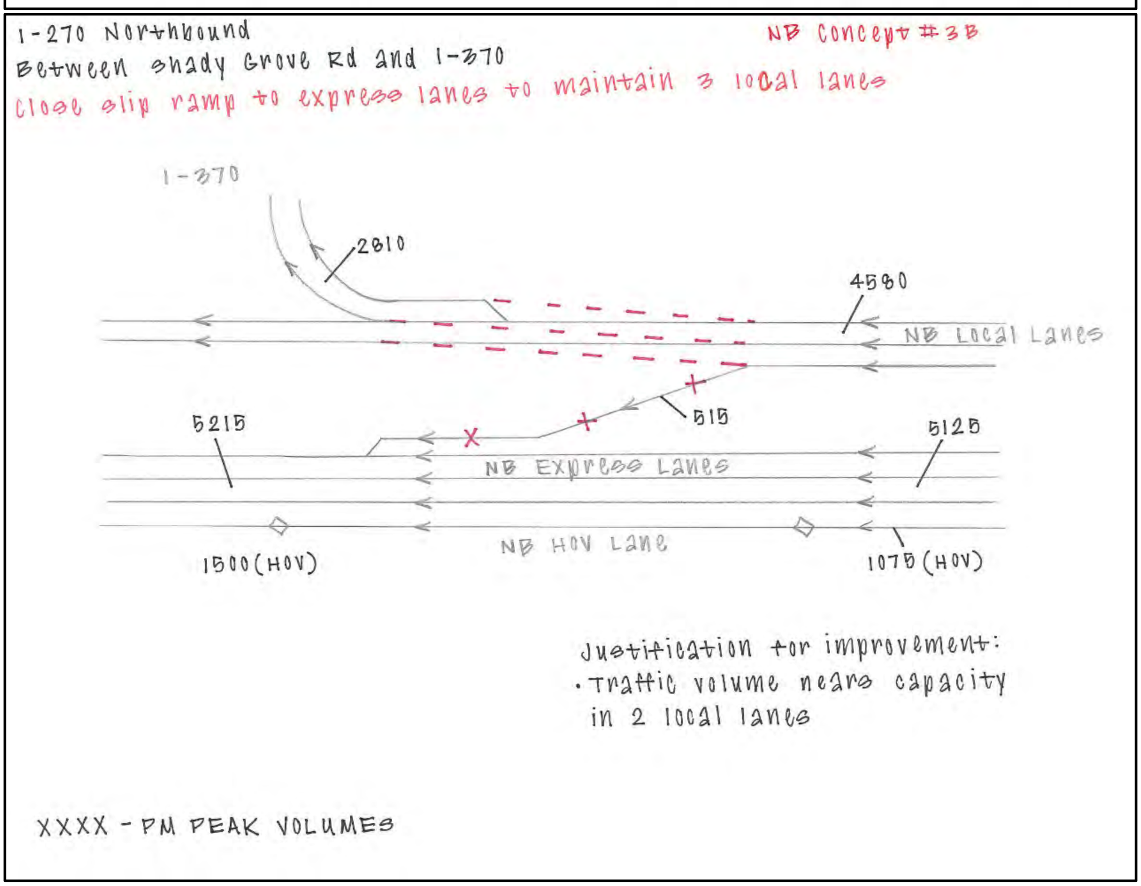


Figure 2. Location Map

C. ANALYSIS

This PTC advances the project goals of increased mobility and safety. In addition, the PTC could be implemented in a configuration that would require no long-term operations or maintenance cost. The mobility and safety benefits are presented in **Table 1**.

Table 1. Mobility and Safety Benefits Resulting from Roadway Modifications to Northbound I-270 at Shady Grove Road and I-370

PTC Element	Mobility	Safety
1. Close NB SGR loop ramp; provide left turn spur to SB SGR ramp	Eliminates a merge along the local lanes; the 675 PM peak hour vehicles that use this ramp can be accommodated on the SB SGR ramp.	Eliminates the simultaneous merge along the local lanes.
2. Close slip ramp from local to express lanes	Eliminates a weave section along the local lanes.	
3. Provide three local lanes between SGR and I-370	Provides additional capacity to accommodate the traffic that would have exited at the slip ramp to the express lanes	Provides sufficient capacity to prevent/reduce recurring congestion along the local lanes

D. POTENTIAL IMPACTS

A new left turn spur would be constructed within the wooded northeast infield area of the Shady Grove Road interchange. No other environmental impacts are anticipated. Shady Grove Road would have to be resurfaced/restriped to eliminate the right side lane drop to the loop ramp and provide a left turn lane for the spur ramp. The existing traffic signal east of the Shady Grove Road Bridge would have to be modified to accommodate a left turn phase. There would be no right-of-way impacts.

E. OTHER PROJECTS

TBD.

F. ADMINISTRATION RISK

Shady Grove Road is a Montgomery County road. Changes to the road, ramp terminals, and existing signal east of the Shady Grove Road Bridge would have to be approved by Montgomery County.

The proposed improvements along Shady Grove Road, the interchange ramps, and the northbound I-270 local lanes would require an MEPA/NEPA study. It is likely that the level of review would fall in the Programmatic Categorical Exclusion (PCE), and therefore, SHA would have the authority to approve the PCE. However, it would necessitate analysis of noise, air quality, socio-economic, cultural, and natural environmental impacts in accordance with MEPA/NEPA. There is the potential that impacts are more extensive than initially anticipated a Categorical Exclusion (CE) would be required. In that case, additional coordination and approval may be needed with FHWA and other state/federal agencies.

The improvements under this PTC would change access to I-270, both within the Shady Grove Road interchange (reconfiguring access from NB Shady Grove Road to NB I-270) and between the local and express lanes (closing the slip ramp north of Shady Grove Road). These change would require an IAPA and FHWA approval.

Providing three local lanes between Shady Grove Road and I-370 can be done within the existing roadway section of the local lanes; however, reconfiguring the road to narrow lanes and shoulders may be needed for a short segment. These modifications would require design exceptions for both lane width and shoulder width. SHA does have the delegated authority from FHWA to approve these design exceptions.

G. DESIGN-BUILDER RISK

TBD.

H. COST/SCHEDULE BENEFITS

TBD.

I. RELATED PTCs

The following PTCs could be implemented in conjunction with this PTC to improve overall operations:

- Ramp metering of nearby upstream ramps.

J. MISCELLANEOUS

TBD.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 3 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Please determine if there are any operational impacts to the existing infrastructure.
3. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
4. Please clarify if the intention is to close the loop ramp from northbound Shady Grove Road permanently or temporarily. If temporarily, please clarify how the closure would be implemented and when it would operate. If permanently, please provide more details regarding how the access would be closed and what would become of the existing infrastructure, such as the existing pavement.
5. Section D, Potential Impacts, definitively states there would be no right-of-way (ROW) impacts. While ROW could potentially be avoided, please note this PTC would likely require elements that often do impact ROW (e.g. stormwater management).
6. Travel lane widths on I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a CAP.
7. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

Michael Higgins, P.E.
Page Two

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 4

ROADWAY MODIFICATIONS TO NORTHBOUND I-270 LANE CONFIGURATION NORTH OF MD 121

A. DESCRIPTION

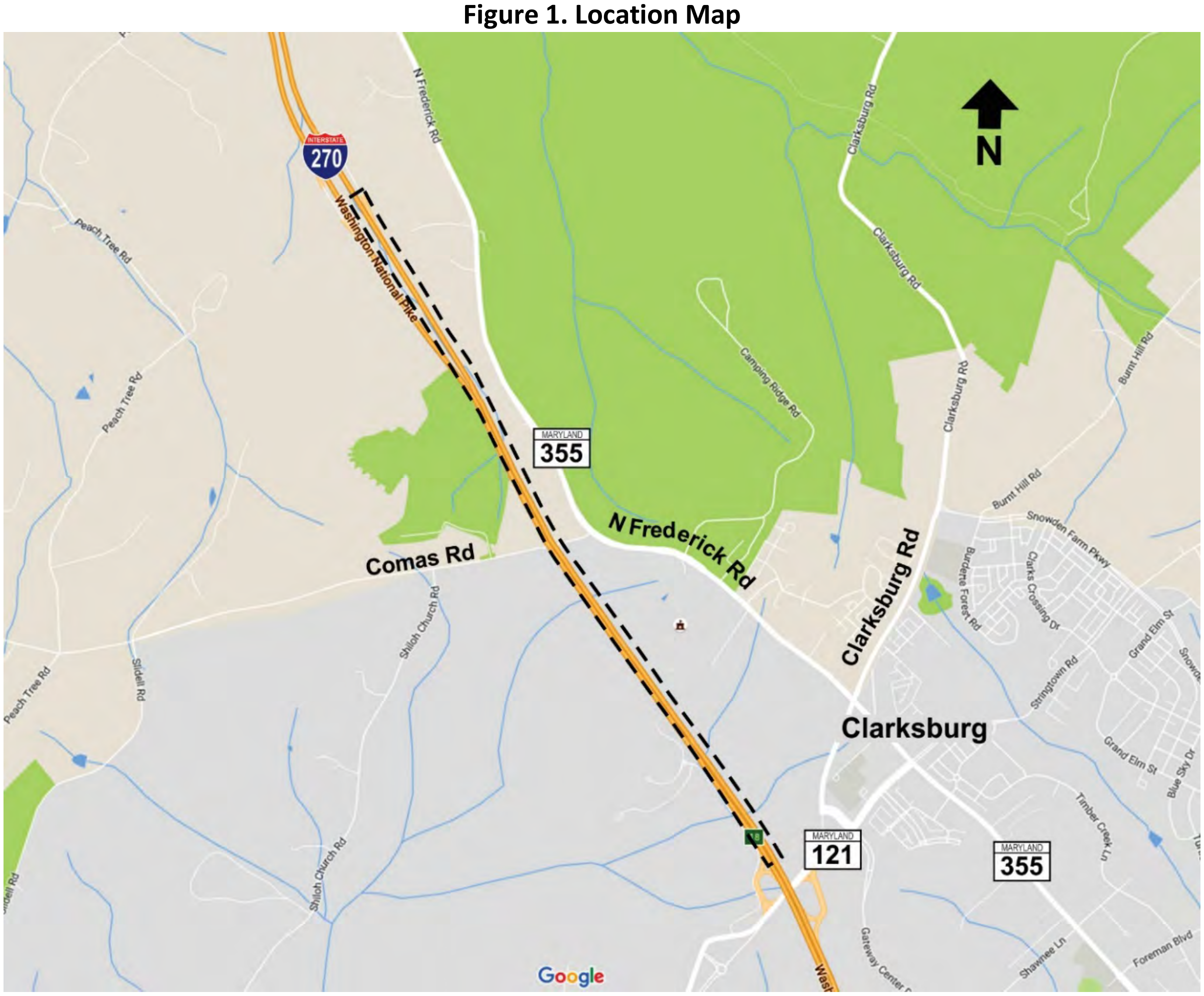
Along northbound I-270, the leftmost lane is designated as an HOV lane during the PM peak period ends. This designation ends at the interchange of I-270 and MD 121 (Clarksburg Road). Approximately one-half mile north of MD 121, the right lane on northbound I-270 drops and the northbound direction is reduced from three to two lanes. These two lanes continue north to I-70, with auxiliary lanes in some locations. The northbound PM peak hour volume north of MD 121 is 4,665 vehicles. During the PM peak period, a recurring bottleneck forms from the location of the right lane drop.

Under this PTC, the third lane on northbound I-270 would be maintained between MD 121 and the weigh station approximately 2.4 miles north of MD 121 during peak periods. The right lane would drop at the weigh station.

B. LOCATION

This PTC is located along northbound I-270 from the lane drop north of MD 121 to the weigh station. The location of this improvement is shown in **Figure 1**.

Figure 1. Location Map



C. ANALYSIS

This PTC advances the project goals of increased mobility and safety. In addition, the PTC could be implemented in a configuration that would require no additional long-term operations or maintenance cost outside of regular roadway maintenance.

1. Mobility

Maintaining a third lane north of MD 121 will provide additional capacity for the 4,665 PM peak vehicles for approximately two miles and will offer a greater distance for vehicles to merge from the right lane into the existing two lanes. The existing traffic volumes would not change; however, the density of the bottleneck at the existing lane drop will be reduced. Reconfiguring the number of lanes will provide a greater distance between the end of the HOV lane designation and reduction in the number of lanes. This change should reduce congestion resulting from vehicles slowing to merge and improve mobility along northbound I-270.

2. Safety

Providing a greater distance for vehicles to merge into two lanes should reduce the density of the bottleneck and related congestion along northbound I-270, therefore reducing congestion-related accidents.

D. POTENTIAL IMPACTS

The third lane would be implemented through resurfacing and restriping the existing paved width. The two lanes would be narrowed by one foot each to provide additional width for the right shoulder to act as a peak period lane. Multiple turn-offs would be provided to provide refuge for vehicles during the PM peak period. The amount of shoulder reconstruction would be limited to the greatest extent possible. However, any full depth pavement reconstruction would require stormwater management treatment. There could be environmental impacts from the limited widening and stormwater management treatment. There would be no right-of-way impacts from this PTC.

E. OTHER PROJECTS

TBD.

F. ADMINISTRATION RISK

The proposed improvements along northbound I-270 would require an MEPA/NEPA study. It is likely that the level of review would fall in the Programmatic Categorical Exclusions (PCE), and therefore, SHA would have the authority to approve the PCE. However, it would necessitate analysis of noise, air quality, socio-economic, cultural, and natural environmental impacts in accordance with MEPA/NEPA. There is the potential that impacts are more extensive than initially anticipated a Categorical Exclusion (CE) would be required. In that case, additional coordination and approval may be needed with FHWA and other state/federal agencies.

Providing a peak period shoulder lane would likely require restriping northbound I-270 to narrow the travel lanes to provide additional width in the right shoulder. These modifications would require design exceptions for lane width (and potentially shoulder width). SHA does have the delegated authority from FHWA to approve these design exceptions.

G. DESIGN-BUILDER RISK

TBD.

H. COST/SCHEDULE BENEFITS

TBD.

I. RELATED PTCs

The following PTCs could be implemented in conjunction with this PTC to improve overall operations:

- Active Traffic Management.

J. MISCELLANEOUS

TBD.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 4 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Section D, Potential Impacts, definitively states there would be no right-of-way (ROW) impacts. While ROW could potentially be avoided, the PTC states this strategy may require stormwater management, an element that often impacts ROW.
3. Section D, Potential Impacts, states multiple turn-offs would be provided for vehicle refuge during the PM peak period. Please specify the number of turn-offs to be provided, or the spacing. Please specify the minimum length of the turn-off (including tapers), or provide a sketch/detail.
4. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
5. The extension of the third lane would be considered a Type I project and require a noise analysis and appropriate mitigation as required by the SHA Noise Policy and the Code of Federal Regulations.
6. Travel lane widths on I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a CAP.
7. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 5

MOVABLE BARRIER ON I-270 BETWEEN MONTROSE ROAD AND I-370

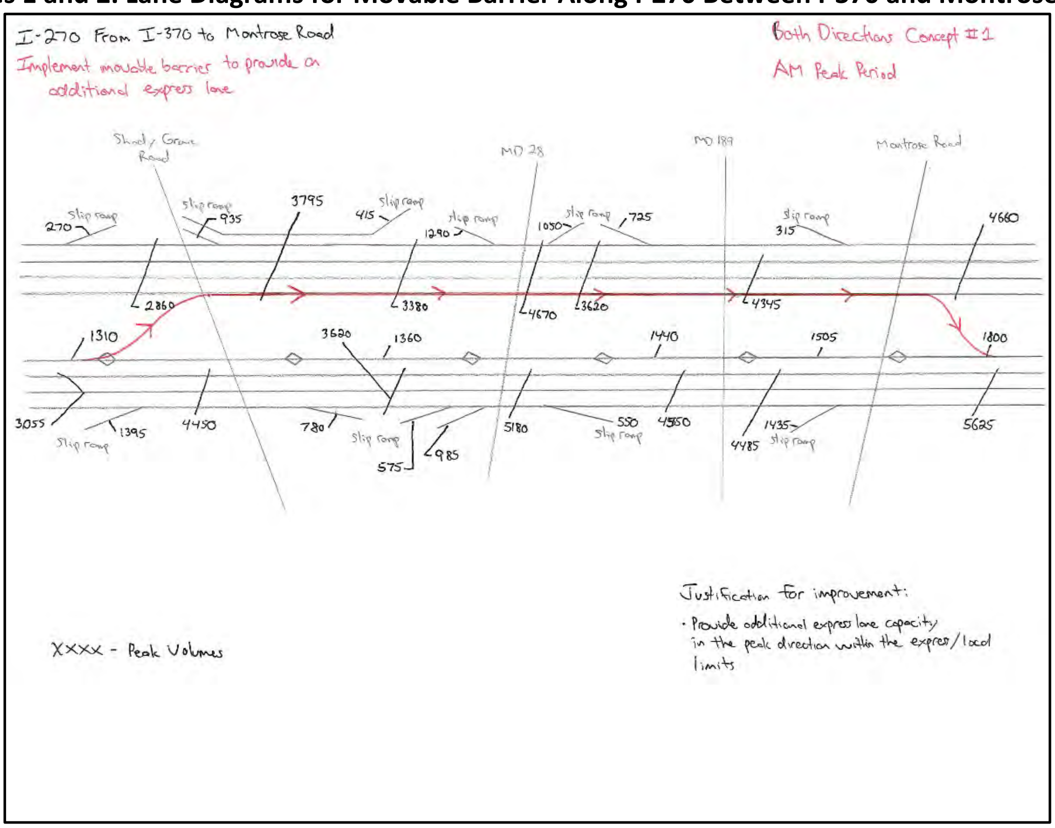
A. DESCRIPTION

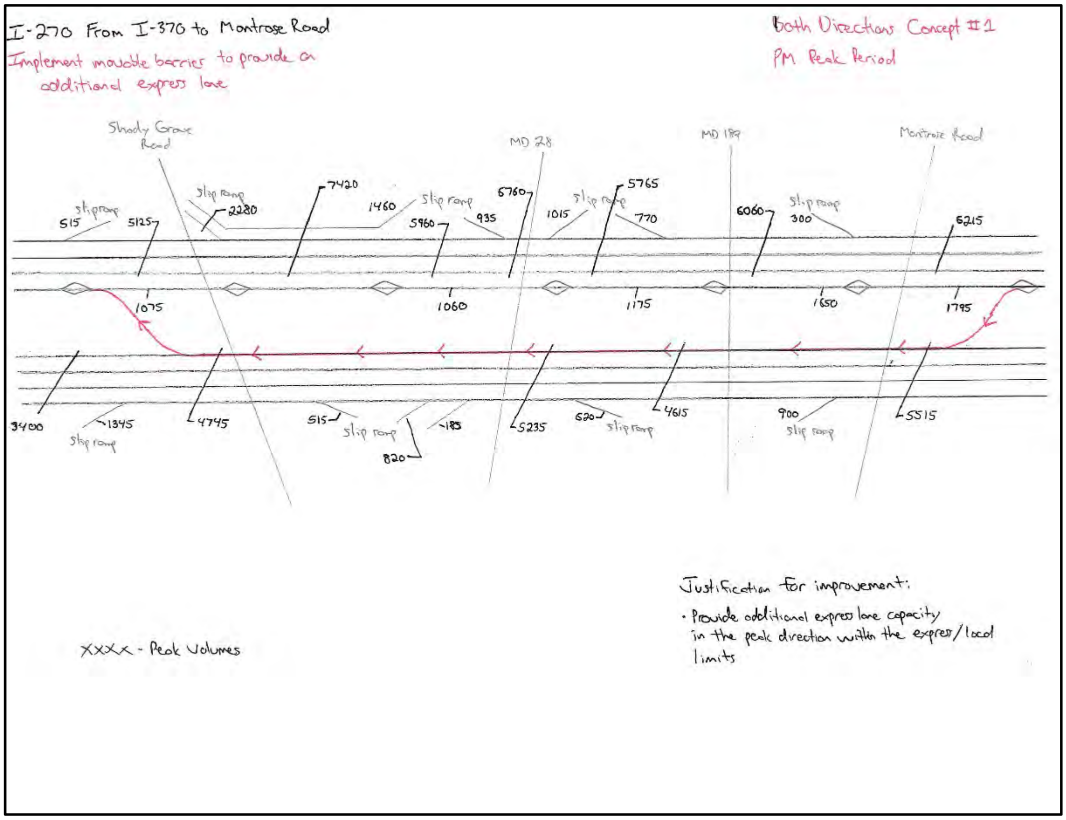
Along the express lane section of I-270 between Montrose Road and I-370, there are three general purpose lanes and one peak period HOV lane in each direction. In the southbound direction, the diverge to the local lanes develops within the I-370 interchange and the local and express lanes merge back together approximately one-half mile south of Montrose Road. In the northbound direction, the local lanes diverge from the express lanes approximately one-half mile south of Montrose Road and the local and express lanes merge back together approximately one-half mile north of MD 124 (Montgomery Village Avenue). The AM peak hour volume in the southbound direction reaches 7,425 vehicles in the four express lanes, including the HOV lane. The PM peak hour volume in the northbound direction reaches 8,010 vehicles in the four express lanes, including the HOV lane.

Under this PTC, movable barrier would be utilized to create a fifth express lane in the peak direction along I-270 between Montrose Road and I-370 during peak periods. The express lane configuration in the off-peak direction would be reduced to three total lanes. Median crossovers would be provided at both ends of the movable barrier limits to provide access/egress to the lanes. The new peak period lane, which would operate in contra-flow (NB in the leftmost SB lane during PM; SB in the leftmost NB lane during the AM) would operate as a general purpose lane. The location of the HOV lanes would be maintained.

The existing lane configuration, proposed modifications, and existing traffic volumes are shown in **Figure 1** and **Figure 2**.

Figures 1 and 2. Lane Diagrams for Movable Barrier Along I-270 Between I-370 and Montrose Road





B. LOCATION

This PTC is located along the I-270 express lanes from the Montrose Road interchange to the I-370 interchange. The location of this improvement is shown in **Figure 3**.

C. ANALYSIS

This PTC advances the project goals of increased mobility and safety. Additional operations and maintenance costs associated with the deployment of moveable barrier would result from this PTC.

1. Mobility

Adding a fifth lane in the peak direction along I-270 will create additional capacity to better accommodate existing traffic volumes. Reducing the number of lanes in the off-peak direction will result in more traffic in three express lanes; however, the volume would still be less than the capacity of three lanes. The existing PM peak hour volume in the southbound direction reaches 5,515 in four express lanes, including the HOV lane. The existing AM peak hour volume in the northbound direction reaches 4,660 vehicles in four express lanes, including the HOV lane. This change to the peak direction lane configuration should reduce congestion and improve mobility along the I-270 express lanes between Montrose Road and I-370.

In addition, the contra-flow lanes created by the movable barrier would operate as true express lanes, as there would be only one entrance and exit (at the endpoints). This would allow drivers whose destinations are beyond the limits of the express/local section to avoid having to mix with any traffic that is entering or exiting at the many slip ramps within this section.

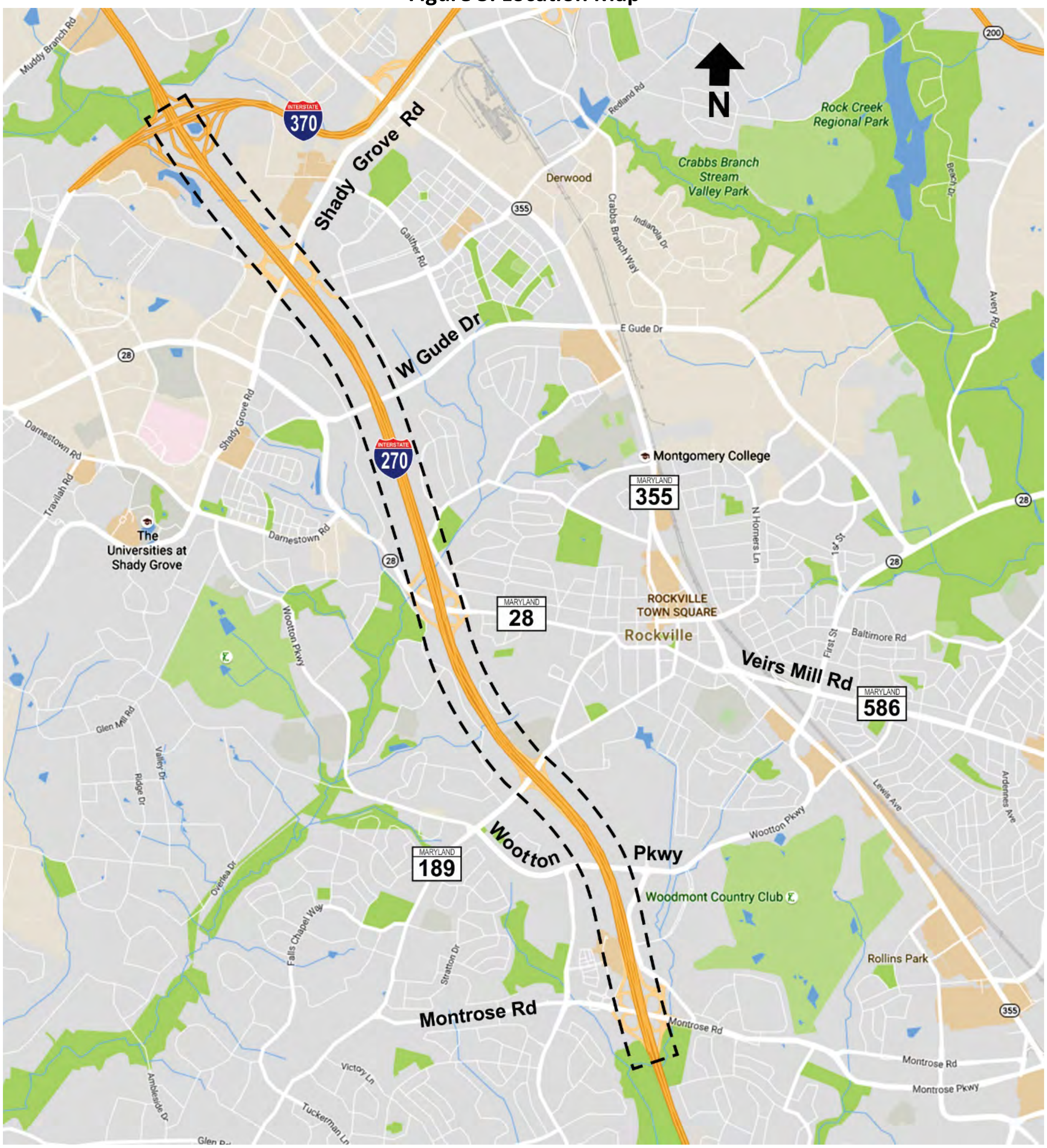
2. Safety

Providing an additional lane of capacity should reduce congestion in the peak direction along the I-270 express lanes, reducing congestion-related accidents.

3. *Operability and Maintainability*

There would be ongoing operations and maintenance costs associated with a movable barrier system. This include the maintenance of the movable barriers. Two movable barriers would be needed with this PTC, one for deployment of the northbound contra-flow lane (along SB I-270) and one of the deployment of the southbound contra-flow lane (along NB I-270). Two movable barrier vehicles would be needed to move the barrier, one for each direction, and these vehicles require upkeep, storage, and must be manned during movable barrier operations.

Figure 3. Location Map



D. POTENTIAL IMPACTS

Two median crossovers would have to be constructed at the ends of the movable barrier system limits. This would require removal of the existing median barrier and at least some reconstruction of the existing median shoulders. The existing express lanes may have to be narrowed slightly to provide width within the existing lanes for the movable barrier to be deployed without having contra-flow vehicles travel partially on the existing median shoulder.

No work would be needed outside of the existing roadway section. There would be no right-of-way or environmental impacts from this PTC.

E. OTHER PROJECTS

TBD.

F. ADMINISTRATION RISK

SHA would be taking on the responsibility of a system that would have to be operated and maintained. Agreements would have to be reached on who would operate and maintain the system (SHA, the movable barrier vendor, or a third party). A long-term cost structure would have to be developed to understand the annual operating cost and overall life cycle costs for a movable barrier system.

G. DESIGN-BUILDER RISK

It is likely that CGI would procure the movable barrier system as part of the ICMC. A better understanding is needed on what the implementation cost would be, and the ability of a movable barrier vendor to provide a length of barrier needed for the proposed PTC.

H. COST/SCHEDULE BENEFITS

TBD.

I. RELATED PTCs

The following PTCs could be implemented in conjunction with this PTC to improve overall operations:

- Active Traffic Management.

J. MISCELLANEOUS

TBD.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 5 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. For clarity, please provide a typical section(s).
3. Please elaborate on Safety, including incident management.
4. If potential costs, or a range of costs, of the Barrier Transfer Machines (BTMs) and moveable barrier are available, please provide in the Operability & Maintainability section.
5. Please clarify how the crossovers will be closed for the non-peak direction of traffic.
6. Travel lane widths on I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a Construction Agreed Price (CAP).
7. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
8. This would be considered a Type I project and require a noise analysis and appropriate mitigation as required by the SHA Noise Policy and the Code of Federal Regulations.
9. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

My telephone number/toll-free number is 410-545-8800 or 1-888-228-6971
Maryland Relay Service for Impaired Hearing or Speech 1.800.735.2258 Statewide Toll Free

Street Address: 707 North Calvert Street • Baltimore, Maryland 21202 • *Phone* 410.545.0300 • www.roads.maryland.gov

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

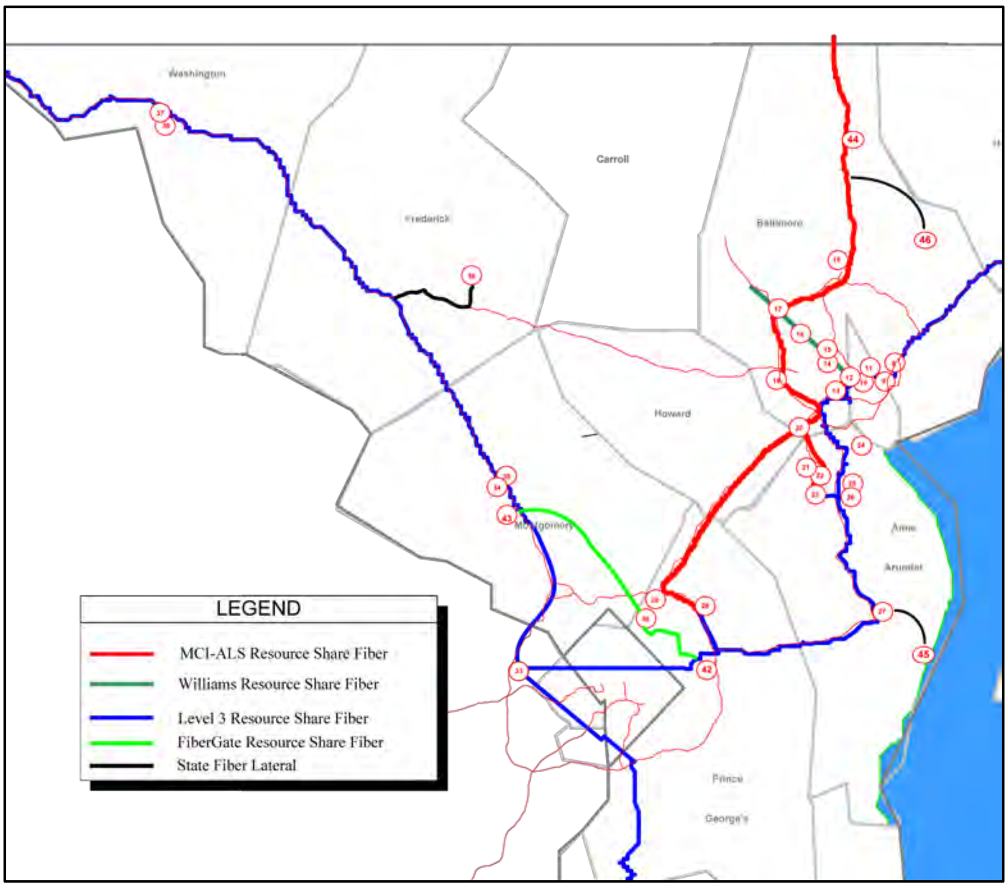
cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 6

USE MDOT SHARED RESOURCE FIBER OPTIC CABLE ALONG I-270

A. DESCRIPTION

In order to provide a communication link to proposed SHA Intelligent Transportation System (ITS) devices, our team proposes to utilize existing MDOT Shared Resource fiber optic cable, owned by Level 3 Communications, which is located along the I-270 corridor. The figure below shows the path of the existing fiber optic through the corridor. The existing SHA ITS devices utilize leased communication lines, typically T1 or Cellular, which require monthly service fees. The MDOT Shared Resource fiber optic cable does not required a monthly service fee.



B. LOCATION

This PTC will be used throughout the I-270 corridor to connect proposed ITS devices to the Maryland Statewide Operations Center (SOC).

C. ANALYSIS

Based on information gathered by the Concrete General Team, MDOT (SHA/MDTA) has access to 48 resource shared fibers, free of charge. MDOT has access to 20 of the fibers, 12 are reserved and 16 are used by network Maryland.

Use of the MDOT Shared Resource fiber would achieve the project goals by reducing the operations/maintenance costs for deployment of ITS devices along the corridor. Connection to the fiber optic cable would result in a one-time capital cost for splicing as opposed to monthly service fees which are currently paid to Verizon, AT&T or Sprint.

D. POTENTIAL IMPACTS

The use of this PTC will reduce the operation cost associated with installation of new ITS devices within the corridor.

E. OTHER PROJECTS

The Maryland Transportation Authority of Maryland Department of Transportation currently utilizes MDOT Shared Resource fiber owned by Level 3 Communications along I-95 for ITS devices.

F. ADMINISTRATION RISK

The SHA will need to confirm that the agreement with Level 3 Communications allows for the shared resource fiber to be utilized by SHA for ITS devices. SHA would need to confirm that two to four of the 20 fiber strands allocated to MDOT/SHA are available for use by SHA ITS devices.

G. DESIGN-BUILDER RISK

In order to tie into the Level 3 fiber optic cable, a request must be submitted through MDOT's Department of Information Technology (DOIT). DOIT than coordinates with Level 3 including providing them location, splice details and owner contact information. Level 3 hires a contractor to complete the splicing. Since the splicing is coordinated through and completed by a third party outside of the Design-Build Team, a risk of delay and schedule impact would be associated with the fiber splicing work. However, since the current SHA procedures require a service request to be filed and installed with a third party utility, such as Verizon, the risk is not much different than the current procedure.

H. COST/SCHEDULE BENEFITS

SHA currently pays approximately $500 per month for T1 communication services associated with ITS devices which require high speed streaming data communication for video images. SHA currently pays approximately $35 per month for cellular communication services for ITS devices which require medium or low speed data communication, such as for dynamic message signs, speed detectors, etc.

Under the existing system design, every new ITS device would require a new communication service and the associated monthly service charge. This would further increase SHA CHART's monthly ITS service bill.

If the Shared Resource fiber optic cable is used to connect the proposed ITS devices back to the SHA SOC, there would be no monthly service charge. The only cost would be associated with completing the splices into the level 3 fiber optic cable during construction. Typically the cost for splicing is $5,000 per device location.

I. RELATED PTCs

The following PTCs could be implemented in conjunction with this PTC to improve overall operations:

- Active Traffic Management. Fiber could be used for ATM devices.
- Ramp metering. Fiber could be used for ramp metering system.
- Connector metering. Fiber could be used for ramp metering system.

- Enhanced detection. Fiber could be used for ramp metering system.
- Integrated Corridor Management. Fiber could be used for ramp metering system.

J. MISCELLANEOUS

TBD.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 6 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. The Administration is currently investigating how many fibers, if any, can be dedicated to the project. Once determined, additional information will be provided.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

My telephone number/toll-free number is 410-545-8800 or 1-888-228-6971
Maryland Relay Service for Impaired Hearing or Speech 1.800.735.2258 Statewide Toll Free

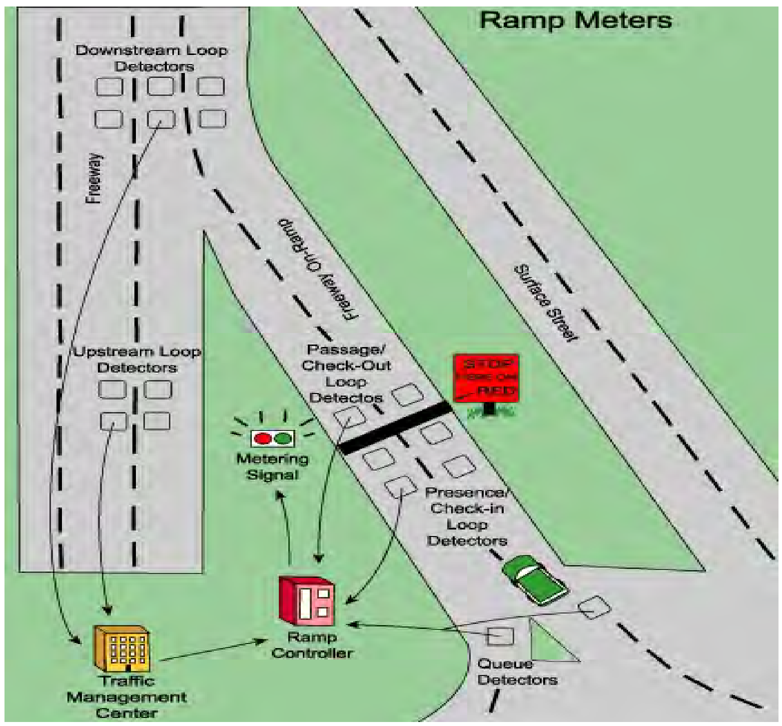
Street Address: 707 North Calvert Street • Baltimore, Maryland 21202 • *Phone* 410.545.0300 • www.roads.maryland.gov

PROPOSED TECHNICAL CONCEPT 7
Adaptive Ramp Metering

A. DESCRIPTION

It is proposed to implement arterial-to-freeway ramp metering throughout the I-270 corridor. Ramp metering is a strategy that involves the use of a traffic signal(s) deployed on a ramp to control the rate at which vehicles enter a freeway. By controlling the rate at which vehicles are allowed to enter a freeway, the flow of traffic onto the freeway becomes more consistent, smoothing the flow of traffic on the mainline and allowing more efficient use of existing freeway capacity.

A typical ramp metering layout is shown below (noting that other types of detectors may be used rather than loops, particularly on the freeway).



All ramps will be equipped with queue management systems to manage the impact on the arterial road network at each location (e.g., if the ramp queues reach the queue detectors at the top of the ramp, the metering rate is relaxed or metering is discontinued). Connections between the ramp meter controller and local intersection controllers feeding the ramp may also be included as part of queue management.

It is envisioned that most metered ramps will operate as part of an area-wide metering control system. With such an adaptive ramp metering approach, metering rates are not set based solely on time of day or on the freeway flow in the immediate vicinity of the ramp. Rather, metering rates are based on freeway flows and ramp conditions throughout a zone – for example, upstream metering rates may become more restrictive in response to downstream ramps exceeding their capacity (queues backing up). The overall goal of adaptive ramp metering is to keep the freeway traffic flow from breaking down while equalizing the ramp delays throughout the corridor. Such area-wide control provides more options in optimizing mainline capacity and reducing the amount of overall system delay by using multiple ramps to control traffic at any given bottleneck or congested location.

B. LOCATION

It is currently proposed to implement metering at every arterial to freeway on-ramp in the northbound and southbound directions. This includes up to 39 ramps. Each ramp is currently being assessed for its suitability for metering (e.g., ramp capacity relative to demands) and the impact on the freeway congestion. Therefore, the final number of ramps to be metered may be less than this number.

C. ANALYSIS

Ramp metering has been successfully applied at numerous locations in the United States, promoting both mobility and safety goals. Some of the results are summarized below:

- Portland, Oregon: 43 percent reduction in peak period collisions and 173 percent increase in average travel speed.
- Seattle, Washington: 39 percent reduction in collision rate and 52 percent reduction in average travel time.
- Minneapolis, Minnesota: 24 percent reduction in peak period collisions 16 percent increase in peak-hour travel speed
- Long Island, New York: 15 percent reduction in collision rate and 9 percent increase in average travel speed

D. POTENTIAL IMPACTS

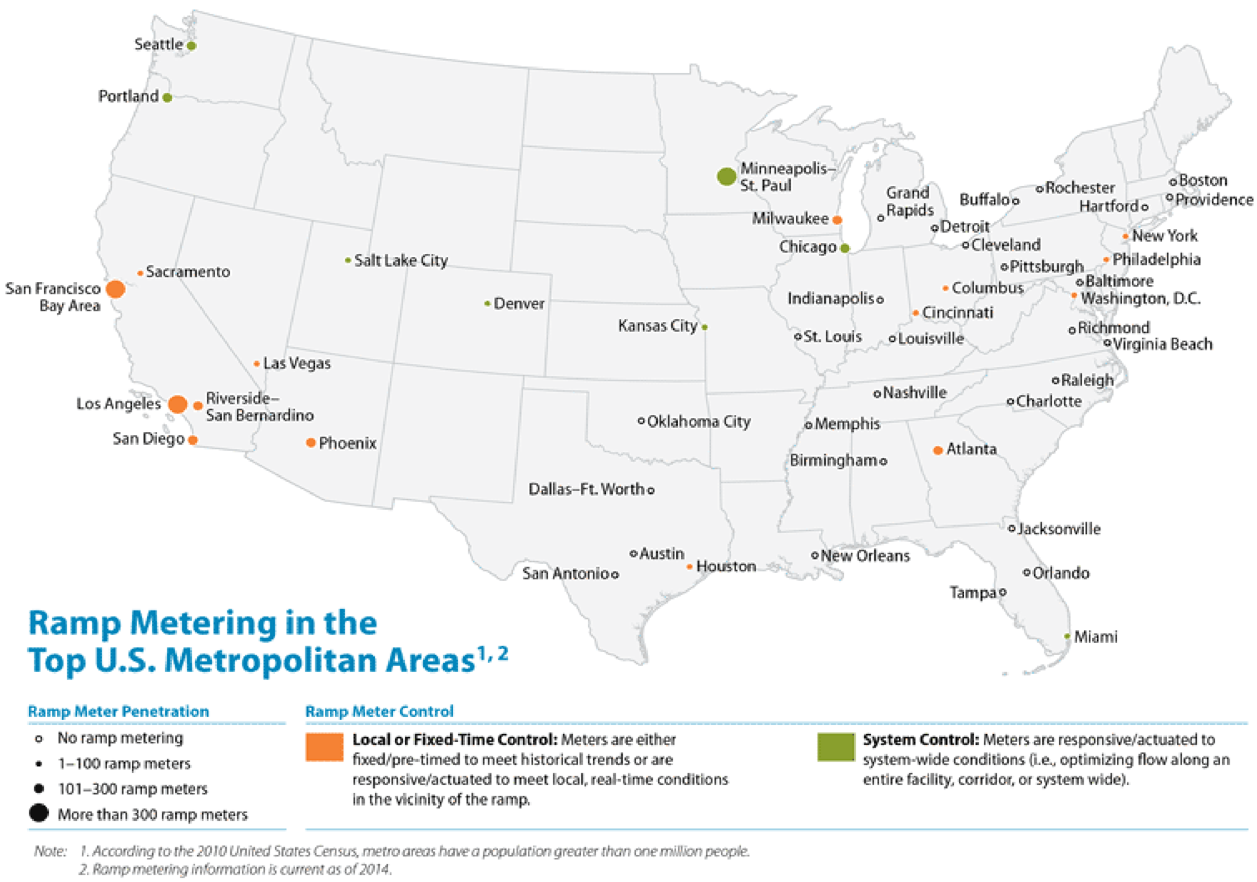
Assessment of the storage capacity and merge speed will be made for each ramp to determine whether metering can be successfully installed with minimum impact on the surface streets and to ensure appropriate acceleration onto the freeway. In some instances, it may be necessary to widen a ramp (i.e., add a lane) to increase storage. The area of metering may be reduced based on overall costs and benefits; but having area-wide, adaptive metering throughout the project corridor should help to reduce any institutional and jurisdictional concerns.

Right-of-way impacts are not foreseen, nor are environmental permitting needs (although queued vehicles at a meter can produce a “hot spot” for emissions, the improved flow and reduced emissions more than outweighs this). There may be environmental issues to address should it be determined that widening a ramp will help operations and reduce the probability of queues backing up onto the surface street.

The additional hardware – meter signals, controllers, and detection – will require on-going maintenance to ensure proper operation.

E. OTHER PROJECTS

Ramp metering is widely used in many of the major metropolitan areas in the US as shown below.



F. ADMINISTRATION RISK

Coordination with the local communities, such as Montgomery County, coupled with the use of queue override strategies and area-wide adaptive metering, will be important to ensure that ramp queues do not back up onto the arterial street network.

New adaptive ramp metering algorithms (e.g., fuzzy logic as used in Seattle, SWARM as used in southern California) will need to be integrated into the CHART system or SHA's signal shop, including the development of the associated databases. In addition, since signals in Montgomery County are operated by the County, any required interfaces with their signal system will need to be investigated.

G. DESIGN-BUILDER RISK

A software developer/integrator will need to be added to the Team to provide the area-wide metering algorithms and to integrate into the CHART system or SHA's signal shop. On the positive side, by determining the extent of need for this concept, the design team will be in a better position to determine an appropriate partner.

H. COST/SCHEDULE BENEFITS

To be developed as part of the in-depth analysis.

I. MISCELLANEOUS

As ramp metering is new to Maryland, a public outreach and education program is strongly recommended prior to an immediately following start-up. An enforcement presence should also be considered during the first few months as well.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 12, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 7 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 28, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.
3. Section B. Location: Please finalize the locations where ramp metering will be applied.
4. Section D. Potential Impacts does not provide a preliminary analysis of potential impacts related to utilities, safety, and life cycle project & infrastructure costs.
5. Section F. Administration Risk appears to defer the decision for which algorithm to utilize until after Notice to Proceed. Please add a note the Design-Builder must consider the cost of any algorithm in its proposal. Consider whether exploring pros and cons of different algorithms during the PTC process would be beneficial to reducing risk.
6. The Office of CHART & ITS Development, through its Statewide Operations Center (SOC) and regional District 3 Traffic Operations Center (TOC 3), acknowledges it will likely have a role in supporting the operations of any elements of an Advanced Traffic Management System (ATMS). This role will need to be consistent with technical capabilities of MDOT SHA's operations program. For the project to be a success, any PTC should reflect these capabilities.
7. Clearly describe how any ATMS system elements will operate to facilitate the overall solution's ability to meet the goals of the project.

8. The existing CHART ATMS resides within the security firewalls of the Maryland Department of Transportation (MDOT) Enterprise network. As such, any integration and data sharing between ATMS elements of the I-270 PTCs will need to comply with network security and system integration requirements as identified by MDOT and the Maryland Department of Information Technology (DoIT).
9. The development of the CHART ATMS software is conducted under a contract managed by the Office of CHART & ITS Development, with specific goals and separate contract requirements. Any modifications to the CHART ATMS software will be conducted under the CHART ATMS contract. Although integration between the CHART ATMS and I-270 ATMS elements is feasible, proposers should not make the success of the I-270 Innovative Congestion Management project contingent on adding functionality to the CHART ATMS. Also note, the CHART ATMS is an information management and advisory system for coordination of response to events on the roadway system. As such, it has not been developed to operate safety sensitive devices (e.g. traffic signals) in real time, which would require robust, instantaneous communications and frequent feedback on device and system status.
10. The CHART system communicates with field infrastructure in two ways: through wireless modems for Dynamic Message Signs, Highway Advisory Radios, Roadway Weather Information Systems and Traffic Speed Sensors, and through a combination of T-1 and fiber optics for cameras streams. CHART accesses fiber optic communication as a customer of Network Maryland and T-1 services from local telecommunications providers. The telecommunications architecture of the CHART system does not currently utilize dedicated circuits for point-to-point connectivity between central servers and field devices. It is also important to note that the CHART system central servers currently reside in an MDOT data center in Glen Burnie; not at the Statewide Operations Center in Hanover, MD.
11. If the PTC is resubmitted, please provide detailed information for the following PTC section(s): Cost/Schedule Benefits.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 8
Freeway-to-Freeway Connector Metering

A. DESCRIPTION

It is proposed to implement metering on the freeway to freeway connectors within the I-270 corridor. Connector metering should be viewed as an extension of the adaptive ramp metering proposed in another PTC prepared by the Team, thereby providing full control of the rates at which **all** vehicles are allowed to enter the corridor, and further smoothing the flow of traffic on I-270. It also provides greater equity between all I-270 users regardless of whether they enter I-270 from a surface street or from another freeway.

The operation of connector metering is analogous to metering of surface street ramps as shown in the picture to the right (from California), including detectors along the entire length of the connector for setting metering rates and for queue management along the connector. The primary differences include:

- Multiple lanes are typically metered, and this may require some sort of alternate lane metering (i.e., vehicles are released alternating between lanes), or platoon metering where 2 or 3 vehicles are released for each green indication.
- Some form of notice is required informing drivers that metering is in operation (as shown in the picture below) well in advance of the metering locations. Dynamic speed limits (part of Active Traffic Management as described in another PTC) may also be used to slow traffic down prior to the metering spot.

B. LOCATION

Candidate locations include the following:

- I-495 (Beltway) NB onto I-270 NB
- I-495 (Beltway) WB onto I-270 NB
- I-370 WB onto I-270 SB
- I-370 WB onto I-270 NB
- I-370 EB onto I-270 SB
- I-370 EB onto I-270 NB

C. ANALYSIS

Each connector ramp will be assessed for its suitability for metering and potential impacts on freeway congestion and operations – both I-270 and the connecting freeways (i.e., I-495 and I-370).

Connector metering has been implemented on over a 100 freeway-to-freeway connectors in San Diego, Los Angeles, and Minneapolis recent decades resulting in positive improvements in mobility and safety.

D. POTENTIAL IMPACTS

Right-of-way impacts are not foreseen, nor are environmental permitting needs (although queued vehicles at a meter can produce a "hot spot" for emissions, the improved flow and reduced emissions more than outweighs this). Safety issues surrounding the stopping of vehicles on a freeway to freeway connector ramp will be carefully assessed and speed management of the joining ramp will also be considered.

The additional hardware – meter signals, controllers, and detection – will require on-going maintenance to ensure proper operation.

E. OTHER PROJECTS

As noted above, connector metering has been implemented on over a 100 freeway-to-freeway connectors in San Diego, Los Angeles, and Minneapolis recent decades resulting in positive improvements in mobility and safety.

F. ADMINISTRATION RISK

Coordination with the Maryland Transportation Authority (operator of the ICC) and local communities, coupled with the use of queue management strategies, will be important to ensure that queues on the connectors do not back up onto the freeway.

Connector metering and the associated queue management requirements for each connector will need to be integrated into the new adaptive ramp metering algorithms (refer to ramp metering PTC) that will be integrated into the CHART system or SHA signal shop.

G. DESIGN-BUILDER RISK

As noted in the PTC for ramp metering, a software developer/integrator will need to be added to the Team to provide the area-wide metering algorithms and to integrate into the CHART system or SHA signal shop. This developer / integrator and their algorithms will need to be able to accommodate connector metering. On the positive side, by determining the extent of need for this concept, the design team will be in a better position to determine an appropriate partner.

H. COST/SCHEDULE BENEFITS

To be developed as part of the in-depth analysis.

I. MISCELLANEOUS

As connector metering will be new to Maryland, a public outreach and education program is strongly recommended prior to an immediately following start-up. An enforcement presence should also be considered during the first few months as well.

October 12, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 8 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 28, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.
3. Section B. Location: Please finalize the locations where Freeway-to-Freeway Connector Metering will be applied.
4. Section C. Analysis: Once your assessment is complete, please elaborate and provide a more thorough/detailed analysis justifying the use of the PTC and how it advances the project goals.
5. Section E. Other Projects: Please elaborate and identify specific locations. If post-construction results are available, please provide.
6. Section D. Potential Impacts does not provide a preliminary analysis of potential impacts related to utilities and life cycle project & infrastructure costs. Please elaborate on safety. If guidance, statistics, or studies from other states (or countries) related to safety is available, please provide.
7. Section F. Administration Risk appears to defer the decision for which algorithm to utilize until after Notice to Proceed. Please add a note the Design-Builder must consider the cost of any algorithm in its proposal. Consider whether exploring pros and cons of different algorithms during the PTC process would be beneficial to reducing risk.

8. This PTC will require coordination with the Federal Highway Administration (FHWA) and a formal coordination letter will need to be sent to FHWA; however, an Interstate Access Point Approval (IAPA) will not be required.
9. Please refer to comments 6 thru 10 in SHA's letter for PTC 7 dated October 12, 2016.
10. If the PTC is resubmitted, please provide detailed information for the following PTC section(s): Cost/Schedule Benefits.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 9
Active Traffic Management (ATM)

A. DESCRIPTION

It is proposed to implement Active Traffic Management (ATM) – consisting of the following combination of strategies:

- **Dynamic Speed Limit (DSL) —** This strategy, which has also been called variable speed limit, adjusts speed limit displays based on real-time traffic, roadway, and/or weather conditions. DSL can either be enforceable (regulatory) speed limits or recommended speed advisories. This "smoothing" process helps minimize the differences between the lowest and highest vehicle speeds, which often contribute to crashes and shockwaves in the traffic flow

- **Dynamic Lane Assignment (DLA)—**This strategy, also known as dynamic lane use control**,** involves dynamically closing or opening of individual traffic lanes as warranted and providing advance warning of the closure(s) to drivers, typically through dynamic lane control signs, to safely merge traffic into adjoining lanes well before the lane blockage, thereby smoothing the traffic flow . DLA is often installed in conjunction with dynamic speed limits.

- **Queue Warning (QW)—**This strategy involves real-time displays of warning messages (typically on dynamic message signs) along a roadway to alert motorists that queues or significant slowdowns are ahead, thus reducing rear-end crashes and improving safety. QW is often included as part of DSL and DLA strategies to provide additional information to motorists as to why the speed limit has been reduced and/or why the lane(s) is closed ahead.

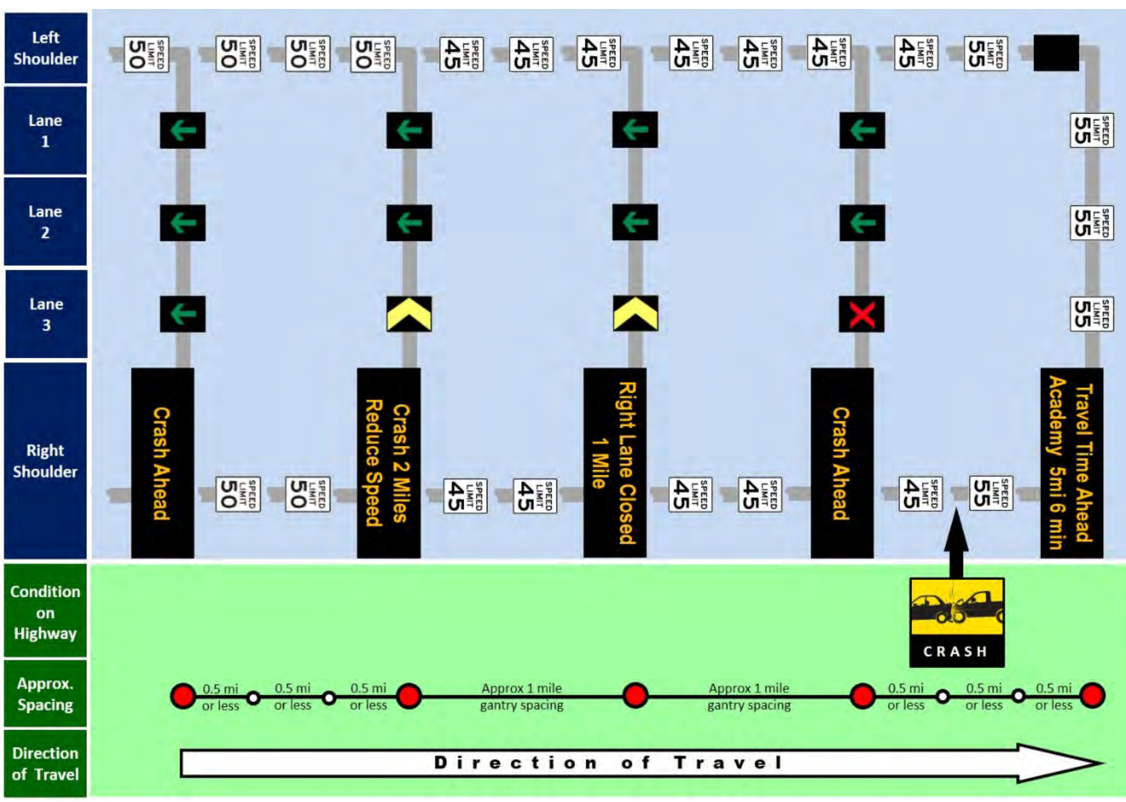
An example of an ATM gantry is shown below. The DMS over each lane can be used for both variable speed limit displays and for dynamic lane use control (although not simultaneously). Speed limit signs may also be installed on the gantry poles as shown below. Should some sort of hard shoulder running be deployed, one of these DMS would also be installed over the shoulder.

Initial deployments of ATM in the United Kingdom (known as Managed Motorways) spaced the gantries such that the driver was presented with a "continuum of information with 'intervisibility' of signs on successive gantries for the driver." This resulted in gantry spacing of between 600 meters (0.37 miles) to 1,000 meters (0.62 miles). On the M42 in the United Kingdom, the gantry spacing is 500 and 800 meters

(0.33 to 0.5 mile). The spacing of gantries for the initial deployment of ATM in the Washington State (Seattle) and Minneapolis systems followed this same concept, with gantries located at roughly 0.5 mile intervals on average.

In England, these earlier ATM implementations and design concepts are now considered conservative, and experience indicates that greater gantry spacing may be appropriate. The U.K. Highways Agency analyzed a new application of the Managed Motorways toolkit, with the overall aim of delivering "schemes that will provide comparable benefits to those expected of current Managed Motorways schemes, but at a reduced cost and with shorter timescales for implementation." The current philosophy is that spacing needs to be sufficient so that drivers know they are still on a controlled roadway. The ATM design concepts in the UK are now based on providing driver information – including speed limits, lane availability and closures, and text legends (e.g., queue warnings) – at intervals not exceeding 1,500 meters (0.93 mile). A full gantry – supporting the over-the-lane DMS for speed limits and lane control displays, and a DMS for other messages (e.g., queue warning) – is always located immediately downstream of an on-ramp(s). Other signage between junctions, and in accordance with the maximum spacing interval noted above, consist of a side-mounted DMS.

This "hybrid" approach is proposed for I-270. It would consist of full gantries every mile (or less in some locations due to on-ramps) augmented with side-mounted dynamic speed limit signs located between gantries – will be explored. (Refer to schematic below).



In addition to the gantry / support poles and the signs, each ATM location will also include a cabinet with DMS controller, power feed, and communications feed. It is also envisioned that some sort of detector (e.g., microwave / radar) will also be included at each location, along with antennas for future Connected Vehicle DSRC and / or Wi-Fi. (This is addressed in another PTC)

B. LOCATION

Preliminary analysis of the I-270 corridor for potential use of ATM was based on the guidance and procedures described in the recently published FHWA document "ATM Feasibility and Screening Guide" (http://www.ops.fhwa.dot.gov/publications/fhwahop14019/index.htm), coupled with an initial review of crash data and congestion information. ATM will be further analyzed for implementation along the following segments listed below in priority order:

- NB and SB between the Beltway and just north of Montgomery Village Ave (Exit 11), including both spurs connecting to the Beltway, approximately 26 directional miles;
- Extend this ATM in the NB direction further north to north of Rt. 121 (Exit 18), approximately 7 directional miles; and,
- SB between Rt. 85 (Exit 31)) and Rt. 109 (Exit 22), approximately 9 directional miles in the vicinity of the truck scales.

C. ANALYSIS

This PTC advances the project goals of increased mobility and safety.

Safety - The segments noted above have the highest number of crashes along the corridor. The majority of crash types are rear-end, followed by fixed object and then sideswipe. Additionally, nearly all of the fixed object crashes involves guard rail, and it may very well be that many of these fixed object crashes were the result of an effort to avoid a sideswipe crash. The majority of the probable causes for the crashes are "followed too closely" and "too fast for conditions". ATM has proven to significantly reduce such types of crashes thereby enhancing safety. For example,

- ATM along NB I-5 in the Seattle, Washington area resulted in a 4.1 percent decrease in crashes over a 3-year period, while during the same period, the SB segment of I-5 (without ATM) experienced a 4.4 percent increase in the number of crashes.
- ATM along WB I-35 in Minneapolis, Minnesota resulted in a 9 percent reduction in fatal plus injury crashes, while the reduction in property damage only crashes was 20 percent.
- In both the Seattle and Minneapolis examples, the roadways were already actively managed via ramp metering, incident management, and traveler information prior to the implementation of ATM, making the reduction in crashes even more impressive.
- Even greater reductions in crashes have occurred following ATM deployment in Europe; although their systems also include automated speed enforcement.

Mobility – The ATM strategies noted above focus mostly on improving safety. However, by reducing the number of crashes, there is a corresponding reduction in non-recurrent congestion. Additionally, these ATM strategies can reduce turbulence in freeway traffic flow, reducing the number of shockwaves and helping to prevent flow breakdown from occurring.

D. POTENTIAL IMPACTS

Right-of-way impacts are not foreseen, nor are environmental permitting needs for ATM. The additional hardware – DMS, controllers, and the associated detection for obtaining real-time data – will require on-going maintenance to ensure proper operation.

E. OTHER PROJECTS

As noted above, ATM systems have been installed in the Seattle and Minneapolis areas. Other recent ATM deployments include I-66 in northern Virginia, and Portland, Oregon (dynamic speed limits only).

F. ADMINISTRATION RISK

By definition, ATM involves automated operation including the posting of the appropriate speed displays. Current DSL algorithms are somewhat "reactive" in their operation in that the speed displays are set based on the measured 85^{th} percentile speed downstream from the displays. This logic is not applied independently to each DSL location (i.e., side-mounted and gantries), but rather is based on data from a series of consecutive DSL display locations – sometimes called a troupe – along the roadway. Work is underway to develop more proactive algorithms, including predictive algorithms. Moreover, Speed displays and changes in these displays will be subject to configurable rules. These will be a user-input to the database, and should include such considerations as:

- Maximum and minimum speeds that can be displayed;
- The minimum time between changes in posted speeds at each location (e.g., 2 to 5 minutes); and,
- The maximum change in speed displays (e.g., increases and decreases of 5 or 10 MPH) at individual signs, and between consecutives gantry/side-mounted sign locations to create a reasonable speed "funnel."

The development and implementation of dynamic speed algorithms and DSS, and their integration into the CHART system including the definition and input of various operational rules, are part of this PTC Dynamic lane and queue warning message do require operator involvement; but this can be greatly aided – and even automated – by the use of a **Decision Support System (DSS)**. The 2006 FHWA scanning tour of ATM systems in Europe identified several recommendations, including *"an expert system that deploys the strategy based on prevailing roadway conditions without requiring operator intervention. It is critical that this expert system be reliable and accurate to gain the trust and acceptance of the public."*

A (DSS) – can be very useful in "automating" the lane control displays for dynamic lane assignment (DLA) and the queue warning and other text messages on the larger DMS. A DSS continuously monitors data and other performance parameters collected from the detection subsystem and operator input (e.g., confirmed incidents, location, severity, number of lanes blocked, anticipated duration; scheduled events) along with equipment status and time of day and day of week. Through a series of IF, AND, OR, and THEN logical statements, this DSS implements the most appropriate response plan, either automatically or with operator confirmation (e.g., approval of the entire plan, or each individual step of the plan on a sequential basis).

Another administrative issue for SHA involves dynamic lane assignment. Most systems either use a Yellow Chevron or Yellow Diagonal Arrows to indicate the need for drivers to start the merge out of a lane. While, the RED X and GREEN ARROW is included in the MUTCD, the yellow chevrons and diagonal arrows are not. Accordingly, SHA will need to request approval from FHWA for using these displays as an "MUTCD Experiment" (as other locations have done).

G. DESIGN-BUILDER RISK

A software developer / integrator will need to be added to the Team to provide the ATM software, including decision support systems, and to integrate these additional capabilities into the CHART system. Several software vendors provide these features, and are continually making improvements to the algorithms and logic. During final design, the Concrete General Team will refine the system requirements, interview several of these vendors – including software demos (to which SHA and CHART staff will be invited) to determine compliance, and then select the most cost-effective solution.

H. COST/SCHEDULE BENEFITS

To be developed as part of the in-depth analysis.

I. MISCELLANEOUS

As ATM is new to Maryland, a public outreach and education program is strongly recommended prior to and immediately following start-up. An enforcement presence should also be considered during the first few months as well.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 12, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 9 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 28, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.
3. Section B. Location: Please finalize the location(s) where this PTC will be applied.
4. Section D. Potential Impacts, does not provide a preliminary analysis of potential impacts related to utilities and life cycle project & infrastructure costs.
5. Please refer to comments 6 thru 10 in SHA's letter for PTC 7 dated October 12, 2016.
6. If the PTC is resubmitted, please provide detailed information for the following PTC section(s): Cost/Schedule Benefits.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

My telephone number/toll-free number is 410-545-8800 or 1-888-228-6971
Maryland Relay Service for Impaired Hearing or Speech 1.800.735.2258 Statewide Toll Free

Street Address: 707 North Calvert Street • Baltimore, Maryland 21202 • *Phone* 410.545.0300 • www.roads.maryland.gov

PROPOSED TECHNICAL CONCEPT 10
Integrated Corridor Management (ICM)

A. DESCRIPTION

It is proposed to implement Integrated Corridor Management (ICM) along segments of the I-270 Corridor. ICM consists of the operational coordination of multiple transportation networks and cross-network connections comprising a corridor on an ongoing and regular basis. Efforts to date to improve the operations and management of the surface transportation network have tended to focus on individual modes and agency networks. In 2006, the U.S. Department of Transportation (USDOT), a joint effort of FHWA and the Federal Transit Administration initiated the ICM initiative with the expectation that "corridors offer an opportunity to operate and optimize the entire system as opposed to the individual networks."

ICM involves numerous approaches and strategies as idenitifed in FHWA documentation. Many of these are addressed in other technology-based PTCs, including ccoordinated operation between ramp meters and arterial traffic signals, dynamic lane use controls and speed limits via ATM, and restricting ramp access. Other ICM strategies to be addressed a part of this PTC for I-270 include the following:

- Suggest / promote route shifts roadways from I-270 to parallel arterial streets via en-route traveler information devices (e.g., DMS, 511) advising motorists of congestion ahead, crashes, and / or differences in travel times between alternative routes, such as shown below. It is also envisioned that this information will be provided to third-party information service providers as well.

Can Use Equivalent info for Maryland/I-270 to Rockville as compared to Alt Routes

- Modify arterial signal timing to accommodate traffic shifting from freeway. Montgomery County is in the process of evaluating traffic adaptive control for subsequent implementation in the County's transportation management system. With traffic adaptive control, any changes in arterial traffic flows are rapidly accommodated in changed signal timings.

It is noted that ICM concepts are nothing new to SHA. The agency submitted a proposal to USDOT in 2006 to be one of the ICM Pioneer Sites. This proposal focused on I-270 between the Beltway and the Montgomery County / Frederick County line. More recently (in 2014), SHA submitted a proposal to FHWA for ICM Deployment Planning Grant project focusing on I-95, MD 295 (Baltimore-Washington Parkway), and US 1 between MD 32 and I-695 (Baltimore Beltway).

B. LOCATION

The ICM concepts will be applied to the length of the I-270 project area and MD 355 (a divided signalized arterial that parallels I-270), along with the numerous roadways connecting these two routes (e.g., I-70, MD 80, MD 109, MD 121, Father Hurley Boulevard, MD 118, Middlebrook Road, MD 124, MD 117, I-370, MD 28, MD 189). This is very similar to the area identified in the 2006 ICM proposal.

C. ANALYSIS

This PTC advances the project goal of increased mobility, by providing drivers with actionable information in real time (e.g., comparative travel times between I-270 and MD 355), thereby allowing them to make informed choices as to the “best” route to take to their destination. Technology-based strategies are used to optimize operations along these routes and the connecting roadways, including adaptive signal control on the arterials, adaptive ramp metering, and active traffic management.

Preliminary analyses of ICM for San Diego and Dallas have indicated benefit-cost ratios of between 7:1 to 25:1.

D. POTENTIAL IMPACTS

Right-of-way impacts are not foreseen, nor are environmental permitting needs for ICM. Assuming that Montgomery County moves forward and implements adaptive signal control in their transportation management system, additional detector deployment will likely be required along MD 355 and the various routes connecting 355 with I-270 to provide real-time journey times and to enable traffic adaptive operation along these arterials. Additional CCTV along the connecting routes and MD 355 may also be required. (CCTV coverage along I-270 is addressed in another PTC). This additional hardware, along with the travel time signs and controllers located on I-270 and on the arterials, will need to be maintained.

E. OTHER PROJECTS

The ICM initiative started with foundational research in 2005, followed by the selection of several pioneer sites to develop ICM concept of operations, and subsequently the deployment of ICM systems in San Diego and Dallas. These two systems are now being evaluated.

F. ADMINISTRATION RISK

Additional software – for calculating (and possibly predicting) the travel times along I-270, MD 355, and the connecting routes for various key destinations will be required. Moreover, the Decision Support System (DSS) discussed in the ATM PTC will be expanded to address ICM-based scenarios and associated diversions. This software and integration into the CHART system, including the definition and input of various operational rules, are part of this PTC. In addition, if signals and travel times are incorporated into one system, integration of signal operations into the CHART system would need to be addressed as this functionality is currently not in operation.

It will also be necessary to enter into an agreement with Montgomery County and potentially Frederick County addressing ICM operations, potential diversion scenarios, and maintenance responsibilities for hardware (signs, detectors) installed on the arterial network.

G. DESIGN-BUILDER RISK

A software developer / integrator will need to be added to the Team to provide the ICM software noted above, and to integrate these additional capabilities into the CHART system.

H. COST/SCHEDULE BENEFITS

To be developed as part of the in-depth analysis.

I. MISCELLANEOUS

As ICM concepts – particularly the comparative travel times – are new to Maryland, a public outreach and education program is strongly recommended prior to and immediately following start-up.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 12, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 10 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 28, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to contribute positively to addressing the goals of this contract; however, some potentially significant challenges to implementing this PTC have not been addressed. Specifically, a number of agreements with 3rd parties may be required. Please state how these agreements will be executed and what Concrete General is sure it can deliver.
2. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.
3. Section D. Potential Impacts does not provide a preliminary analysis of potential impacts related to utilities and life cycle project & infrastructure costs. Also, Section D assumes Montgomery County will implement adaptive signal control. What are the impacts assuming Montgomery County does not implement adaptive signal control?
4. Please refer to comments 6 thru 10 in SHA's letter for PTC 7 dated October 12, 2016.
5. If the PTC is resubmitted, please provide detailed information for the following PTC section(s): Cost/Schedule Benefits.

My telephone number/toll-free number is 410-545-8800 or 1-888-228-6971
Maryland Relay Service for Impaired Hearing or Speech 1.800.735.2258 Statewide Toll Free

Street Address: 707 North Calvert Street • Baltimore, Maryland 21202 • *Phone* 410.545.0300 • www.roads.maryland.gov

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

PROPOSED TECHNICAL CONCEPT 11
Enhanced Detection and Incident Management

A. DESCRIPTION

The GCI Team proposes to implement enhanced detection to support other technology-based strategies (e.g., active traffic management, ramp metering) and also in association with upgraded Incident Management capabilities throughout the corridor.

The enhanced detection component may be accomplished through an expanded purchase of data from a third-party vendor such as INRIX, which already supplies travel-time data to SHA; deployment of SHA-owned field devices, or a combination of both approaches. This PTC may also include innovative business relationships with organizations such as Waze to share data in mutually beneficial ways, beyond simply pushing incident data from CHART to the third party application as is currently done. Detection will likely include speeds, volumes, vehicle classification, journey times, incident detection and road weather conditions, in addition to real-time video.

Upgraded Incident Management will focus on using enhanced detection to more quickly identify and initiate response to incidents, along with augmenting the existing Emergency Traffic Patrols with additional agency-owned resources and/or private –sector resources to be deployed during peak periods.

B. LOCATION

Enhanced detection will be implemented on the entire footprint of the corridor from the Beltway Spurs to the northern terminus at I-70. This will include all access/egress points and ramps.

Camera coverage will be improved to provide 100% coverage of the entirely of the project footprint, including ramps. Existing cameras will be augmented by full color PTZ cameras mounted on poles at roadside and/or on existing and new sign gantries.

RWIS to collect road weather data will be placed at the Montrose Road interchange, the Route 124 Interchange, the Father Hurley Boulevard interchange and the MD 80 Interchange.

Upgraded incident management will be accomplished via additional Emergency Traffic Patrol vehicles and staff to be utilized during peak period. For the section from Father Hurley Boulevard to the northern terminus, vehicles will be based in the Frederick Satelite TOC and will run continuously during peak period, with at least one vehicle traveling in each direction on a constant basis. For the section from Father Hurley to I-495, vehicles will be based at the Montgomery County Shop on Quince Orchard road and will likewise run continuously in each direction during peak period. This PTC will investigate broadening the existing partnership with State Farm as well as finding other private sector sponsors.

C. ANALYSIS

Enhanced Detection is a crosscutting approach that will support all other technology-based PTCs. The first analysis to be undertaken is the “make or buy” analysis to determine whether it is more cost efficient to purchase detection data entirely from a third party, to deploy SHA-owned and maintained field detection, or to develop a hybrid solution combining both options. Once this is determined, the next analysis will be a cost/benefit calculation to determine the dollar value of the additional data derived from Enhanced Detection.

D. POTENTIAL IMPACTS

Potential impacts are virtually non-existent if the third party purchase option is pursued, and are minimal under either a hybrid or entirely SHA-owned option. Placement of field devices such as sidefire (or over the lane) radar (RTMS) units, microwave detection and CCTV can be accomplished entirely within existing right of way, and in most cases can be mounted on existing and proposed future poles or gantries. Geotechnical borings, utility relocations and environmental permitting are not required, and the impacts to safety would be confined to a few lane closures during device placement. Life-cycle maintenance costs for these devices are minimal and are estimated at 2% of construction cost annually.

If the decision is made to rely entirely or primarily on INRIX Data, there are some considerations and impacts. The INRIX XD data segments are nominally 250 meters (273 yards) in length, with updates provided once every minute. The use of these data will likely impact gantry spacing such that the sign displays are closely aligned with the INRIX segment boundaries. It is also envisioned that existing ATM software may need to be modified to work with the INRIX data. The current state of the art in ramp metering software and the associated algorithms for automatically determining metering rates is to rely more on INRIX data for average speed information. If it is determined to use the INRIX XD data, as described, this will likely prove adequate for ATM strategies, although approaches and sign display strategies that are based on per-lane volumes and speeds will not be possible.

The final location and design of the gantries will need to be coordinated with the INRIX segment boundaries (information which is proprietary, and will therefore require some sort of confidentiality agreement). It is also envisioned that additional software costs will be incurred to accommodate the INRIX data streams. As for ramp metering strategies, it is doubtful if the INRIX data will work with existing ramp metering algorithms. Future applications of ATM and ramp metering will need to take advantage of the information provided by INRIX and other data providers, taking advantage of “big data” concepts. This will require a transition over time to include major changes to the current ATM and ramp metering software and associated logic. In the future, cooperative vehicle data (i.e. Connected Vehicles) may be used as a primary detection source for speed drop and other incidents. Therefore, the system will be designed in such a way to allow this data to be incorporated into the incident detection system.

For upgraded incident management, impacts include the operations and maintenance costs of the vehicles and the need to hire, train and compensate additional drivers.

E. OTHER PROJECTS

Enhanced detection under all three of the potential models has been implemented in support of Active Traffic Management projects across the nation and the globe. Examples include I-66 in Virginia, I-90 in Seattle, I-35 in Minneapolis and I-70 in Colorado. Additionally, DOTs such as PennDOT have decided to move away from fixed detectors owned by the Department and rely more heavily on travel time information provided by INRIX.

SHA through CHART has been a leader in incident management, and this PTC extends and expands this excellent program.

F. ADMINISTRATION RISK

There is little risk related to liability or institutional issues for SHA or third parties. The primary risk is the rapidly changing state of detection technology, methodologies and business arrangements. If SHA invests in a fully-owned Enhanced Detection System the risk is the technology may become quickly obsolete (e.g., Connected Vehicle technology rapidly expands and becomes more ubiquitous), or that the third party purchase option proves to be a preferred business model. If SHA elects to rely entirely on third-party data, the risk is that the third party may, for a variety of reasons, become unable or unwilling to provide the required data, in the required formats.

An additional risk is the public perception that Enhanced Detection may be a form of government intrusion into the private lives of citizens.

G. DESIGN-BUILDER RISK

The risk to the Design/Build Team is similar to the risks to SHA for the fully owned, hybrid or fully purchased options.

H. COST/SCHEDULE BENEFITS

Enhanced Detection can be implemented immediately under a fully purchased approach, or within one year under a fully owned option. The costs of the various detection options, and the impacts from and with other PTCs, is currently being analyzed.

I. MISCELLANEOUS

Enhanced Detection is a crosscutting and supporting PTC that is essential to implementation of any PTCs for Active Traffic Management, Ramp Metering or geometric improvements.

October 12, 2016

Michael Higgins, P.E.
Concrete General, Inc.
8000 Beechcraft Avenue
Gaithersburg MD 20879

Dear Mr. Higgins:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 11 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 28, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. The PTC must clearly define what the Design-Build Team can and will deliver. Regarding upgraded incident management, the Administration questions Concrete General's ability to augment existing Emergency Traffic Patrols, and to develop/enhance relationships with Waze, State Farm, etc. Please clarify how Concrete General will implement these strategies should they be proposed.
3. Section C, Analysis: Please finalize the "make or buy" decision that Concrete General is proposing, present the analysis behind the selected option, and update the other Sections of the PTC accordingly.
4. Please refer to comments 6 thru 10 in SHA's letter for PTC 7 dated October 12, 2016.
5. If the PTC is resubmitted, please provide detailed information for the following PTC section(s): Cost/Schedule Benefits.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

for Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Mark W. Miller, Concrete General, Inc.

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

Appendix C

INTERSTATE 270

Detailed Concept Descriptions

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

Appendix C: Detailed Concept Descriptions

The program of improvements proposed by the CGI Team includes a combination of roadway improvements and innovative technologies and techniques that will combine to substantially improve operations along I-270. This Appendix describes additional details, including detailed scope elements, for the following improvements.

- Roadway improvements with display sheets for conceptual plans for each improvement;
- Adaptive ramp metering with display sheets for locations where ramps may be widened for two lanes;
- Active Traffic Management infrastructure; and
- Virtual weigh station installation.

Southbound 1 (SB 1)

This roadway improvement consists of two distinct components: extending the length of the deceleration lane for the exit to MD 80 from southbound I-270, and extending the length of the acceleration lane for the entrance from MD 80 to southbound I-270.

See display sheets SB 1-1 and SB 1-2 in this Appendix for conceptual plans for this improvement.

Existing Conditions and Proposed Design for SB 1

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Acceleration lane - Entrance from MD 80 to SB I-270	▪ Length of existing lane is 570 feet ▪ Mainline design speed = 70 MPH ▪ Ramp design speed = 25 MPH	▪ Acceleration lane extended 850 feet for total length of 1,420 feet ▪ 6-foot wide right shoulder (minimum) provided along extended lane and taper ▪ Existing pavement in shoulder will be used for extended lane ▪ 350 square feet of outside widening proposed for right shoulder
Deceleration lane - Exit from SB I-270 to MD 80	▪ Length of existing lane is 450 feet ▪ Mainline design speed = 70 MPH ▪ Ramp design speed = 25 MPH	▪ Deceleration lane extended 150 feet for total length of 600 feet ▪ 300-foot long taper provided at start of deceleration lane ▪ No roadway widening proposed ▪ Existing pavement in shoulder will be used for extended lane
Traffic barrier	▪ Guardrail located along outside of the deceleration lane ▪ No barrier located along outside of the acceleration lane	▪ 695 linear feet of concrete traffic barrier will be constructed at edge of right shoulder along acceleration lane where widening ▪ Side slopes will be reconstructed at 1V:2H or flatter behind barrier
Structures	▪ The existing deceleration lane is located on the bridge over MD 80	▪ The bridge over MD 80 will not be impacted under this improvement
Traffic signals, signage & lighting		▪ Post-mounted signs will be replaced in the location of the extended acceleration and deceleration lanes ▪ Existing light pole along extended acceleration lane will be replaced in adjacent location

Southbound 2 (SB 2)

This improvement involves extending the length of the acceleration lane for the entrance from MD 109 to southbound I-270.

See display sheets SB 2-1 to SB 2-2 in this Appendix for conceptual plans for this improvement.

Existing Conditions and Proposed Design for SB 2

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Acceleration lane - Entrance from MD 109 to SB I-270	▪ Length of existing lane is 270 feet ▪ Mainline design speed = 70 MPH ▪ Ramp design speed = 30 MPH	▪ Acceleration lane extended 1,080 feet for total length of 1,350 feet ▪ 10-foot wide right shoulder (minimum) provided along extended lane and taper ▪ Existing pavement in shoulder will be used for extended lane ▪ 400 square feet of outside widening proposed for new right shoulder
Traffic barrier	▪ No barrier located along outside of acceleration lane	▪ 795 linear feet of concrete traffic barrier will be constructed at edge of right shoulder along acceleration lane where widening ▪ Side slopes will be reconstructed at 1V:2H or flatter behind barrier
Structures	▪ No structures located near this improvement	▪ No impact to structures under this improvement
Traffic signals, signage & lighting		▪ Post-mounted signs will be replaced in the location of the extended acceleration lane ▪ Existing light pole along extended acceleration lane will be replaced in adjacent location

Southbound 5A (SB 5A)

This concept involves restriping southbound I-270 approaching the exit to I-370 so the outside lane becomes the right lane on the two-lane exit ramp to I-370. The interior lane next to the right lane on I-270 will become a choice lane for vehicles to exit on the ramp to I-370 or continue south on I-270.

See display sheet SB 5A-1 in this Appendix for conceptual plans for this improvement.

Existing Conditions and Proposed Design for SB 5A

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Deceleration lane - Exit from SB I-270 to I-370	▪ Lane configuration: 4 express lanes + 2 dedicated exit lanes to I-370 ▪ Mainline design speed = 70 MPH	▪ Lane configuration: 4 express lanes + 1 dedicated exit lane to I-370 ▪ No roadway widening proposed
Traffic barrier	▪ Concrete barrier exists on right side along this section of SB I-270	▪ No modification to existing barrier proposed
Structures	▪ A retaining wall and noise walls exist on the right side along this section of SB I-270	▪ No impact to the retaining wall and noise walls under this improvement
Traffic signals, signage & lighting	▪ Three overhead sign structures are located along SB I-270 prior to the exit ramp to I-370	▪ The existing three overhead sign structures will be replaced as a result of this improvement

Southbound 6 (SB 6)

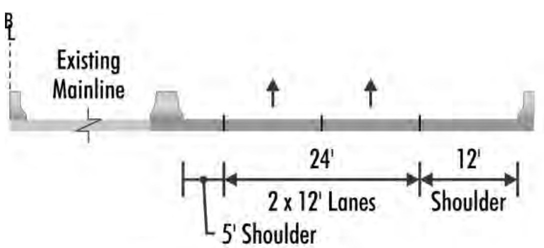
This improvement involves creating a third local lane by providing an auxiliary lane between the slip ramps south of Shady Grove Road. The entrance slip ramp from the express lanes to the local lanes will be connected to the first exit slip ramp from the local lanes to the express lanes.

See display sheets SB 6-1 and SB 6-2 in this Appendix for conceptual plans for this improvement. See Figure C-1 below for the existing and proposed typical sections along the local lanes under this improvement.

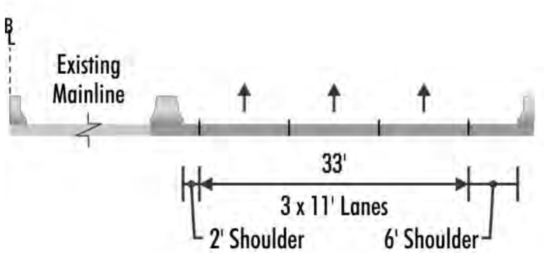
Existing Conditions and Proposed Design for SB 6

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Local Lanes	▪ Lane configuration: two 12-foot travel lanes + 5-foot left shoulder + 12-foot right shoulder	▪ Lane configuration: three 11-foot travel lanes + 2-foot left shoulder + 6-foot right shoulder ▪ No roadway widening proposed ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width in local lanes will be resurfaced to restripe lane markings
Traffic barrier	▪ Concrete barrier is located in the median and on the outside of the local lane section	▪ No modification to existing barrier proposed
Structures	▪ Gude Drive crosses over I-270 on a bridge over this section	▪ There will be no impact to the abutment of the Gude Drive bridge under this improvement
Traffic signals, signage & lighting		▪ Signing along the local lanes will be replaced as a result of this improvement

Figure C-1. Southbound 6 Typical Sections – I-270 Local Lanes



SB 6 EXISTING – I-270 Local Lanes



SB 6 PROPOSED – I-270 Local Lanes

Southbound 7 (SB 7)

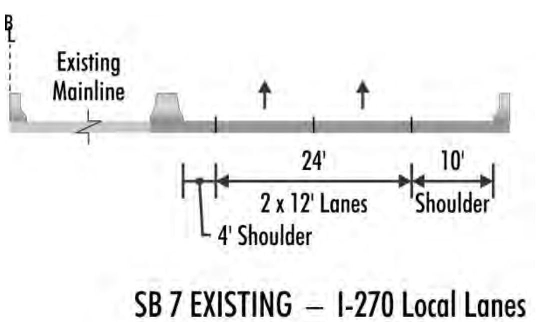
This improvement involves creating an auxiliary (third) lane in the local lanes by connecting the entrance from eastbound MD 28 to the exit to MD 189.

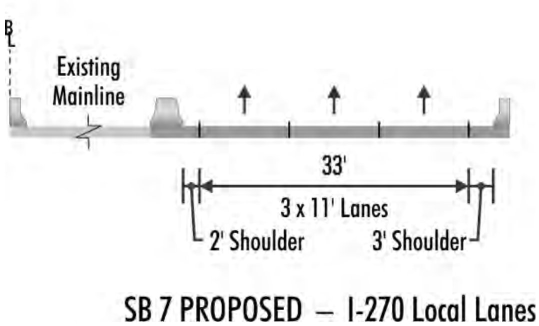
See display sheets SB 7-1 through SB 7-3 in this Appendix for conceptual plans for this improvement. See Figure C-2 below for the existing and proposed typical sections along the local lanes under this improvement.

Existing Conditions and Proposed Design for SB 7

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Local Lanes	▪ Lane configuration: two 12-foot travel lanes + 4-foot left shoulder + 10-foot right shoulder	▪ Lane configuration: three 11-foot travel lanes + 2-foot left shoulder + 3-foot right shoulder ▪ No roadway widening proposed ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width in local lanes will be resurfaced to restripe lane markings
Traffic barrier	▪ Concrete barrier is located in the median and on the outside of the local lane section	▪ No modification to existing barrier proposed
Structures	▪ Retaining walls and noise walls exist along right shoulder	▪ No impact to structures under this improvement
Traffic signals, signage & lighting		▪ Signing along the local lanes will be replaced as a result of this improvement

Figure C-2. Southbound 7 Typical Sections – I-270 Local Lanes





Southbound 8 (SB 8)

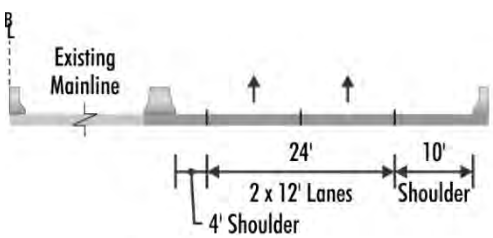
This improvement involves developing a third lane in the local lanes by connecting the entrance ramp from MD 189 with the exit ramp to Montrose Road. The existing inside (left) local lane will become a dedicated exit at the slip ramp to the express lanes north of Montrose Road and two lanes will continue to the exit to Montrose Road.

See display sheets SB 8-1 through SB 8-3 in this Appendix for conceptual plans for this improvement. See Figure C-3 below for the existing and proposed typical sections along the local lanes under this improvement.

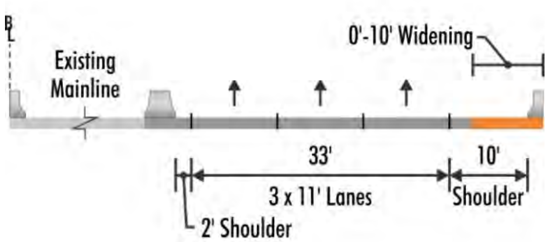
Existing Conditions and Proposed Design for SB 8

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Local Lanes	▪ Lane configuration: two 12-foot travel lanes + 4-foot left shoulder + 10-foot right shoulder	▪ Lane configuration: three 11-foot travel lanes + 2-foot left shoulder + 10-foot right shoulder ▪ 1,230 square feet of outside widening proposed for new right shoulder ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width in local lanes will be resurfaced to restripe lane markings
Traffic barrier	▪ Concrete barrier is located in the median ▪ Guardrail is located on the outside of the local lanes along the majority of this section	▪ 2,455 linear feet of concrete traffic barrier will be constructed at edge of right shoulder where widening ▪ Side slopes will be reconstructed at 1V:2H or flatter behind barrier
Structures	▪ Wootton Parkway crosses over I-270 on a bridge over this section	▪ There will be no impact to the abutment of the Wootton Parkway bridge under this improvement
Traffic signals, signage & lighting		▪ Signing along the local lanes will be replaced as a result of this improvement

Figure C-3. Southbound 8 Typical Sections – I-270 Local Lanes



SB 8 EXISTING – I-270 Local Lanes



SB 8 PROPOSED – I-270 Local Lanes

Southbound 10 (SB 10)

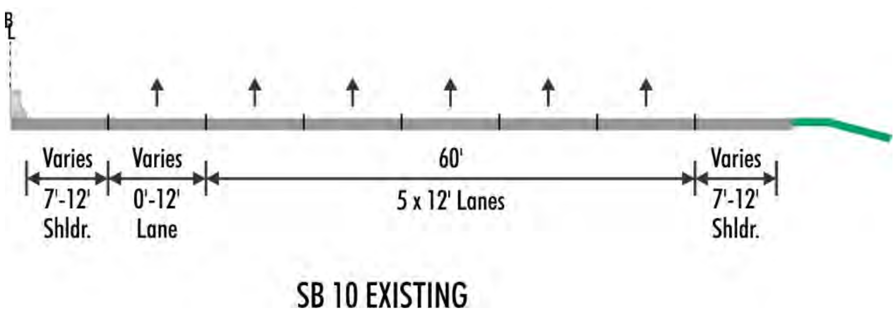
This improvement involves restriping the I-495 outer loop at the merge with the southbound I-270 west spur. Instead of dropping the inside (left) lane from the I-270 spur, the three lanes from I-270 will continue on I-495 and the right lane on I-495 will drop to maintain five lanes.

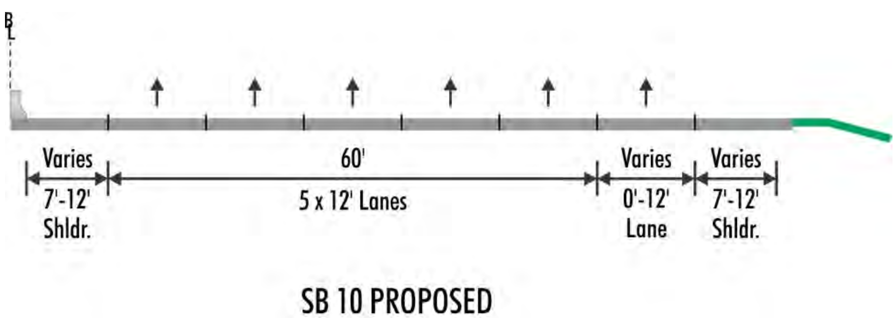
See display sheet SB 10-1 in this Appendix for conceptual plans for this improvement. See Figure C-4 below for the existing and proposed typical sections along the I-495 outer loop under this improvement.

Existing Conditions and Proposed Design for SB 10

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
I-270 West Spur / I-495 Merge Lane Configuration	▪ 6 lanes drop to 5 lanes with left lane merge	▪ 6 lanes drop to 5 lanes with right lane merge ▪ No roadway widening proposed
Traffic barrier	▪ Concrete barrier is located in the median ▪ Guardrail is located on the outside of I-495 along this section	▪ No modification to the existing barrier or guardrail proposed
Structures	▪ Noise walls are located along the outside of the I-495 Outer Loop in this section	▪ No impact to structures under this improvement
Traffic signals, signage & lighting		▪ Signing along the I-495 Outer Loop and I-270 West Spur at the merge location will be modified and replaced

Figure C-4. Southbound 10 Typical Sections – I-495 Outer Loop





SOUTHBOUND 12 (SB 12)

This improvement consists of restriping southbound I-270 to provide an additional travel lane within the existing typical section from the slip ramp entrance to the express lanes north of Montrose Road to the interchange at Democracy Boulevard on the West Spur, a distance of approximately 3.1 miles.

See display sheets SB 12-1 through SB 12-12 in this Appendix for conceptual plans for this improvement, including the limits of roadway widening and resurfacing. See Figures C-5 through C-7 below for the existing and proposed typical sections along I-270 under this improvement.

Existing Conditions and Proposed Design for SB 12

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Roadway (General)	▪ Existing number of travel lanes varies from six lanes north of the Y-split to three lanes on the West Spur ▪ Design Speed = 70 MPH	▪ Proposed number of travel lanes varies from seven 11.5-foot lanes north of the Y-split to three 11-foot lanes on the West Spur ▪ Entire roadway width will be resurfaced to restripe lane markings ▪ Existing pavement in shoulders will be used for travel lanes
Express Lanes at Montrose Road	▪ Lane configuration: four 12-foot wide lanes + 10-foot wide left shoulder + 12-foot wide right shoulder	▪ Lane configuration: five 11.5-foot wide lanes + 2-foot wide left shoulder + 10.5-foot wide right shoulder
Local lanes at Montrose Road	▪ Lane configuration: two 12-foot wide lanes + 2-foot wide left shoulder + 14-foot wide right shoulder	▪ No changes to local lanes proposed
Mainline from Montrose Road to the I-270 West Spur	▪ Lane configuration: six 12-foot wide lanes + 10-foot wide left shoulder + 14-foot wide right shoulder	▪ Lane configuration: five 11.5-foot wide lanes + two 12-foot wide lanes + 2-foot wide left shoulder + 12.5-foot wide right shoulder
I-270 West Spur	▪ Lane configuration: three 12-foot wide lane + 10-16-foot wide left shoulder + 6-10-foot wide right shoulder	▪ Lane configuration: four 11-foot wide lanes + 2-6-foot wide left shoulder + 10-foot wide minimum right shoulder ▪ 4,050 square feet of outside widening proposed for new right shoulder
Traffic barrier	▪ Concrete barrier is located in the median ▪ Guardrail is located on the outside north of the Y-split	▪ 2,115 linear feet of concrete traffic barrier will be constructed at edge of right shoulder where widening ▪ Side slopes will be constructed at 1V:2H or flatter behind the barrier
Structures	▪ Retaining walls exist on the right side of the roadway north of the Y-split ▪ SB I-270 crosses over Tuckerman Lane on a bridge	▪ A 10-foot high and 1,130-foot long retaining wall will be constructed at the edge of the right shoulder along SB I-270 just south of Tuckerman Lane ▪ An 8-foot high and 700-foot long retaining wall will be constructed at the edge of the right shoulder along the SB I-270 West Spur north of Westlake Terrace ▪ Modifications to the bridge over Tuckerman Lane include: adjusting the deck to align the cross slope breaks at the shoulder with the reconfigured lane edges and reconstructing the median bridge parapet to accommodate the adjusted deck elevation resulting from the deck cross slope adjustment

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Traffic signals, signage & lighting		▪ Overhead signs will be replaced at the interchange at Democracy Blvd ▪ Post-mounted signing along this section of SB I-270 will be replaced ▪ 13 light poles will be replaced as a result of this improvement

Figure C-5. Southbound 12 Typical Sections – I-270 Express Lanes

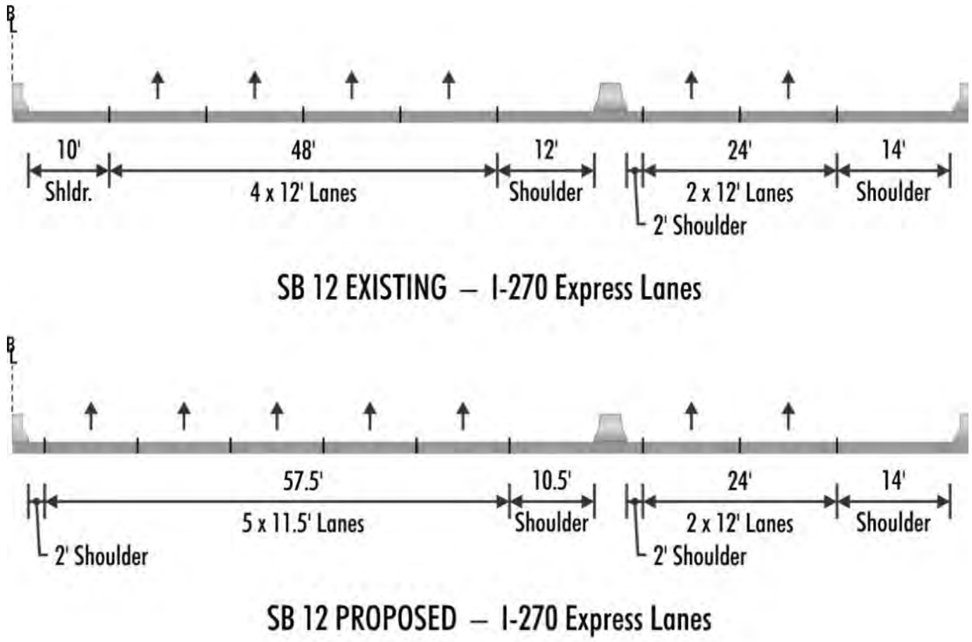


Figure C-6. Southbound 12 Typical Sections – I-270 from Montrose Road to West Spur

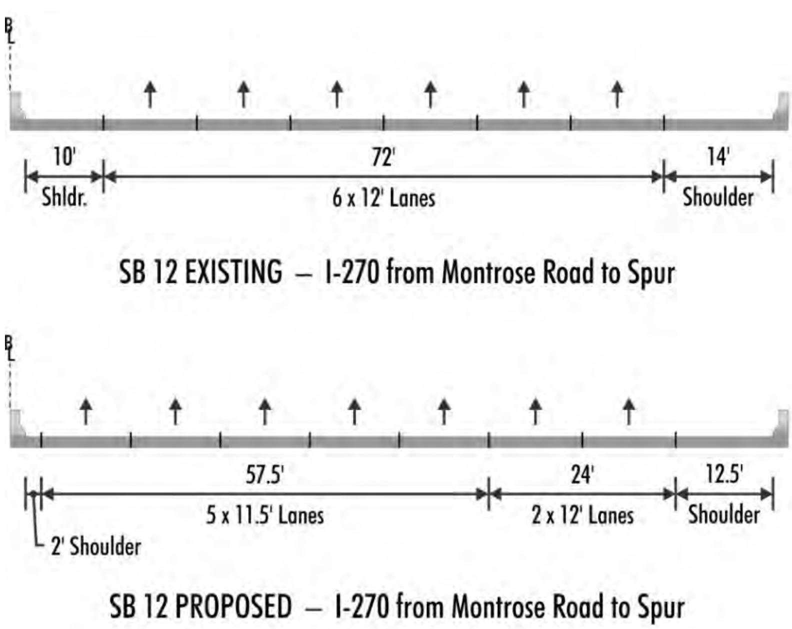
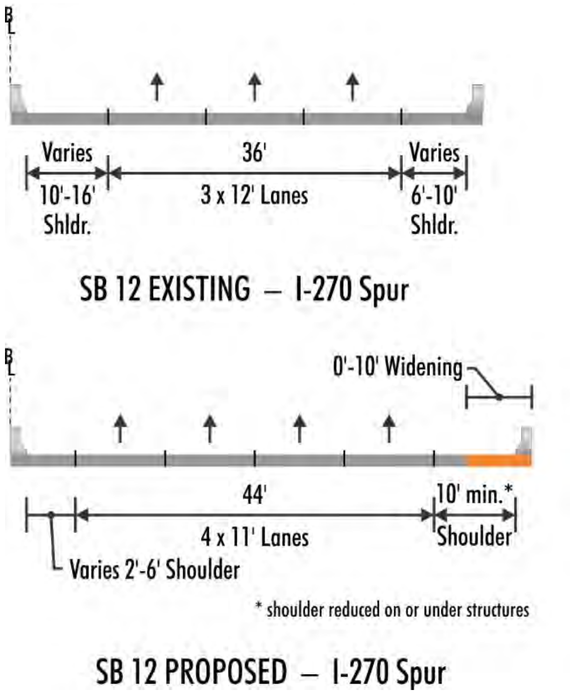


Figure C-7. Southbound 12 Typical Sections – I-270 West Spur



Northbound 1 (NB 1)

This improvement involves restriping northbound I-270 to provide an additional travel lane within the existing typical section between the entrance from westbound Democracy Boulevard on the I-270 West Spur to the slip ramp exit to the local lanes just north of Montrose Road, a distance of approximately 2.7 miles.

See display sheets NB 1-1 through NB 1-11 in this Appendix for conceptual plans for this improvement, including the limits of roadway widening and resurfacing. See Figures C-8 through C-10 below for the existing and proposed typical sections along I-270 under this improvement.

Existing Conditions and Proposed Design for NB 1

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Roadway (General)	▪ Existing number of travel lanes varies from three lanes on the West Spur to six lanes north of the Y-split ▪ Design Speed = 60 MPH	▪ Proposed number of travel lanes varies from four 11-foot wide lanes on the West Spur to four 11-foot wide lanes and two 12-foot wide lanes north of the Y-split ▪ Entire roadway width will be resurfaced to restripe the lane markings ▪ Existing pavement in shoulders will be used for travel lanes
I-270 West Spur	▪ Lane configuration: three 12-foot wide lanes + 4-7-foot wide left shoulder + 8-12-foot wide right shoulder	▪ Lane configuration: four 11-foot wide lanes + 1-7-foot wide left shoulder + 10-foot wide minimum right shoulder ▪ 1,960 square feet of outside widening proposed for new right shoulder
Mainline from Montrose Road to the I-270 West Spur	▪ Lane configuration: six 12-foot wide lanes + 10-foot wide left shoulder + 12-foot wide right shoulder	▪ Lane configuration: five 11-foot wide lanes + two 12-foot wide lanes + 4-foot wide left shoulder + 11-foot wide right shoulder
Express Lanes at Montrose Road	▪ Lane configuration: four 12-foot wide lanes + 10-foot wide left shoulder + 12-foot wide right shoulder	▪ Lane configuration: five 11-foot wide lanes + 4-foot wide left shoulder + 11-foot wide right shoulder
Local lanes at Montrose Road	▪ Lane configuration: two 12-foot wide lanes + 2-foot wide left shoulder + 14-foot wide right shoulder	▪ No changes to local lanes proposed
Traffic barrier	▪ Concrete barrier is located in the median ▪ Concrete barrier and guardrail are located on the outside of NB I-270 in this section	▪ 2,995 linear feet of concrete traffic barrier will be constructed at edge of right shoulder where widening ▪ Side slopes will be reconstructed at 1V:2H or flatter behind the barrier
Structures	▪ Noise walls exist on the right side of the roadway north of the Y-split ▪ NB I-270 crosses over Tuckerman Lane on a bridge	▪ No proposed impacts to the existing noise walls ▪ Modifications to the bridge over Tuckerman Lane include: adjusting the deck to align the cross slope breaks at the shoulder with the reconfigured lane edges and reconstructing the median bridge parapet to accommodate the adjusted deck elevation resulting from the deck cross slope adjustment
Traffic signals, signage & lighting		▪ Post-mounted and overhead signing along this section of NB I-270 will be replaced

Figure C-8. Northbound 1 Typical Sections – I-270 Spur

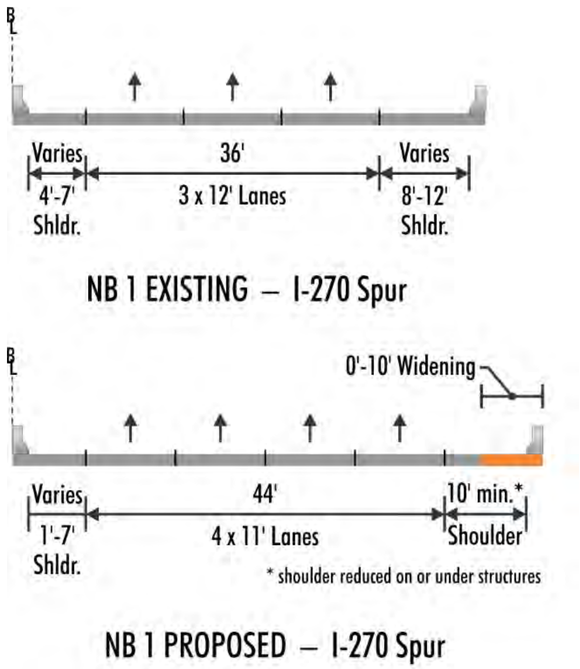


Figure C-9. Northbound 1 Typical Sections – I-270 from Spur to Montrose Road

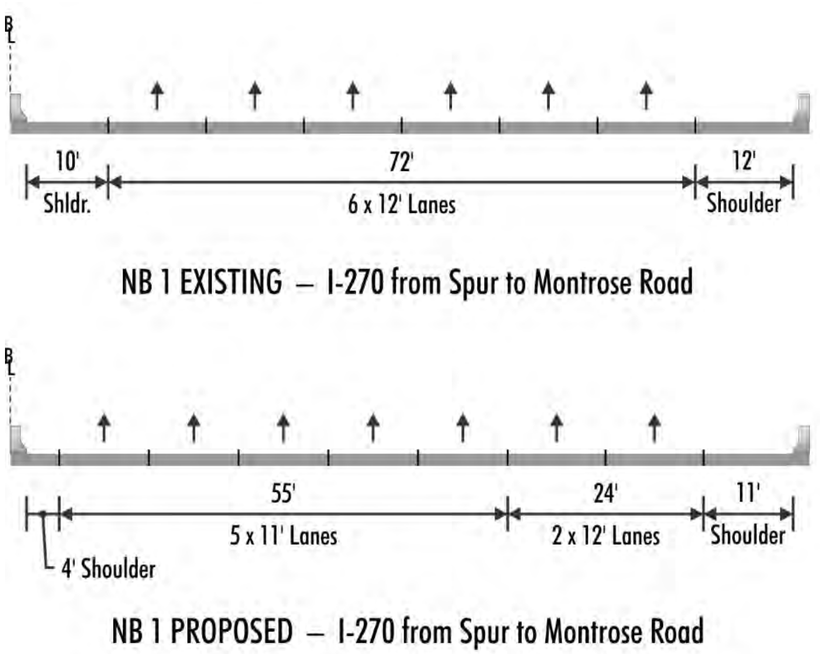
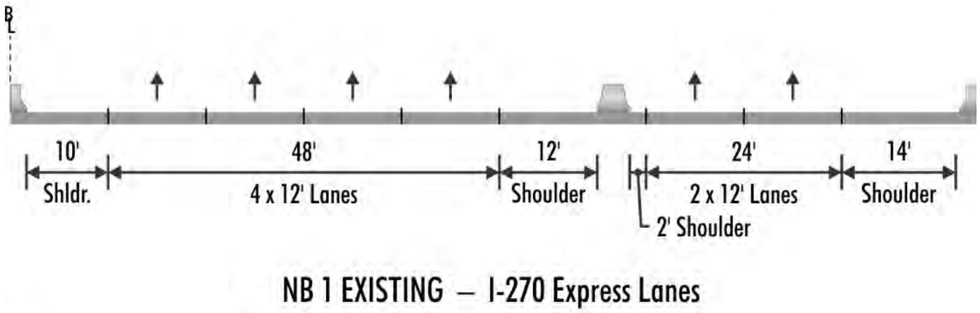
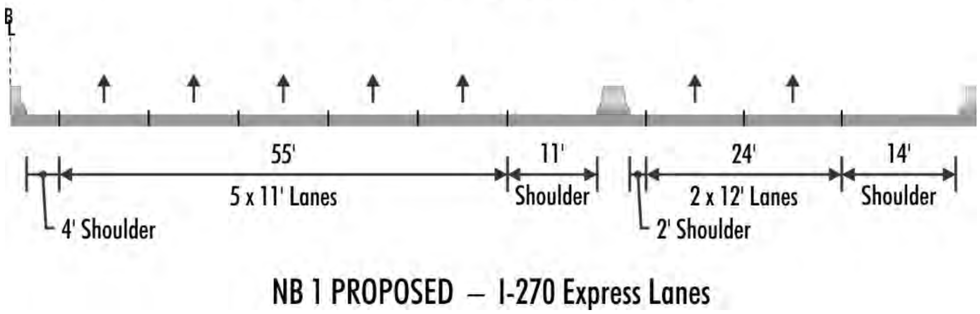


Figure C-10. Northbound 1 Typical Sections – I-270 Express Lanes





Northbound 2 (NB 2)

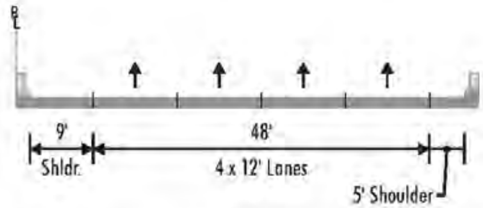
This improvement involves creating an auxiliary (third) lane in the local lanes by connecting the entrance from MD 189 to the exit to MD 28. This concept also involves restriping the northbound express lanes within the existing typical section to create an auxiliary lane by connecting the entrance slip ramp from the local lanes south of MD 28 with the exit slip ramp to the local lanes north of MD 28.

See display sheets NB 2-1 through NB 2-4 in this Appendix for conceptual plans for this improvement. See Figure C-11 below for the existing and proposed typical sections along the I-270 express lanes under this improvement.

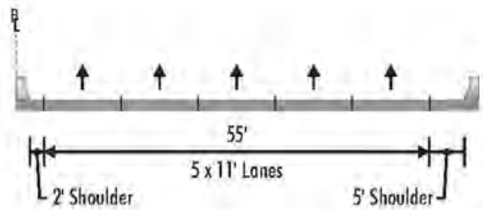
Existing Conditions and Proposed Design for NB 2

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Local Lanes	▪ Lane configuration: two 12-foot travel lanes + varying shoulder widths	▪ Lane configuration: three 12-foot travel lanes + 10-foot minimum right shoulder ▪ 990 square feet of outside widening is proposed for new right shoulder ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width will be resurfaced to restripe lane markings
Express Lanes	▪ Lane configuration: four 12-foot wide travel lanes+ 9-foot wide left shoulder + 5-foot wide right shoulder	▪ Lane configuration: five 11-foot wide travel lanes + 2-foot wide left shoulder + 5-foot wide right shoulder ▪ No roadway widening proposed ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width will be resurfaced to restripe lane markings
Traffic barrier	▪ Concrete barrier is located on both sides and in the median of the express lanes and local lanes	▪ 1,235 feet of concrete traffic barrier will be constructed at edge of right shoulder where widening ▪ Side slopes will be reconstructed at 1V:2H or flatter behind the barrier
Structures	▪ Retaining walls exist on the right side of the NB I-270 local lanes	▪ An 18-foot high and 1,585-foot long noise wall is proposed to be constructed by SHA on the right side of the NB I-270 local lanes
Traffic signals, signage & lighting		▪ Signing along this section of NB I-270 will be replaced as a result of this improvement

Figure C-11. Northbound 2 Typical Sections – I-270 Express Lanes at MD 28



NB 2 EXISTING – I-270 Express Lanes under MD 28



NB 2 PROPOSED – I-270 Express Lanes under MD 28

Northbound 3 (NB 3)

This improvement involves closing the existing loop ramp from northbound Shady Grove Road to northbound I-270. Northbound Shady Grove Road will be reconfigured to provide dual left turn lanes in the median north of the existing bridge over I-270, and a new left turn spur will be constructed at the existing intersection to connect with the existing entrance ramp from southbound Shady Grove Road

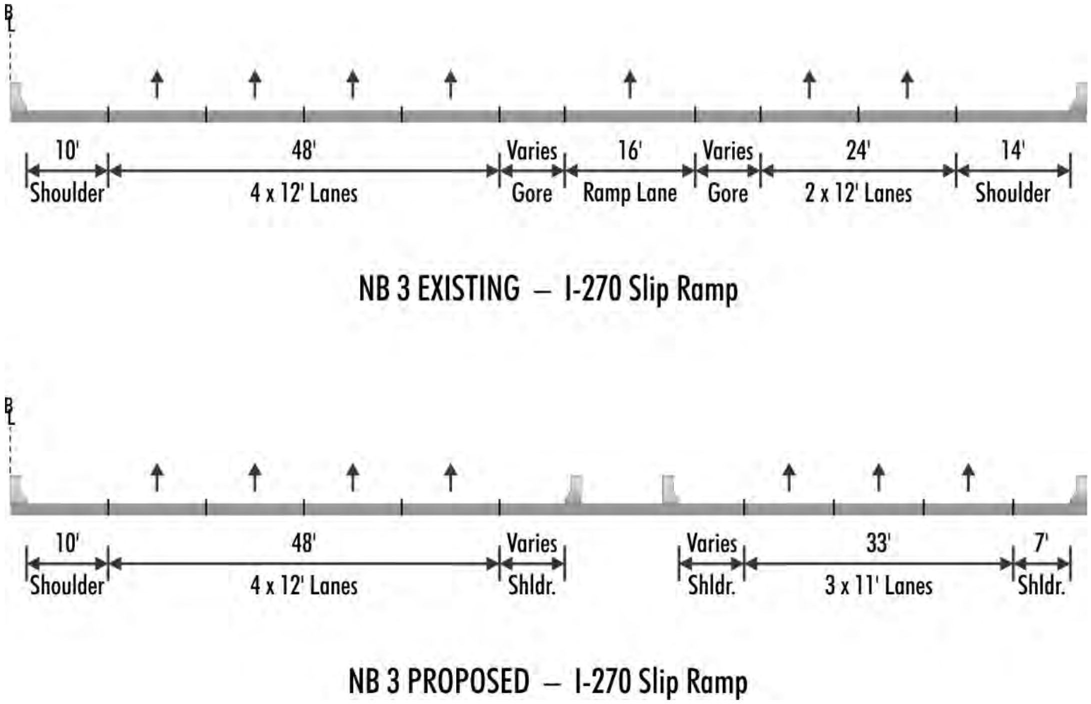
This improvement also involves closing the slip ramp exit from the local lanes on northbound I-270 to the express lanes south of the I-370 interchange. The left (third) local lane that drops at the slip ramp in the existing configuration will be extended to connect with the exit to I-370.

See display sheets NB 3-1 through NB 3-3 in this Appendix for conceptual plans for this improvement. See Figure C-12 below for the existing and proposed typical sections along I-270 under this improvement.

Existing Conditions and Proposed Design for NB 3

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Shady Grove Road	▪ Loop ramp connects northbound Shady Grove Road to northbound I-270 local lanes	▪ Approximately 1,280 square feet of new pavement is required to provide the new left turn lanes on northbound Shady Grove Road and two-lane spur to connect to existing entrance ramp from southbound Shady Grove Road
Local lanes south of I-370	▪ Lane configuration: two 12-foot wide travel lanes + 4-foot wide left shoulder + 12-foot wide right shoulder	▪ Lane configuration: three 11-foot wide travel lanes + 2-foot wide left shoulder + 7-foot wide right shoulder ▪ No roadway widening proposed ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width will be resurfaced to restripe lane markings
Traffic barrier	▪ Concrete barrier is located on both sides of the I-270 local lanes	▪ 135 linear feet of concrete barrier will be constructed along northbound Shady Grove Road to close the existing entrance to the loop ramp ▪ 915 linear feet of concrete barrier will be constructed along the local lanes and express lanes to close the existing slip ramp
Structures	▪ NB Shady Grove Road crosses over I-270 on a bridge	▪ Minimal impacts to the Shady Grove Road bridge over I-270 to reconfigure lanes ▪ An 18-foot high and 1,340-foot long noise wall is proposed to be constructed by SHA on the right side of the SB I-270 local lanes due to existing noise levels in the area of this improvement
Traffic signals, signage & lighting	▪ There is an existing traffic signal on Shady Grove Road at the ramp terminus for the exit from NB I-270	▪ Modifications to the existing traffic signal are proposed at the intersection on Shady Grove Road to accommodate the new left turn movement ▪ Overhead signs will be replaced at the Shady Grove Road interchange ▪ Signing along NB Shady Grove Road will be replaced as a result of this improvement ▪ Signing along this section of NB I-270 will be replaced as a result of this improvement

Figure C-12. Northbound 3 Typical Sections – I-270 Slip Ramp



Northbound 4 (NB 4)

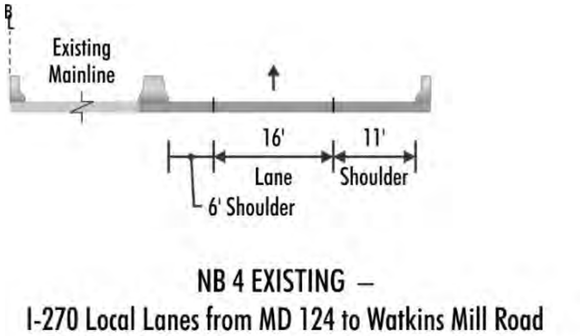
This improvement consists of two components: an auxiliary lane will be provided in the northbound local lanes by connecting the entrance from MD 124 to the exit at the new Watkins Mill Road interchange and an auxiliary lane will be provided along northbound I-270 by connecting the entrance from Watkins Mill Road with the exit to westbound Middlebrook Road (loop ramp).

See display sheets NB 4-1 through NB 4-7 in this Appendix for conceptual plans for this improvement. See Figures C-13 and C-14 below for the existing and proposed typical sections along I-270 under this improvement.

Existing Conditions and Proposed Design for NB 4

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Local lanes from MD 124 to Watkins Mill Road	▪ Lane configuration: 16-foot wide travel lane + 6-foot wide left shoulder + 11-foot wide right shoulder	▪ Lane configuration: two 12-foot wide travel lanes + 5-foot wide left shoulder + 4-foot wide right shoulder ▪ No roadway widening necessary
I-270 Mainline from Watkins Mill Road to Middlebrook Road	▪ Lane configuration: four 12-foot wide travel lanes + 12-foot wide left shoulder + 8-20-foot wide right shoulder	▪ Lane configuration: three 11.5-foot wide travel lanes + 6-foot wide left shoulder + 10-foot wide minimum right shoulder ▪ Approximately 1,410 SF of outside widening proposed for new right shoulder ▪ Existing pavement in shoulders will be used for travel lanes
Traffic barrier	▪ Concrete barrier is located on both sides of the I-270 local lanes and along both sides of the mainline from MD 124 to Middlebrook Road	▪ Concrete traffic barrier will be reconstructed along the edge of the right shoulder where widening ▪ Side slopes will be reconstructed at 1V:2H or flatter behind the barrier
Structures	▪ Retaining walls and noise walls exist along the right side of the roadway on this section of NB I-270 ▪ NB I-270 crosses over Game Preserve Road on a bridge	▪ No impacts to existing retaining walls and noise walls ▪ Modifications to the bridge over Game Preserve Road include: adjusting the deck to align the cross slope breaks at the shoulder with the reconfigured lane edges and reconstructing the median bridge parapet to accommodate the adjusted deck elevation resulting from the deck cross slope adjustment
Traffic signals, signage & lighting		▪ Signing along NB I-270 in this section will be replaced as a result of this improvement

Figure C-13. Northbound 4 Typical Section – I-270 Local Lanes from MD 124 to Watkins Mill Road



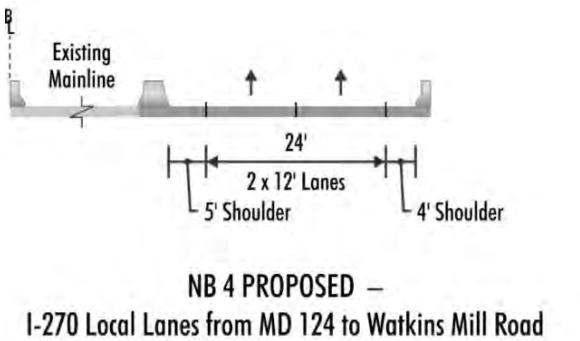
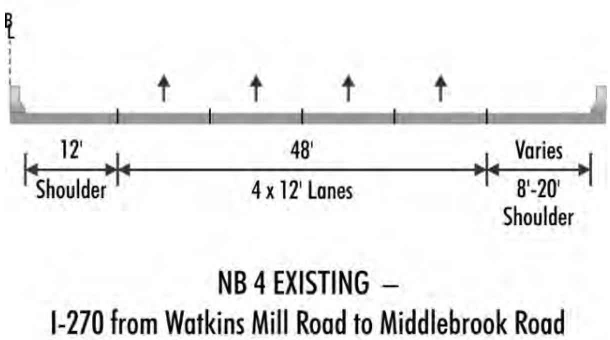
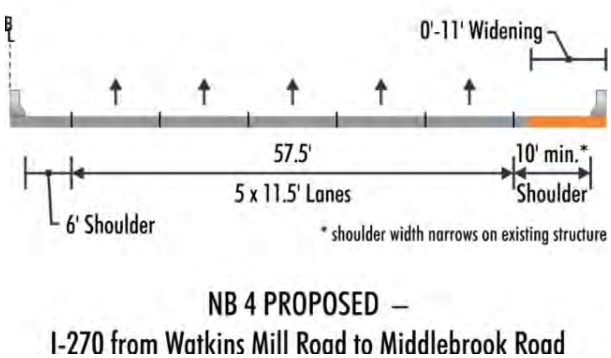


Figure C-14. Northbound 4 Typical Section – I-270 from Watkins Mill Road to Middlebrook Road





Northbound 5 (NB 5)

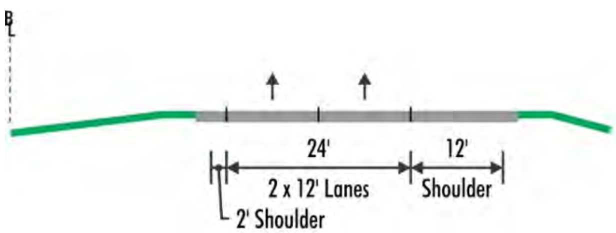
This improvement will extend the right (third) lane drop from its current location north of MD 121 to Comus Road, a distance of approximately 0.8 miles. The additional lane will be provided by widening into the median.

See display sheets NB 5-1 through NB 5-3 in this Appendix for conceptual plans for this improvement. See Figure C-15 below for the existing and proposed typical sections along I-270 under this improvement.

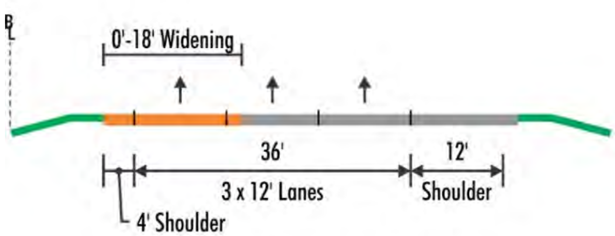
Existing Conditions and Proposed Design for NB 5

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
I-270 Mainline	▪ Lane configuration: two 12-foot travel lanes + 2-foot left shoulder + 12-foot right shoulder ▪ Design speed = 70 MPH	▪ Lane configuration: three 12-foot travel lanes + 4-foot left shoulder + 12-foot right shoulder ▪ 4,100 square feet of inside widening is proposed for new travel lane and left shoulder ▪ Existing pavement in shoulders will be used for travel lanes ▪ Entire roadway width will be resurfaced to restripe lane markings
Traffic barrier	▪ Guardrail is located on both sides of the roadway	▪ Guardrail in the median will be reconstructed
Structures	▪ No structures located near this improvement	▪ No impact to structures under this improvement
Traffic signals, signage & lighting		▪ Signing along NB I-270 in this section will be replaced as a result of this improvement

Figure C-15. Northbound 5 Typical Sections – I-270 Mainline



NB 5 EXISTING – I-270 Mainline



NB 5 PROPOSED – I-270 Mainline

Northbound 7 (NB 7)

This improvement involves extending the length of the deceleration lane for the exit to eastbound MD 118.

See display sheet NB 7-1 in this Appendix for conceptual plans for this improvement.

Existing Conditions and Proposed Design for NB 7

ELEMENT	EXISTING CONDITION	PROPOSED DESIGN
Deceleration lane for Exit Ramp to MD 118	▪ Mainline design speed = 70 MPH ▪ Ramp design speed = 50 MPH ▪ Length of existing acceleration lane is 450 feet	▪ Deceleration lane extended 340 feet for total length of 600 feet ▪ 10-foot wide right shoulder (minimum) provided ▪ Pavement in existing shoulders will be used for extended lane ▪ No roadway widening proposed
Traffic barrier	▪ Concrete barrier exists along the edge of the right shoulder along the deceleration lane	▪ No modification to the existing barrier is proposed
Structures	▪ No structures located near this improvement	▪ No impact to structures under this improvement
Traffic signals, signage & lighting		▪ Signing along this section of NB I-270 will be replaced as a result of the extended deceleration lane

Southbound Adaptive Ramp Metering

Adaptive ramp meters will be installed at every entrance ramp from the arterial to southbound I-270 between and including MD 80 to Montrose Road. Adaptive ramp meters will also be installed on the connector ramp from I-370 to I-270 in the southbound direction.

Concept Elements

The scope of work reflected in the cost estimate for each ramp meter location includes the following elements:

- Removal and disposal of existing signal equipment (as necessary)
- Installing Econolite 2070 controller cabinet with Intelight MaxTime ramp metering software
- Connecting the control cabinet to a nearby power source
- Connecting the control cabinet to an Ethernet network with a cellular modem
- Installing a mast arm pole with traffic signal head(s) and video detection camera
- Installing a video detection camera mounted on a pole upstream of the mast arm pole
- Installing a Wavetronix radar detector mounted on a pole downstream of the mast arm pole
- Installing an advanced warning sign with flashing beacon
- Installing traffic barrier to protect the roadside equipment (if necessary)
- Resurfacing the roadway to restripe pavement markings (as necessary)
- Furnishing pavement markings
- Meeting all necessary erosion and sediment control requirements related to the construction activities
- Maintaining travel lanes to the maximum extent during construction
- Deploying Intelight MaxView central management software for remote access to the ramp metering firmware

Design Assumptions

The proposed roadway design for each ramp meter location is based upon guidance and design criteria provided in the *Caltrans Ramp Metering Design Manual*, April 2016. The following design assumptions were made:

- Limit line (stop line) is located a minimum of 75 feet behind the physical gore nose
- Initial design speed for entrance ramp is 0 MPH (stop condition)
- Design speed along SB I-270 mainline is 60 MPH
- Design speed along SB I-270 local lanes is 50 MPH
- Acceleration lengths meet minimum AASHTO 2011 guidance for entrance ramp design
- Existing pavement in shoulder on SB I-270 will be used for extended acceleration lane

Ramp Meter Locations

Ramp meters will be installed at the following entrance ramps to SB I-270:

- MD 80 on ramp
- MD 109 on ramp
- MD 121 on ramp
- MD 27 westbound on ramp
- MD 27 eastbound on ramp
- MD 118 westbound on ramp
- MD 118 eastbound on ramp
- Middlebrook Road on ramp*
- MD 124 on ramp*
- MD 117 on ramp*
- Shady Grove Road westbound on ramp
- Shady Grove Road eastbound on ramp
- MD 28 westbound on ramp
- MD 28 eastbound on ramp*
- MD 189 on ramp
- Montrose Rd westbound on ramp*
- Montrose Rd eastbound on ramp

A ramp meter will be installed at the following freeway-to-freeway connector ramp to SB I-270:

- I-370 on ramp*

* Ramp may be reconfigured to two lanes at this location to provide adequate storage space for queued vehicles.

See display sheets TBM 1-1 through TBM 1-5 and TBM 2-1 in this Appendix for conceptual plans for how ramps may be widened at each location.

Localized widening could be provided where it may be necessary to provide an extended acceleration lane and a 6-foot wide right shoulder (minimum). This widening could occur at the following ramp locations along SB I-270:

- MD 27 westbound on ramp
- MD 118 westbound ramp
- MD 118 eastbound on ramp
- MD 124 on ramp

Active Traffic Management

Active Traffic Management (ATM) strategies involve the use of technologies to dynamically manage recurring and non-recurring congestion based on prevailing and predicted traffic conditions. The specific ATM strategies proposed by the CGI Team for I-270 include:

- Dynamic speed limits (DSL), also known as variable speed limits, to adjust speed limit displays based on real-time traffic, roadway, and/or weather conditions. DSL will be recommended speed advisories, and they can be applied to an entire roadway segment or to individual lanes. This "smoothing" process helps minimize the differences between the lowest and highest vehicle speeds. During the Concept of Operations process, the CGI Team will work with SHA to determine if dynamic advisory speed signs are more appropriate than dynamic speed limit signs for the project based on policy issues such as enforcement and record keeping of dynamic speed limits.
- Queue warning (QW) to provide real-time displays of warning messages (on DMS) along I-270 to alert motorists that queues or significant slowdowns are ahead. QW is also used to provide additional information to motorists as to why the speed limit is being reduced.

Concept Elements

The scope of work reflected in the cost estimate for ATM includes the following elements:

- Implement full coverage of CCTV Cameras (with pan, tilt, and zoom capabilities)
- Install DMS on mast arms over the roadway approximately every ½ mile (to display the dynamic speed limits)
- Install DMS on mast arms over the roadway approximately every mile (to display the queue warning messages)
- Mount detectors on the ATM infrastructure
- Install ATM software on the connected central server

Virtual Weigh Station

A Virtual Weigh Station (VWS) is a method of pre-screening trucks at highway speeds for weight and height violations. Scaling equipment embedded in the pavement of the travel lanes and adjacent height sensors measure the weight and height of a vehicle while an infrared camera photographs the vehicle and the license plate. Within seconds, a report is transmitted wirelessly to the computer of an enforcement officer located downstream of the VWS so the officer can determine if the vehicle is violating any regulations. If the vehicle is in violation, the officer can choose to pull over the vehicle for inspection and/or static weighing.

As a part of the proposed improvements, the VWS will be constructed in the northbound and southbound directions in advance of the existing weigh stations south of MD 109 along relative flat and tangent sections of I-270 as required for proper VWS operations. The existing weigh station facilities will serve as a pull-off area for an enforcement officer to pull over, inspect, and weigh a vehicle in violation and portable scales will not be necessary.

Concept Elements

The scope of work reflected in the cost estimate for each VWS includes the following work elements:

- Embedding weigh-in-motion (WIM) sensors in the pavement of the travel lanes and ancillary cabling
- Embedding loops in the pavement of the travel lanes and ancillary cabling
- Installing a control cabinet to house all necessary electrical connections
- Connecting the control cabinet to a nearby power source
- Connecting the control cabinet to a wireless network so the VWS readings can be transmitted to the computer of an enforcement officer
- Installing an overheight detector pole
- Installing an infrared camera mounted on a pole downstream of the overheight detector pole
- Installing an overheight reflector pole on the opposite side of the roadway from the overheight detector pole
- Installing traffic barrier to protect the roadside equipment (if necessary)
- Resurfacing the roadway 200 feet in advance of and 100 feet beyond the VWS
- Meeting all necessary erosion and sediment control requirements related to the construction activities
- Maintaining travel lanes to the maximum extent during construction


SB 1
SB 1 - Extend deceleration lane at exit ramp to MD 80; Extend acceleration lane at entrance ramp from MD 80
INTERSTATE 270
MARYLAND 80
450
455
460
465
LIMIT OF WORK
STA. 453+97
LIMIT OF WORK
STA. 460+39
TO MD 85
N
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″=100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
SB 1
January 2017
SB 1-1

PROPOSED IMPROVEMENTS	
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PROPOSED IMPROVEMENTS

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SB 2

January 2017 | SB 2-1

PROPOSED IMPROVEMENTS

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SB 2

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PROPOSED IMPROVEMENTS

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SB 5A

January 2017	SB 5A-1

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management	
SB 6	
January 2017	SB 6-1


SB 6
INTERSTATE 270
1430
1435
1440
W GUDE DRIVE
MATCH LINE – SEE SHEET SB 6-1
LIMIT OF WORK
STA. 1441+10
TO Shady Grove Rd
TO MD 28
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″=100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
SB 6
January 2017
SB 6-2

MARYLAND
28
SB 7
SB 7 - Create auxiliary lane by connecting entrance ramp from MD 28 with exit ramp to MD 189
1490
1495
INTERSTATE
270
1500
MATCH LINE – SEE SHEET SB 7-2
LIMIT OF WORK
STA. 1500+00
WATTS BRANCH PKWY
TO Shady Grove Rd
TO MD 189
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″=100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
SB 7
January 2017
SB 7-1

PROPOSED IMPROVEMENTS

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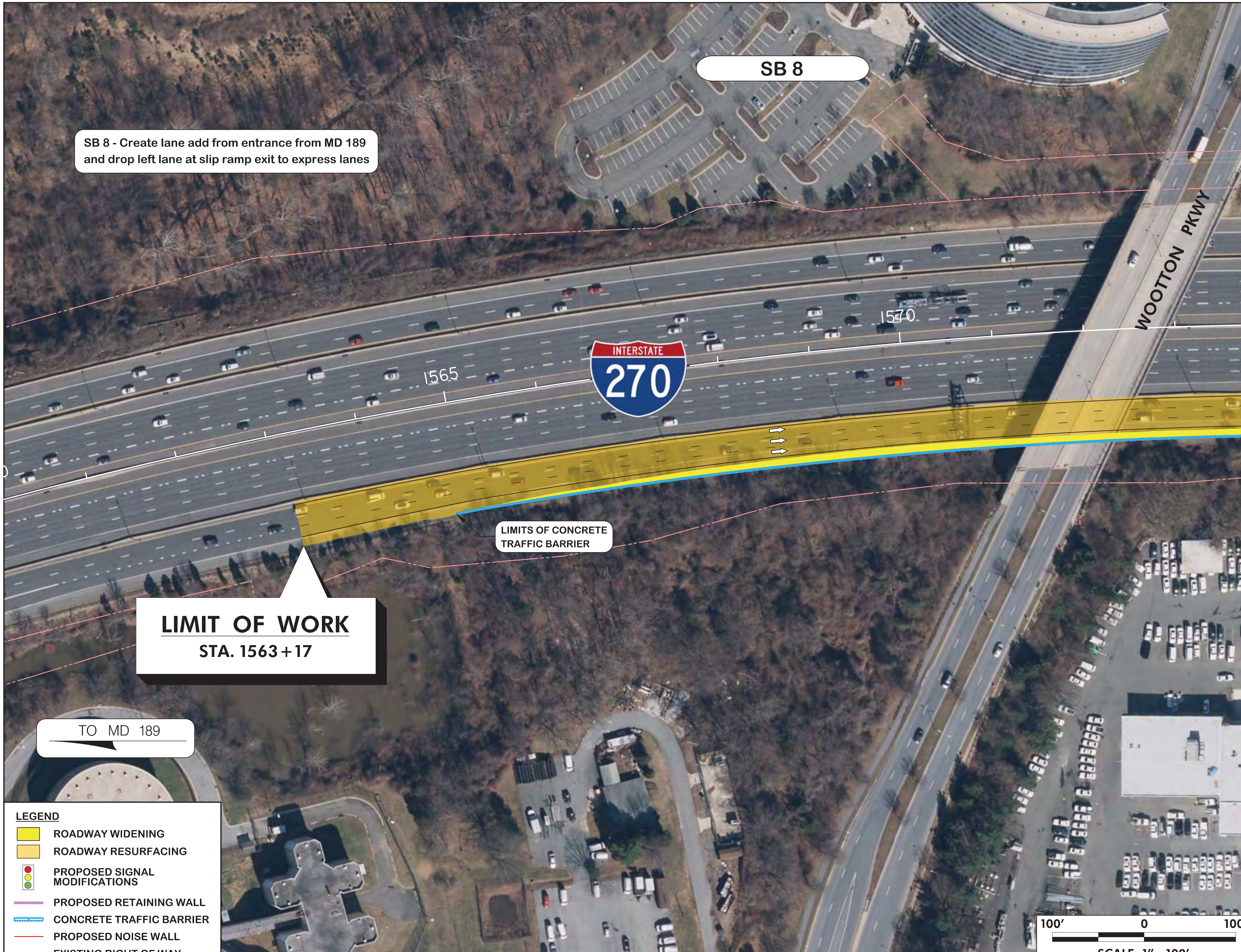
SB 7

January 2017 | SB 7-2

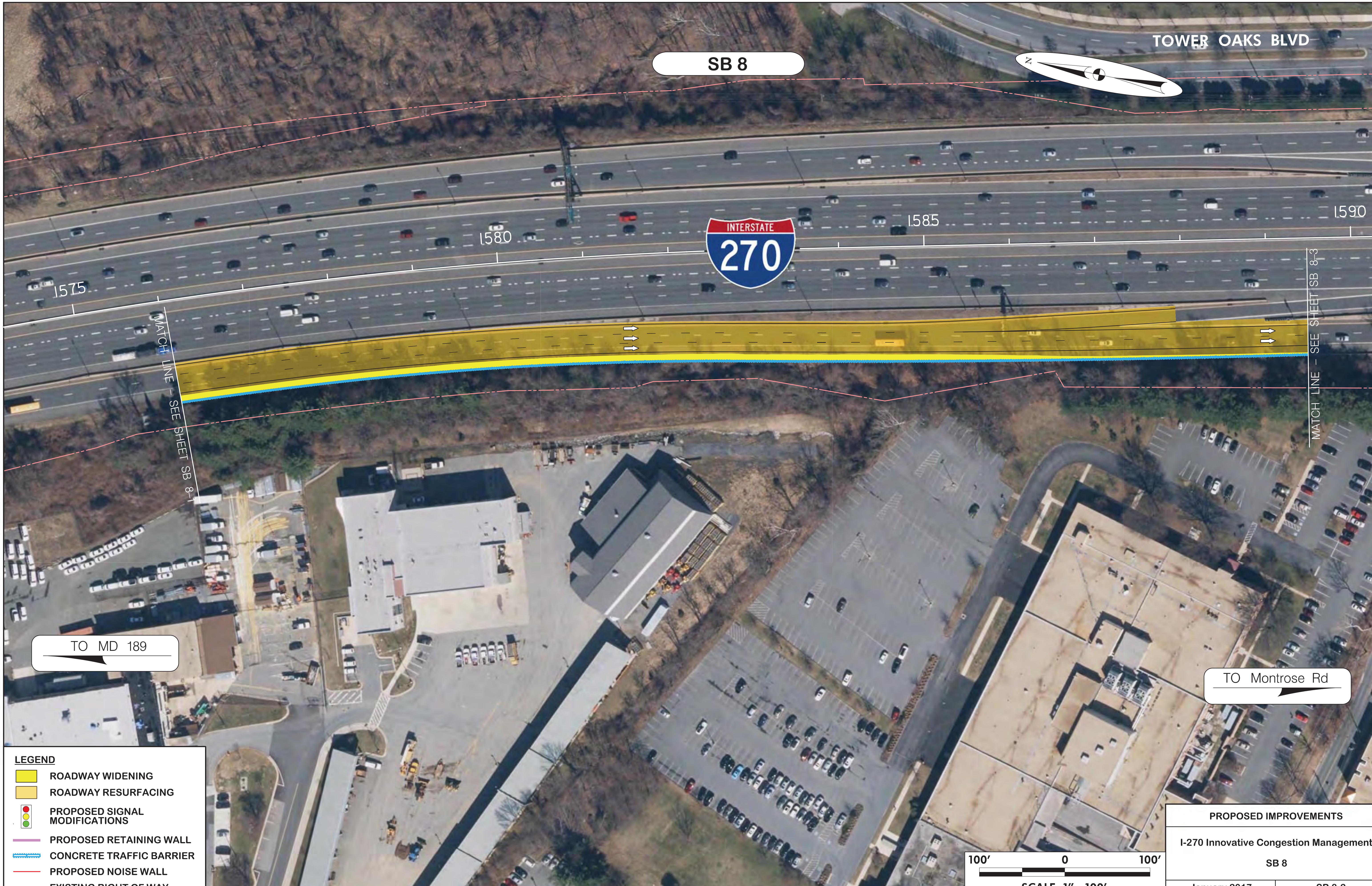
LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB 7	
January 2017	SB 7-3



PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB 8	
January 2017	SB 8-1



PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 8

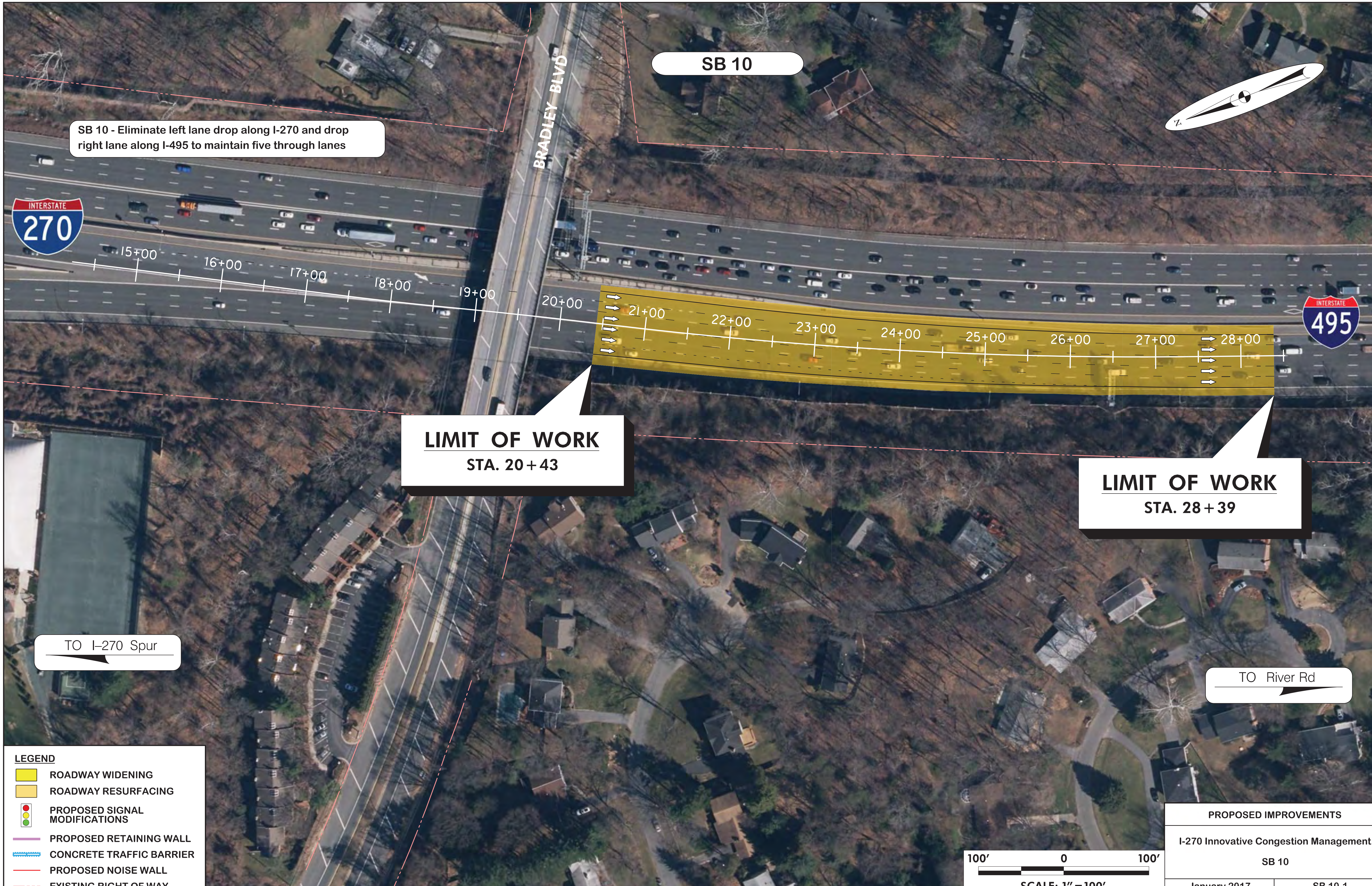
January 2017 | SB 8-2

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 8

January 2017	SB 8-3

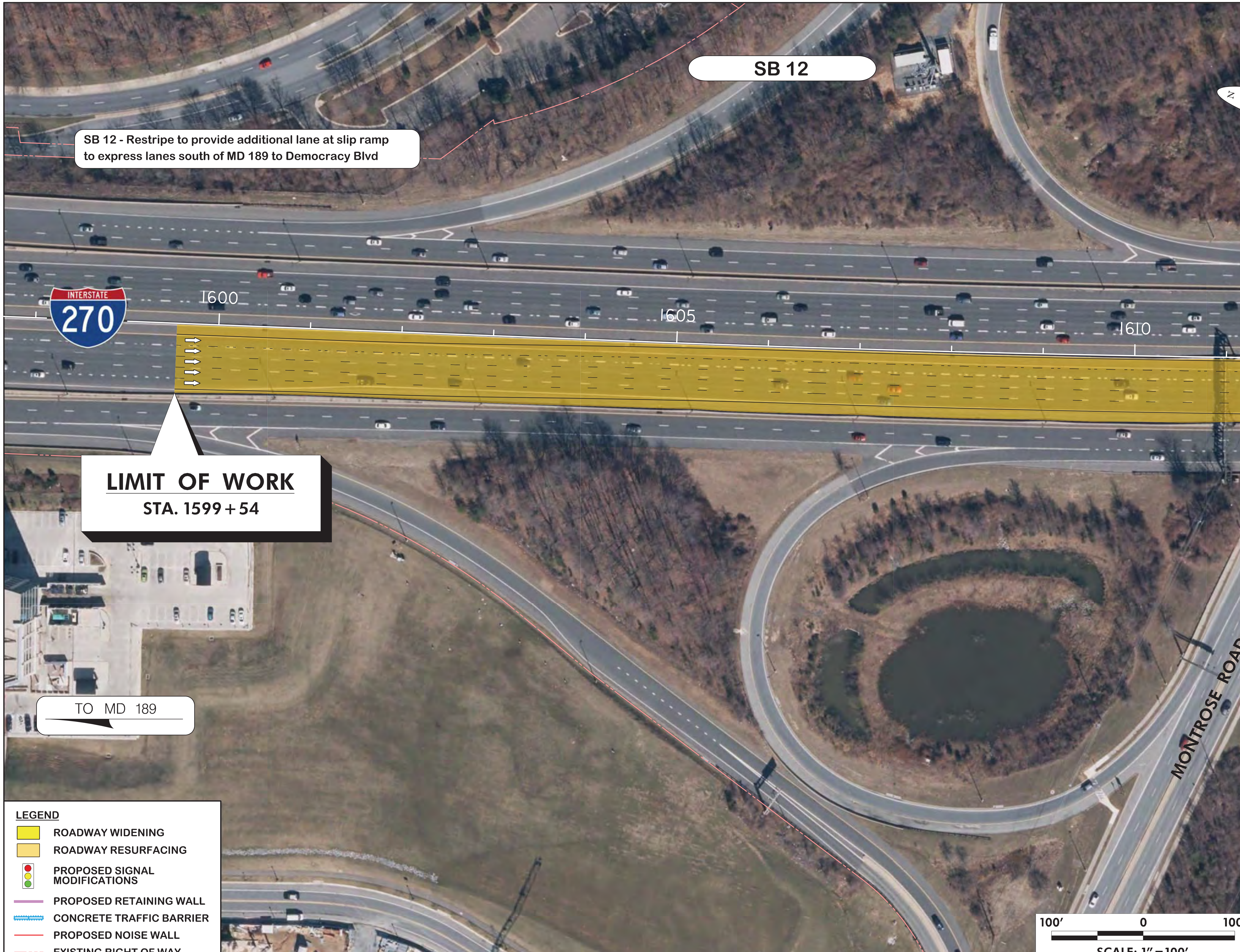


PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 10

January 2017 | SB 10-1

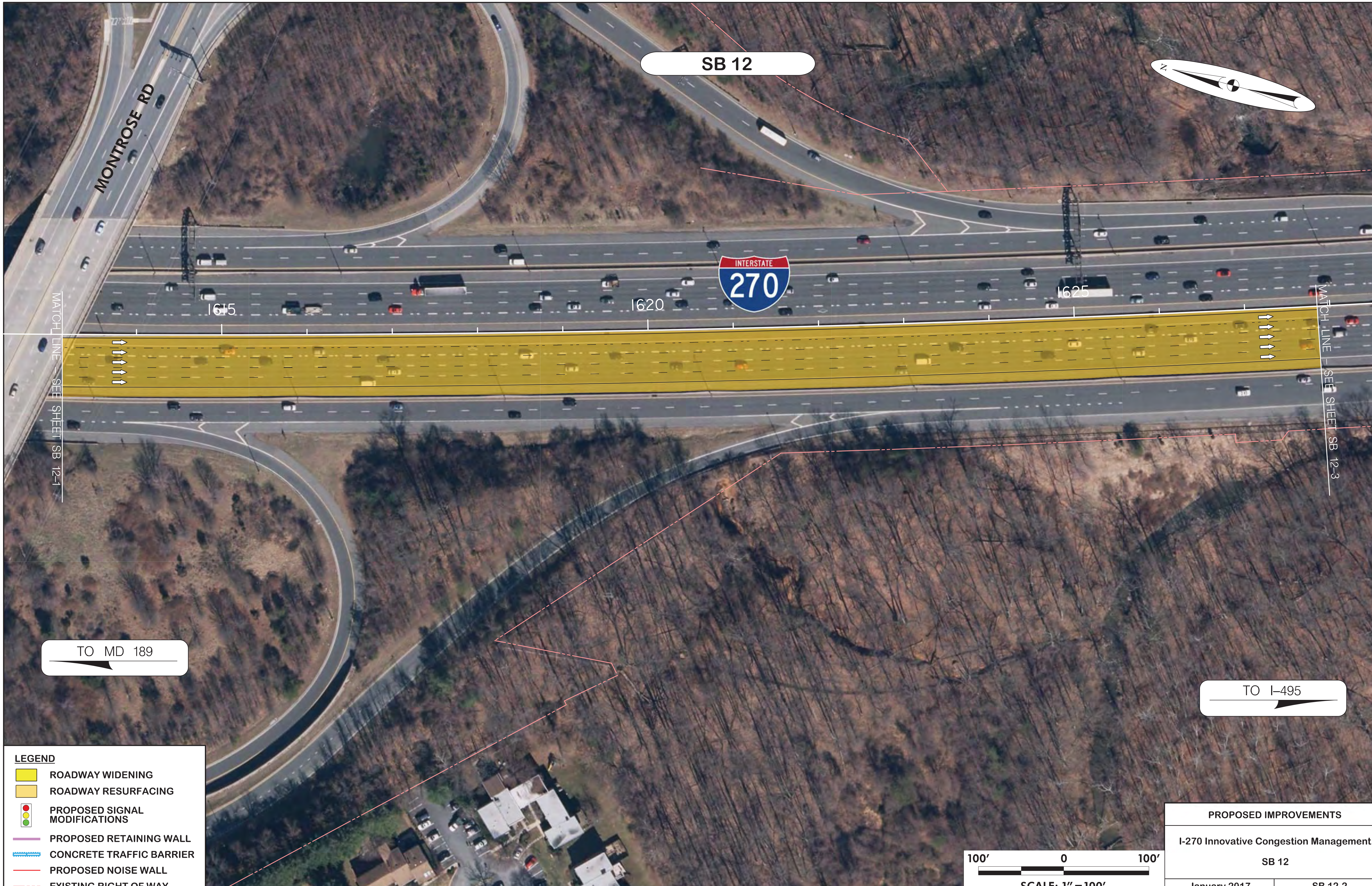


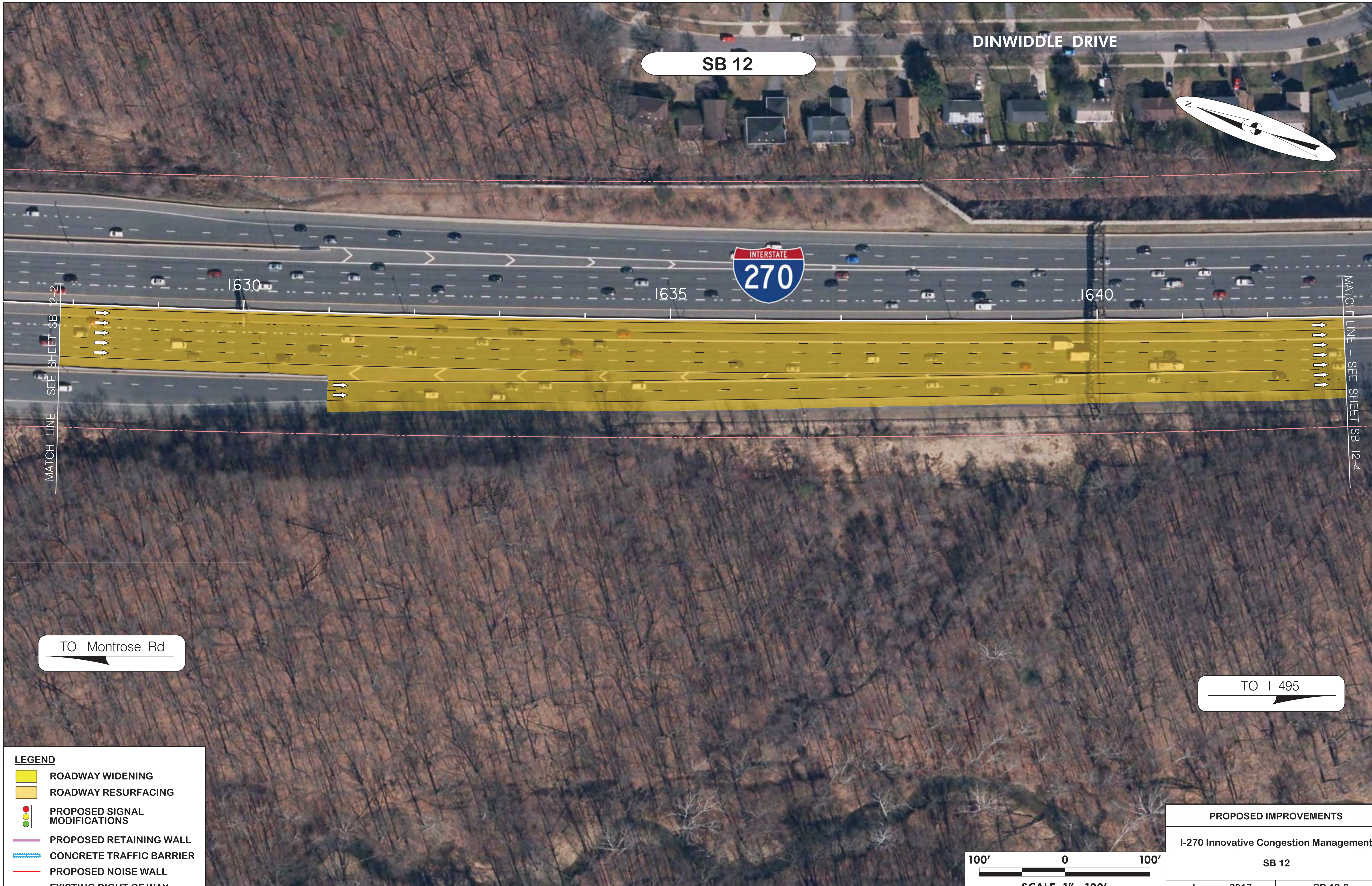
PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 12

January 2017	SB 12-1


MONTROSE RD
SB 12
INTERSTATE
270
1615
1620
1625
MATCH LINE – SEE SHEET SB 12-1
MATCH LINE – SEE SHEET SB 12-3
TO MD 189
TO I–495
N
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″ = 100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
SB 12
January 2017
SB 12-2



LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB 12	
January 2017	SB 12-3

LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS

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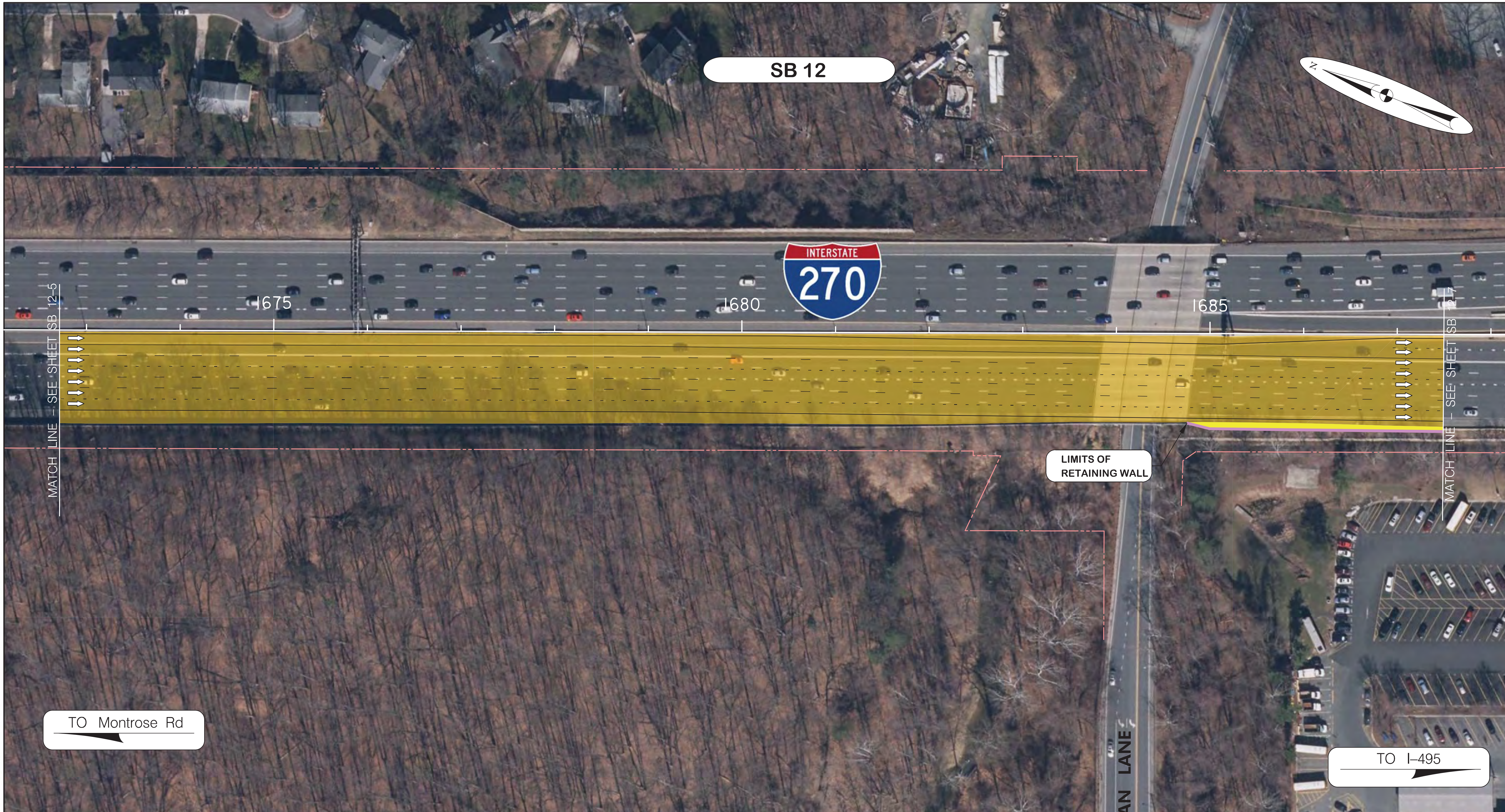
SB 12

January 2017 | SB 12-4

LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB 12	
January 2017	SB 12-5



LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

100′ 0 100′

SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 12

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PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 12

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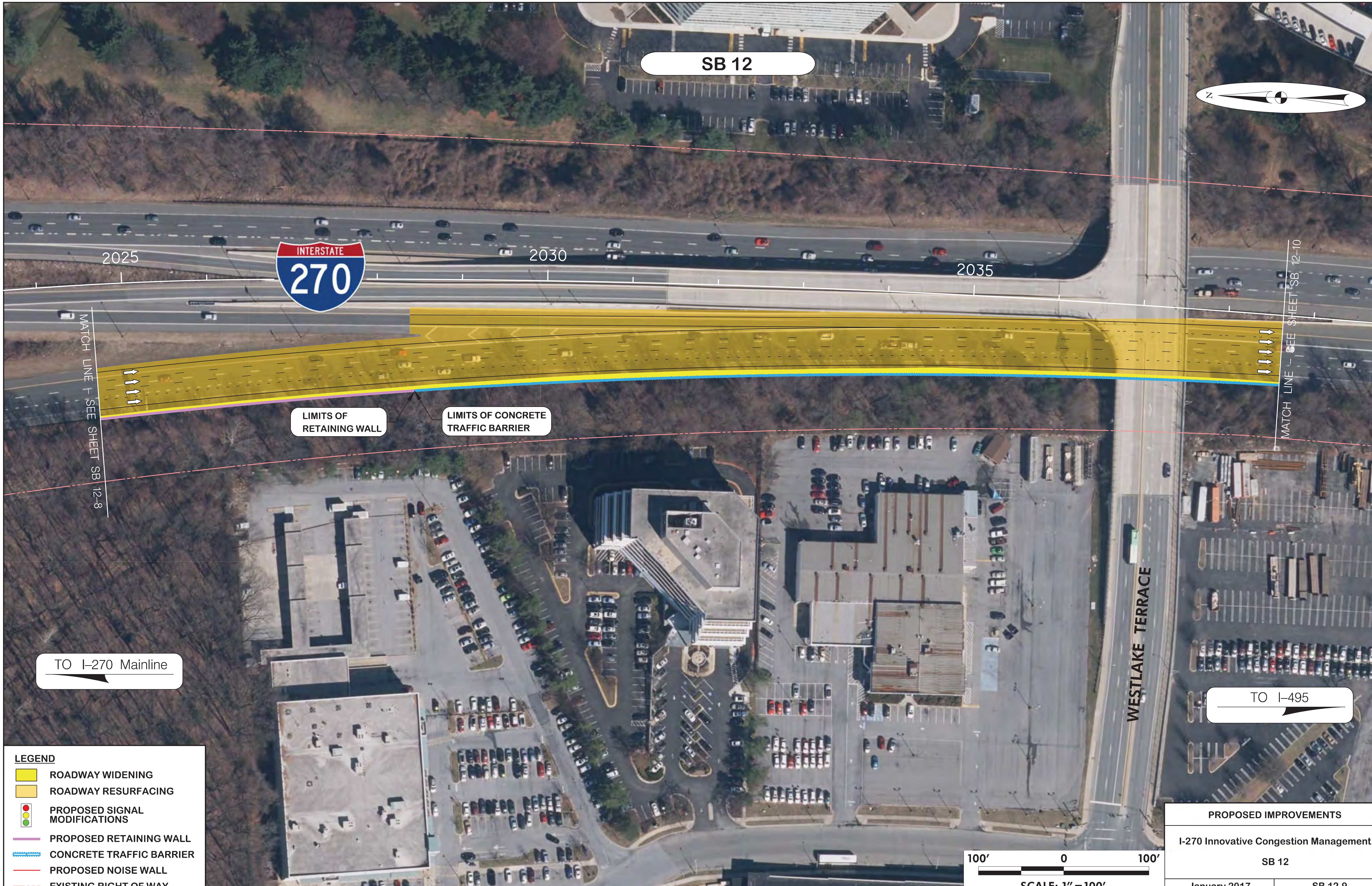
LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

100′ 0 100′

SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB 12	
January 2017	SB 12-8



PROPOSED IMPROVEMENTS

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SB 12

January 2017 | SB 12-9

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB 12

January 2017	SB 12-10

PROPOSED IMPROVEMENTS

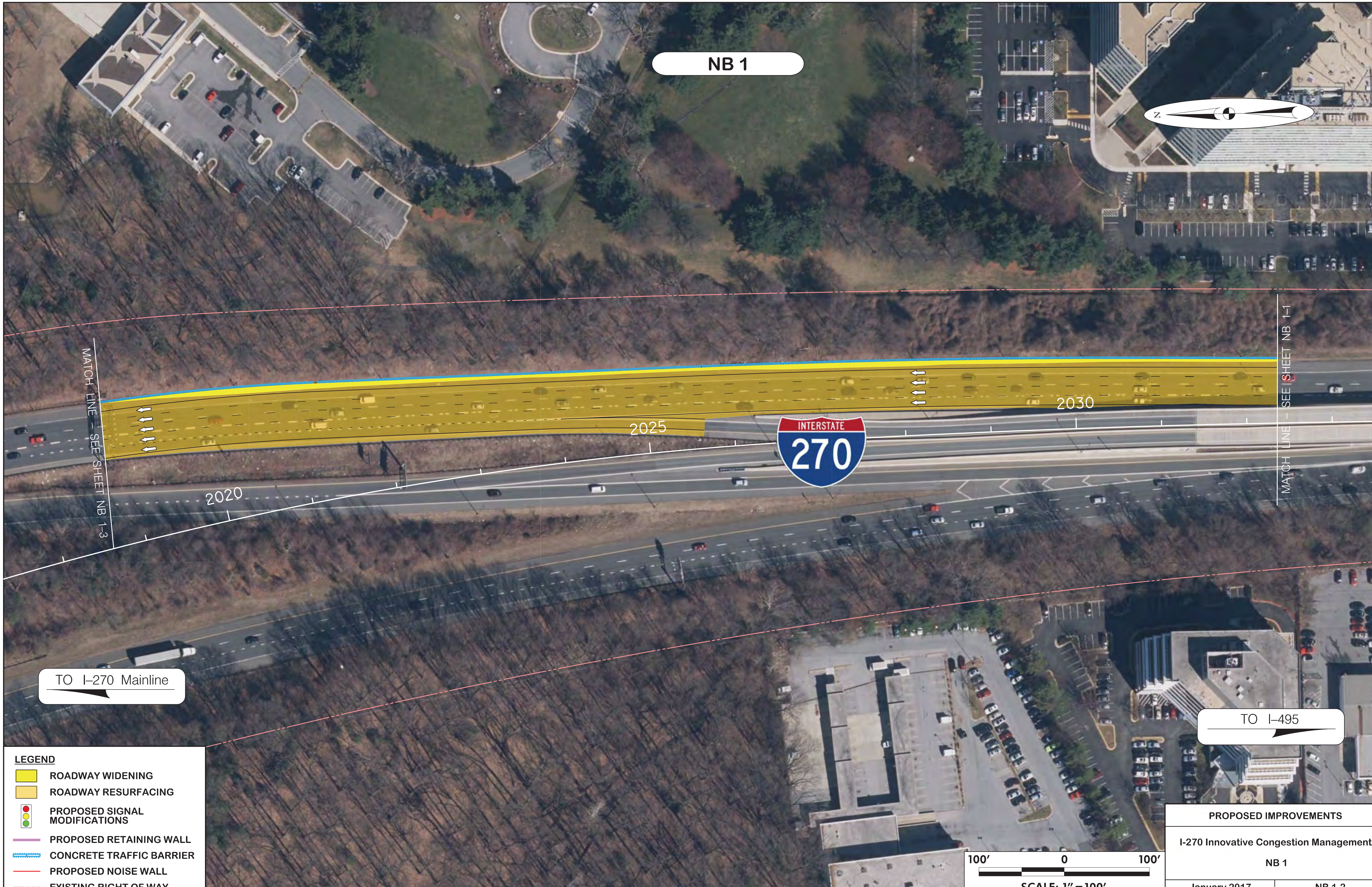
I-270 Innovative Congestion Management

SB 12

January 2017	SB 12-11

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB 12	
January 2017	SB 12-12


NB 1
NB 1 - Restripe to provide additional lane at entrance ramp from Democracy Blvd to slip ramp to local lanes just north of Montrose Rd
WESTLAKE TERRACE
LIMITS OF CONCRETE TRAFFIC BARRIER
MATCH LINE – SEE SHEET NB 1-2
2035
2040
2045
LIMIT OF WORK
STA. 2044+74
INTERSTATE
270
TO I–270 Mainline
TO I–495
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″ = 100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 1
January 2017
NB 1-1

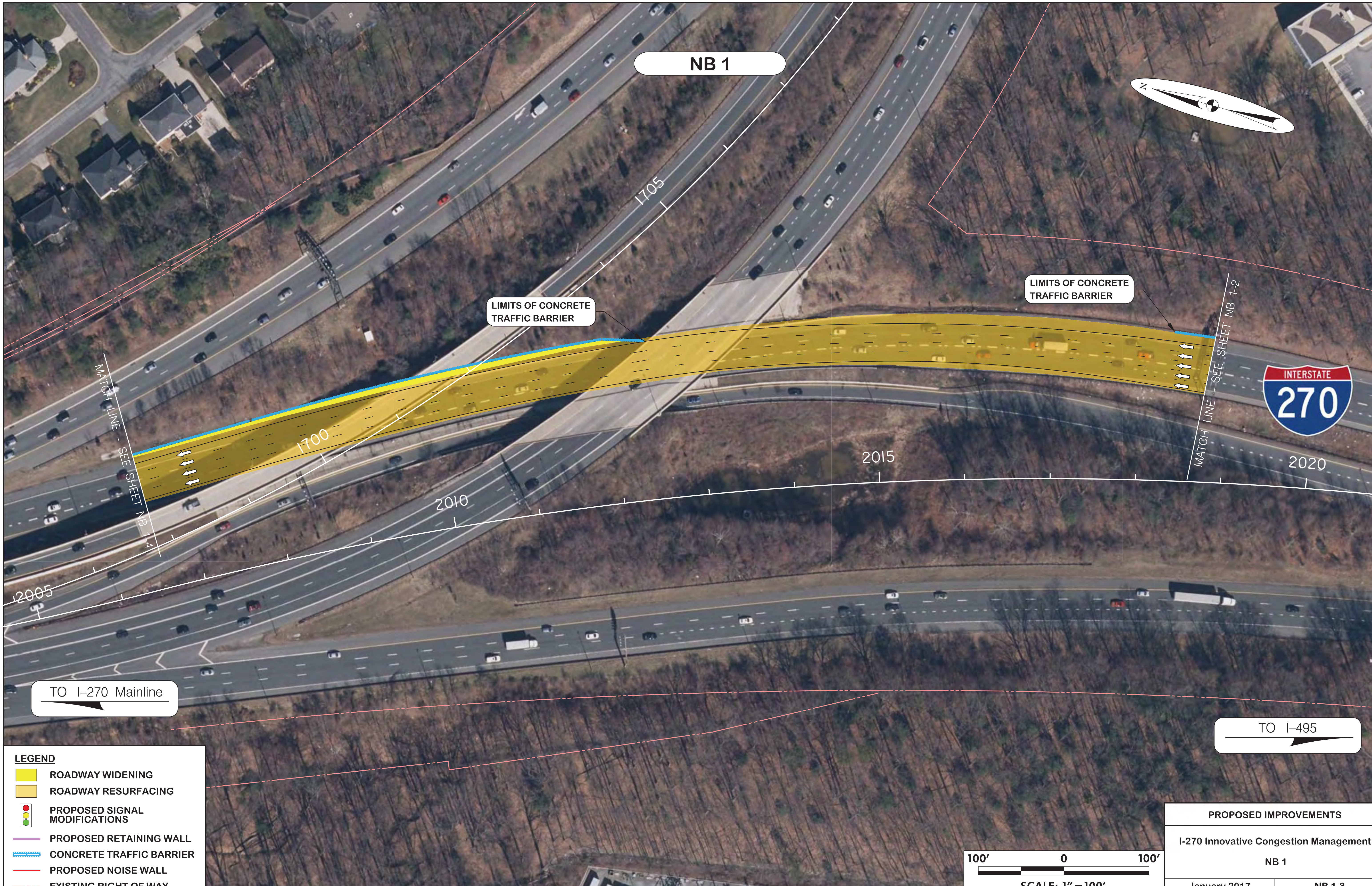


PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 1

January 2017 | NB 1-2


NB 1
INTERSTATE
270
LIMITS OF CONCRETE TRAFFIC BARRIER
LIMITS OF CONCRETE TRAFFIC BARRIER
MATCH LINE - SEE SHEET NB 1-2
MATCH LINE - SEE SHEET NB 1-4
1700
1705
2005
2010
2015
2020
TO I-270 Mainline
TO I-495
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100' 0 100'
SCALE: 1" = 100'
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 1
January 2017
NB 1-3

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 1

January 2017 | NB 1-4

LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 1

January 2017 | NB 1-5

LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

100′ 0 100′
SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 1

January 2017 | NB 1-6

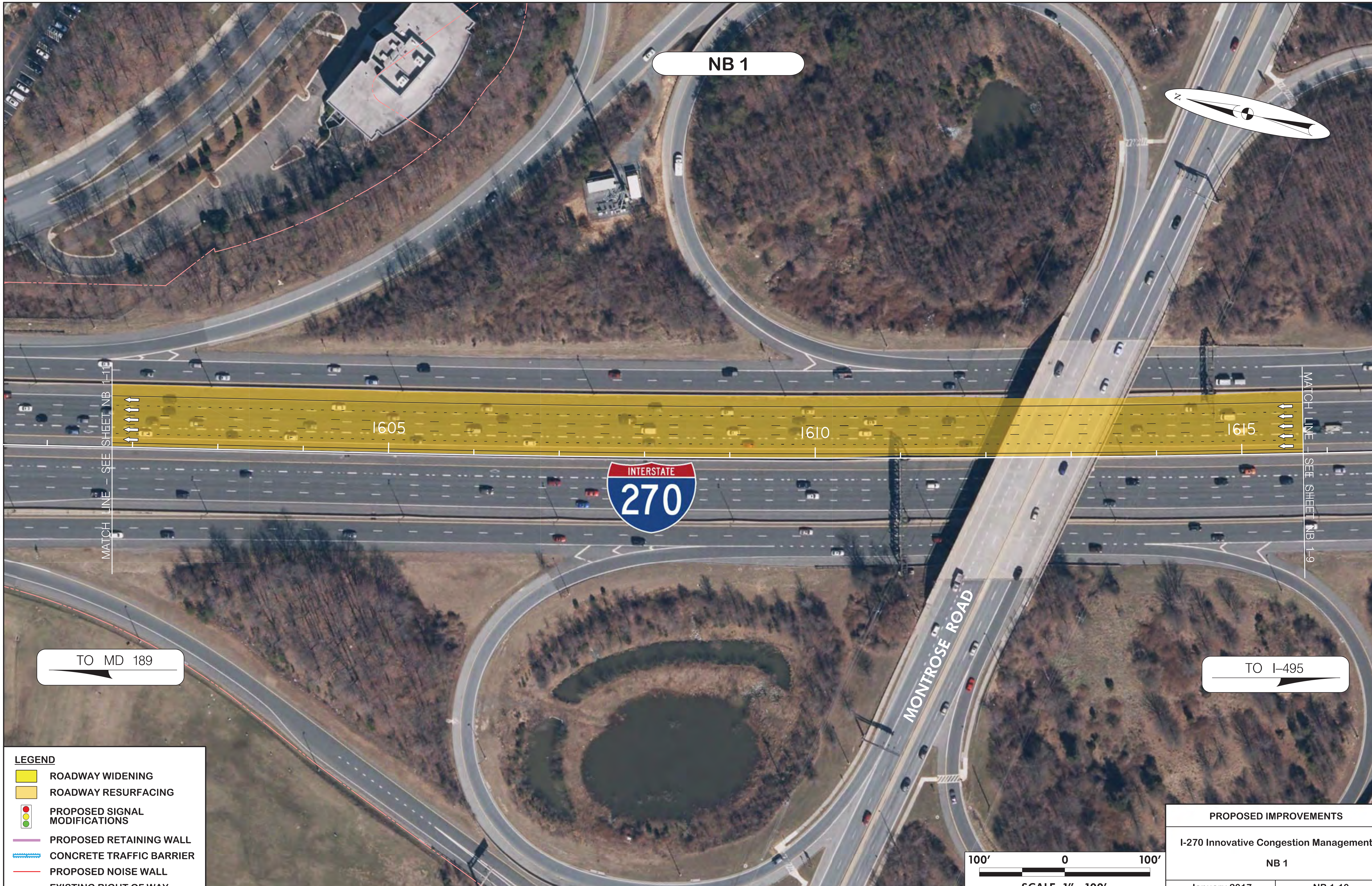
LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management	
NB 1	
January 2017	NB 1-7


NB 1
DINWIDDLE DRIVE
MATCH LINE – SEE SHEET NB 1-9
MATCH LINE – SEE SHEET NB 1-7
1630
1635
1640
INTERSTATE
270
TO Montrose Rd
TO I-495
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″ = 100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 1
January 2017
NB 1-8


NB 1
MONTROSE ROAD
MATCH LINE - SEE SHEET NB 1-10
MATCH LINE - SEE SHEET NB 1-8
1615
1620
1625
1630
INTERSTATE 270
TO Montrose Rd
TO I-495
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″ = 100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 1
January 2017
NB 1-9



LEGEND
- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

100′ 0 100′

SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 1

January 2017 | NB 1-10

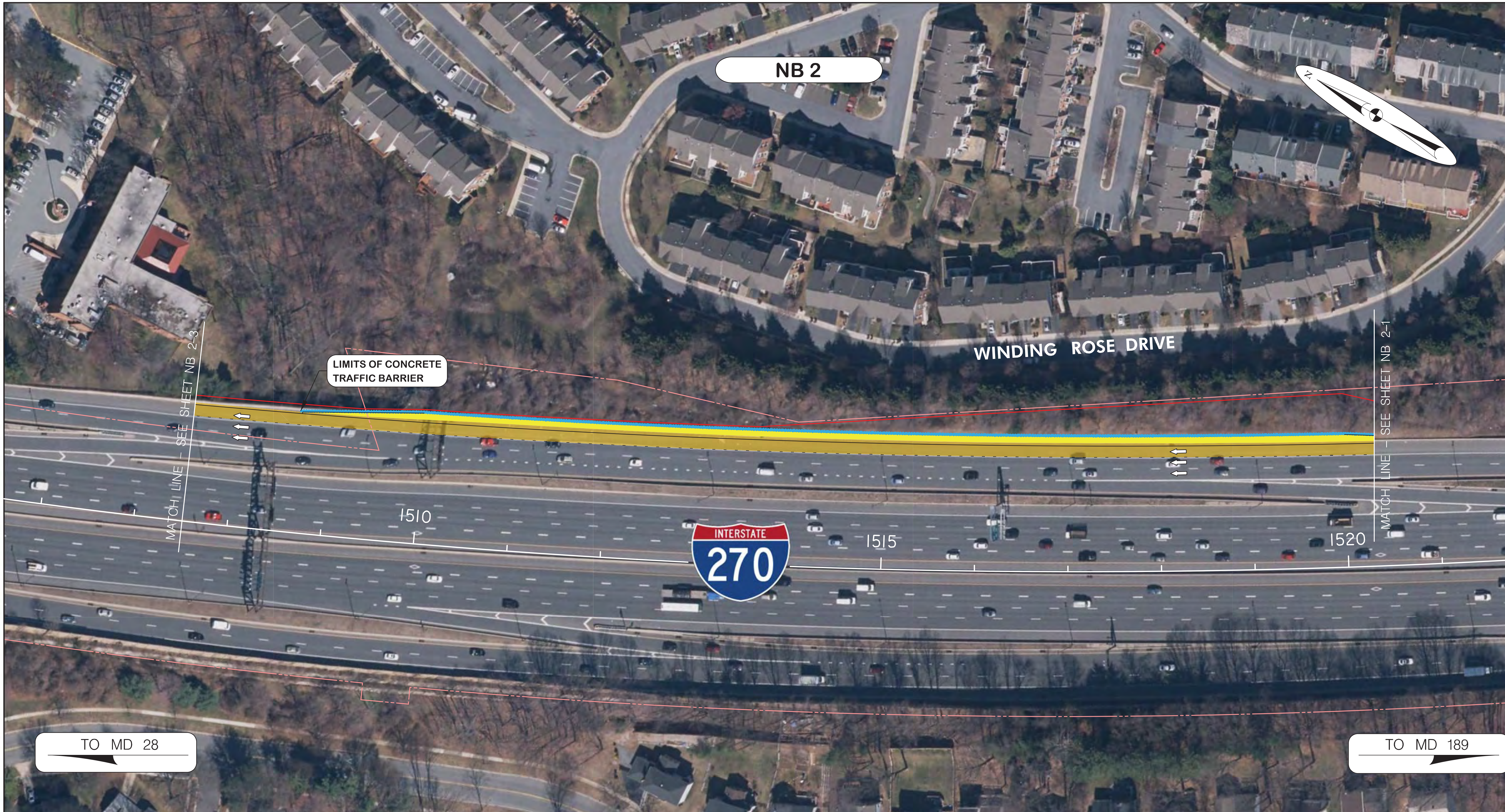

NB 1
TOWER OAKS BLVD
INTERSTATE
270
1590
1595
1600
MATCH LINE – SEE SHEET NB 1-10
LIMIT OF WORK
STA. 1592 + 32
TO MD 189
TO Montrose Rd
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′ 0 100′
SCALE: 1″ = 100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 1
January 2017
NB 1-11

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 2

January 2017	NB 2-1



LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 2

January 2017 | NB 2-2

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 2

January 2017 | NB 2-3

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 2

January 2017 | NB 2-4

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 3

January 2017 | NB 3-1

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 3

January 2017 | NB 3-2

PROPOSED IMPROVEMENTS

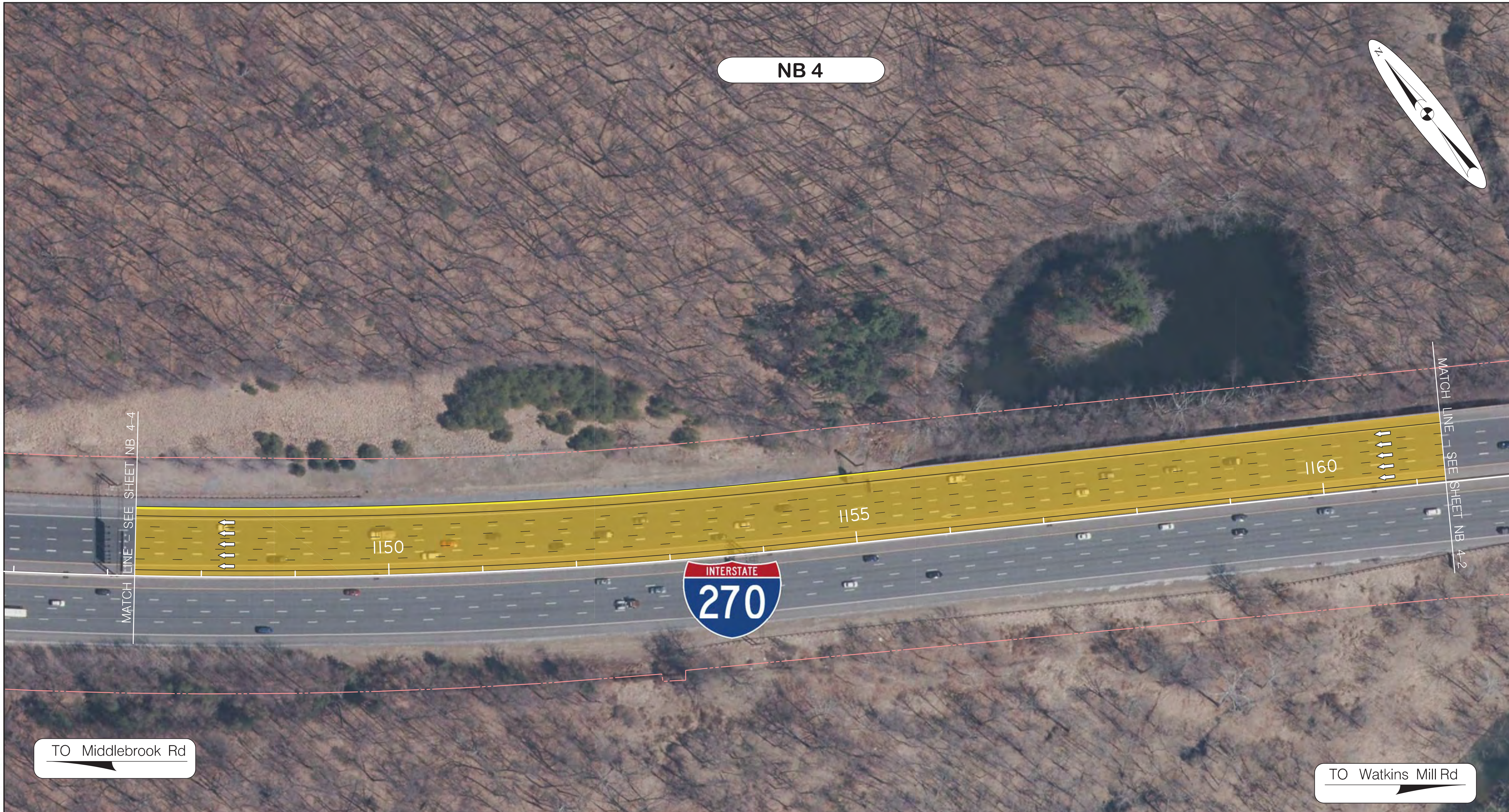
I-270 Innovative Congestion Management

NB 3

January 2017 | NB 3-3

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management NB 4	
January 2017	NB 4-1


NB 4
LIMIT OF WORK
STA. 1175+15
LIMITS OF CONCRETE TRAFFIC BARRIER
LIMITS OF CONCRETE TRAFFIC BARRIER
1165
1170
1175
INTERSTATE
270
MATCH LINE – SEE SHEET NB 4-3
TO Middlebrook Rd
TO Watkins Mill Rd
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
PROPOSED WATKINS MILL RD INTERCHANGE
100′ 0 100′
SCALE: 1″=100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 4
January 2017
NB 4-2



LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

100′ 0 100′

SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 4

January 2017 | NB 4-3

LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 4

January 2017 | NB 4-4

LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

100′ 0 100′

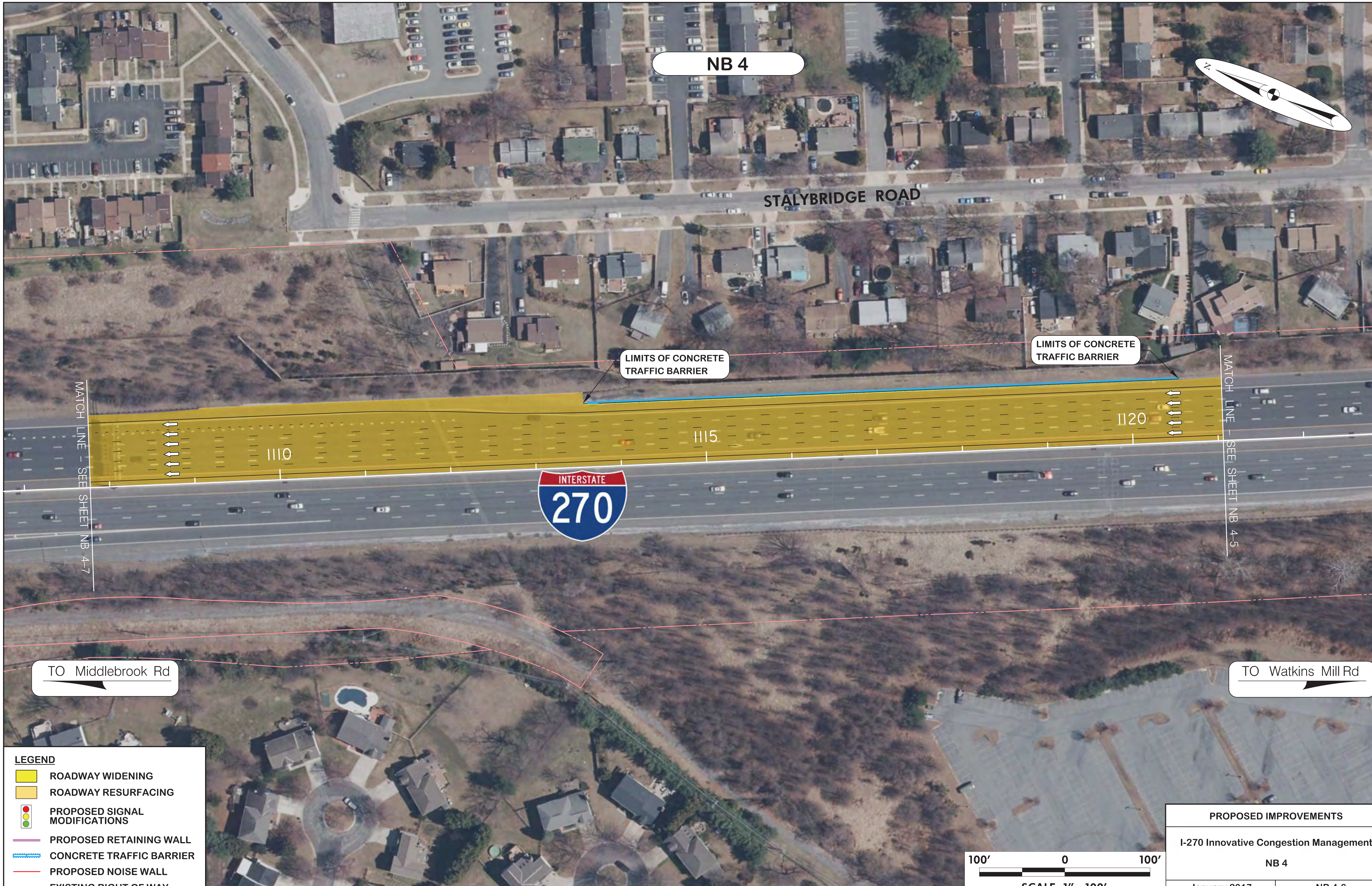
SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 4

January 2017 | NB 4-5



PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 4

January 2017 | NB 4-6

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 4

January 2017 | NB 4-7


NB 5
NB 5 - Widen in median to extend 3rd lane north of MD 121 to Comus Rd bridge
LIMIT OF WORK
STA. 834+04
MATCH LINE - SEE SHEET NB 5-2
820
825
830
835
INTERSTATE
270
WHELAN LANE
TO MD 109
TO MD 121
Montgomery County Correctional Facility
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
100′
0
100′
SCALE: 1″=100′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
NB 5
January 2017
NB 5-1

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 5

January 2017 | NB 5-2

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 5

January 2017 | NB 5-3

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

NB 7

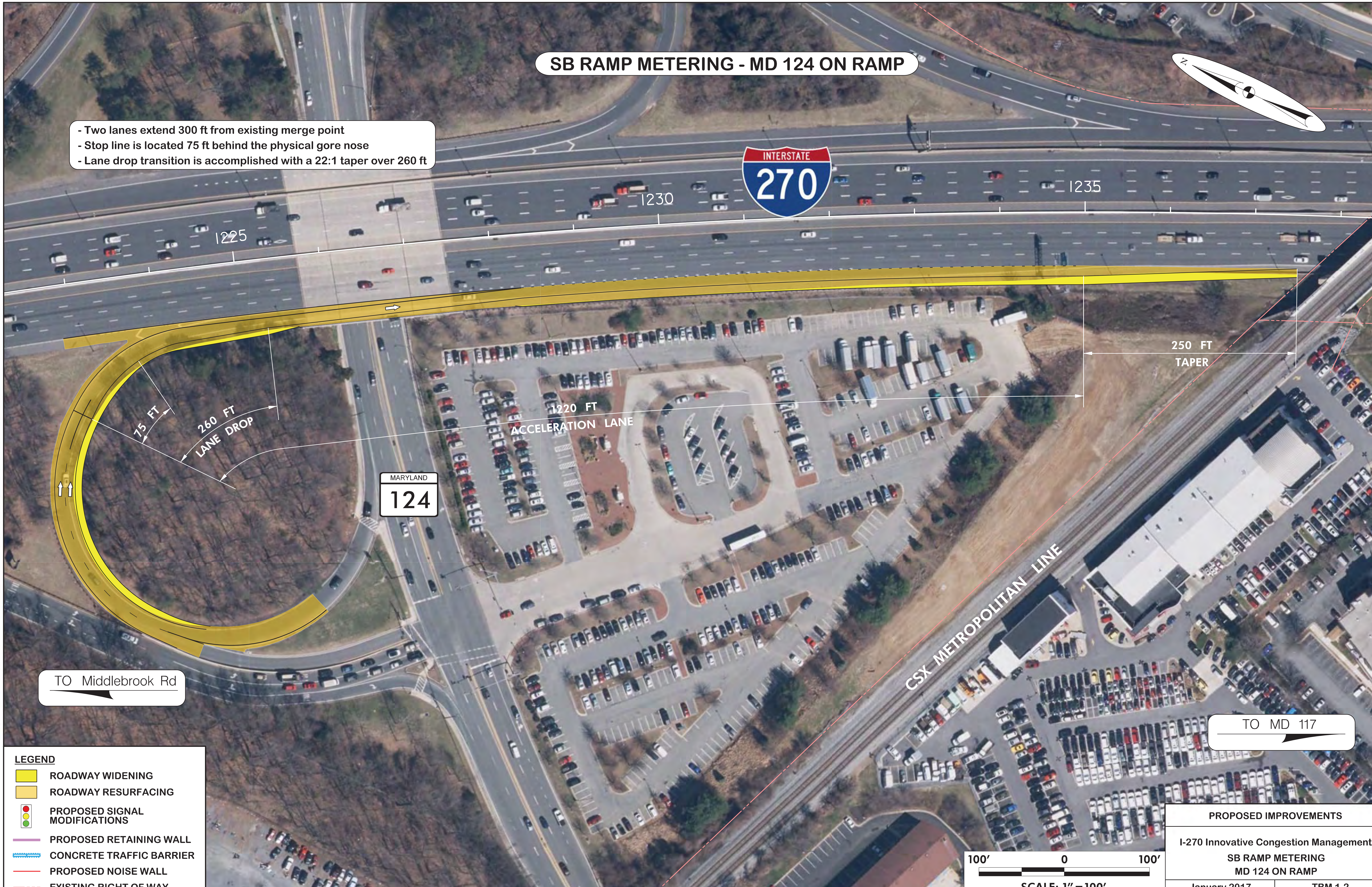
January 2017 | NB 7-1

SB RAMP METERING - MIDDLEBROOK RD ON RAMP

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management
SB RAMP METERING
MIDDLEBROOK RD ON RAMP

January 2017 | TBM 1-1



PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management

SB RAMP METERING

MD 124 ON RAMP

January 2017	TBM 1-2

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management
SB RAMP METERING
MD 117 ON RAMP

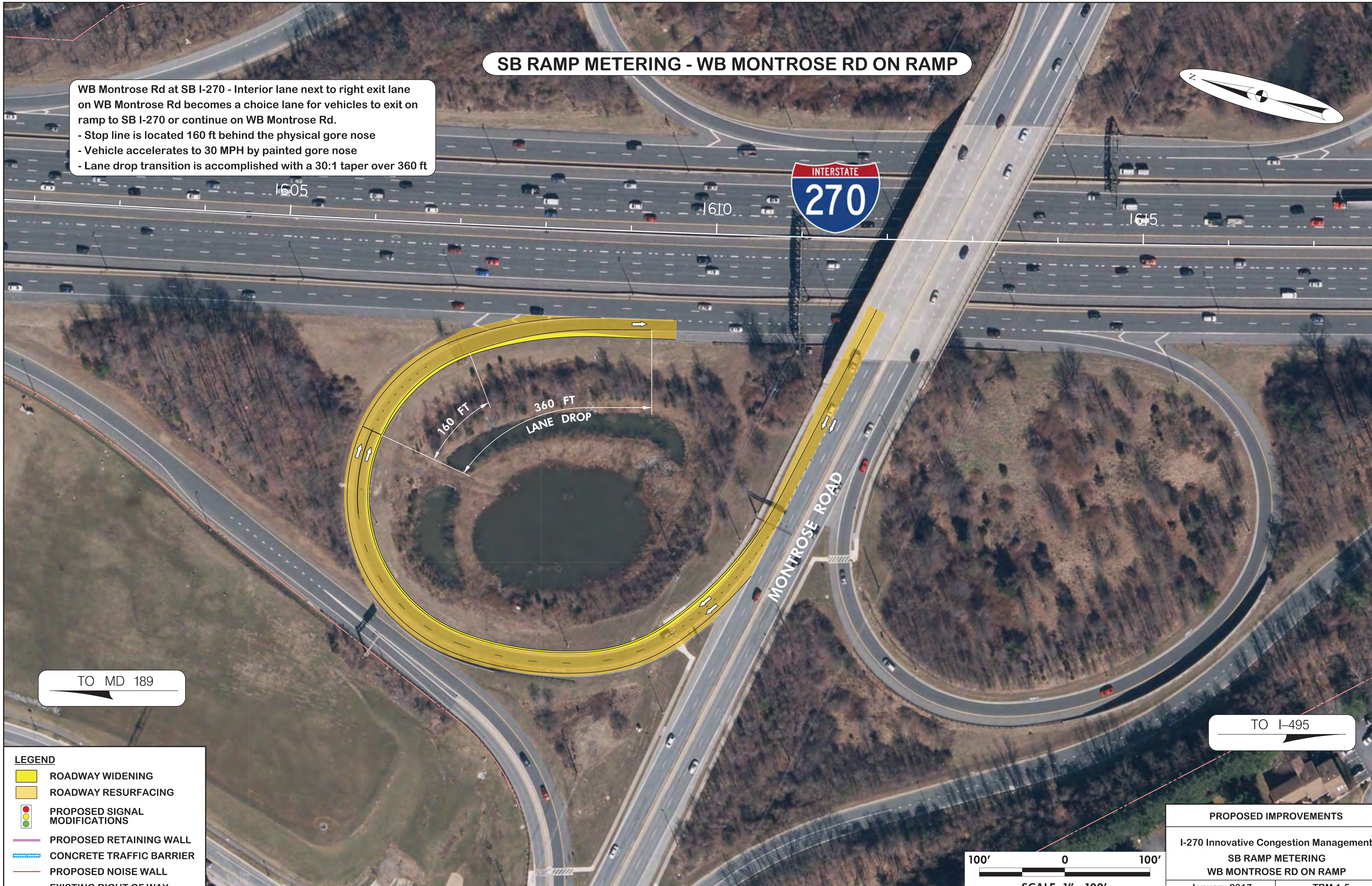
January 2017 | TBM 1-3

PROPOSED IMPROVEMENTS	
I-270 Innovative Congestion Management SB RAMP METERING EB MD 28 ON RAMP	
January 2017	TBM 1-4

SB RAMP METERING - WB MONTROSE RD ON RAMP

WB Montrose Rd at SB I-270 - Interior lane next to right exit lane on WB Montrose Rd becomes a choice lane for vehicles to exit on ramp to SB I-270 or continue on WB Montrose Rd.

- Stop line is located 160 ft behind the physical gore nose
- Vehicle accelerates to 30 MPH by painted gore nose
- Lane drop transition is accomplished with a 30:1 taper over 360 ft



LEGEND

- ROADWAY WIDENING
- ROADWAY RESURFACING
- PROPOSED SIGNAL MODIFICATIONS
- PROPOSED RETAINING WALL
- CONCRETE TRAFFIC BARRIER
- PROPOSED NOISE WALL
- EXISTING RIGHT OF WAY

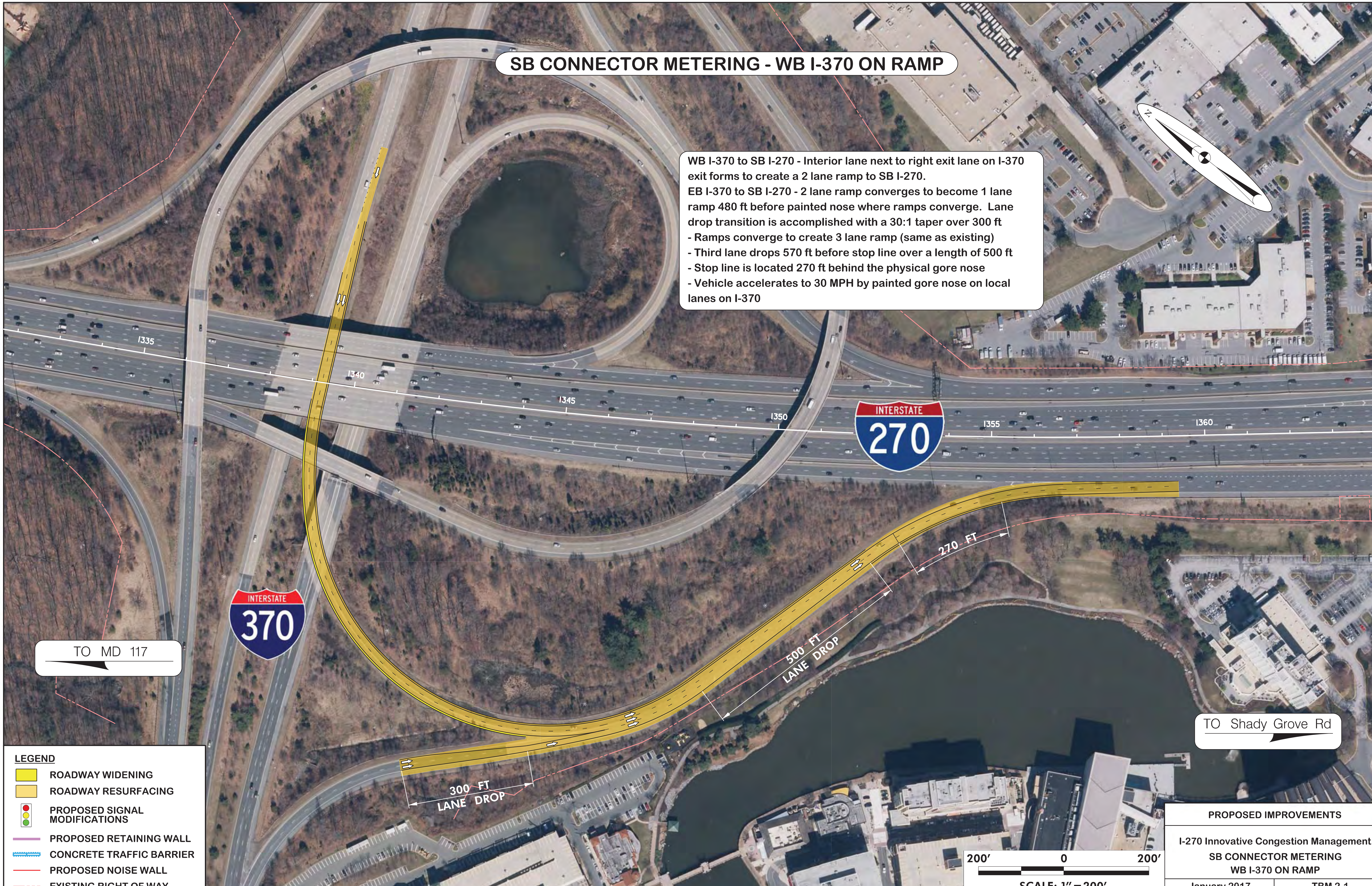
100′ 0 100′

SCALE: 1″ = 100′

PROPOSED IMPROVEMENTS

I-270 Innovative Congestion Management
SB RAMP METERING
WB MONTROSE RD ON RAMP

January 2017	TBM 1-5


SB CONNECTOR METERING - WB I-370 ON RAMP
WB I-370 to SB I-270 - Interior lane next to right exit lane on I-370 exit forms to create a 2 lane ramp to SB I-270.
EB I-370 to SB I-270 - 2 lane ramp converges to become 1 lane ramp 480 ft before painted nose where ramps converge. Lane drop transition is accomplished with a 30:1 taper over 300 ft
- Ramps converge to create 3 lane ramp (same as existing)
- Third lane drops 570 ft before stop line over a length of 500 ft
- Stop line is located 270 ft behind the physical gore nose
- Vehicle accelerates to 30 MPH by painted gore nose on local lanes on I-370
INTERSTATE 270
INTERSTATE 370
I335
I340
I345
I350
I355
I360
270 FT
500 FT LANE DROP
300 FT LANE DROP
TO MD 117
TO Shady Grove Rd
N
LEGEND
ROADWAY WIDENING
ROADWAY RESURFACING
PROPOSED SIGNAL MODIFICATIONS
PROPOSED RETAINING WALL
CONCRETE TRAFFIC BARRIER
PROPOSED NOISE WALL
EXISTING RIGHT OF WAY
200′ 0 200′
SCALE: 1″ = 200′
PROPOSED IMPROVEMENTS
I-270 Innovative Congestion Management
SB CONNECTOR METERING
WB I-370 ON RAMP
January 2017
TBM 2-1

Submitted to:

State Highway Administration
Maryland Department of Transportation

Appendix D

INTERSTATE 270

Pavement Analysis Summary

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

D Appendix D: Pavement Analysis Summary

Pavement Analysis

The CGI Team referenced the as-built plans, pavement cores, and borings provided by SHA to determine the existing pavement design throughout the length of I-270. An analysis of the existing shoulders, given existing and future traffic volumes and proposed lane configurations, was performed to determine:

(1) If the existing shoulder pavement sections could support full-time traffic loading;
(2) The design life of the existing pavement in the shoulders with full-time traffic loading; and
(3) The recommended design for all new or reconstructed pavement along I-270.

As noted in Section 4, this analysis revealed that in all locations where we are proposing to reconfigure the roadway, the existing shoulders are sufficient to support full-time traffic loading. Our analysis also revealed:

- In the locations of these improvements, the existing shoulder pavement sections is not considered to be “full-depth” and as such would not be expected to perform as well as the existing mainline pavement.
- Once under full-time traffic loading, these existing shoulders are anticipated to have a design life of approximately 15 years before major rehabilitation would be needed. This is approximately 10 years less than the anticipated life of the adjacent mainline pavement.
- The recommended design for new or reconstructed pavement sections, based on a 25-year design life, consists of 2 inches surface course HMA, 15 inches base course HMA, and 18 inches GAB.

The supporting documentation for our pavement analysis is provided in the following pages.

RK&K
81 Mosher Street
Baltimore, Maryland 21217

GEOTECHNICAL QUALITY CONTROL SIGN OFF SHEET

Project Name: I-270

Commission Number: P1605-001

Client Name: SHA

Document Title: Pavement Answers

Document Type: (Check One)
- ☐ Proposal
- ☐ Report/Memo
- ☒ Calculations
- ☐ Boring Logs
- ☐ Specification
- ☐ Other: ______

Project Milestone: ______ **Due Date:** ______

This is to certify that I was the originator of this work product, and that I have carefully checked my work prior to passing it on for Quality Control checking.

Printed Name: Bradley Wright

Signature: [signature] **Date:** 11/4/16

	Print Name	Signature	Date
☑ Checked:	Scott Berkheimer	[signature]	11/7/16
☑ Corrected:	Bradley Wright	[signature]	11/7/16
☑ Checked:	Scott Berkheimer	[signature]	11/8/16
☐ Corrected:			
☐ Checked:			
☑ Project Engr:	Scott Berkheimer	[signature]	11/8/16
☐ PM/Manager:			

RK&K
81 Mosher Street
Baltimore, Maryland 21217

GEOTECHNICAL CALCULATION QUALITY CONTROL CHECKLIST

Project: I-270 **Comm. No:** P1605-001

Title of Calculation Set: Pavement Answer

RK&K Project Manager: ______________ **Coordinating Discipline POC:** ______________

Calculations Prepared By: BW **Design Method/Code:** ______________

File Path on Network: \\BALSRV01\v5\Mktg\Submissions\00-2016_SUBMISSIONS\1-Current Proposals\P1605-001 - MDOT I-270 DB\Geotech

Subsurface Characterization Approved By: ______________

Initial Calculations: Signature of Originator: [signature] Date: 11/4/16

- ☒ Geotech Quality Control Sign Off Sheet is provided.
- ☒ Calculations are neat, legible and understandable.
- ☒ Variable inputs are highlighted and check confirmations are clearly marked in calculation spreadsheets.
- ☒ Table of Contents is provided.
- ☒ Heading on each page filled out, including computer input and output.
- ☒ The first page contains purpose of the calculation.
- ☒ References for design criteria, data, methods, formulas and computer program names and version numbers are given, and included in appendices as necessary.
- ☒ All assumptions are listed, explained, and those needed to be verified later are flagged.
- ☒ All input by others is attached and includes originator, date provided. (i.e. Structures loads, concrete/steel properties, etc.)
- ☒ Can the analytical steps involved be followed independent of the originator?
- ☒ Do the calculations agree with the other inter-department / project documents?
- ☒ Footer with file path/tab name and print date is provided on calculation spreadsheets.
- ☐ Detailed CAD ready sketches are provided that clearly depict the design requirements.
- ☒ Calculation Summary with recommendations included in front of calculation set.
- ☒ All calculations are checked and each calculation sheet is initialed by the originator before giving to the checker.

Finalized Calculations: Signature of Originator: [signature] Date: 11/8/16

- ☑ All pages are numbered sequentially and cross-references are complete and accurate.
- ☑ All calculations are checked and each calculation sheet initialed by the checker.
- ☑ Calculation set reviewed by Project Manager.
- ☐ Has this calculation been superseded? Reference new calculation, if applicable.

RK&K

Subject I-270 Page 1 of 13
Pavement Answers Cm. No. P1605-001
Prepared By BW Date 11/4/16 Checked By SAB Date 11/8/16

~~Objective~~ Answer the follow questions:

#1) What shoulder segments have full depth pavement sections?
#2) What is a normal pavement section in this area?
#3) How long will the shoulders last if used as a travel lane?

TABLE of CONTENTS

SUMMARY

Q1)

MEDIAN SHOULDER
- STA 970+00 to STA 1037+00
- STA 1698+00 WB to STA 1720+00
- STA 1713+00 EB
- STA 1742+00 to STA 1805+00 EB
- STA 1812+00 WB

OUTSIDE SHOULDER
- STA 970+00 to STA 1050+00
- STA 1050+00 to 1106+00 NB

Q2) SN = 9.04, Required SN = 8.95
- 2" Surface Course HMA
- 15" Base Course HMA
- 18" GAB Subbase

Q3) 15 years

RK&K	Subject: I-270 — Pavement Answers
Page 1 of 15	Cm. No. P1605-001
Prepared By: BAW, Date 11/4/16	Checked By: SAB, Date 11/8/16

What outside shoulder segments have full depth pavement sections?

STA 970+00 to 1050+00
STA 1050+00 to 1106+00 NB shoulder

Does this include outside & median shoulders? [illegible]

What median shoulder segments have full depth pavement section?

STA 970+00 to 1037+00

STA 1698+00 WB / 1713+00 EB to 1720+00

STA 1742+00 to 1805+00 EB / 1812+00 WB

Bd 11/8/16

2

SAB 11/8/16

Map Location	Station Limits From	Station Limits To	Location	Full Depth Shoulder?	Shoulder Pavement Section	Reference	Full Depth Section	Shoulder Surface Course Thickness	Struct. Coef.	Shoulder Base Course Thickness	Struct. Coef.	Shoulder Subbase Thickness	Struct. Coef.	Structural Number
1	970+00	1037+00	North of MD 118 to north of Father Hurley Blvd	Both outside and median	Median and Outside: 2" Surface, 11.5" HMA Base, 9" GAB	As Built M401-511-372	2" Surface, 11.5" Base, 9" GAB							
2	1037+00	1050+00	Just north of MD 118	Outside but not median	Outside: 2' Surface, 11.5" HMA Base 9" GAB	As Built M401-511-372	2" Surface, 11.5" Base, 9" GAB	2	0.38	11.5	0.36	9	0.11	5.89
3	1050+00	1106+00	Middlebrook Rd to north of MD 118	NB outside shoulder	Outside: 2" Surface, 11.5" HMA Base, 9" GAB	As Built M401-511-372	2" Surface, 11.5" Base, 9" GAB							
	1078+00	1087+00	Just north of Middlebrook Rd	SB outside shoulder	Outside: 1.5" Surface, 5" HMA Base, 14" GAB	As Built M401-506-372	1.5" Surface, 10" Base, 9" GAB	1.5	0.38	10	0.36	9	0.11	5.16
4	1106+00	1163+00	Game Preserve Rd to Middlebrook Rd	Outside but not median	Outside: 1.5" Surface, 5" HMA Base, 14" GAB	As Built M401-506-372	1.5" Surface, 10" Base, 9" GAB	1.5	0.38	10	0.36	9	0.11	5.16
5	1156+00	1241+00	MD 124 to Game Preserve Rd	Outside and CD shoulders but not median	Outside: 3" Surface, 6" HMA Base, 16" GAB	As Built M401-501-372	3" Surface, 13" Base, 9" GAB	3	0.38	6	0.36	16	0.11	5.06
					CDR: 3" Surface, 2" Base, 15" GAB		CDR: 3" Surface, 8" Base, 9" GAB	3	0.38	2	0.36	15	0.11	3.51
	1241+00	1375+00	North of Shady Grove Rd to MD 124	No full depth shoulders	(Inconclusive, limited details)	As Built M485-005-320								
6	1494+00	1535+00	MD 189 to MD 28	Outside, median, and CD shoulders	Median and Outside: 6" surface, 3" HMA base, 16" GAB	As Built M278-501-372	7.25" Surface, 8.5" Base, 9" GAB	6	0.38	3	0.36	16	0.11	5.12
					CDR: 3" surface, 2" HMA base, 15" GAB		3" Surface, 5" Base, 9" GAB	3	0.38	2	0.36	15	0.11	3.51
7	1535+00	1597+00	Montrose Rd to MD 189	Outside and CD shoulders but not median	Outside: 6" surface, 3" HMA base, 16" GAB	As Built M278-501-372	7.25" Surface, 8.5" Base, 9" GAB	6	0.38	3	0.36	16	0.11	5.12
					CDR: 3" surface, 2" HMA base, 15" GAB		3" Surface, 8" Base, 9" GAB	3	0.38	2	0.36	15	0.11	3.51
	1589+00	1611+00			Outside and CDR: 3" Surface, 6" HMA Base, 16" GAB	As Built M401-505-372	3" Surface, 13" Base, 9" GAB							
8	1611+00	1651+00	Y-split to Montrose Rd	Outside, median, and CD shoulders	Median, Outside, and CDR: 3" Surface, 6" HMA Base, 16" GAB	As Built M401-505-372	3" Surface, 13" Base, 9" GAB	3	0.38	6	0.36	16	0.11	5.06
	1651+00	1693+00 NB 1696+00 SB		All except NB outside	Median and Outside: 3" Surface, 6" HMA Base, 16" GAB	As Built M401-505-372	3" Surface, 13" Base, 9" GAB							
9	1698+00 WB 1713+00 EB	1720+00	East Spur: MD 187 to Y-split	Median but not outside	Median: 2" surface, 7" HMA base, 18" GAB	As Built M401-508-372	2" Surface, 7" Base, 18" GAB	2	0.38	7	0.36	18	0.11	5.26
	1720+00	1742+00		Both outside and median	Median and Outside: 2" surface, 10.5" HMA base, 9" GAB	As Built M401-508-372	Not shown in as builts	2	0.38	10.5	0.36	9	0.11	5.53
10	1742+00	1805+00 EB 1812+00 WB	East Spur: I-495 to MD 187	Median but not outside	Median: 2" surface, 7" HMA base, 18" GAB	As Built M401-508-372	2" Surface, 7" Base, 18" GAB	2	0.38	7	0.36	18	0.11	5.26
11	2000+00	2061+00	West Spur: Democracy Blvd to Y-split	Full depth median shoulder, outside shoulder varies	Median and Outside: 2" Surface, 10" HMA Base, 15" GAB	As Built M401-513-372	Not shown in as builts	2	0.38	10	0.36	15	0.11	6.01
12	2061+00	2105+00	West Spur: I-495 to Democracy Blvd	No full depth shoulder		As Built M485-017-320								

Highlight Station limits that are full depth so they stand out. Use different colors for full depth outside/median/both if necessary.

☆ I think these were considered full depth by planning because they had details w/ surface, base and subbase but when compared to the existing widened roadway these areas have lower SN's

= Full Depth outside Shoulder = Full Depth Median = Both Full Depth outside Shoulder and Median

What is a normal pavement section in this area?

- Determine the required Structural Number (SN) based on highest concentrated ADT
  - Highest Concentrated ADT determined from ADT spreadsheet (p. 4)
  - Design inputs determined using SHA Pavement and Geotech Design guide and Table 6.10 (p. 5-8)
  - A CBR of 3 was assumed, as it is general practice to improve unsuitable pavement subgrade to at least a CBR of 3. Therefore, a soil resilient modulus of 4.5 ksi was used for analysis
  - The Design EAL - E18's was determined using an AASHTO Pavement Design spreadsheet (p. 9)
  - The parameters above were input into the AASHTO 1986 pavement design program (p. 10)
- The analysis resulted in a required SN = 8.95

The full depth pavement section below satisfies the required SN (Note: Desired Structural Coefficient from SHA Pavement and Geotechnical Design Guide 4.07, see p 12+13)

2" Surface HMA
15" Base HMA
18" GAB Subbase

SN = 9.04

BW 11/8/16 4

SNB 11/8/16

Station Limits From	Station Limits To	Location	2015 ADT Volumes Southbound	% of total	2015 ADT Volumes Northbound	% of total	2015 Total	2040 ADT Volumes Southbound	% of total	2040 ADT Volumes Northbound	% of total	2040 Total	Existing # of lanes Southbound	Existing Northbound	Existing Total	Proposed # of lanes Southbound	Proposed Northbound	Proposed Total	Total 2015 ADT/# of lanes	Total 2040 ADT/# of lanes
100+00	190+00	I-70 to MD 85	55,475	0.49	57,000	0.51	112,475	66,550	0.49	68,050	0.51	134,600	3	4	7	4	5	9	16068	14956
190+00	460+00	MD 85 to MD 80	39,900	0.46	46,800	0.54	86,700	46,550	0.46	54,650	0.54	101,200	2	2	4	3	3	6	21675	16867
460+00	660+00	MD 80 to MD 109	41,050	0.47	45,500	0.53	86,550	48,000	0.48	52,975	0.52	100,975	2	2	4	3	3	6	21638	16829
660+00	860+00	MD 109 to MD 121	43,050	0.48	47,200	0.52	90,250	50,800	0.48	55,375	0.52	106,175	2	2	4	3	3	6	22563	17696
860+00	1000+00	MD 121 to Father Hurley Blvd	48,750	0.48	51,900	0.52	100,650	60,100	0.48	63,975	0.52	124,075	3	3	6	4	4	8	16775	15509
1000+00	1055+00	Father Hurley Blvd to MD 118	56,075	0.47	62,925	0.53	119,000	65,900	0.47	74,125	0.53	140,025	4	4	8	5	5	10	14875	14003
1050+00	1095+00	MD 118 to Middlebrook Rd	61,675	0.47	68,875	0.53	130,550	72,350	0.47	81,125	0.53	153,475	3	4	7	4	5	9	18650	17053
1095+00	1225+00	Middlebrook Rd to MD 124	77,500	0.48	83,375	0.52	160,875	N/A -- See new segments below					4	4	8	5	5	10	20109	N/A
1095+00	1190+00	Middlebrook Rd to Watkins Mill Rd	N/A -- New Segment					89,350	0.48	97,075	0.52	186,425	4	4	8	5	5	10		18643
1190+00	1225+00	Watkins Mill Rd to MD-124						74,100	0.43	Express 71,875 Local 25,000	0.57	170,975	4	5	9	5	6	11		15543
1225+00	1260+00	MD 124 to MD 117	83,000	0.48	Express 69,000 Local 19,775	0.52	171,775	92,900	0.48	Express 71,875 Local 29,550	0.52	194,325	4	Express 4 Local 2	10	5	Express 5 Local 3	13	17178	14948
1260+00	1340+00	MD 117 to I-370	100,775	0.49	Express 67,075 Local 38,400	0.51	206,250	111,900	0.48	Express 73,575 Local 45,750	0.52	231,225	5	Express 5 Local 2	12	6	Express 6 Local 3	15	17188	15415
1340+00	1390+00	I-370 to Shady Grove Rd	Express 59,575 Local 46,475	0.51	Express 60,600 Local 43,100	0.49	209,750	Express 64,450 Local 52,400	0.50	Express 66,475 Local 48,350	0.50	231,675	Express 4 Local 2	Express 5 Local 2	13	Express 5 Local 3	Express 6 Local 3	17	16135	13628
1390+00	1490+00	Shady Grove Rd to MD 28	Express 76,150 Local 31,125	0.49	Express 72,575 Local 39,150	0.51	219,000	Express 83,450 Local 33,450	0.49	Express 81,425 Local 42,250	0.51	240,575	Express 4 Local 2	Express 4 Local 2	12	Express 5 Local 3	Express 5 Local 3	16	18250	15036
1490+00	1540+00	MD 28 to MD 189	Express 72,400 Local 50,050	0.50	Express 68,625 Local 56,125	0.50	247,200	Express 79,250 Local 54,500	0.49	Express 76,875 Local 60,550	0.51	271,175	Express 4 Local 2	Express 4 Local 2	12	Express 5 Local 3	Express 5 Local 3	16	20600	16948
1540+00	1615+00	MD 189 to Montrose Rd	Express 72,400 Local 50,500	0.49	Express 81,550 Local 44,900	0.51	249,350	Express 79,250 Local 55,000	0.49	Express 91,175 Local 48,050	0.51	273,475	Express 4 Local 2	Express 4 Local 2	12	Express 5 Local 3	Express 5 Local 3	16	20779	17092
1615+00	1690+00	Montrose Rd to Y-split	121,925	0.48	129,625	0.52	251,550 Δ	132,600	0.48	142,425	0.52	275,025 Δ	6	6	12	7	7	14	20963	19645
1690+00	1750+00	East Spur: Y-split to MD 187	59,325	0.50	58,400	0.50	117,725	64,350	0.50	64,075	0.50	128,425	3	3	6	4	4	8	19621	16053
1750+00	1830+00	East Spur: MD 187 to I-495	54,725	0.49	56,700	0.51	111,425	58,850	0.49	62,425	0.51	121,275	3	3	6	4	4	8	18571	15159
2000+00	2055+00	West Spur: Y-split to Democracy Blvd	62,600	0.47	71,225	0.53	133,825	68,250	0.47	78,350	0.53	146,600	4	4	8	5	5	10	16728	14660
2055+00	2095+00	West Spur: Democracy Blvd to I-495	73,325	0.52	68,925	0.48	142,250 *	79,900	0.51	75,600	0.49	155,500 *	3	3	6	4	4	8	23708	19438

[black box] = New Segment

[red box] = Highest Total ADT per # of lanes

[green box] = Lowest Total ADT per # of lanes

* Used for design for question #2

Δ Used to determine growth rate for question #3 of the existing roadway, both structurally and functionally. New pavement design does not take into account any of the existing conditions of the pavement other than geotechnical and drainage conditions because it is a new design.

It is the design engineer's responsibility to use both design processes concurrently where needed and take care to monitor that both designs are agreeable with one another for design and for construction related reasons.

9.12.03.01 *Preliminary Steps*

Step 1. Conduct the steps as detailed in Preliminary Procedures.

Step 2. Conduct the steps as detailed in Testing & Data Collection.

Step 3. Conduct the steps as detailed in Analysis Procedures.

9.12.03.02 *Design Inputs*

Click to go to Concrete Overlay Design

Calculate the required structural capacity (SC_f) for future traffic for each new pavement section. SC_f is obtained from Figures 3.1 and 3.7 and the nomograph equations on page II-32 and II-45 in the "AASHTO Guide for Design of Pavement Structures", for flexible and rigid pavement sections respectively. The following design inputs are required in order to use the nomograph or equation on pages II-32 and II-45:

- Initial Serviceability: 4.2
- Terminal Serviceability:

Interstates	3.0
Other Expressways and Principal Arterials	2.9
Minor Arterials	2.8
Collectors and Locals	2.6

- Reliability:

Interstates	95
Other Expressways and Principal Arterials	90
Minor Arterials	85
Collectors and Locals	80

- Standard Deviation: 0.49 for Flexible, 0.39 for Rigid
- Design ESALs: Refer to Traffic Analysis.
- Design Subgrade Resilient Modulus (M_r) – Obtained from geotechnical soils investigation for new pavement designs. Materials and Typical Design Properties includes default values for various types of subgrade materials.
- Modulus of Subgrade Reaction (k) – Obtained from geotechnical soils investigation for new pavement designs. Materials and Typical Design Properties includes default values for various types of subgrade materials. The modulus of subgrade reaction can

Functional Class	RSL = 50				
	IRI	SCI	FCI	Rut	FN
1	45	100	100	0.07	55
2	50	100	100	0.07	50
6	55	100	100	0.07	50
7	60	100	100	0.07	50
8	70	100	100	0.07	50
9	70	100	100	0.07	45
11	45	100	100	0.07	55
12	50	100	100	0.07	50
14	55	100	100	0.07	50
16	60	100	100	0.07	50
17	70	100	100	0.07	50
19	70	100	100	0.07	45

To determine the RSL for other values, interpolate between the values given in the preceding charts.

Note: the procedure to determine the actual fix life (in calendar years, from the initial to the final performance targets), using a combination of MEPDG and performance data is detailed in Pavement Preservation & Rehabilitation Design. This value will be used to compare against the LMY targets required for the Districts for Fund 77 projects.

6.01.01.07 *Traffic Lane Distribution*

Click to go to Traffic Analysis

Use the following table to select the appropriate traffic lane distribution factor based on the number lanes in each (design) direction. Refer to Traffic Analysis Data Collection.

Number of Lanes in Design Direction	Range of Percent of ADTT in Design Lane – New Construction or Right-Side Widening	Desired Percent of ADTT in Design Lane – New Construction or Right-Side Widening
1	100	100
2	80 – 100	90
3	60 – 80	80
4	50 – 75	70
5+	40 – 70	60

Number of Lanes in Design Direction	Range of Percent of ADTT in Design Lane – Left Side Widening	Desired Percent of ADTT in Design Lane – Left Side Widening
2	30 – 50	40
3	10 – 30	20
4+	5 – 15	10

6.01.02 *Shoulder Design*

Click to go to New Pavement Design

The design inputs required for shoulder pavement design vary depending on the existing conditions at the project site, the functional classification of the roadway, and the pavement type. These design inputs follow the same guidelines as those developed by AASHTO, but modified for local conditions. **The design inputs are identical to those for new design with the exception of the truck adjustment factor.**

6.01.02.01 *Truck Adjustment Factor (Shoulder)*

The design ADTT for the pavement design of the shoulder will be based on a percentage of the design ADTT for the mainline roadway. Use the following table to select the appropriate ADTT adjustment factor based on the functional class of the roadway:

Functional Class	Percent of Design ADTT
Interstate	100%
Freeways and Expressways	100%
Principal Arterial – Other	100%
Minor Arterial	10%
Major Collector	10%
Minor Collector	10%
Collector	10%
Local	10%

For pavement design purposes, any auxiliary, acceleration, deceleration and ramp lanes that are directly adjacent to mainline pavement shall be considered to be part of the mainline pavement until those lanes split off at the gore area.

6.01.03 *Temporary/Detour Road Design*

The design inputs required for temporary / detour road pavements vary depending on the existing conditions at the project site, the functional classification of the roadway, the pavement type, and whether the road will be removed or left in service. These design inputs follow the same guidelines as those developed by AASHTO, but modified for local conditions.

TABLE 6.10 DISTRIBUTION OF TRUCK FACTORS FOR DIFFERENT CLASSES OF HIGHWAYS AND VEHICLES IN THE UNITED STATES[a]

	Truck factors											
	Rural systems						Urban systems					
				Collectors								
Vehicle type	Interstate	Other Principal	Minor Arterial	Major	Minor	Range	Interstate	Other Freeways	Other Principal	Minor Arterial	Collectors	Range
Single-unit trucks												
2-axle, 4-tire	0.003	0.003	0.003	0.017	0.003	0.003–0.017	0.002	0.015	0.002	0.006	—	0.006–0.015
2-axle, 6-tire	0.21	0.25	0.28	0.41	0.19	0.19–0.41	0.17	0.13	0.24	0.23	0.13	0.13–0.24
3-axle or more	0.61	0.86	1.06	1.26	0.45	0.45–1.26	0.61	0.74	1.02	0.76	0.72	0.61–1.02
All single units	0.06	0.08	0.08	0.12	0.03	0.03–0.12	0.05	0.06	0.09	0.04	0.16	0.04–0.16
Tractor semitrailers												
4-axle or less	0.62	0.92	0.62	0.37	0.91	0.37–0.91	0.98	0.48	0.71	0.46	0.40	0.40–0.98
5-axle[b]	1.09	1.25	1.05	1.67	1.11	1.05–1.67	1.07	1.17	0.97	0.77	0.63	0.63–1.17
6-axle or more[b]	1.23	1.54	1.04	2.21	1.35	1.04–2.21	1.05	1.19	0.90	0.64	—	0.64–1.19
All multiple units	1.04	1.21	0.97	1.52	1.08	0.97–1.52	1.05	0.96	0.91	0.67	0.53	0.53–1.05
All trucks	0.52	0.38	0.21	0.30	0.12	0.12–0.52	0.39	0.23	0.21	0.07	0.24	0.07–0.39

[a] Compiled from data supplied by the Highway Statistics Division, U.S. Federal Highway Administration.

[b] Including full-trailer combinations in some states.

Source. After AI (1991).

BW 11/7/16
SAB 11/7/16

AASHTO Pavement Design
Assumes CBR = 3
Based on ADT

Project: I-270

Date: 11/7/2016
Revised based on SHA comments

Constr. Year ADT	142,250	Design Period	25 Years
Design ADT	155,500	Directional Distribution	52 48
Est. EAL for Autos	0.06	Lane Distribution -Autos	60 / 40
Est. EAL for Trucks	0.52	Lane Distribution -Trucks	100 / 0
		Truck Traffic	8%

Determine Growth Rate, r, from Traffic Data

Design ADT = Current ADT $(1 + r)^{\text{Design Period}}$ **r = 0.0036**

Growth Factor = $\frac{(1 + r)^{\text{Design Period}} - 1}{r}$ **GF = 26.1**

Calculate Design EAL

Design Traffic = Current ADT * Directional Distribution * Lane Distribution * Growth Factor

Traffic Type	Current ADT	Directional Distribution	Lane Distribution	Growth Factor	Design Traffic	EAL Factor	Design Daily EAL
Autos	130,870	0.52	0.6	26.1	1065721	0.06	63943
Trucks	11380	0.52	1	26.1	154452	0.91	140552
							204,495

Design EAL - E18's = Design Daily EAL X 365 = **74,640,622**

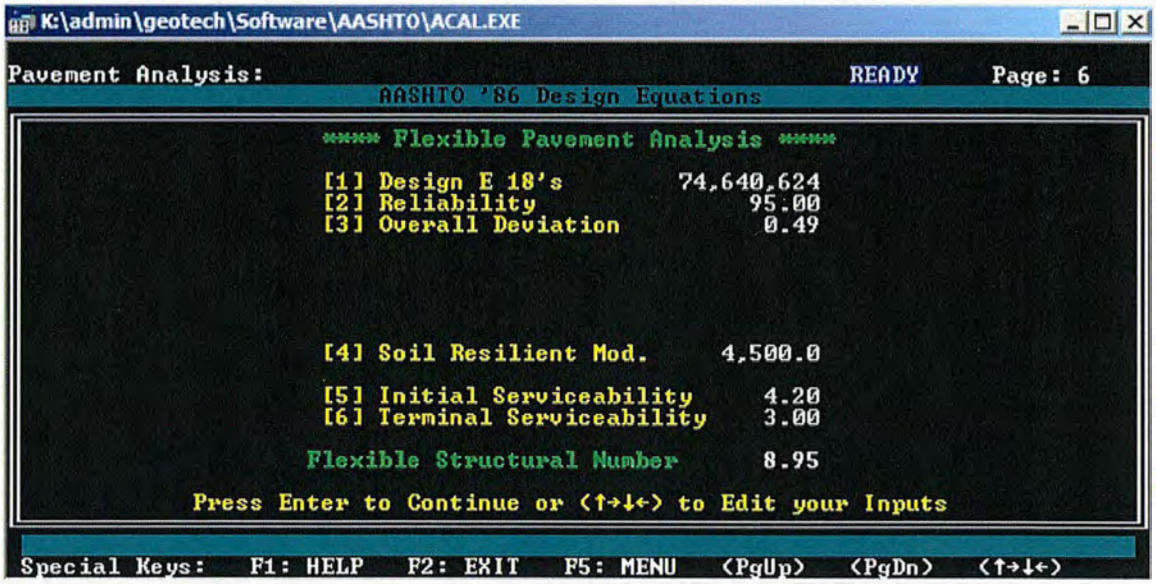
Using AASHTO 1986 Pavement Design Program, develop flexible structural number required: (see p.10)

Design E 18's	74,640,622	
Reliablitity (%)	95	
Overall Deviation	0.49	
Resilient Modulus (psi)	4500	=CBR X 1500
Initial Service	4.2	
Final Service	3	

Req'd Structural Number = **8.95**

BW 11/7/16

SAB 11/7/16



How long will the current shoulder last if used as a ~~traffic~~ lane?

- Previously determined design inputs were used for analysis (p. 5-8)
- The lowest shoulder structural number was determined with SHA Pavement and Geotechnical Design Guide 4.07 (see p. 2, 12, 13)

- The design inputs and structural number were input into the AASHTO 1986 pavement design program and yielded a EAL capacity of 126,900 (p. 14)
- A growth rate was determined by using 2015 and 2040 ADT data $\left[r = \left(\frac{275025}{251550}\right)^{\frac{1}{25}} - 1 \right]$
- An excel spreadsheet was created in order to input design period (which in this case is equal to time until terminal serviceability of 3 is reached) and return EAL (p. 15)
- Through trail and error with the spreadsheet, a design life of 15 years was determined

↑ FOR SHOULDER USE W/O MODIFICATION.

SAY 10-YEARS LESS THAN INTENDED DESIGN LIFE

= Used for design for question #2

= Used to determine structural number for question #3

4.07 DESIGN PROPERTIES FOR PAVEMENT MATERIALS – AASHTO 1993

Click to go to Flexible Pavement for New Design – AASHTO 1993.
Click to go to Overlay Design – Existing Flexible Pavement – AASHTO 1993

The following table presents numerous design parameters for materials commonly used by MDSHA.

Material	Design Use	Structural Coefficient Range for New Material	Desired Structural Coefficient	Min. Lift Thickness	Desired Lift Thickness	Max. Lift Thickness	Structural Coefficient Range After Deterioration	Structural Coefficient for Deteriorated Material	Drainage Coefficient
PCC	Surface	N/A	N/A	6.0"	N/A	14.0"	N/A	N/A	N/A
Break/Crack and Seat PCC	Base	0.20 – 0.35	0.25	6.0"	N/A	14.0"	N/A	N/A	1.0
Rubbilized PCC	Base	0.15 – 0.30	0.20	6.0"	N/A	14.0"	N/A	N/A	1.0
HMA Superpave 4.75 mm	Surface	0.44	0.44	0.5"	0.75"	1.0"	0.3 – 0.44	0.38	1.0
HMA Superpave 9.5 mm Gap Graded	Surface	0.44	0.44	1.0"	1.5"	1.5"	0.3 – 0.44	0.38	1.0
HMA Superpave 9.5 mm	Surface, W/L	0.44	0.44	1.0"	1.5"	2.0"	0.3 – 0.44	0.38	1.0
HMA Superpave 12.5 mm Gap Graded	Surface	0.44	0.44	1.5"	2.0"	2.0"	0.3 – 0.44	0.38	1.0
HMA Superpave 12.5 mm	Surface	0.44	0.44	1.5"	2.0"	3.0"	0.3 – 0.44	0.38	1.0
HMA Superpave 19.0 mm Gap Graded	Surface	0.44	0.44	2.0"	2.5"	2.5"	0.3 – 0.44	0.38	1.0
HMA Superpave 19.0 mm	Base, Surface	0.40	0.40	2.0"	3.0"	4.0"	0.3 – 0.40	0.36	1.0
HMA Superpave 25.0 mm	Base	0.40	0.40	3.0"	4.0"	5.0"	0.3 – 0.40	0.36	1.0
HMA Superpave 37.5 mm	Base	0.38	0.38	4.0"	5.0"	6.0"	0.3 – 0.38	0.34	1.0
Asphalt Treated Aggregate Base	Base	0.10 – 0.25	0.20	4.0"	6.0"	6.0"	0.10 – 0.25	0.20	1.0
Penetration Macadam	Base	0.10 – 0.25	0.20	3.0"	6.0"	8.0"	0.10 – 0.25	0.20	1.0
Macadam	Base	0.10 – 0.20	0.15	3.0"	6.0"	8.0"	0.10 – 0.20	0.15	*
Soil Cement Base Course	Base	0.15 – 0.25	0.20	4.0"	6.0"	6.0"	0.15 – 0.25	0.20	1.0

Material	Design Use	Structural Coefficient Range for New Material	Desired Structural Coefficient	Min. Lift Thickness	Desired Lift Thickness	Max. Lift Thickness	Structural Coefficient Range After Deterioration	Structural Coefficient for Deteriorated Material	Drainage Coefficient
Cement Modified Subgrade*	Subbase	0.05 – 0.07	0.06	4.0"	6.0"	8.0"	0.05 – 0.07	0.06	1.0
Graded Aggregate Base, GAB	Base	0.08 – 0.14	0.12	3.0"	6.0"	6.0"	0.08 – 0.14	0.11	*
Bank Run Gravel	Base	0.06 – 0.12	0.10	3.0"	6.0"	6.0"	0.06 – 0.12	0.10	*
GSS w/ GAB	Base	0.05 – 0.10	0.08	3.0"	6.0"	12.0"	0.05 – 0.10	0.08	*
Soil Contaminated Aggregate Base	Base	0.05 – 0.10	0.08	3.0"	6.0"	6.0"	0.05 – 0.10	0.08	*
Common Borrow	Subbase	0.03 – 0.06	0.04	3.0"	6.0"	8.0"	0.03 – 0.06	0.04	*
Select Borrow	Subbase	0.04 – 0.08	0.05	3.0"	6.0"	8.0"	0.04 – 0.08	0.05	*
Capping Borrow	Subbase	0.04 – 0.08	0.06	3.0"	6.0"	8.0"	0.04 – 0.08	0.06	*
Modified Borrow	Subbase	0.05 – 0.09	0.07	3.0"	6.0"	8.0"	0.05 – 0.09	0.07	*

* MDSHA has adopted an approach to adjust the structural coefficient of unbound base rather than introduce a drainage coefficient. The structural coefficient of the unbound layer is affected by the thickness of the overlying material and degree of saturation of the base layer. This section further describes this relationship between degree of saturation and the effect on structural coefficient.

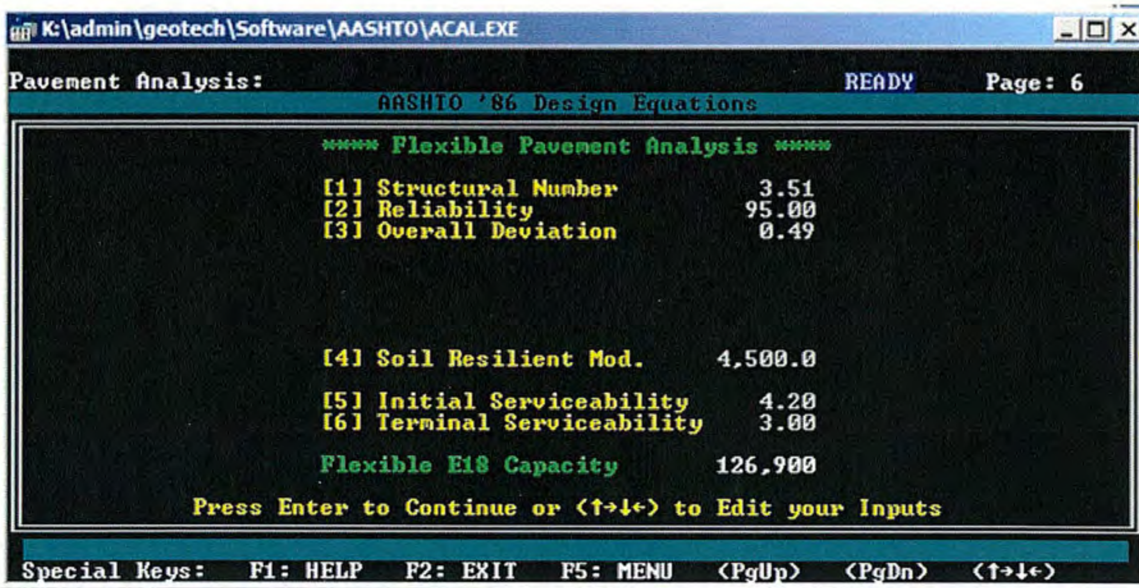
= Used for design for question #2

= Used to determine structural number for question #3

14

BW 11/7/16

SAB 11/7/16



BW 11/7/16

CAB 11/7/16

AASHTO Pavement Design
Assumes CBR = 3
Based on ADT

Project: **I-270**
Design: **Design Period analysis**
Date: **11/7/2016**

~~Revised based on SHA comments~~

Constr. Year ADT	142,250
Design ADT	150,487
Est. EAL for Autos	0.06
Est. EAL for Trucks	0.52

Design Period	15.773	Years
Directional Distribution	52	48
Lane Distribution -Autos	60 /	40
Lane Distribution -Trucks	100 /	0
Truck Traffic	8%	

Determine Growth Rate, r, from Traffic Data

Design ADT = Current ADT $(1 + r)^{\text{Design Period}}$ **r =** 0.003575

Growth Factor = $\frac{(1 + r)^{\text{Design Period}} - 1}{r}$ **GF =** 16.19676

Calculate Design EAL

Design Traffic = Current ADT * Directional Distribution * Lane Distribution * Growth Factor

Traffic Type	Current ADT	Directional Distribution	Lane Distribution	Growth Factor	Design Traffic	EAL Factor	Design Daily EAL
Autos	130,870	0.52	0.6	16.2	661337	0.06	39680
Trucks	11380	0.52	1	16.2	95846	0.91	87220
							126,900

Submitted to:

State Highway Administration

Maryland Department of Transportation

Appendix E

Model Calibration Memorandum

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

Appendix E: Model Calibration Memorandum

Purpose

The purpose of this memorandum is to provide supporting information for developing the VISSIM traffic models for 2015 and 2040 build design years related to the I-270 Innovative Congestion Management Design-Build proposal, including the necessary revisions to the 2015 existing and 2040 no-build base models. The memorandum consists of the following four (4) parts:

- The model parameters for the proposed VISSIM improvement concepts;
- Discussion of the truck weigh stations south of MD 109, which were not modeled in the VISSIM models provided by SHA, and the assumptions used to model the virtual weigh station improvement;
- Revisions for the 2040 No-Build base models that SHA provided to fix northbound discrepancies at Watkins Mill Road and match the geometry shown in the design plans provided as part of the RFP files; and
- Methodologies and assumptions to develop Ramp Metering Control.

Note that the Active Traffic Management improvement was not modeled in the VISSIM build files, so the mobility benefits could potentially be greater than those discussed in Section 2 of the proposal.

Model Parameters

In developing the proposed improvement concepts, calibration parameters, such as vehicle inputs, vehicle routes, driving behavior, link behavior type, lane change distance, speed distributions and decisions were not modified from the SHA-provided VISSIM models. If any proposed design changed a segment within the VISSIM model, engineering judgement was used to incorporate the proper calibration adjustment. The detailed VISSIM model parameters and assumptions are listed below in Table E-1.

Table E-1. VISSIM Model Parameters and Assumptions

Scenarios	Existing and 2040 No Build AM	Existing and 2040 No Build PM	Alternative AM	Alternative PM
VISSIM Version	Version 7.00-13 32-bit			
Simulation Resolution	8 time steps/second			
Seeding Time (seconds)	0 – 5400	0 – 1800	0 – 5400	0 – 1800
Analysis Period (seconds)	5400 – 9000	1800 – 5400	5400 – 9000	1800 – 5400
Recording Time	3600 seconds			
Number of Simulation Runs	5			
Random Seeds	Starting seed 8, with an increment of 27			
Driver Behavior	No changes to the VISSIM calibrated model		If proposed design changes segment, use engineering judgment to roll back calibration adjustment	
Signal Controller Frequency	1			
Vehicle Input	Exact Volume			

Truck Weigh Stations

In reviewing the I-270 VISSIM files provided by SHA, it was observed that the models did not account for the utilization of the truck weigh stations located approximately one mile to the south of MD 109 in both the northbound and southbound directions. The AM and PM simulations for both 2015 and 2040 revealed that all trucks by-passed the truck weigh station.

While the existing and no-build concepts were not modified from what was provided by SHA, the 2015 and 2040 build concepts were analyzed with all trucks using a virtual weigh station along northbound and southbound I-270 in the vicinity of the existing weigh station. The virtual weigh station was modeled in VISSIM under the assumption that 10% of all trucks would be flagged due to a violation and subject to exit to the weigh station for inspection. Trucks exiting the weigh station were modeled to slow down to 10 mph before merging back onto northbound and southbound I-270.

Since the no-build models did not incorporate the truck weigh station, the quantitative benefits of the virtual weigh station improvement could not be documented as part of the proposal.

Watkins Mill Road Interchange

After reviewing the 2040 no-build base models that SHA provided, coding discrepancies were found on the northbound local lanes at the Watkins Mill Road interchange. The models did not match the interchange geometry shown in the design plans that were provided as part of the I-270 RFP package. This discrepancy would significantly impact the model results for both 2040 no-build and 2040 build. Both 2040 no-build and proposed models were updated to be consistent with the geometry in the design plans from the RFP between MD 124 and Middlebrook Rd. The revisions to the northbound local lanes at Watkins Mill Road interchange are listed in the Table E-2.

Table E-2. 2040 No-Build VISSIM Base Model Revisions at Watkins Mill Road Interchange

	Original 2040 No Build Base Models	Revised 2040 No Build Base Models
Revision 1	2-Lanes on northbound local lane between MD 124 and Watkins Mill Rd	1-Lane on northbound local lane between MD 124 and Watkins Mill Rd with acceleration and deceleration lanes for on- and off- ramps
Revision 2	Northbound local lane merges with on-ramp from Watkins Mill Road, then merges to northbound I-270 mainline	Northbound local lane merges to I-270 mainline just south of the Watkins Mill Road bridge

Adaptive Ramp Metering

Ramp meters are traffic control signals placed at entrances to freeways to address four main operational considerations:

1. Reduce freeway demand
2. Break up vehicle platoons that form from upstream ramp terminal intersections
3. Control the number of vehicles that are allowed on the facility
4. Increase the throughput on the main line by reducing the frequency and length of periods of flow breakdown

The first criterion is to provide a disincentive for vehicles making shorter trips from using the freeway. While this is an important element when considering adaptive ramp metering, this component cannot be adequately incorporated into the VISSIM model. The latter three criteria are to ensure the total traffic entering the freeway remains below the bottleneck capacity on the freeway for as long as possible, and can be assessed through the modeling effort. When ramp meters are installed properly, they have the potential to improve freeway speeds, provide safer operations, decrease fuel and vehicle emissions, and improve vehicle throughput. More discussion regarding adaptive ramp metering may be found in Sections 2, 3, and 4 of the proposal.

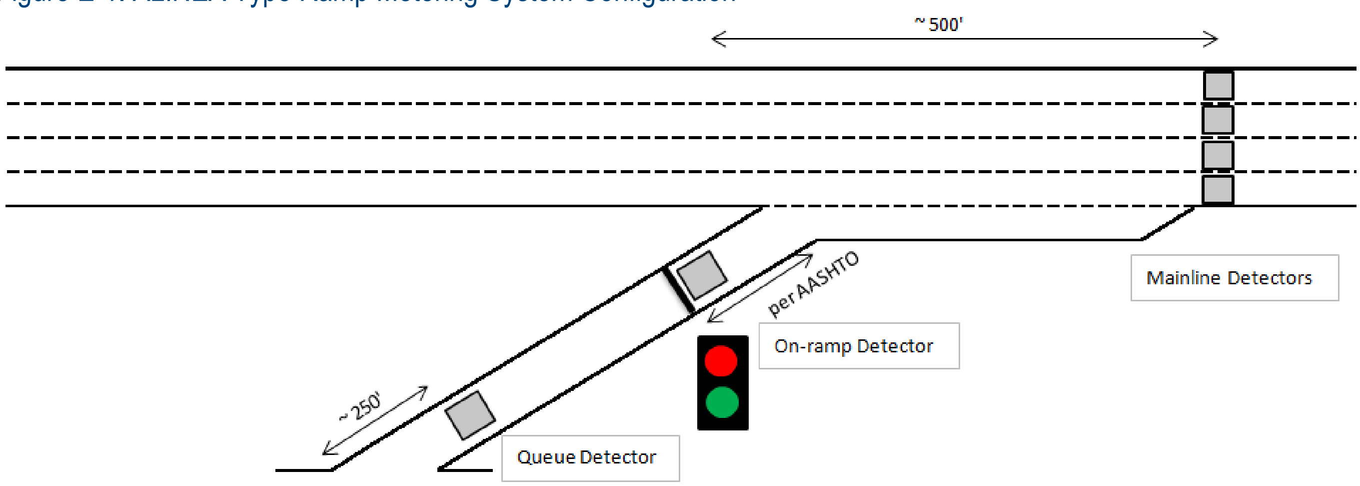
Proposed Algorithm:

The ALINEA algorithm was used to implement adaptive ramp metering in the VISSIM build files. ALINEA is a localized, traffic responsive ramp metering strategy. It is shown to be simple, efficient, effective, and easily implemented. Its primary objective is to maximize mainline throughput by maintaining occupancy downstream of the entrance ramp at a level lower than the flow breakdown level. Metering rates are calculated using a closed-loop traffic responsive control where these rates are used to maintain the desired mainline occupancy. ALINEA can also be modified to allow for an excessive queue override. This control may be required to increase the metering rate to discharge excessive vehicle queues on the ramp to minimize interference with arterial traffic operations.

In general, the ALINEA ramp metering system would require three sets of detectors. First, downstream mainline detectors are used to measure mainline occupancy rates at the point of flow breakdown downstream of the entrance ramp. On-ramp detection is used to determine vehicle throughput while queue detectors are used to assess excessive queue lengths.

Figure E-1 shows a typical layout of the ALINEA type ramp metering system.

Figure E-1. ALINEA Type Ramp Metering System Configuration



For ramps operating under ALINEA control logic, its metering rate during interval t is calculated as follows:

$$r(t) = r(t-1) + K_r[O - O_{out}(t)]$$

where:

$r(t)$ = Metering rate for time period t

O = Desired occupancy of the downstream detector (Generally between 18 to 31 percent)

$O_{out}(t)$ = Measured occupancy at time t

$r(t-1)$ = Metering rate in the previous time period

K_r = Regulatory constant (Suggested value of 70 - this figure has been used in the majority of modeling studies and field applications, however, it can be adjusted depending on the responsiveness required.)

Implementation in VISSIM:

The following section describes the geometric, algorithmic, and operational assumptions that were used to implement ramp metering in the VISSIM build models.

Design-Based Assumptions:

Ramp Meter Signal Placement

The ability of metered vehicles to smoothly merge with freeway traffic requires adequate acceleration distance. AASHTO's "A Policy on Geometric Design of Highways and Streets" Tables 10-3 and 10-4 provide guidance on required ramp acceleration lengths. The ramp meter signal heads were located in the VISSIM build models using the minimum length required for a vehicle to travel from a stopped condition to accelerate to highway speeds. Based on the location of the ramp meter signal, the available storage for each ramp was calculated.

Excessive Queue Detection

Research indicates that the excessive queue detector should be installed at least 250 feet downstream of an intersection and that the location of the detector should be revised if the excessive queue detector is frequently activated. During the VISSIM build simulations, the average queue lengths were contained on the ramps. The excessive queue detectors were not routinely activated, so the locations were not revised.

ALINEA-Based Assumptions:

Based on previous research, there are four parameters that should be calibrated if ALINEA is implemented in the field:

- Desired Occupancy Threshold (O)
- K_r Regulatory Constant
- Downstream Detector Location
- Time to update cycle length

For the purpose of the VISSIM modeling, the following values were assumed based on documented research and best practices:

- O was set at 2% below the downstream critical occupancy at bottleneck locations
- K_r = 70 vehicles per hour
- Downstream detector location = slightly upstream of the point of flow breakdown (approximately 500 feet)
- Time interval (time to update ramp metering rates) = 30 seconds

Ramp Meter Rates and Queue Occupancy Assumptions:

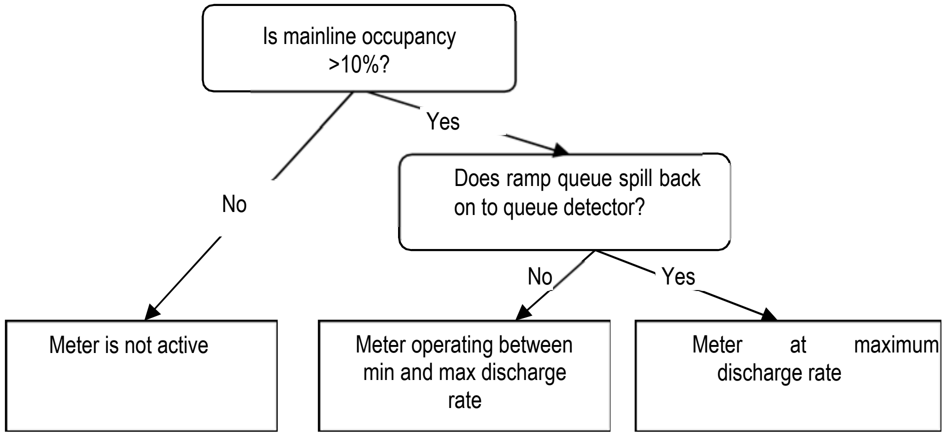
The following discharge and occupancy rates were assumed for the VISSIM analysis:

- Minimum discharge rate: Varying between 180 veh/hr/ln – 500 veh/hr/ln (adjusted based on queues and ramp demand)
- Maximum discharge rate: Varying between 900 veh/hr/ln – 1050 veh/hr/ln (adjusted based on queues and ramp demand)
- Minimum mainline occupancy for ramp metering activation: 10%

In addition to the parameters described above, the excessive queue detectors were constantly monitored during the simulation period. For the purpose of this analysis, if the excessive queue detector was occupied for 80 percent of the time during a given time interval (30 seconds), the ramp meter was switched to the maximum discharge rate until the queue was flushed and queuing was eliminated on the ramp. This was to avoid interfering with arterial operations.

Figure E-2 shows a flowchart of potential ramp metering rates based on mainline and ramp conditions.

Figure E-2. Ramp Metering Rate Flowchart



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Maryland Department of Transportation

Appendix F

Comprehensive Traffic Model Results

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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SHA State Highway Administration
Maryland Department of Transportation

Appendix F

INTERSTATE 270

1 - VISSIM Traffic Models

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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F Appendix F: Comprehensive Traffic Model Results

The purpose of this appendix is to present simulation results from the VISSIM traffic models. The following sections are included:

- VISSIM Traffic Models
- Travel Time Figures
- Ramp Metering Queue Tables
- Throughput vs. Demand Graphics
- Travel Speed Heat Maps

This appendix does not include the Concept Evaluation files, which are presented in Appendix G.

1. VISSIM Traffic Models

The following scenarios were modeled in VISSIM:

- Existing AM No Build – files provided by SHA
- Existing PM No Build – files provided by SHA
- Existing AM Build – roadway improvements, adaptive ramp metering, and virtual weigh stations modeled
- Existing PM Build – roadway improvements, adaptive ramp metering, and virtual weigh stations modeled
- 2040 AM No Build – files provided by SHA, slightly modified to properly model the Watkins Mill interchange (see Appendix E for more details)
- 2040 PM No Build - files provided by SHA, slightly modified to properly model the Watkins Mill interchange (see Appendix E for more details)
- 2040 AM Build – roadway improvements, adaptive ramp metering, and virtual weigh stations modeled
- 2040 PM Build – roadway improvements, adaptive ramp metering, and virtual weigh stations modeled

The VISSIM files for each scenario are included electronically. Refer to Appendix E for a discussion on how the improvements were modeled in VISSIM. Note that ATM improvements were not modeled in VISSIM.

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Appendix F

INTERSTATE 270

2 - Travel Time Tables

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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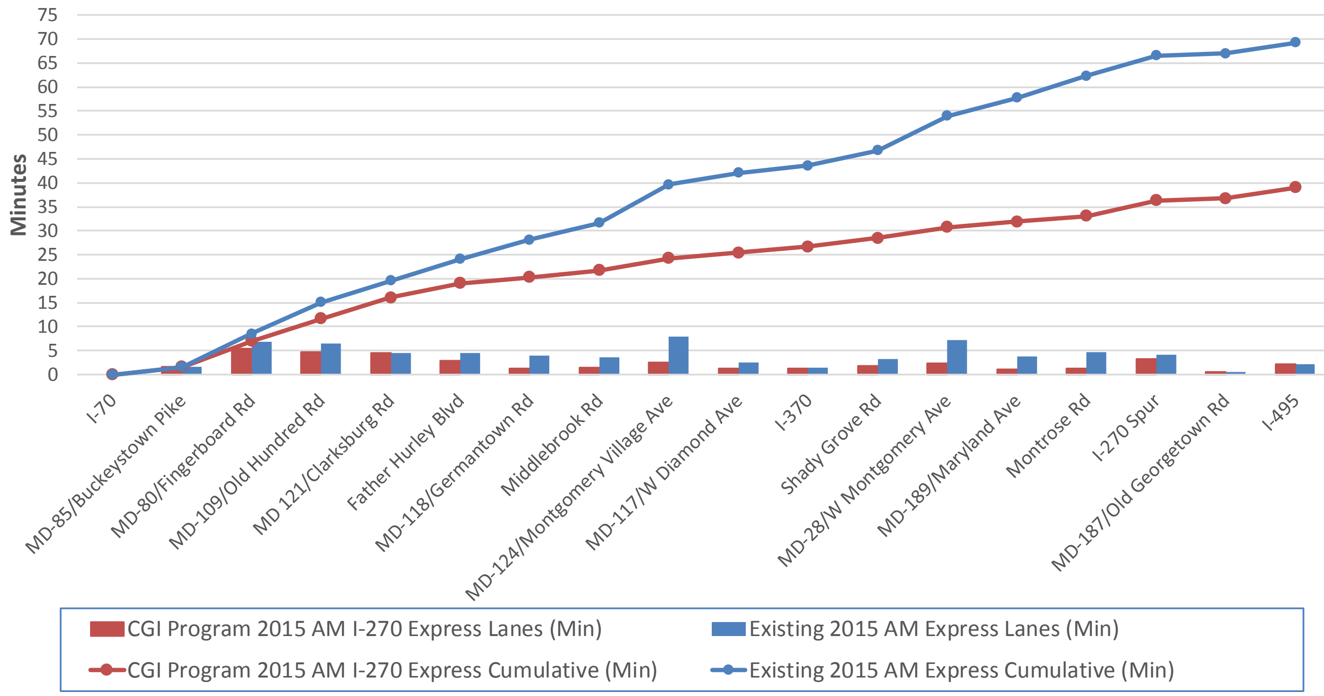
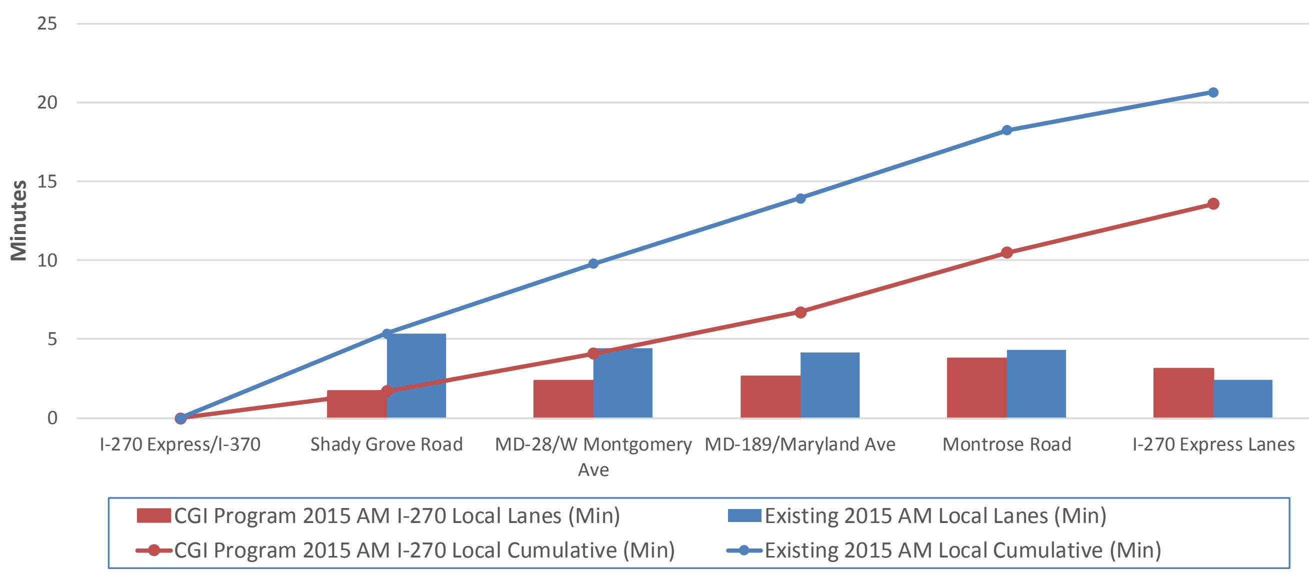
2. Travel Time Figures

The following figures compare travel time results between build (CGI Program) and no-build (existing) scenarios for both 2015 and 2040. The peak direction (i.e., southbound in the AM, northbound in the PM) travel time results are compared for each segment and cumulatively.

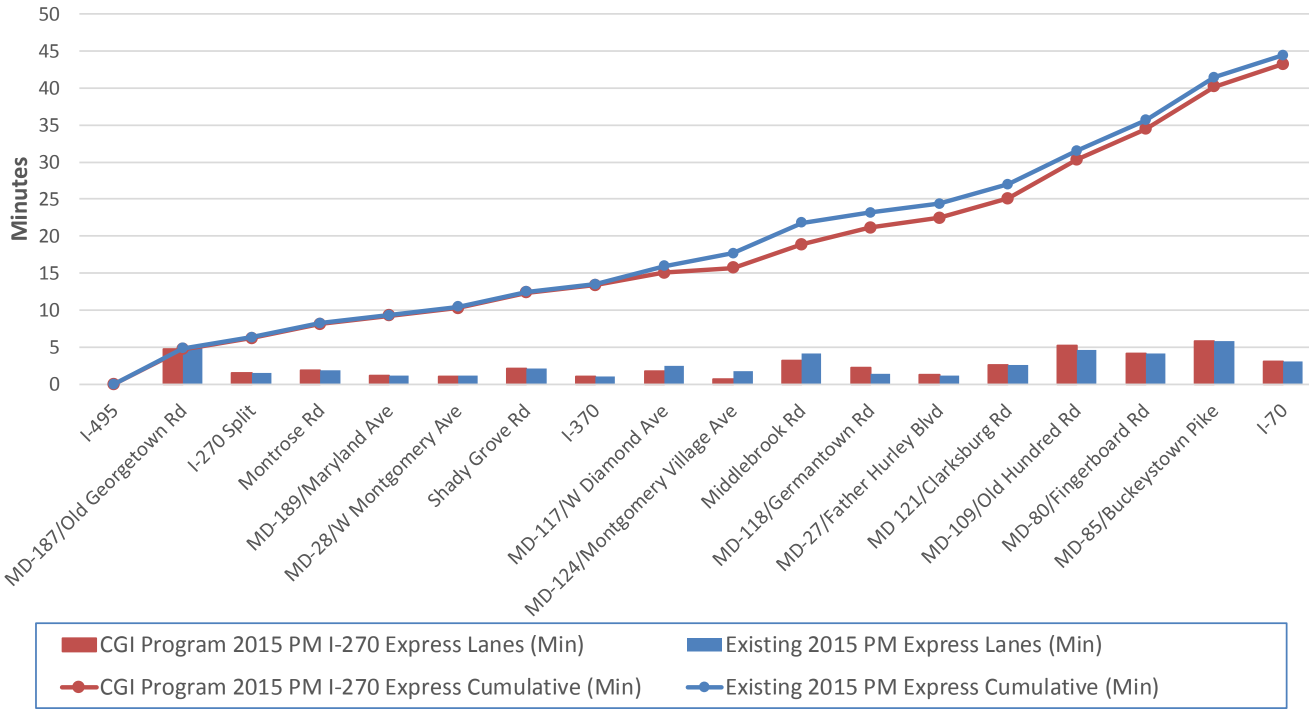
2015 Southbound AM Peak Express Lanes Travel Time Comparison



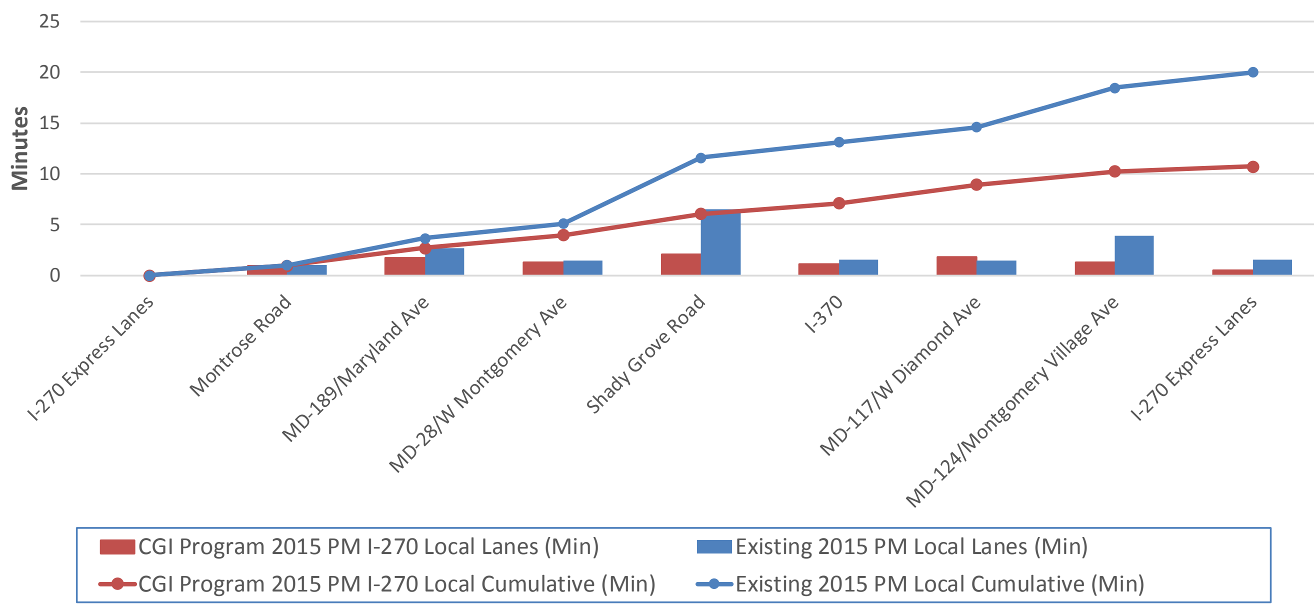
2015 Southbound AM Peak Local Lanes Travel Time Comparison



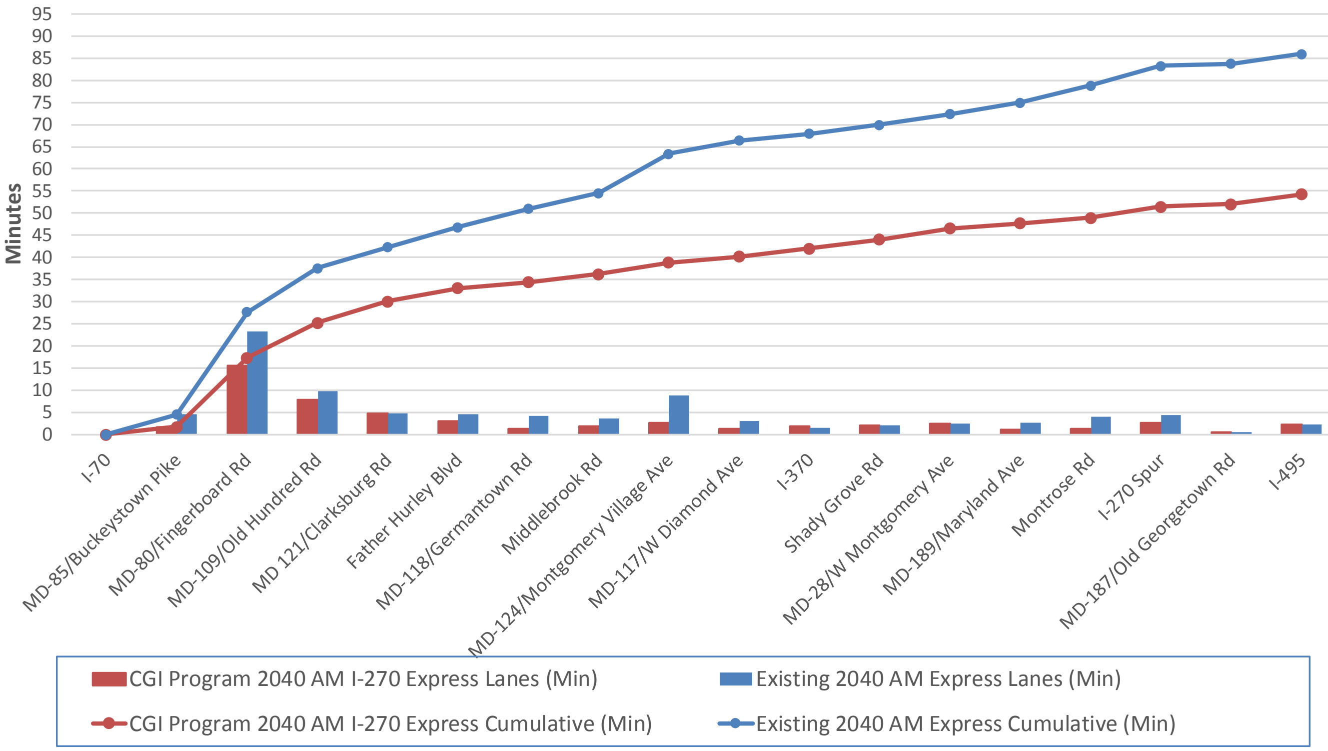
2015 Northbound PM Peak Express Lanes Travel Time Comparison



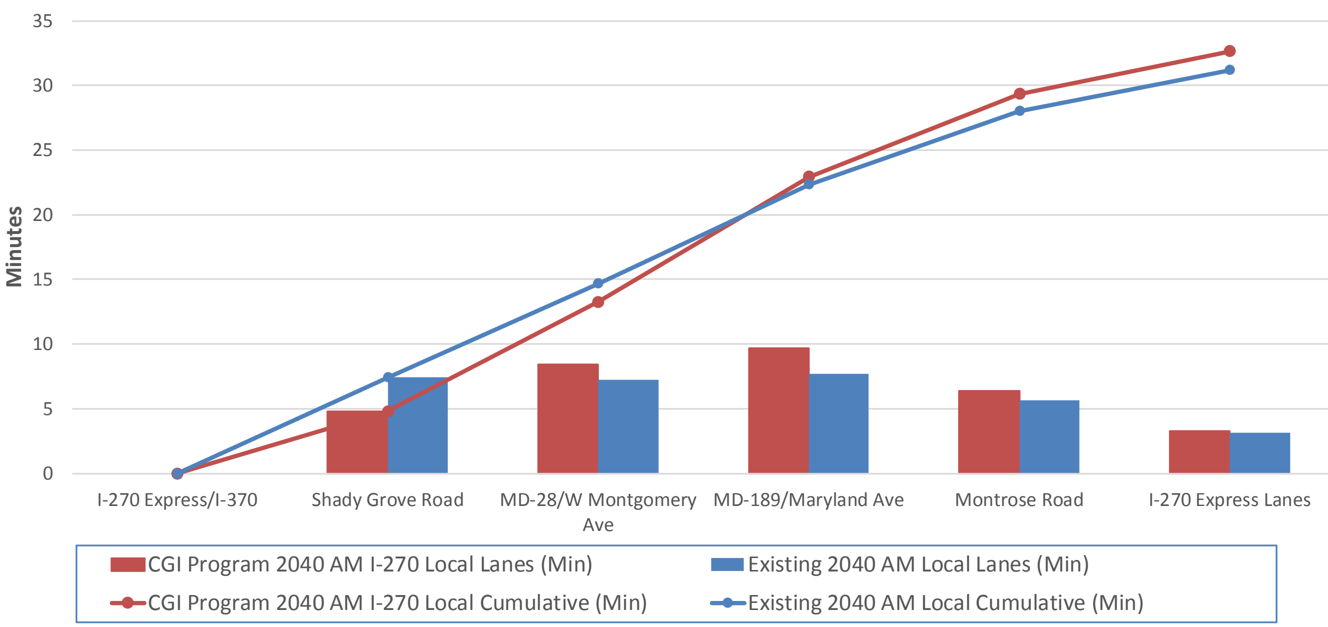
2015 Northbound PM Peak Local Lanes Travel Time Comparison



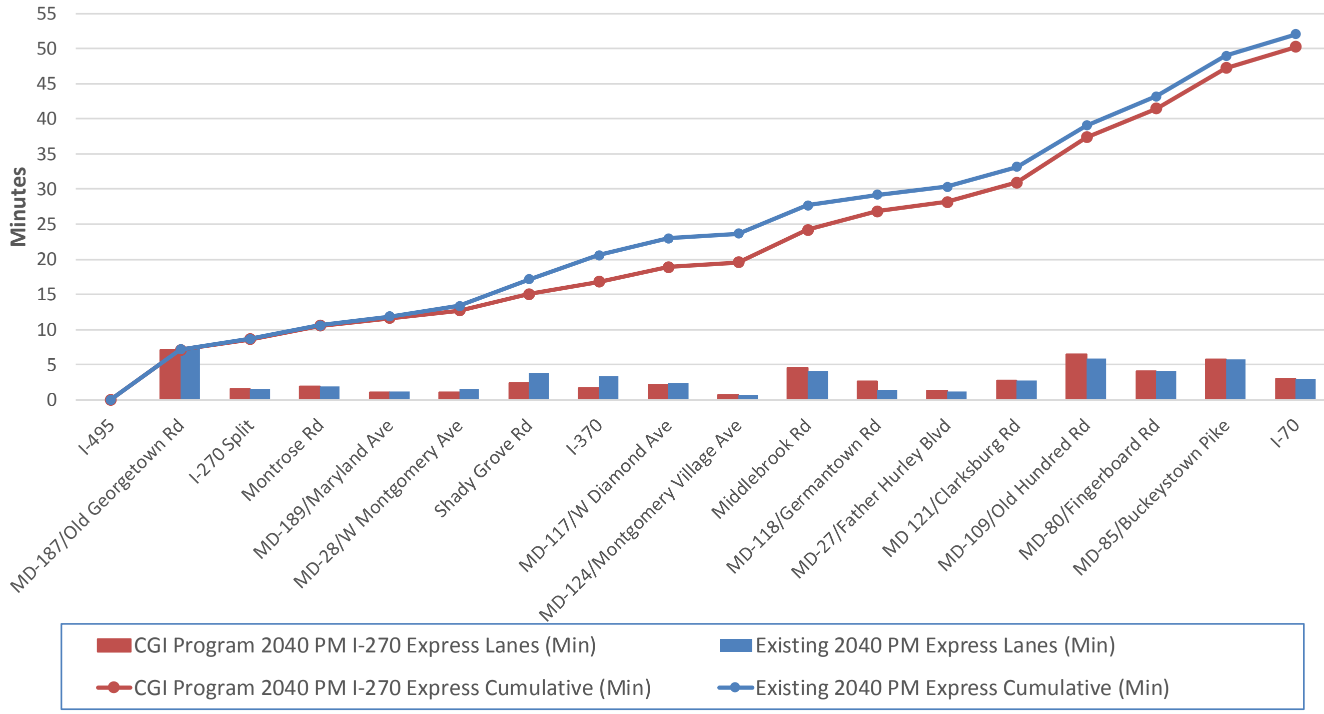
2040 Southbound AM Peak Express Lanes Travel Time Comparison



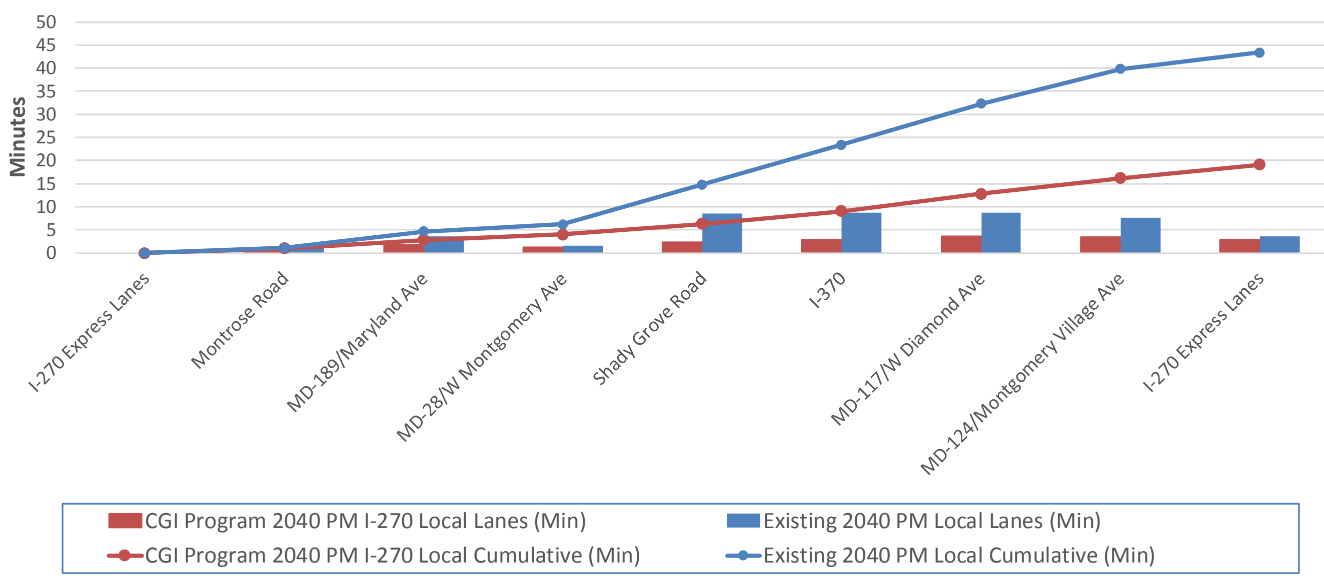
2040 Southbound AM Peak Local Lanes Travel Time Comparison



2040 Northbound PM Peak Express Lanes Travel Time Comparison



2040 Northbound PM Peak Local Lanes Travel Time Comparison



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Appendix F

3 - Ramp Metering Queue Tables

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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3. Ramp Metering Queue Tables

Table F-1 shows the 2015 AM peak average queue length of ramps with adaptive ramp metering compared to the storage length of each ramp. The queues are contained along the ramps and do not spill back onto the arterials.

Table F-1. Ramp Meter Queue Table

	RAMP METER LOCATION	STORAGE LENGTH (FT)	2015 AM PEAK AVERAGE QUEUE (FT)
↑ I-270 Southbound Direction of Travel ↑	On ramp from Montrose East	1,500	1,375
	On ramp from Montrose West	900	637
	On ramp from MD 189	1,100	1,030
	On ramp from MD 28 East	1,500	1,249
	On ramp from MD 28 West	600	343
	On ramp from Shady Grove North	800	479
	On ramp from Shady Grove South	1,200	1,037
	I-370 Eastbound	1,650	0
	I-370 Westbound	1,900	53
	On ramp from MD 117	1,150	824
	On ramp from Montgomery Village Avenue	600	86
	On ramp from Middlebrook Road	1,500	938
	On ramp from MD 118 North	1,500	316
	On ramp from MD 118 South	1,400	43
	On ramp from MD 27 East	1,500	237
	On ramp from MD 27 West	1,500	1,416
	On ramp from MD 121	900	308
	On ramp from MD 109	800	101
	On ramp from MD 80	650	184

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Appendix F

INTERSTATE 270

4 - Throughput versus Demand Graphics

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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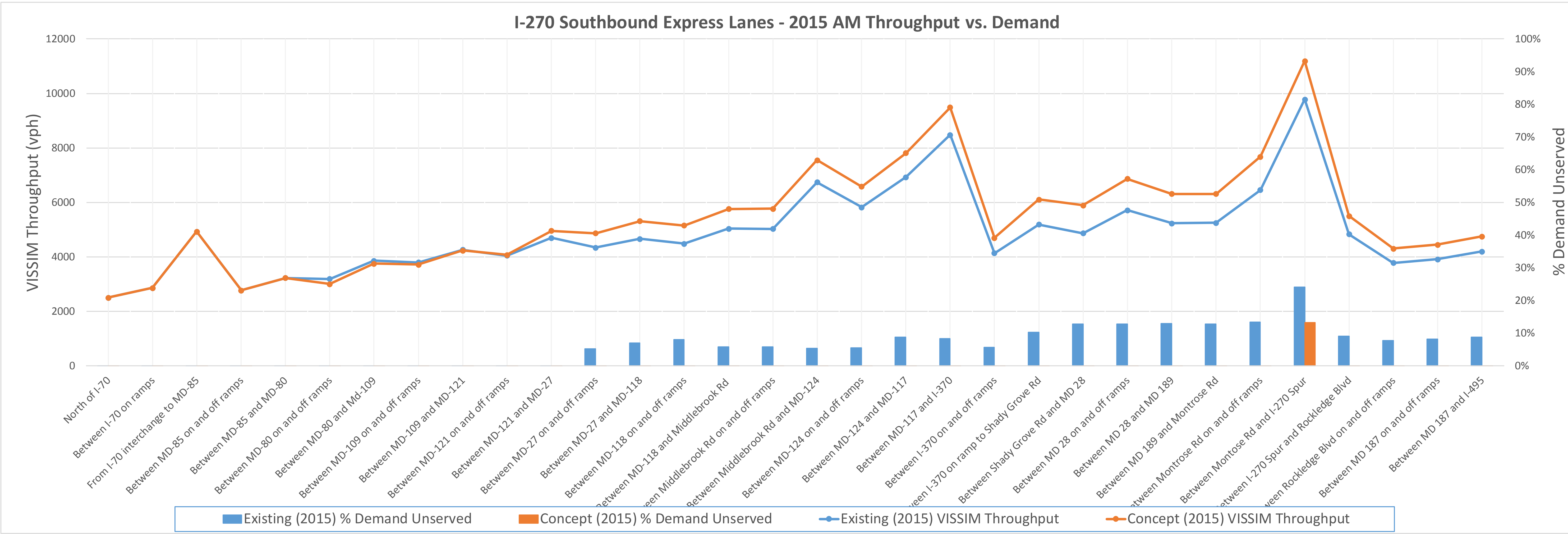
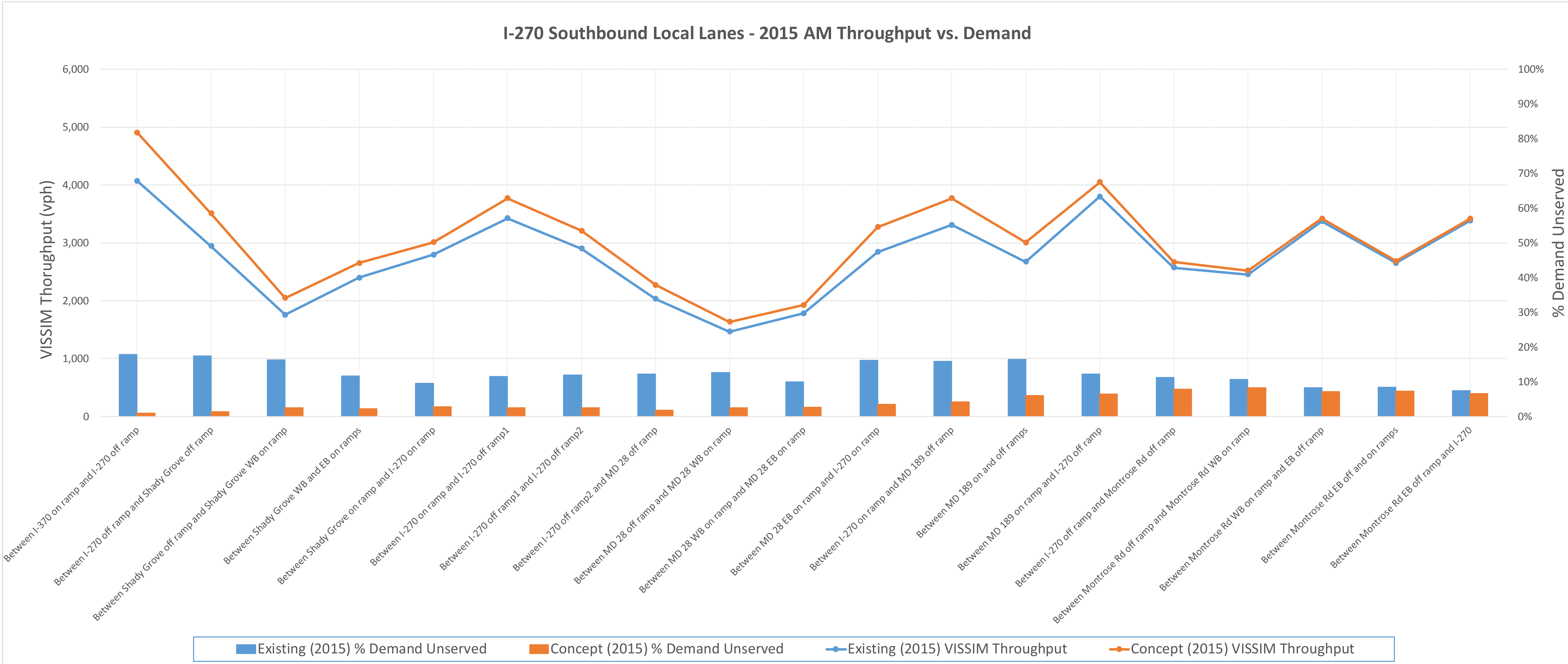
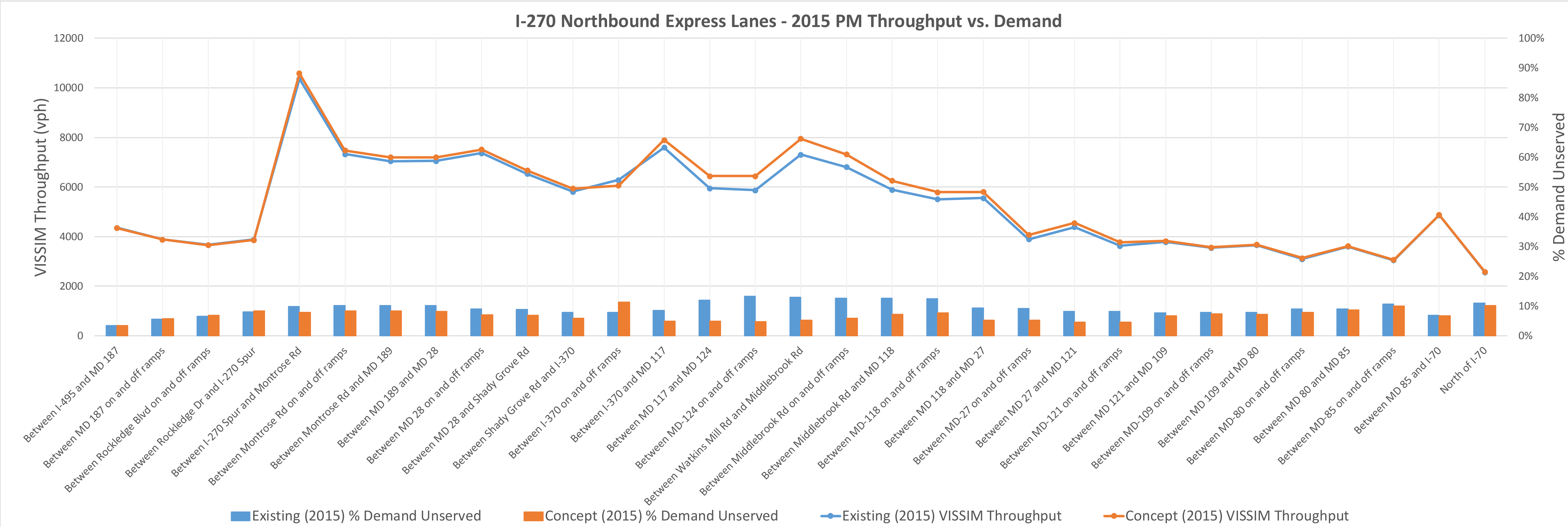
4. Throughput vs. Demand Graphics

The following pages show figures that compare peak direction VISSIM throughput by segment for the build (concept) and no-build (existing) scenarios for both 2015 and 2040. The figures also compare the concept and existing percent demand unserved for each segment.

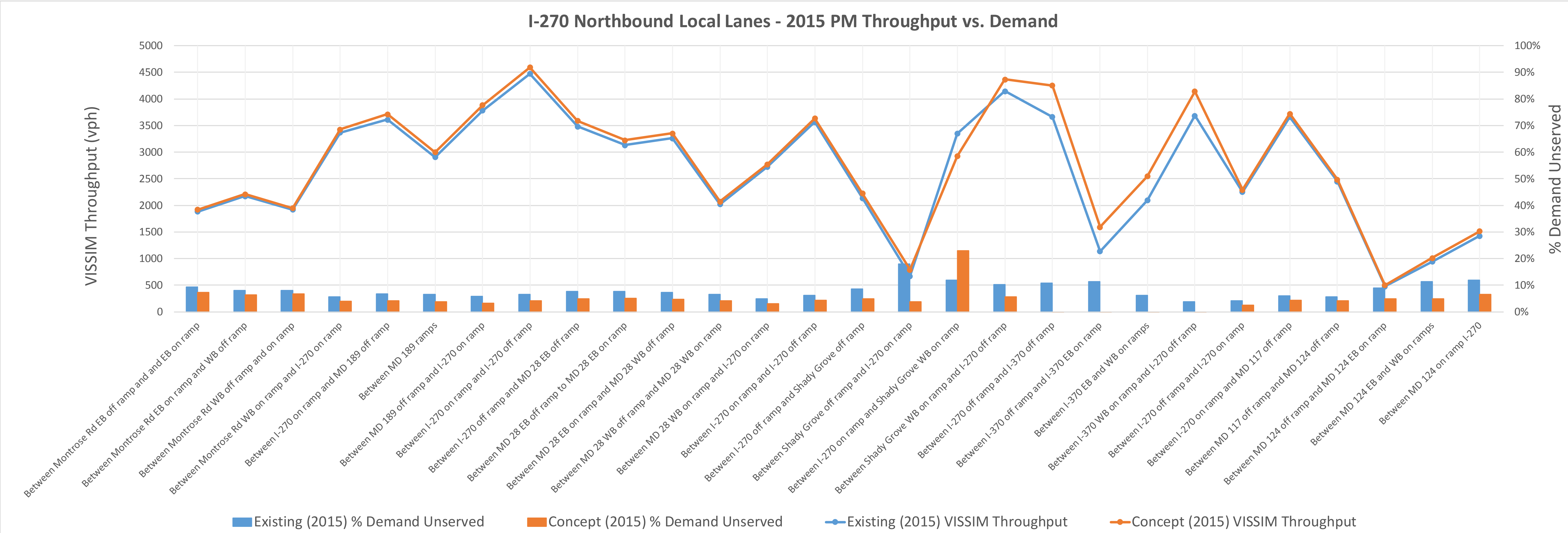
Note that the demand shown on the figures includes all vehicles (HOV lanes and regular lanes).

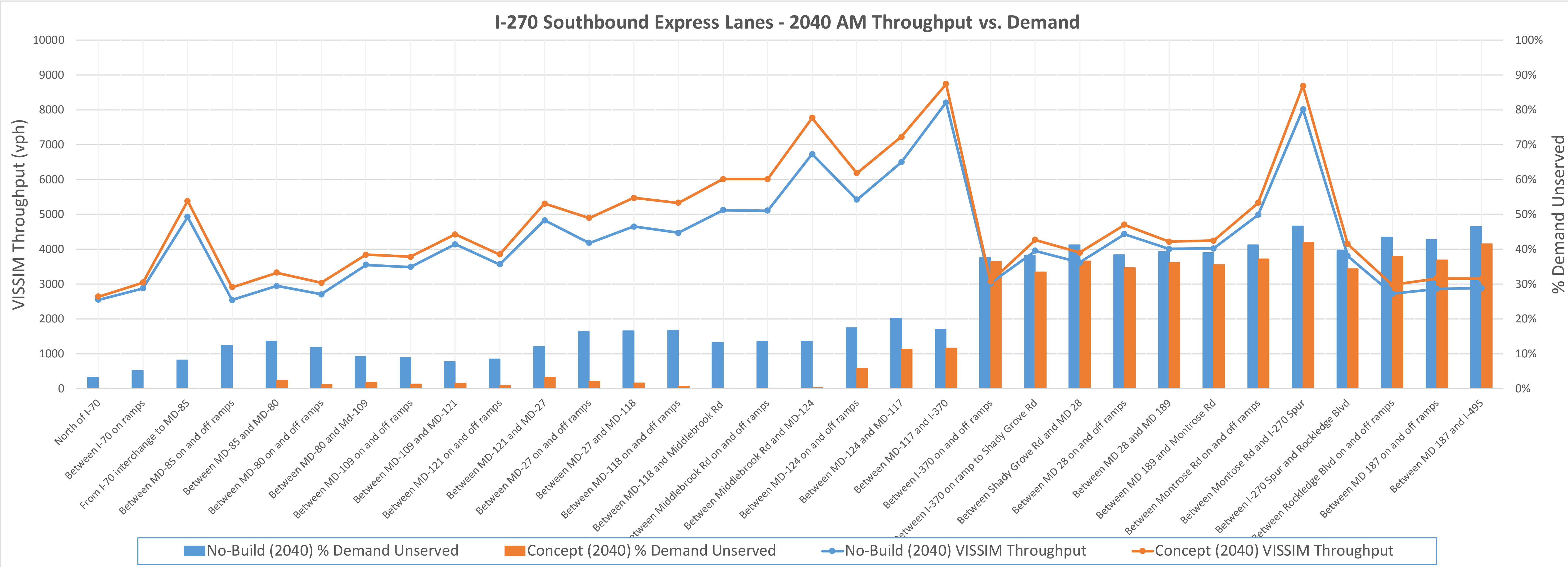

I-270 Southbound Express Lanes - 2015 AM Throughput vs. Demand
VISSIM Throughput (vph)
% Demand Unserved
Existing (2015) % Demand Unserved
Concept (2015) % Demand Unserved
Existing (2015) VISSIM Throughput
Concept (2015) VISSIM Throughput
North of I-70
Between I-70 on ramps
From I-70 interchange to MD-85
Between MD-85 on and off ramps
Between MD-85 and MD-80
Between MD-80 on and off ramps
Between MD-80 and Md-109
Between MD-109 on and off ramps
Between MD-109 and MD-121
Between MD-121 on and off ramps
Between MD-121 and MD-27
Between MD-27 on and off ramps
Between MD-27 and MD-118
Between MD-118 on and off ramps
Between MD-124 on and off ramps
Between MD-124 and MD-117
Between MD-117 and I-370
Between I-370 on and off ramps
Between Shady Grove Rd and MD 28
Between MD 28 on and off ramps
Between MD 28 and MD 189
Between Montose Rd and I-270 Spur
Between MD 187 on and off ramps
Between MD 187 and I-495

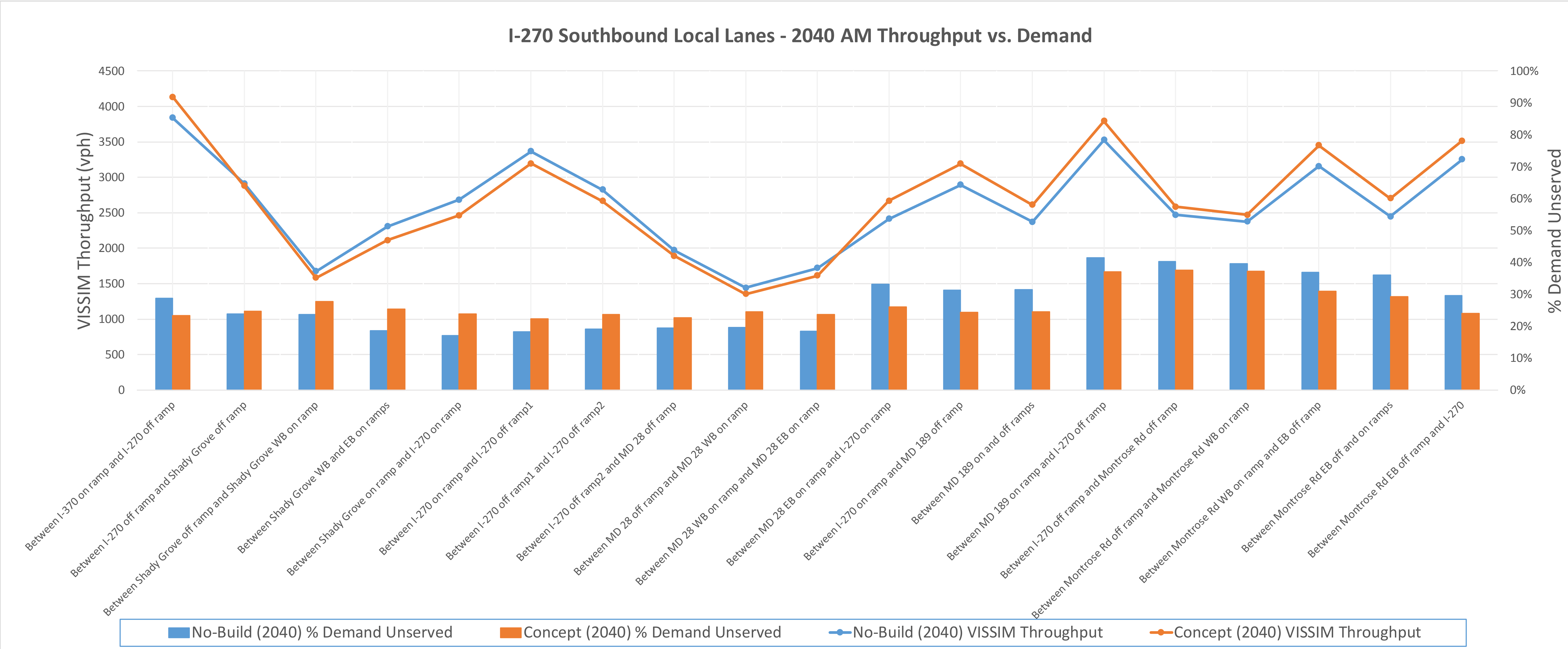

I-270 Southbound Local Lanes - 2015 AM Throughput vs. Demand
VISSIM Thorughput (vph)
% Demand Unserved
6,000
5,000
4,000
3,000
2,000
1,000
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Between I-370 on ramp and I-270 off ramp
Between I-270 off ramp and Shady Grove off ramp
Between Shady Grove off ramp and Shady Grove WB on ramp
Between Shady Grove WB and EB on ramps
Between Shady Grove on ramp and I-270 on ramp
Between I-270 on ramp and I-270 off ramp1
Between I-270 off ramp1 and I-270 off ramp2
Between I-270 off ramp2 and MD 28 off ramp
Between MD 28 off ramp and MD 28 WB on ramp
Between MD 28 WB on ramp and MD 28 EB on ramp
Between MD 28 EB on ramp and I-270 on ramp
Between I-270 on ramp and MD 189 off ramp
Between MD 189 on and off ramps
Between MD 189 on ramp and I-270 off ramp
Between I-270 off ramp and Montrose Rd off ramp
Between Montrose Rd off ramp and Montrose Rd WB on ramp
Between Montrose Rd WB on ramp and EB off ramp
Between Montrose Rd EB off and on ramps
Between Montrose Rd EB off ramp and I-270
Existing (2015) % Demand Unserved
Concept (2015) % Demand Unserved
Existing (2015) VISSIM Throughput
Concept (2015) VISSIM Throughput

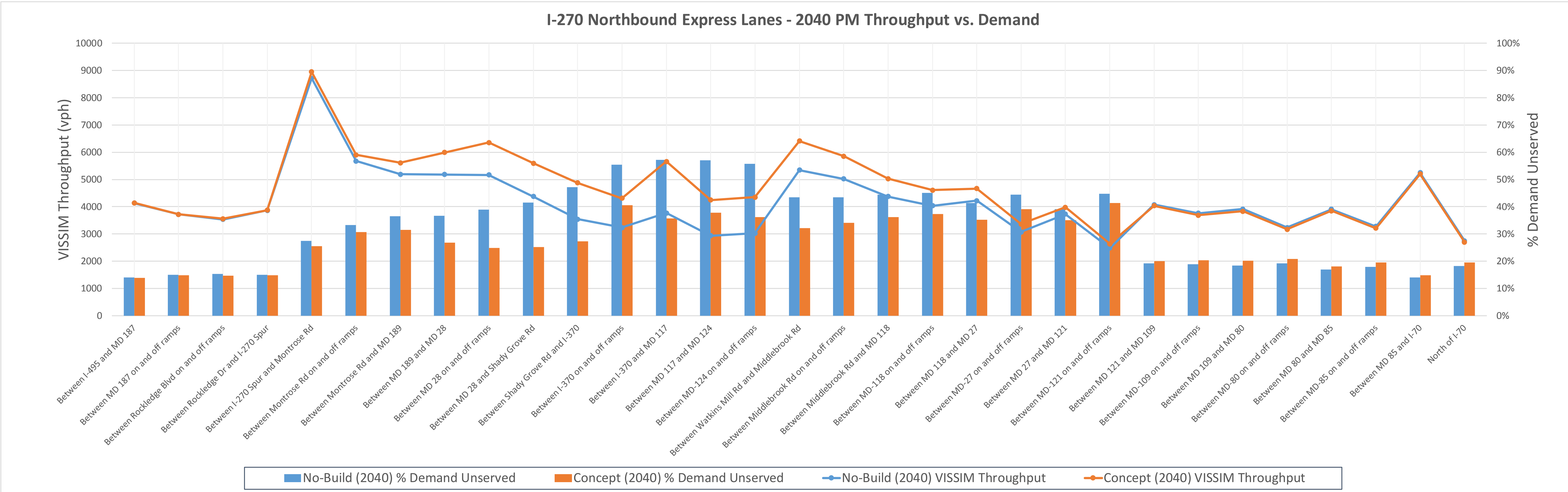


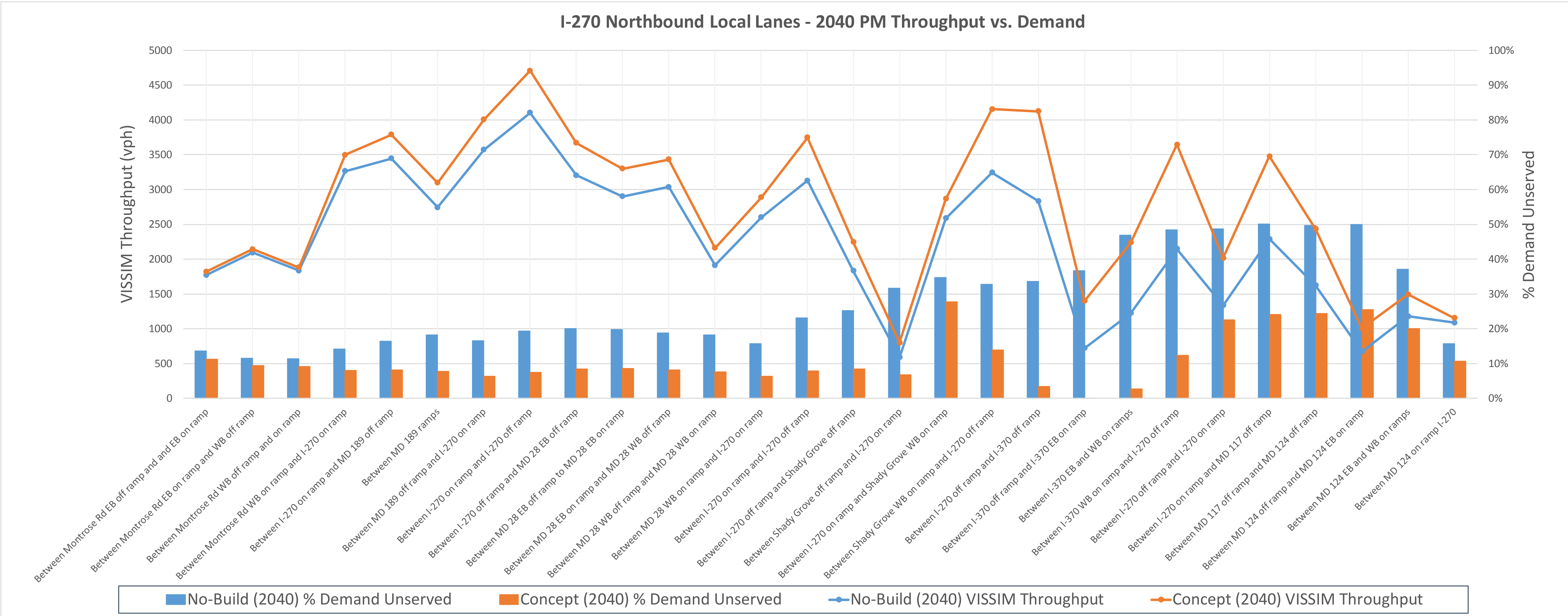
I-270 Northbound Express Lanes - 2015 PM Throughput vs. Demand
VISSIM Throughput (vph)
% Demand Unserved
0
2000
4000
6000
8000
10000
12000
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Between I-495 and MD 187
Between MD 187 on and off ramps
Between Rockledge Blvd on and off ramps
Between Rockledge Dr and I-270 Spur
Between I-270 Spur and Montrose Rd
Between Montrose Rd on and off ramps
Between Montrose Rd and MD 189
Between MD 189 and MD 28
Between MD 28 on and off ramps
Between MD 28 and Shady Grove Rd
Between Shady Grove Rd and I-370
Between I-370 on and off ramps
Between I-370 and MD 117
Between MD 117 and MD 124
Between MD-124 on and off ramps
Between Watkins Mill Rd and Middlebrook Rd
Between Middlebrook Rd on and off ramps
Between Middlebrook Rd and MD 118
Between MD-118 on and off ramps
Between MD 118 and MD 27
Between MD-27 on and off ramps
Between MD 27 and MD 121
Between MD-121 on and off ramps
Between MD 121 and MD 109
Between MD-109 on and off ramps
Between MD 109 and MD 80
Between MD-80 on and off ramps
Between MD 80 and MD 85
Between MD-85 on and off ramps
Between MD 85 and I-70
North of I-70
Existing (2015) % Demand Unserved
Concept (2015) % Demand Unserved
Existing (2015) VISSIM Throughput
Concept (2015) VISSIM Throughput


I-270 Northbound Local Lanes - 2015 PM Throughput vs. Demand
VISSIM Throughput (vph)
% Demand Unserved
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Between Montrose Rd EB off ramp and EB on ramp
Between Montrose Rd EB on ramp and WB off ramp
Between Montrose Rd WB off ramp and on ramp
Between Montrose Rd WB on ramp and I-270 on ramp
Between I-270 on ramp and MD 189 off ramp
Between MD 189 ramps
Between MD 189 off ramp and I-270 on ramp
Between I-270 on ramp and I-270 off ramp
Between I-270 off ramp and MD 28 EB off ramp
Between MD 28 EB off ramp to MD 28 EB on ramp
Between MD 28 EB on ramp and MD 28 WB off ramp
Between MD 28 WB off ramp and MD 28 WB on ramp
Between MD 28 WB on ramp and I-270 on ramp
Between I-270 on ramp and I-270 off ramp
Between I-270 off ramp and Shady Grove off ramp
Between Shady Grove off ramp and I-270 on ramp
Between I-270 on ramp and Shady Grove WB on ramp
Between Shady Grove WB on ramp and I-270 off ramp
Between I-270 off ramp and I-370 off ramp
Between I-370 off ramp and I-370 EB on ramp
Between I-370 EB and WB on ramps
Between I-370 WB on ramp and I-270 off ramp
Between I-270 off ramp and I-270 on ramp
Between I-270 on ramp and MD 117 off ramp
Between MD 117 off ramp and MD 124 off ramp
Between MD 124 off ramp and MD 124 EB on ramp
Between MD 124 EB and WB on ramps
Between MD 124 on ramp I-270
Existing (2015) % Demand Unserved
Concept (2015) % Demand Unserved
Existing (2015) VISSIM Throughput
Concept (2015) VISSIM Throughput


I-270 Southbound Express Lanes - 2040 AM Throughput vs. Demand
VISSIM Throughput (vph)
% Demand Unserved
No-Build (2040) % Demand Unserved
Concept (2040) % Demand Unserved
No-Build (2040) VISSIM Throughput
Concept (2040) VISSIM Throughput


I-270 Southbound Local Lanes - 2040 AM Throughput vs. Demand
VISSIM Thorughput (vph)
% Demand Unserved
4500
4000
3500
3000
2500
2000
1500
1000
500
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Between I-370 on ramp and I-270 off ramp
Between I-270 off ramp and Shady Grove off ramp
Between Shady Grove off ramp and Shady Grove WB on ramp
Between Shady Grove WB and EB on ramps
Between Shady Grove on ramp and I-270 on ramp
Between I-270 on ramp and I-270 off ramp1
Between I-270 off ramp1 and I-270 off ramp2
Between I-270 off ramp2 and MD 28 off ramp
Between MD 28 off ramp and MD 28 WB on ramp
Between MD 28 WB on ramp and MD 28 EB on ramp
Between MD 28 EB on ramp and I-270 on ramp
Between I-270 on ramp and MD 189 off ramp
Between MD 189 on and off ramps
Between MD 189 on ramp and I-270 off ramp
Between I-270 off ramp and Montrose Rd off ramp
Between Montrose Rd off ramp and Montrose Rd WB on ramp
Between Montrose Rd WB on ramp and EB off ramp
Between Montrose Rd EB off and on ramps
Between Montrose Rd EB off ramp and I-270
No-Build (2040) % Demand Unserved
Concept (2040) % Demand Unserved
No-Build (2040) VISSIM Throughput
Concept (2040) VISSIM Throughput

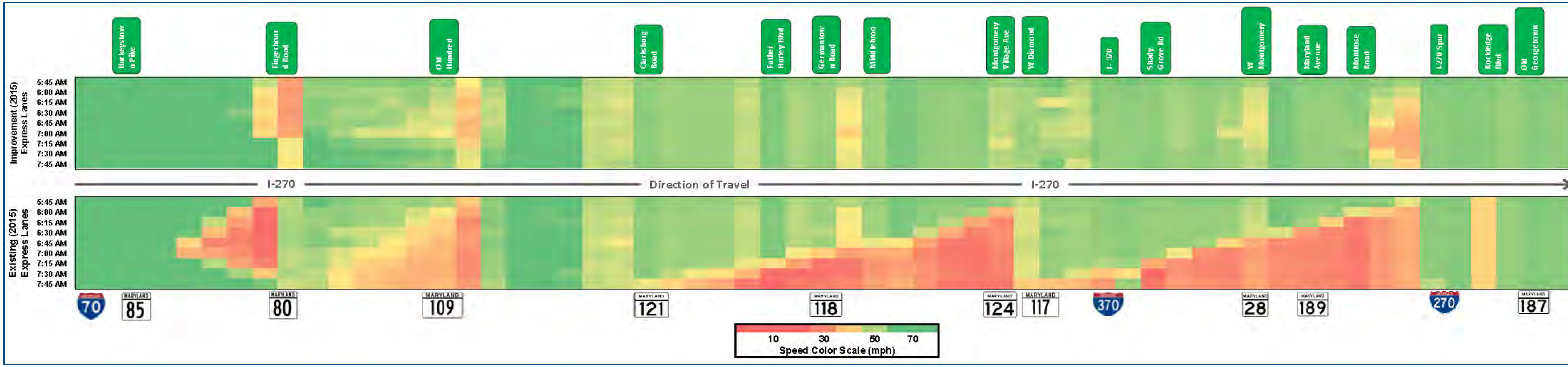

I-270 Northbound Express Lanes - 2040 PM Throughput vs. Demand
VISSIM Throughput (vph)
% Demand Unserved
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Between I-495 and MD 187
Between MD 187 on and off ramps
Between Rockledge Blvd on and off ramps
Between Rockledge Dr and I-270 Spur
Between I-270 Spur and Montrose Rd
Between Montrose Rd on and off ramps
Between Montrose Rd and MD 189
Between MD 189 and MD 28
Between MD 28 on and off ramps
Between MD 28 and Shady Grove Rd
Between Shady Grove Rd and I-370
Between I-370 on and off ramps
Between I-370 and MD 117
Between MD 117 and MD 124
Between MD-124 on and off ramps
Between Watkins Mill Rd and Middlebrook Rd
Between Middlebrook Rd on and off ramps
Between Middlebrook Rd and MD 118
Between MD-118 on and off ramps
Between MD 118 and MD 27
Between MD-27 on and off ramps
Between MD 27 and MD 121
Between MD-121 on and off ramps
Between MD 121 and MD 109
Between MD-109 on and off ramps
Between MD 109 and MD 80
Between MD-80 on and off ramps
Between MD 80 and MD 85
Between MD-85 on and off ramps
Between MD 85 and I-70
North of I-70
No-Build (2040) % Demand Unserved
Concept (2040) % Demand Unserved
No-Build (2040) VISSIM Throughput
Concept (2040) VISSIM Throughput


I-270 Northbound Local Lanes - 2040 PM Throughput vs. Demand
VISSIM Throughput (vph)
% Demand Unserved
No-Build (2040) % Demand Unserved
Concept (2040) % Demand Unserved
No-Build (2040) VISSIM Throughput
Concept (2040) VISSIM Throughput
Between Montrose Rd EB off ramp and and EB on ramp
Between Montrose Rd EB on ramp and WB off ramp
Between Montrose Rd WB off ramp and on ramp
Between Montrose Rd WB on ramp and I-270 on ramp
Between I-270 on ramp and MD 189 off ramp
Between MD 189 ramps
Between MD 189 off ramp and I-270 on ramp
Between I-270 on ramp and I-270 off ramp
Between I-270 off ramp and MD 28 EB off ramp
Between MD 28 EB off ramp to MD 28 EB on ramp
Between MD 28 EB on ramp and MD 28 WB off ramp
Between MD 28 WB off ramp and MD 28 WB on ramp
Between MD 28 WB on ramp and I-270 on ramp
Between I-270 on ramp and I-270 off ramp
Between I-270 off ramp and Shady Grove off ramp
Between Shady Grove off ramp and I-270 on ramp
Between I-270 on ramp and Shady Grove WB on ramp
Between Shady Grove WB on ramp and I-270 off ramp
Between I-270 off ramp and I-370 off ramp
Between I-370 off ramp and I-370 EB on ramp
Between I-370 EB and WB on ramps
Between I-370 WB on ramp and I-270 off ramp
Between I-270 off ramp and I-270 on ramp
Between I-270 on ramp and MD 117 off ramp
Between MD 117 off ramp and MD 124 off ramp
Between MD 124 off ramp and MD 124 EB on ramp
Between MD 124 EB and WB on ramps
Between MD 124 on ramp I-270

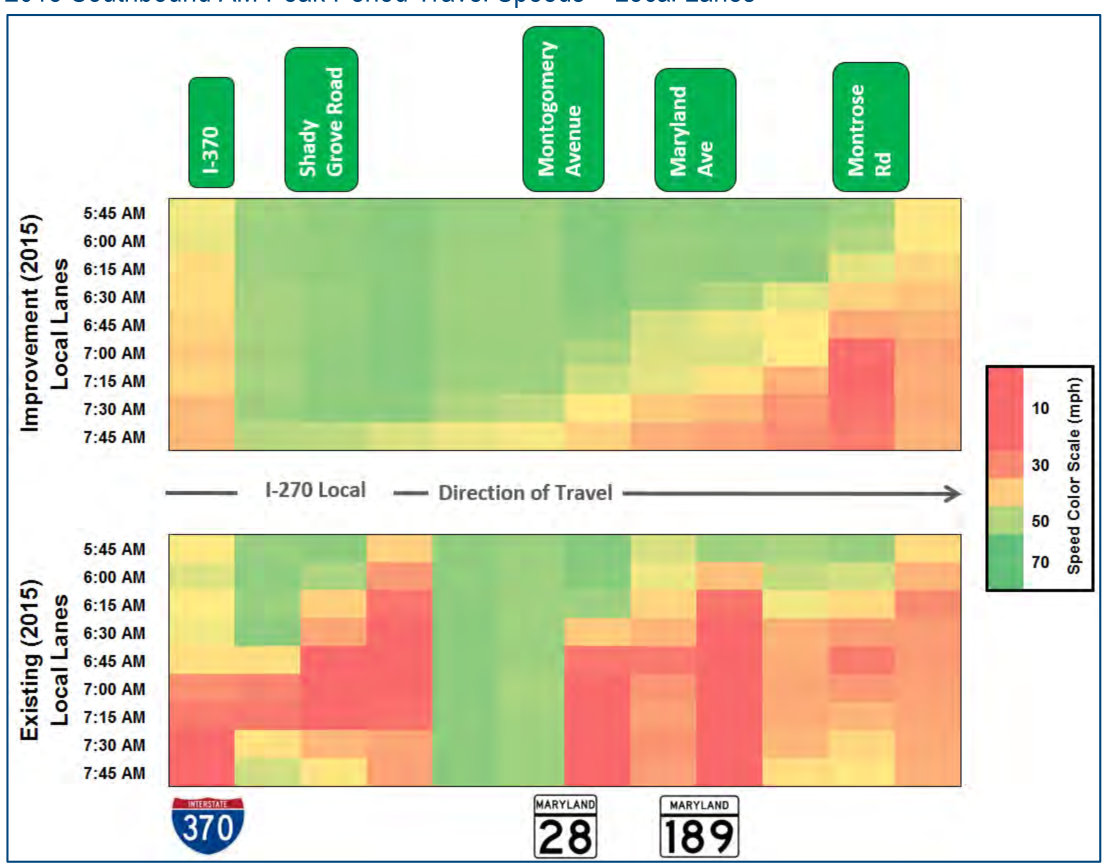
5. Throughput vs. Demand Graphics

The following figures show heat maps that compare peak direction travel speeds for the no-build (existing) and improvement scenarios. Southbound travel speeds during the AM peak period are compared for 2015 and 2040. Northbound travel speeds during the PM peak period are also compared for 2015 and 2040.

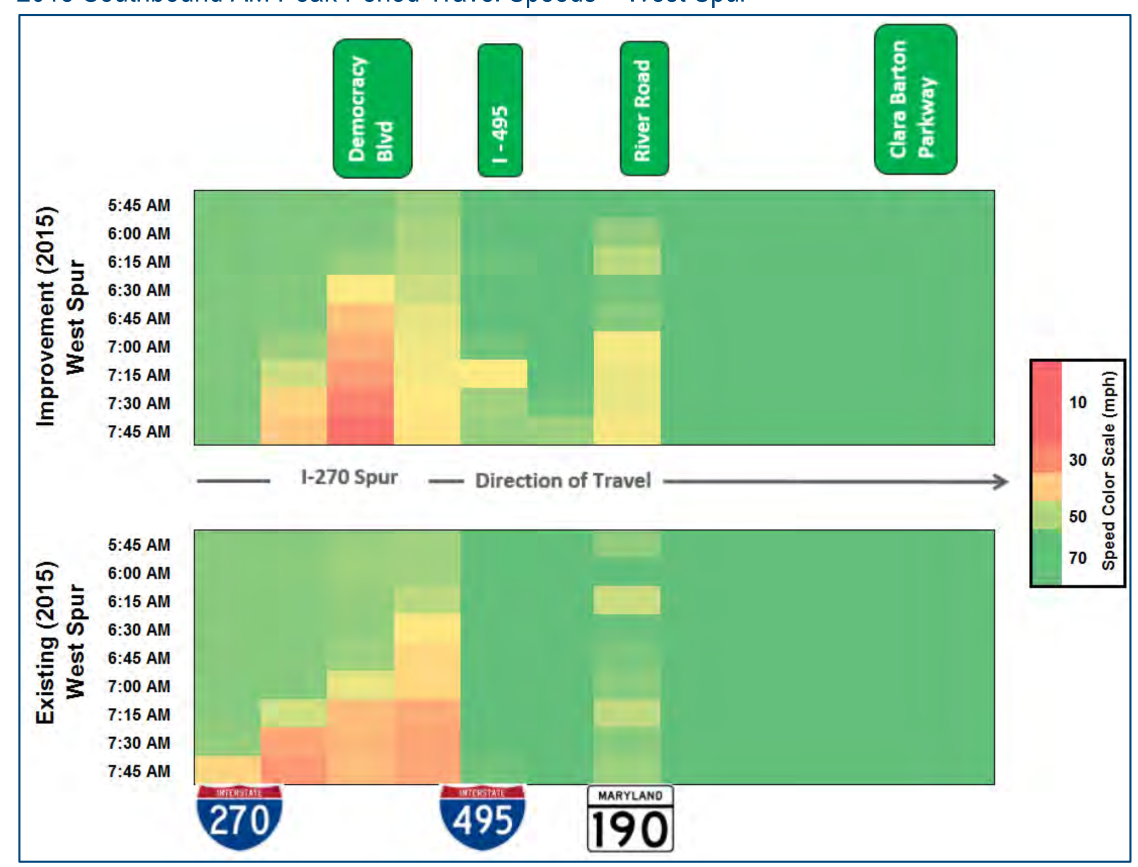
2015 Southbound AM Peak Period Travel Speeds – Express Lanes



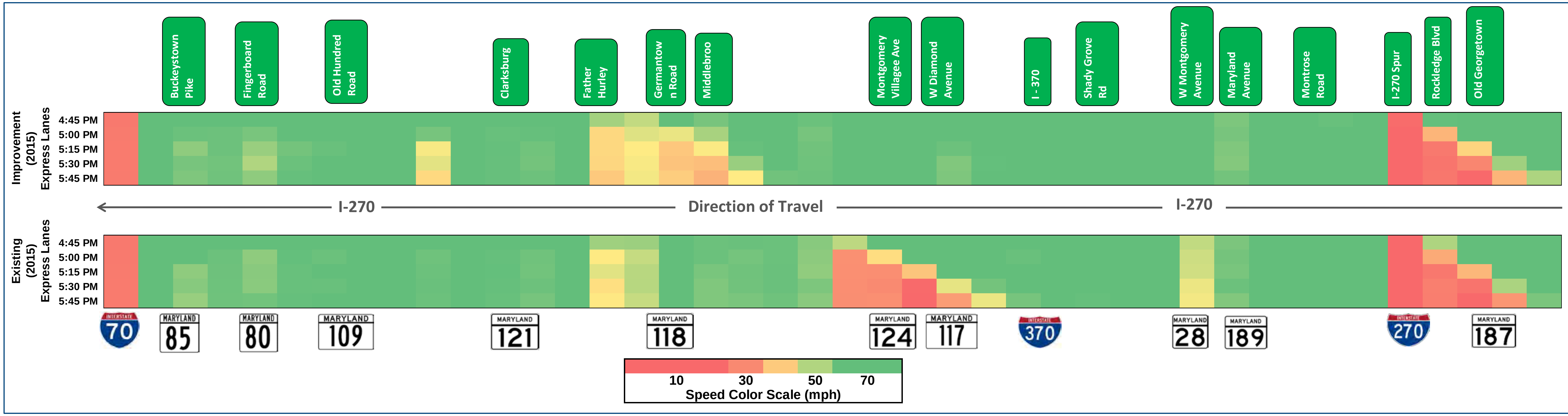
2015 Southbound AM Peak Period Travel Speeds – Local Lanes



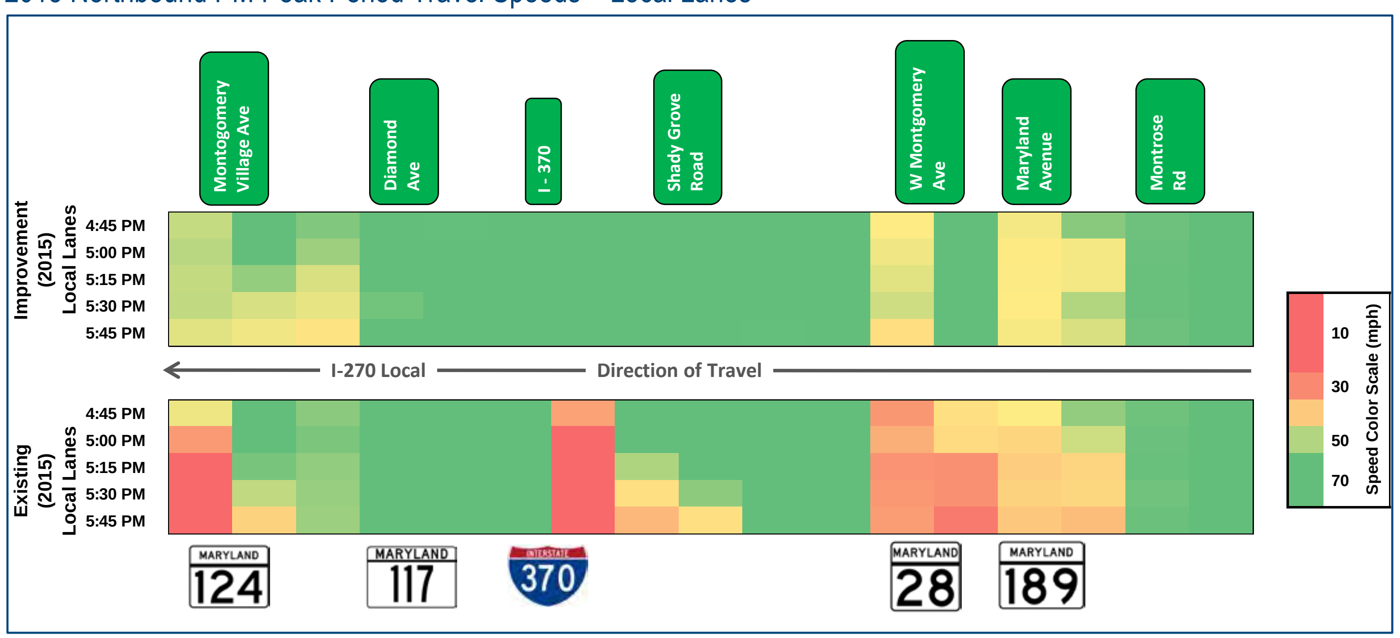
2015 Southbound AM Peak Period Travel Speeds – West Spur



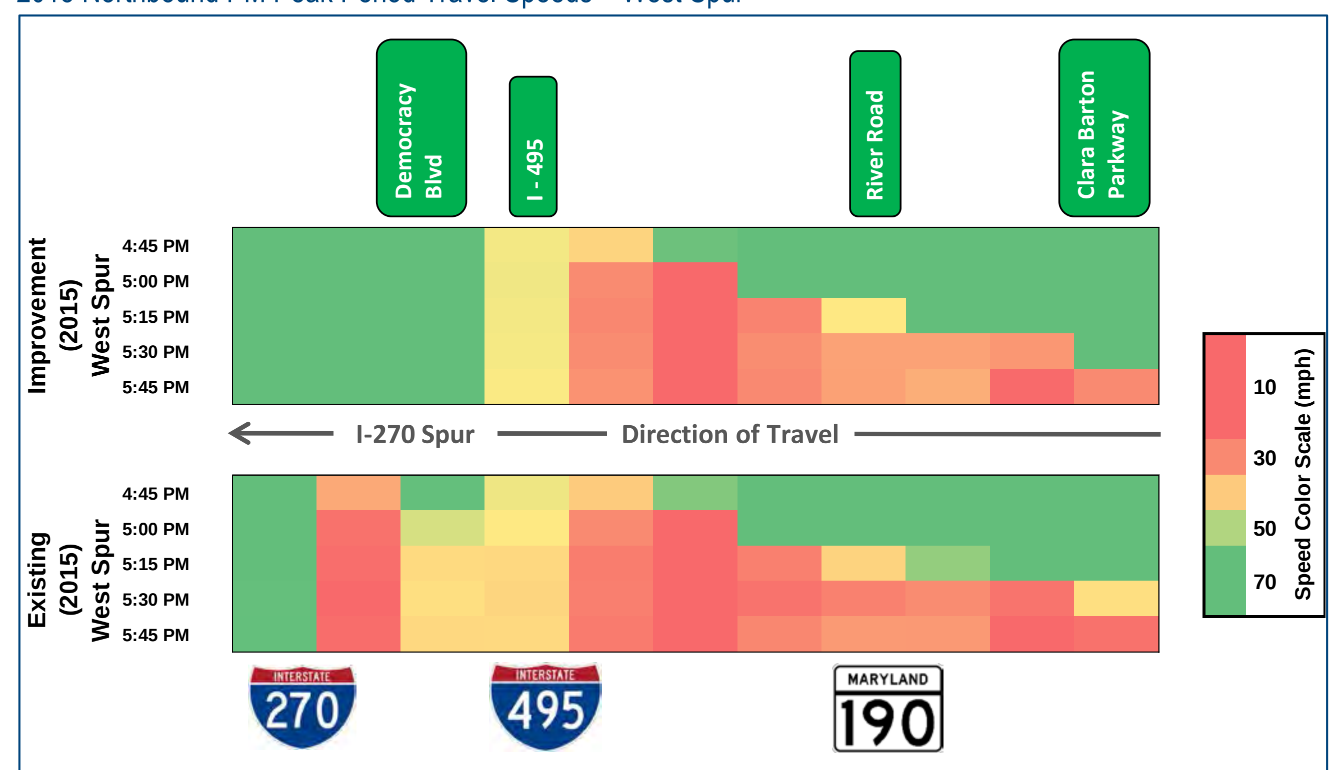
2015 Northbound PM Peak Period Travel Speeds – Express Lanes



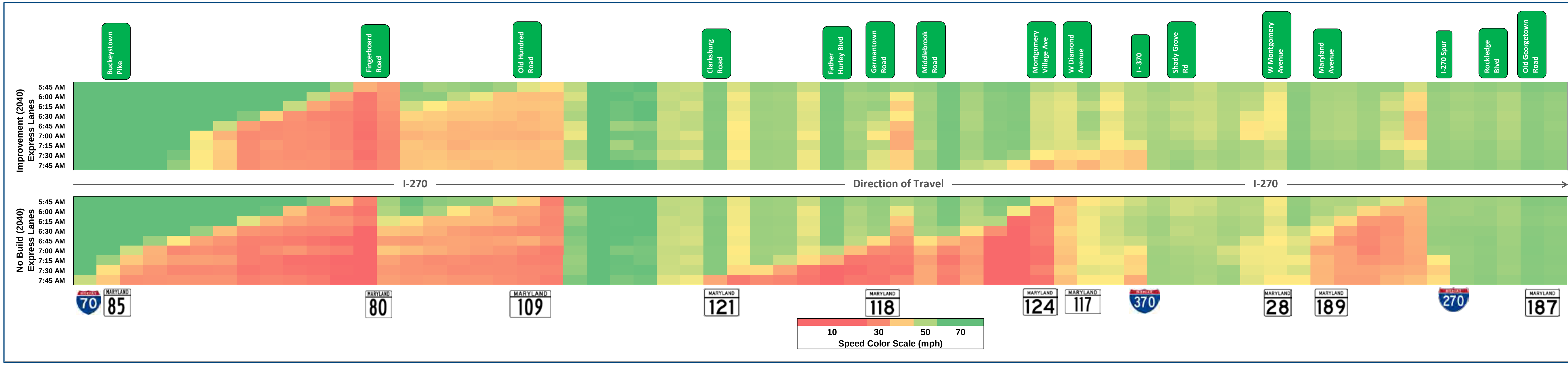
2015 Northbound PM Peak Period Travel Speeds – Local Lanes



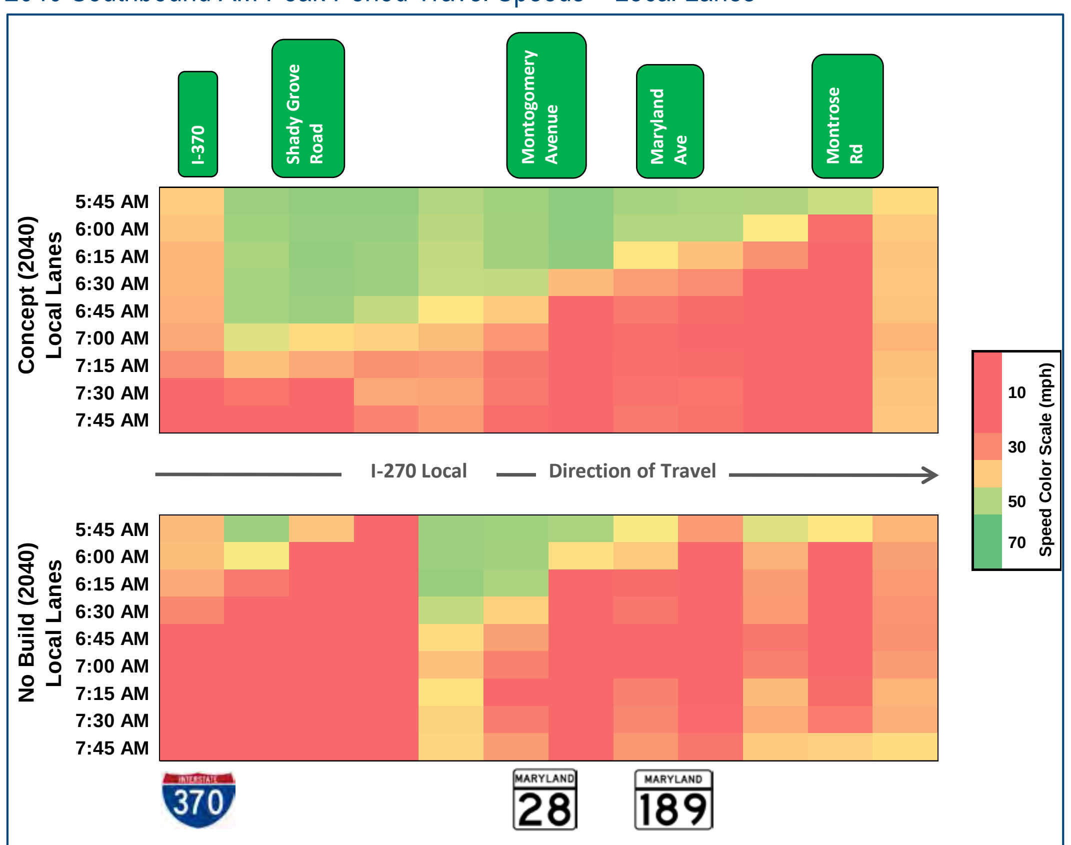
2015 Northbound PM Peak Period Travel Speeds – West Spur



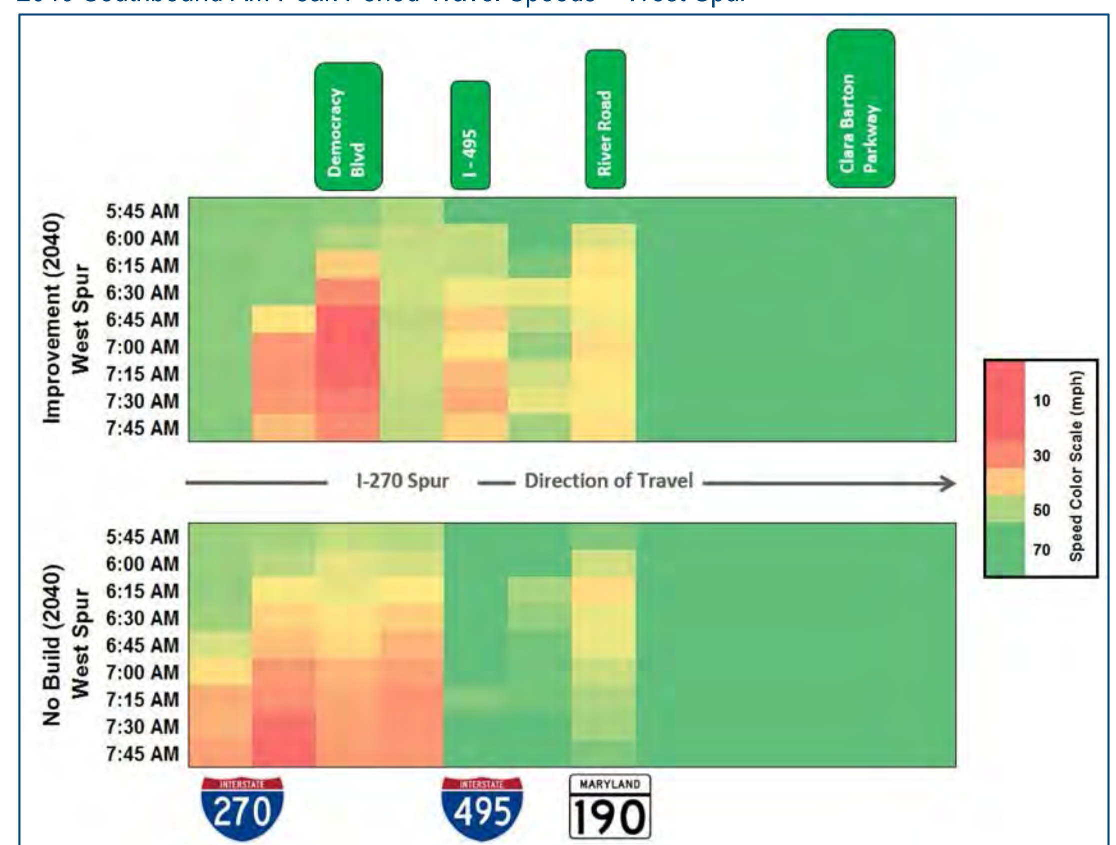
2040 Southbound AM Peak Period Travel Speeds – Express Lanes



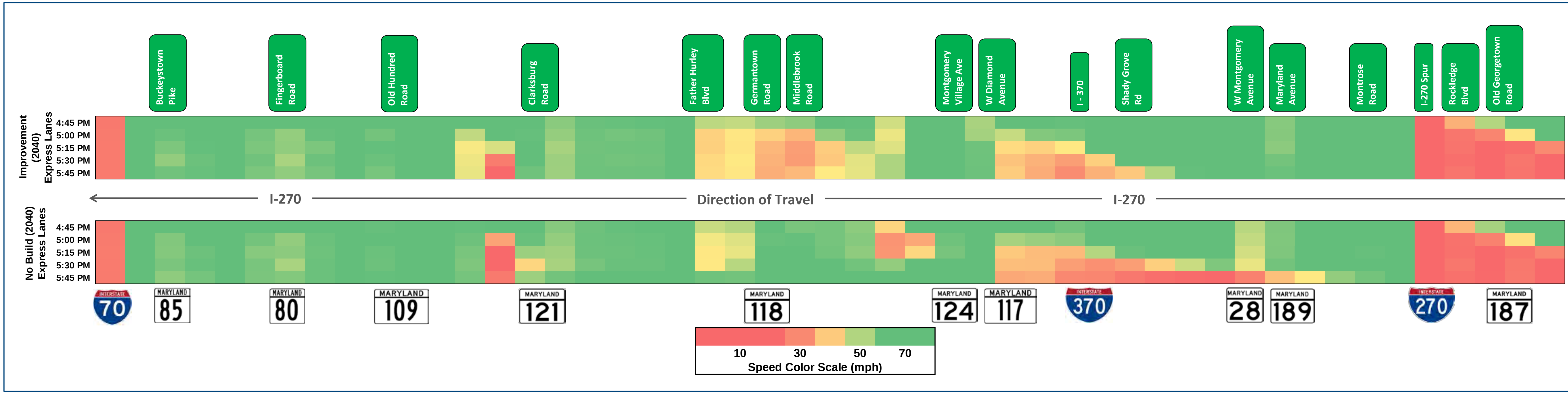
2040 Southbound AM Peak Period Travel Speeds – Local Lanes



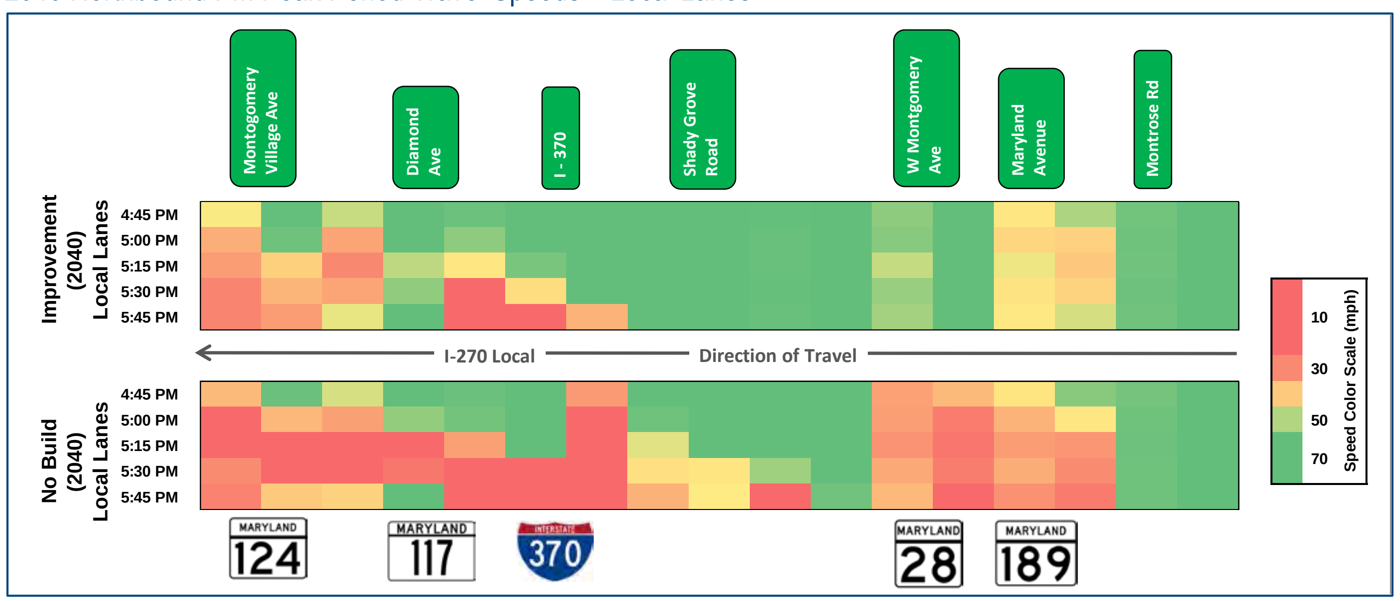
2040 Southbound AM Peak Period Travel Speeds – West Spur



2040 Northbound PM Peak Period Travel Speeds – Express Lanes



2040 Northbound PM Peak Period Travel Speeds – Local Lanes



2040 Northbound PM Peak Period Travel Speeds – West Spur

Submitted to:

State Highway Administration
Maryland Department of Transportation

Appendix G

INTERSTATE 270

Concept Evaluation Tables

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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Appendix G: Concept Evaluation Tables

The following pages present Concept Evaluation tables. SHA provided Concept Evaluation templates in order to compare no-build and build VISSIM simulation results for 2015 and 2040. The Concept Evaluation tables compare results for the following categories:

- Vehicle Travel Time and Speed
- Vehicle Density
- Vehicle Throughput
- Vehicle Queue Length
- Intersection Delay and Level of Service
- Network Performance

The tables were provided prepopulated with results from 2015 and 2040 no-build simulations. It is important to note that, as discussed in Appendix E – Model Calibration Memorandum, the 2040 no-build VISSIM files that were provided by SHA were revised. The SHA-provided files did not model the Watkins Mill Road interchange as depicted in final design plans that were also included with the RFP. In order to properly compare the results of the 2040 no-build and build scenarios, the files were revised to match the Watkins Mill Road interchange plans. Therefore, the Concept Evaluation table values for 2040 no-build that are contained in this appendix will not match the values in the Concept Evaluation tables that were provided by SHA.

The Concept Evaluation template files are also included electronically.

I-270 Concept Evaluation (VISSIM Results)

Table of Contents

2015 Conditions

AM Peak

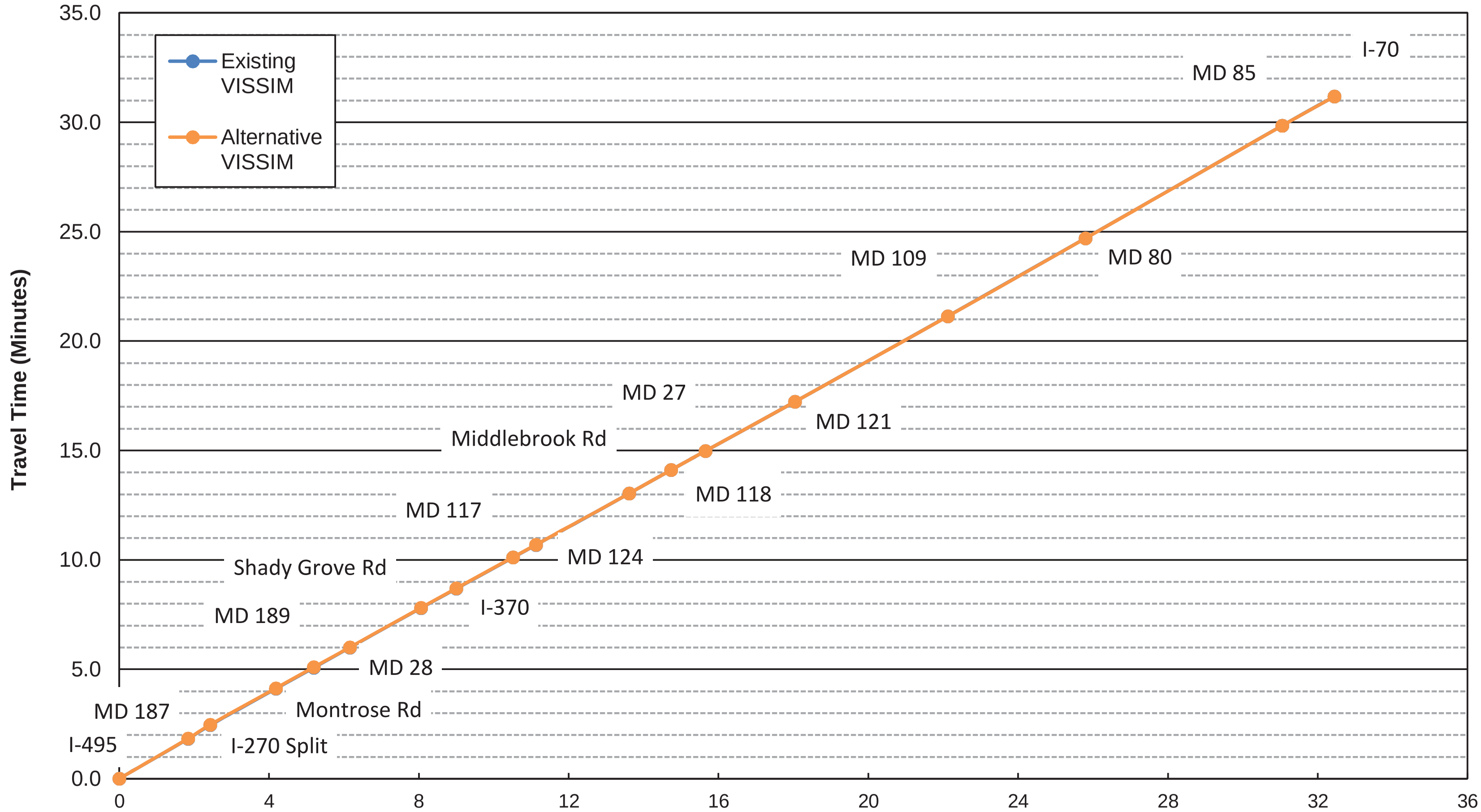
Table A.1: AM Peak - Existing - I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	109.0	109.7	0.9%	to MD 85	1.7	97.0	97.0	0.0%
to I-270 Split	0.6	37.5	38.1	0.0%	to MD 80	5.4	414.5	321.9	-22.4%
to Montrose Rd	1.8	100.1	99.9	0.0%	to MD 109	3.7	390.6	281.3	-28.1%
to MD 189	1.0	57.6	57.7	0.0%	to MD 121	3.6	273.2	265.1	-2.9%
to MD 28	1.0	55.1	54.7	0.0%	to MD 27	2.5	267.9	175.8	-34.3%
to Shady Grove Rd	1.9	108.4	108.5	0.0%	to MD 118	1.1	241.4	75.0	-68.9%
to I-370	0.9	53.0	53.0	0.0%	to Middlebrook Rd	1.1	211.7	87.3	-59.0%
to MD 117	1.5	85.5	85.4	0.0%	to MD 124	2.2	480.5	152.7	-68.1%
to MD 124	0.6	34.5	34.5	0.0%	to MD 117	0.9	148.4	71.0	-52.0%
to Middlebrook Rd	2.5	140.9	140.3	-0.7%	to I-370	1.0	90.2	75.8	-15.6%
to MD 118	1.1	64.8	64.9	0.0%	to Shady Grove Rd	1.5	190.3	103.2	-45.8%
to MD 27	0.9	51.8	51.8	0.0%	to MD 28	1.9	431.1	137.3	-68.2%
to MD 121	2.4	135.3	135.3	0.0%	to MD 189	1.0	227.1	68.4	-70.0%
to MD 109	4.1	234.5	234.0	0.0%	to Montrose Rd	1.0	276.2	72.0	-73.9%
to MD 80	3.7	213.8	213.9	0.0%	to I-270 Split	1.9	250.6	192.3	-23.5%
to MD 85	5.3	309.0	309.1	0.0%	to MD 187	0.4	30.0	30.2	0.0%
to I-70	1.4	79.9	79.8	0.0%	to I-495 interchange	1.9	131.8	132.8	0.8%
I-270 Total (miles/minutes)	**32.4**	**31.2**	**31.2**	**0.0%**	**I-270 Total (miles/minutes)**	**32.7**	**69.2**	**39.0**	**-43.5%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	32.2	32.2	0.0%	to I-270 Split	30.3	3990.6	2,176.2	-45.5%
to I-495	1.1	66.7	66.7	0.0%	to Democracy Blvd	0.7	88.4	77.3	-12.5%
to Democracy Blvd	1.4	91.2	92.3	1.1%	to I-495	1.3	183.1	180.1	-1.6%
to I-270 Split	0.9	51.0	50.5	0.0%	to MD 190	1.3	92.2	101.5	9.8%
to I-70	30.0	1724.3	1,722.8	-0.1%	to Cabin John Pkwy	0.6	35.0	35.1	0.0%
I-270 Spur Total (miles/minutes)	**34.0**	**32.8**	**32.7**	**0.0%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**73.2**	**42.8**	**-41.1%**

Table A.2: AM Peak - Existing - I-270 Local Vehicle Travel Time

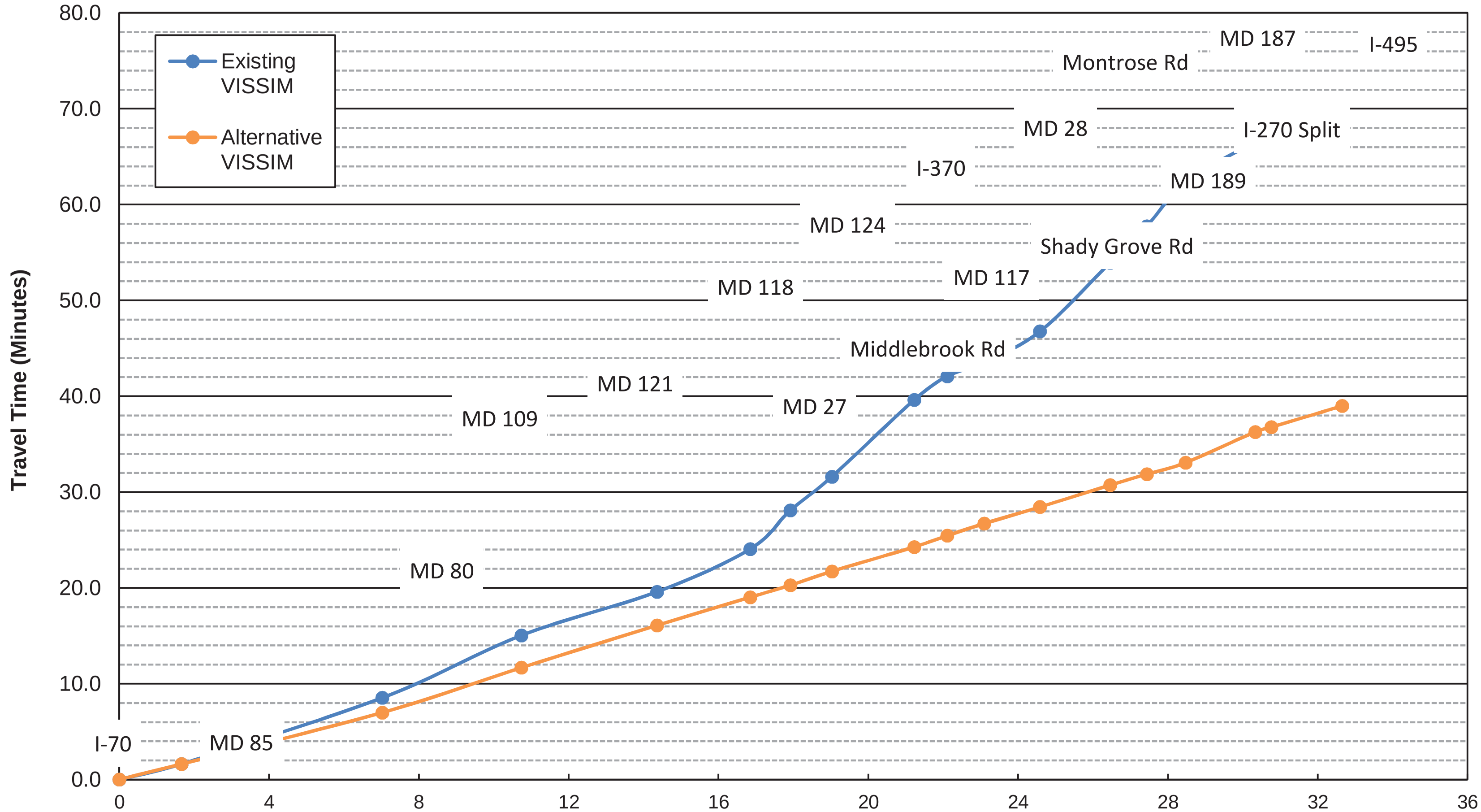
I-270 Northbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	51.6	52.5	1.9%	to Shady Grove	1.3	322.1	102.5	-68.0%
to MD 189	1.3	79.3	79.1	0.0%	to MD 28	1.8	264.8	143.3	-46.0%
to MD 28	1.0	60.7	58.5	-3.3%	to MD 189	1.1	249.5	157.7	-36.5%
to Shady Grove	2.0	119.1	119.1	0.0%	to Montrose	1.2	259.4	225.2	-13.1%
to I-370	1.0	56.3	55.8	0.0%	to I-270 mainline	0.9	144.4	186.7	29.9%
to MD 117	1.2	72.3	72.4	0.0%					
to MD 124	0.8	52.1	61.1	17.3%					
to I-270 mainline	0.4	21.4	21.1	0.0%					
I-270 Local Total (miles/minutes)	**8.5**	**8.5**	**8.7**	**0.0%**	**I-270 Local Total (miles/minutes)**	**6.3**	**20.7**	**13.6**	**-33.3%**

Figure A.1: AM Peak - Existing
I-270 Travel Time Graph - Northbound



Miles Along Corridor / *Direction of Traffic Flow* ↑

Figure A.2: AM Peak - Existing
I-270 Travel Time Graph - Southbound



Miles Along Corridor / *Direction of Traffic Flow*

Figure A.3: AM Peak - Existing
I-270 Spur Travel Time Graph - Northbound

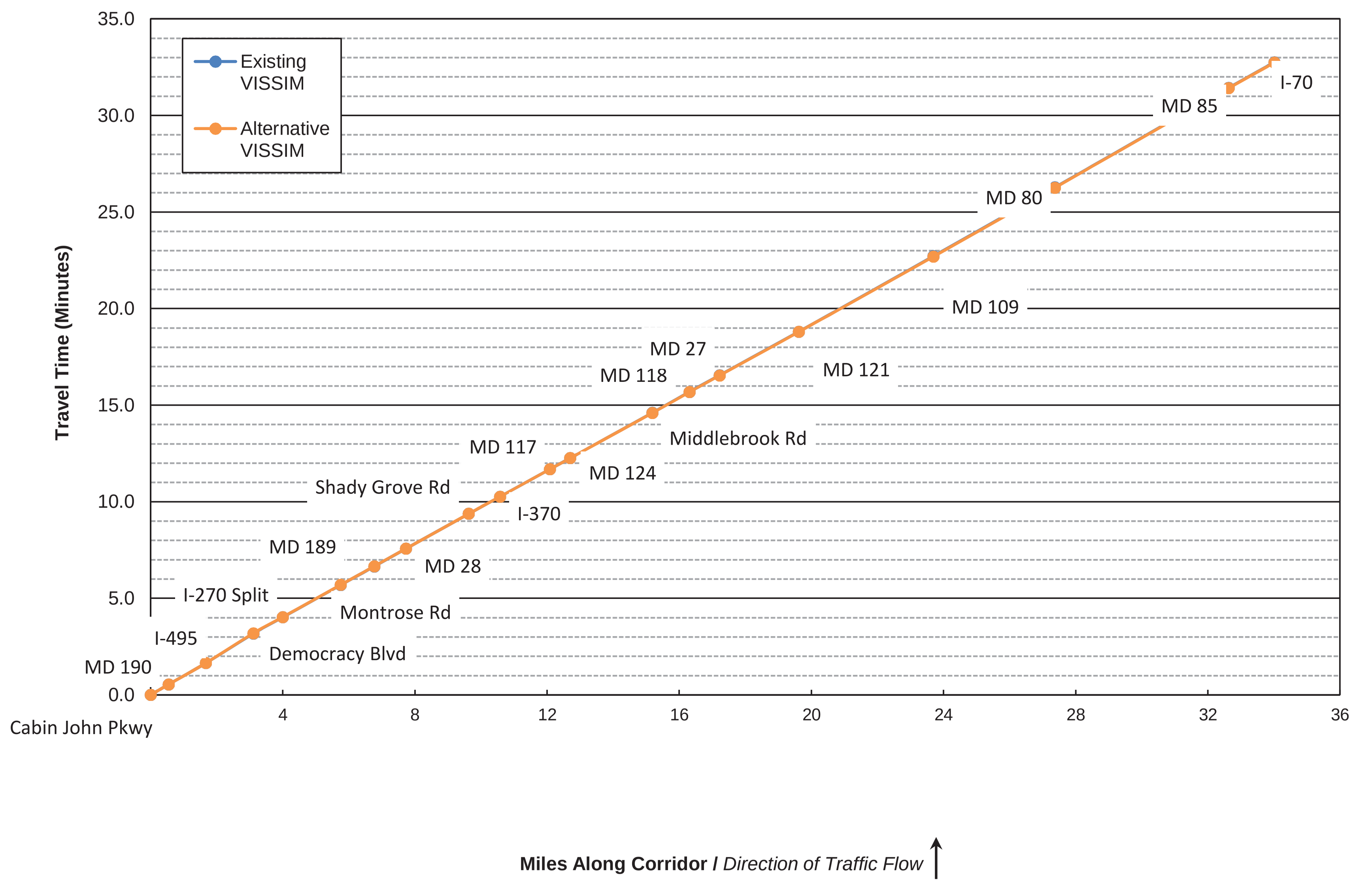


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Figure A.4: AM Peak - Existing
I-270 Spur Travel Time Graph - Southbound

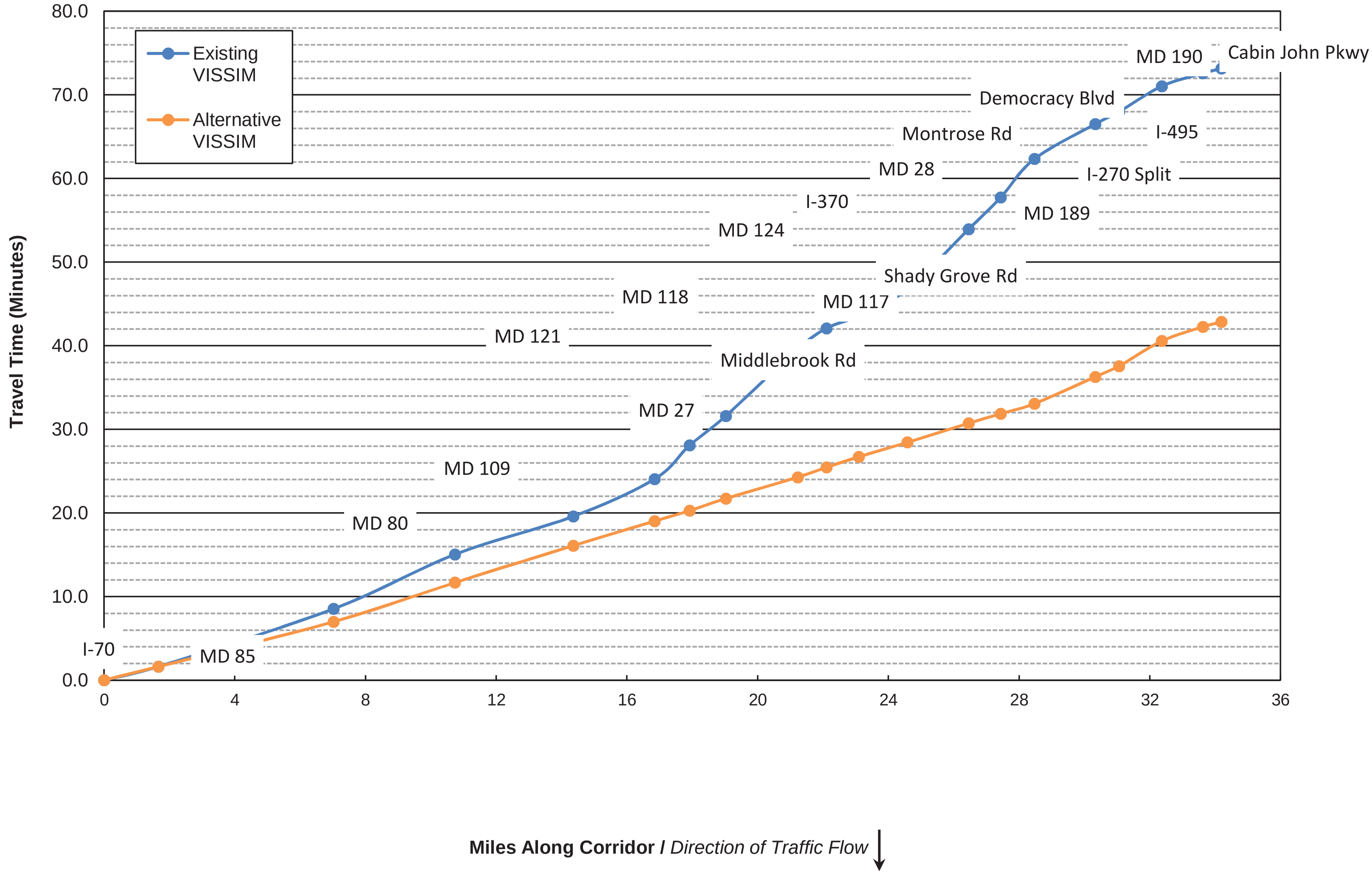

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Figure A.5: AM Peak - Existing
I-270 Local Travel Time Graph - Northbound

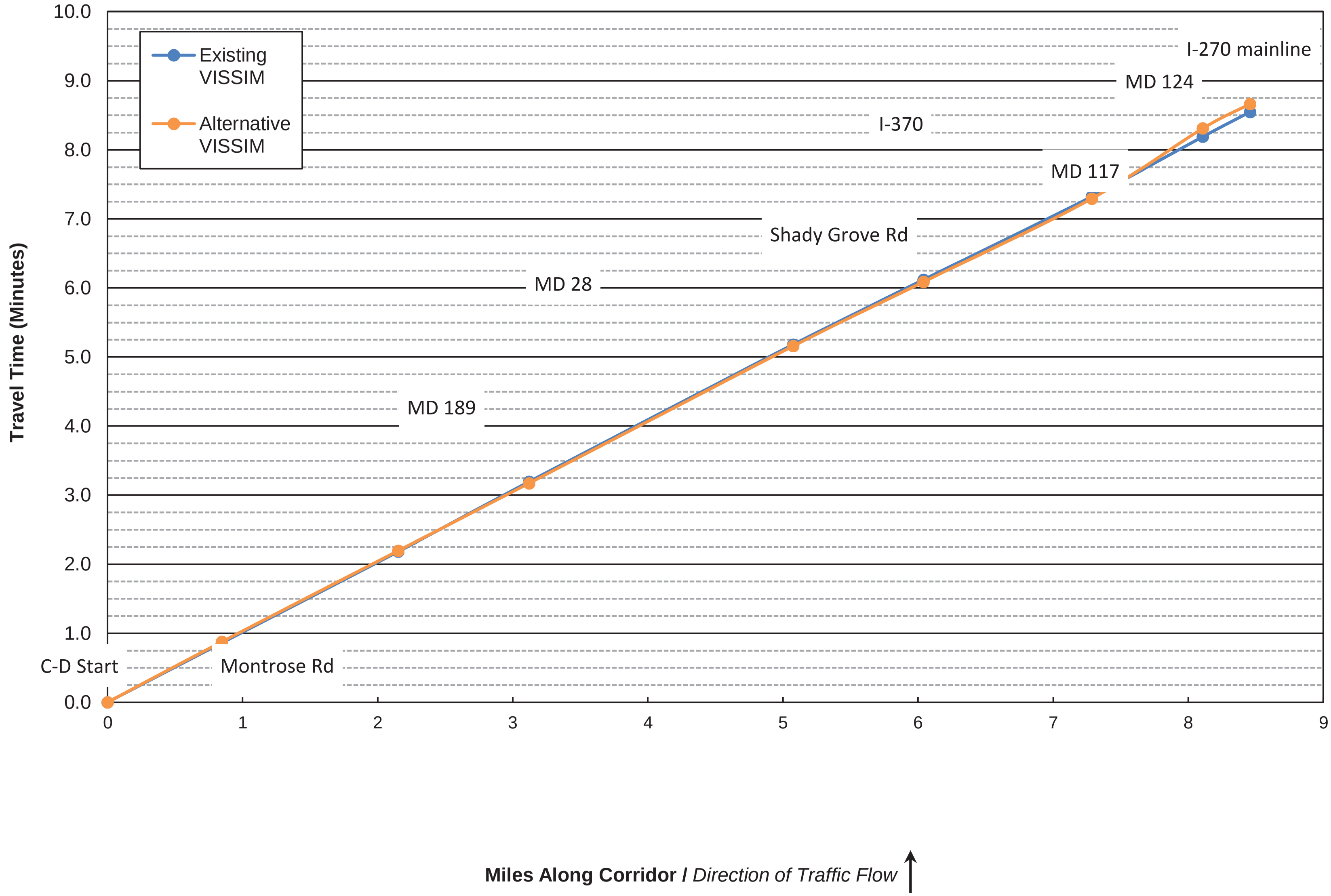

Figure A.6: AM Peak - Existing
I-270 Local Travel Time Graph - Southbound

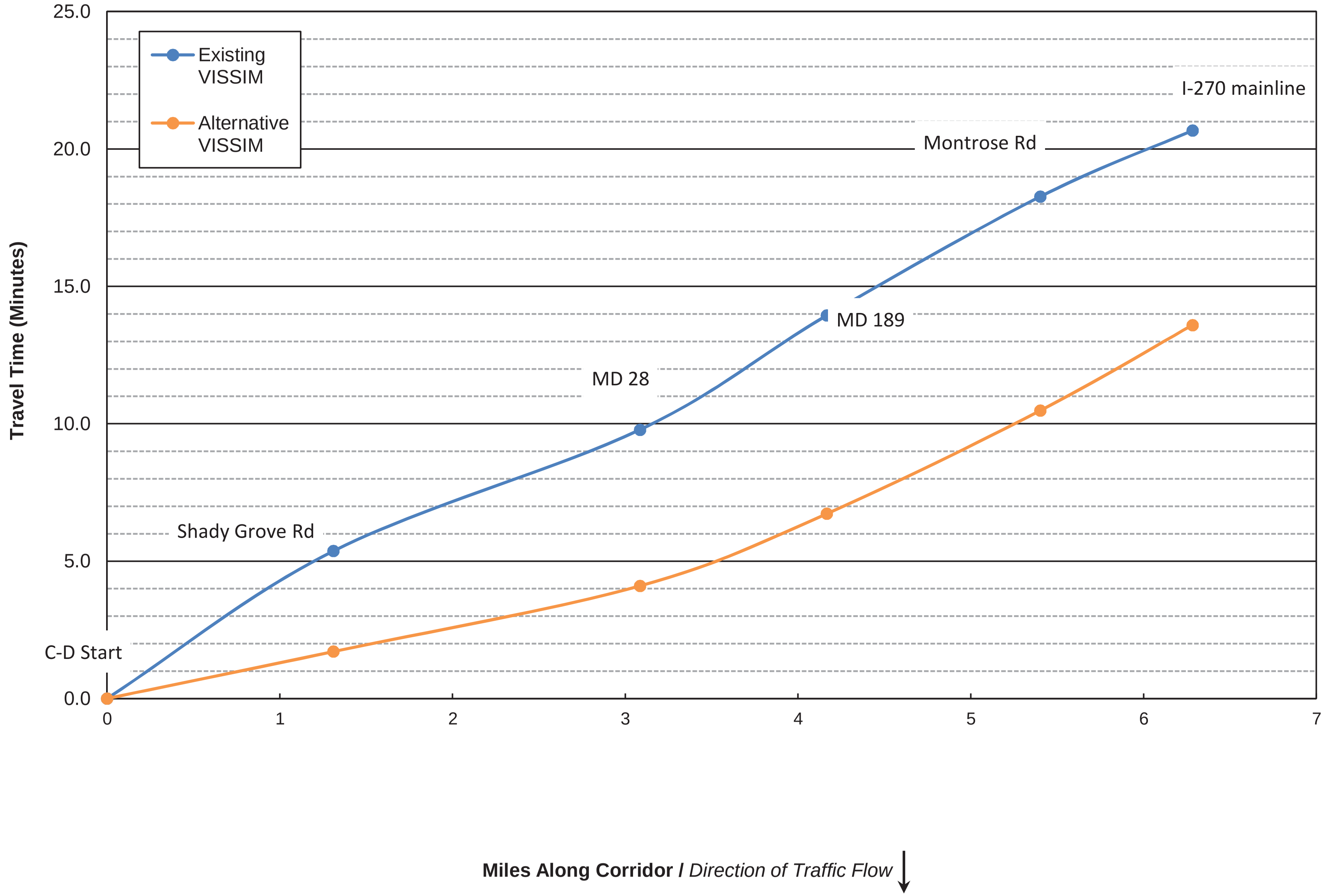

Table A.3: AM Peak - Existing - I-270 Vehicle Speed

I-270 Northbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	60.5	60.2	-1.6%	to MD 85	61.7	61.7	0.0%
to I-270 Split	56.7	55.8	-1.8%	to MD 80	46.5	59.9	27.7%
to Montrose Rd	63.0	63.2	0.0%	to MD 109	34.3	47.6	41.2%
to MD 189	63.3	63.2	0.0%	to MD 121	47.7	49.2	2.1%
to MD 28	62.9	63.4	0.0%	to MD 27	33.4	50.9	54.5%
to Shady Grove Rd	63.0	63.0	0.0%	to MD 118	16.0	51.5	218.8%
to I-370	64.1	64.1	0.0%	to Middlebrook Rd	18.9	45.8	142.1%
to MD 117	63.8	63.9	0.0%	to MD 124	16.5	51.8	225.0%
to MD 124	63.9	64.0	0.0%	to MD 117	21.5	44.9	104.5%
to Middlebrook Rd	63.6	63.8	0.0%	to I-370	39.3	46.8	20.5%
to MD 118	62.3	62.2	0.0%	to Shady Grove Rd	28.1	51.9	85.7%
to MD 27	63.6	63.7	0.0%	to MD 28	15.7	49.2	206.3%
to MD 121	63.7	63.7	0.0%	to MD 189	15.5	51.5	240.0%
to MD 109	62.6	62.7	0.0%	to Montrose Rd	13.5	51.6	300.0%
to MD 80	61.9	61.9	0.0%	to I-270 Split	26.7	34.8	29.6%
to MD 85	61.2	61.2	0.0%	to MD 187	52.3	51.9	0.0%
to I-70	62.7	62.8	0.0%	to I-495 interchange	51.7	51.3	-1.9%
I-270 Total (miles/minutes)	**62.4**	**62.4**	**0.0%**	**I-270 Total (miles/minutes)**	**28.3**	**50.3**	**78.6%**
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	60.3	60.3	0.0%	to I-270 Split	27.4	50.2	85.2%
to I-495	61.2	61.2	0.0%	to Democracy Blvd	29.8	34.0	13.3%
to Democracy Blvd	56.6	55.9	-1.8%	to I-495	25.8	26.2	0.0%
to I-270 Split	62.9	63.6	1.6%	to MD 190	48.9	44.5	-10.2%
to I-70	62.7	62.7	0.0%	to Cabin John Pkwy	58.6	58.5	-1.7%
I-270 Spur Total (miles/minutes)	**62.3**	**62.3**	**0.0%**	**I-270 Spur Total (miles/minutes)**	**28.0**	**47.9**	**71.4%**

Table A.4: AM Peak - Existing - I-270 Local Vehicle Speed

I-270 Northbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	59.0	57.9	-1.7%	to Shady Grove	14.6	46.0	206.7%
to MD 189	59.3	59.5	0.0%	to MD 28	24.1	44.6	87.5%
to MD 28	57.4	59.5	5.3%	to MD 189	15.6	24.7	56.3%
to Shady Grove	59.1	59.1	0.0%	to Montrose	17.1	19.7	17.6%
to I-370	61.7	62.3	0.0%	to I-270 mainline	22.0	17.0	-22.7%
to MD 117	62.1	62.0	0.0%				
to MD 124	56.8	48.5	-15.8%				
to I-270 mainline	58.9	59.8	1.7%				
I-270 Local Total (miles/minutes)	**59.4**	**58.6**	**0.0**	**I-270 Local Total (miles/minutes)**	**18.2**	**27.7**	**0.6**

Figure A.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table A.5: AM Peak - Existing - I-270 Vehicle Density

		Existing		Alternative					Existing		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	25	C	25	C	0%	I-270	Freeway	20	C	20	C	0%
I-270 Diverge to MD 187	Diverge	19	B	19	B	0%	I-270 Merge from WB I-70	Merge	13	B	13	B	0%
I-270	Freeway	22	C	22	C	0%	I-270	Freeway	24	C	24	C	0%
I-270 Diverge to Rockledge Rd	Diverge	19	B	19	B	0%	I-270 Merge from EB I-70	Merge	20	B	20	B	0%
I-270	Freeway	19	C	19	C	0%	I-270	Freeway	28	D	28	D	0%
I-270 Weave from MD 187 to I-270 HOV	Weave	10	B	11	B	10%	I-270 Diverge to SB MD 85	Diverge	31	D	31	D	0%
I-270 Lane Drop	Merge	15	B	15	B	0%	I-270	Freeway	27	D	27	D	0%
I-270	Freeway	27	D	27	D	0%	I-270 Diverge to NB MD 85	Diverge	15	B	15	B	0%
I-270 Merge from I-270 Spur	Merge	24	C	20	B	-17%	I-270	Freeway	23	C	23	C	0%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	27	C	25	C	-7%	I-270 Merge from MD 85	Merge	14	B	14	B	0%
I-270	Freeway	23	C	22	C	-4%	I-270	Freeway	36	E	27	D	-25%
I-270 Diverge to C-D (MD 189)	Diverge	21	C	18	B	-14%	I-270 Diverge to MD 80	Diverge	39	E	19	B	-51%
I-270	Freeway	18	B	18	B	0%	I-270	Freeway	75	F	36	E	-52%
I-270 Diverge to C-D (MD 28)	Diverge	19	B	20	B	5%	I-270 Merge from MD 80	Merge	85	F	24	C	-72%
I-270	Freeway	15	B	15	B	0%	I-270	Freeway	55	F	39	E	-29%
I-270 Merge from C-D (MD 189)	Merge	18	B	18	B	0%	I-270 Diverge to MD 109	Diverge	33	D	21	C	-36%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	26	C	23	C	-12%	I-270	Freeway	66	F	42	E	-36%
I-270	Freeway	14	B	14	B	0%	I-270 Merge from MD 109	Merge	55	F	26	C	-53%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	13	B	14	B	8%	I-270	Freeway	47	F	46	F	-2%
I-270	Freeway	11	B	11	B	0%	I-270 Diverge to SB Weigh Station	Diverge	19	B	20	C	5%
I-270 Merge from C-D (Shady Grove Rd)	Merge	10	B	8	A	-20%	I-270	Freeway	39	E	38	E	-3%
I-270	Freeway	13	B	12	B	-8%	I-270 Merge from SB Weigh Station	Merge	20	C	20	C	0%
I-270 Merge from C-D (I-370)	Merge	11	B	11	B	0%	I-270	Freeway	41	E	41	E	0%
I-270 Diverge to C-D (MD 117)	Diverge	16	B	17	B	6%	I-270 Diverge to MD 121	Diverge	20	C	18	B	-10%
I-270	Freeway	13	B	13	B	0%	I-270	Freeway	31	D	27	D	-13%
I-270 Merge from C-D (MD 124)	Merge	14	B	14	B	0%	I-270 Merge from MD 121	Merge	32	D	23	C	-28%
I-270	Freeway	17	B	13	B	-24%	I-270	Freeway	53	F	33	D	-38%
I-270 Diverge to EB Middlebrook Rd	Diverge	11	B	8	A	-27%	I-270 Diverge to MD 27	Diverge	55	F	22	C	-60%
I-270	Freeway	15	B	10	A	-33%	I-270	Freeway	80	F	25	C	-69%
I-270 Diverge to WB Middlebrook Rd	Diverge	10	A	11	B	10%	I-270 Merge from WB MD 27	Merge	83	F	23	C	-72%
I-270	Freeway	14	B	14	B	0%	I-270	Freeway	78	F	32	D	-59%
I-270 Diverge to EB MD 118	Diverge	11	B	12	B	9%	I-270 Weave from EB MD 27 to MD 118	Weave	76	F	25	C	-67%
I-270 Diverge to WB MD 118	Diverge	14	B	15	B	7%	I-270	Freeway	89	F	33	D	-63%
I-270	Freeway	13	B	13	B	0%	I-270 Merge from WB MD 118	Merge	70	F	28	D	-60%
I-270 Weave from MD 118 to MD 27	Weave	13	B	13	B	0%	I-270	Freeway	85	F	45	E	-47%
I-270	Freeway	12	B	12	B	0%	I-270 Merge from EB MD 118	Merge	70	F	35	D	-50%
I-270 Merge from EB MD 27	Merge	13	B	13	B	0%	I-270	Freeway	75	F	39	E	-48%
I-270	Freeway	13	B	13	B	0%	I-270 Merge from Middlebrook Rd	Merge	99	F	38	E	-62%
I-270 Merge from WB MD 27	Merge	10	A	10	A	0%	I-270	Freeway	107	F	36	E	-66%
I-270	Freeway	14	B	14	B	0%	I-270 Diverge to MD 124	Diverge	93	F	25	C	-73%
I-270 Diverge to MD 121	Diverge	10	A	10	A	0%	I-270	Freeway	92	F	35	E	-62%

Table A.5: AM Peak - Existing - I-270 Vehicle Density

		Existing		Alternative					Existing		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	12	B	12	B	0%	I-270 Merge from WB MD 124	Merge	119	F	36	E	-70%
I-270 Merge from EB MD 121	Merge	9	A	9	A	0%	I-270	Freeway	47	F	42	E	-11%
I-270 Lane Drop	Merge	13	B	13	B	0%	I-270 Merge from MD 117	Merge	46	F	47	F	2%
I-270	Freeway	18	C	13	B	-28%	I-270	Freeway	48	F	44	E	-8%
I-270 Diverge to NB Weigh Station	Diverge	10	A	10	B	0%	I-270 Diverge to I-370	Diverge	43	F	33	D	-23%
I-270	Freeway	20	C	20	C	0%	I-270	Freeway	51	F	35	D	-31%
I-270 Merge from NB Weight Station	Merge	10	B	10	B	0%	I-270 Diverge to I-270 C-D	Diverge	81	F	29	D	-64%
I-270	Freeway	20	C	20	C	0%	I-270	Freeway	36	E	23	C	-36%
I-270 Diverge to MD 109	Diverge	11	B	11	B	0%	I-270 Merge from I-270 (I-370)	Merge	94	F	23	C	-76%
I-270	Freeway	19	C	19	C	0%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	87	F	32	D	-63%
I-270 Merge from MD 109	Merge	10	B	10	A	0%	I-270	Freeway	90	F	26	D	-71%
I-270	Freeway	20	C	20	C	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	102	F	20	C	-80%
I-270 Diverge to MD 80	Diverge	12	B	12	B	0%	I-270	Freeway	86	F	32	D	-63%
I-270	Freeway	18	B	18	B	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	107	F	33	D	-69%
I-270 Merge from MD 80	Merge	12	B	12	B	0%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	89	F	38	E	-57%
I-270	Freeway	22	C	22	C	0%	I-270	Freeway	100	F	31	D	-69%
I-270 Diverge to Scenic View	Diverge	11	B	11	B	0%	I-270 Merge from I-270 C-D (MD 189)	Merge	123	F	32	D	-74%
I-270	Freeway	22	C	22	C	0%	I-270	Freeway	83	F	64	F	-23%
I-270 Merge from Scenic View	Merge	11	B	11	B	0%	I-270 Merge from I-270 C-D	Merge	41	F	31	D	-24%
I-270	Freeway	22	C	22	C	0%	I-270 Diverge to I-270 HOV Lane	Diverge	21	C	32	D	52%
I-270 Diverge to NB MD 85	Diverge	12	B	13	B	8%	I-270 Diverge to I-270 Spur	Diverge	40	E	28	D	-30%
I-270	Freeway	21	C	21	C	0%	I-270	Freeway	24	C	27	D	13%
I-270 Diverge to SB MD 85	Diverge	16	B	16	B	0%	I-270 Diverge to Rockledge Dr / MD 187	Diverge	16	B	20	C	25%
I-270	Freeway	17	B	17	B	0%	I-270	Freeway	25	C	28	D	12%
I-270 Weave from MD 85 to I-70	Weave	11	B	11	B	0%	I-270 Merge from Rockledge Dr	Merge	20	B	22	C	10%
I-270	Freeway	15	B	15	B	0%	I-270	Freeway	25	C	29	D	16%
						0%	I-270 Merge from Rockledge Dr / MD 187	Merge	22	C	25	C	14%
						0%	I-270	Freeway	27	D	31	D	15%

Table A.6: AM Peak - Existing - I-270 Spur Vehicle Density

		Existing		Alternative					Existing		Alternative		
I-270 Spur Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 Spur	Freeway	34	D	34	D	0%	I-270 Spur	Freeway	48	F	35	D	-27%
I-270 Spur Merge from Clara Barton Parkway	Merge	24	C	24	C	0%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	53	F	52	F	-2%
I-270 Spur	Freeway	37	E	37	E	0%	I-270 Spur	Freeway	52	F	95	F	83%
I-270 Diverge to MD 190	Diverge	27	C	27	C	0%	I-270 Merge from Democracy Blvd	Merge	28	D	50	F	79%
I-270 Spur	Freeway	32	D	32	D	0%	I-270 Spur Lane Drop	Merge	52	F	47	F	-10%
I-270 Spur Merge from Cabin John Parkway	Merge	23	C	23	C	0%	I-270 Spur	Freeway	72	F	35	E	-51%
I-270 Spur Merge from MD 190	Merge	23	C	23	C	0%	I-270 Spur Merge from I-495	Merge	37	E	49	F	32%
I-270 Spur	Freeway	30	D	30	D	0%	I-270 Spur	Freeway	39	E	45	E	15%
I-270 Spur Diverge to I-495	Merge	32	D	32	D	0%	I-270 Spur Diverve to EB MD 190	Diverge	46	F	58	F	26%
I-270 Spur	Freeway	31	D	31	D	0%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	27	C	29	D	7%
I-270 Spur Diverge to Democracy Blvd	Diverge	25	C	26	C	4%	I-270 Spur	Freeway	28	D	30	D	7%
I-270 Spur	Freeway	23	C	23	C	0%	I-270 Merge from MD 190	Merge	25	C	26	C	4%
I-270 Spur Merge from EB Democracy Blvd	Merge	15	B	15	B	0%	I-270 Spur	Freeway	33	D	35	E	6%
I-270 Spur	Freeway	23	C	23	C	0%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	22	C	23	C	5%
I-270 Spur Merge from WB Democracy Blvd	Merge	15	B	15	B	0%	I-270 Spur	Freeway	32	D	34	D	6%
I-270 Spur	Freeway	23	C	15	B	-35%	I-270 Merge from Clara Barton Pkwy	Merge	28	D	29	D	4%
I-270 Spur Merge from Westlake Terrace	Merge	23	C	16	B	-30%							
I-270 Spur	Freeway	24	C	16	B	-33%							

Table A.7: AM Peak - Existing - I-270 Local Vehicle Density

I-270 Northbound	Type	Existing Density (pc/mi/ln)	Existing LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change	I-270 Souhbound	Type	Existing Density (pc/mi/ln)	Existing LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change
I-270 C-D	Freeway	33	D	33	D	0%	I-270 C-D	Freeway	87	F	26	D	-70%
I-270 C-D Diverge to EB Montrose Rd	Diverge	21	C	21	C	0%	I-270 C-D Weave from I-370 EB to I-270	Weave	88	F	33	D	-63%
I-270 C-D	Freeway	19	C	19	C	0%	I-270 C-D Diverge to Shady Grove Rd	Diverge	53	F	27	C	-49%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	13	B	13	B	0%	I-270 C-D	Freeway	76	F	22	C	-71%
I-270 C-D	Freeway	18	B	18	B	0%	I-270 C-D Merge from WB Shady Grove Rd	Merge	62	F	17	B	-73%
I-270 C-D Merge from WB Montrose Rd	Merge	20	B	20	C	0%	I-270 C-D	Freeway	75	F	29	D	-61%
I-270 C-D	Freeway	28	D	28	D	0%	I-270 C-D Merge from EB Shady Grove Rd	Merge	53	F	17	B	-68%
I-270 C-D Merge from I-270	Merge	28	D	28	D	0%	I-270 C-D	Freeway	68	F	37	E	-46%
I-270 C-D	Freeway	29	D	29	D	0%	I-270 C-D Merge from I-270	Merge	75	F	36	E	-52%
I-270 C-D Diverge to MD 189	Diverge	16	B	16	B	0%	I-270 C-D Diverge to I-270	Diverge	42	F	39	E	-7%
I-270 C-D	Freeway	22	C	22	C	0%	I-270 C-D Diverge to I-270	Diverge	29	D	39	E	34%
I-270 C-D Merge from MD 189	Merge	15	B	13	B	-13%	I-270 C-D	Freeway	20	C	31	D	55%
I-270 C-D	Freeway	29	D	12	B	-59%	I-270 C-D Diverge to MD 28	Diverge	13	B	19	B	46%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	28	C	16	B	-43%	I-270 C-D	Freeway	20	C	27	D	35%
I-270 C-D	Freeway	30	D	22	C	-27%	I-270 C-D Merge from WB MD 28	Merge	36	E	26	C	-28%
I-270 C-D Diverge to MD 28	Diverge	21	C	28	C	33%	I-270 C-D	Freeway	64	F	33	D	-48%
I-270 C-D	Freeway	26	C	27	D	4%	I-270 C-D Merge from EB MD 28	Merge	134	F	42	F	-69%
I-270 C-D Weave between MD 28 Ramps	Weave	35	D	35	D	0%	I-270 C-D	Freeway	109	F	50	F	-54%
I-270 C-D	Freeway	10	A	10	A	0%	I-270 C-D Merge from I-270	Merge	112	F	51	F	-54%
I-270 C-D Merge from MD 28 WB	Merge	7	A	7	A	0%	I-270 C-D	Freeway	79	F	46	F	-42%
I-270 C-D Merge from I-270 and Drop Lane	Merge	9	A	9	A	0%	I-270 C-D Diverge to MD 189	Diverge	48	F	53	F	10%
I-270 C-D Diverge to I-270	Diverge	14	B	15	B	7%	I-270 C-D	Freeway	113	F	69	F	-39%
I-270 C-D	Freeway	23	C	24	C	4%	I-270 C-D Merge from MD 189	Merge	110	F	61	F	-45%
I-270 C-D Diverge to Shady Grove Rd	Diverge	19	B	19	B	0%	I-270 C-D Diverge to I-270	Diverge	68	F	72	F	6%
I-270 C-D	Freeway	5	A	5	A	0%	I-270 C-D	Freeway	40	E	81	F	103%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	9	A	6	A	-33%	I-270 C-D Diverge to WB Montrose Rd	Diverge	26	C	45	F	73%
I-270 C-D	Freeway	9	A	7	A	-22%	I-270 C-D	Freeway	53	F	90	F	70%
I-270 C-D Merge from WB Shady Grove Rd	Merge	10	B	11	B	10%	I-270 Weave between Montrose Rd Loops	Weave	61	F	86	F	41%
I-270 C-D Diverge to I-270	Diverge	15	B	14	B	-7%	I-270 C-D	Freeway	67	F	82	F	22%
I-270 C-D	Freeway	14	B	14	B	0%	I-270 C-D Merge from EB Montrose Rd	Merge	54	F	59	F	9%
I-270 C-D Diverge to I-370	Diverge	13	B	15	B	15%	I-270 C-D	Freeway	59	F	58	F	-2%
I-270 C-D	Freeway	3	A	5	A	67%							
I-270 Merge from I-370 EB	Merge	6	A	7	A	17%							
I-270 C-D	Freeway	7	A	9	A	29%							
I-270 C-D Weave from I-370 to I-270	Weave	16	B	17	B	6%							
I-270 C-D	Freeway	11	A	11	A	0%							
I-270 C-D Weave from I-270 to MD 117	Weave	16	B	17	B	6%							
I-270 C-D Diverge to MD 124	Diverge	11	B	13	B	18%							
I-270 C-D	Freeway	2	A	2	A	0%							
I-270 C-D Merge from EB MD 124	Merge	5	A	5	A	0%							
I-270 C-D Merge From WB MD 124	Merge	8	A	7	A	-13%							

Table A.8: AM Peak - Existing - I-270 Vehicle Throughput

I-270 Northbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change	I-270 Southbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between I-495 and MD 187	4495	4495	0%	North of I-70	2502	2503	0%
Between MD 187 on and off ramps	3999	3999	0%	Between I-70 on ramps	2857	2856	0%
Between Rockledge Blvd on and off ramps	3361	3362	0%	From I-70 interchange to MD-85	4925	4925	0%
Between Rockledge Dr and I-270 Spur	3094	3093	0%	Between MD-85 on and off ramps	2771	2771	0%
Between I-270 Spur and Montrose Rd	8311	8306	0%	Between MD-85 and MD-80	3221	3220	0%
Between Montrose Rd on and off ramps	4705	4697	0%	Between MD-80 on and off ramps	3185	3000	-6%
Between Montrose Rd and MD 189	4376	4374	0%	Between MD-80 and Md-109	3861	3747	-3%
Between MD 189 and MD 28	4381	4375	0%	Between MD-109 on and off ramps	3800	3714	-2%
Between MD 28 on and off ramps	4677	4688	0%	Between MD-109 and MD-121	4257	4231	-1%
Between MD 28 and Shady Grove Rd	3378	3387	0%	Between MD-121 on and off ramps	4043	4073	1%
Between Shady Grove Rd and I-370	2853	2867	0%	Between MD-121 and MD-27	4694	4952	5%
Between I-370 on and off ramps	3129	2860	-9%	Between MD-27 on and off ramps	4342	4868	12%
Between I-370 and MD 117	4195	4198	0%	Between MD-27 and MD-118	4665	5312	14%
Between MD 117 and MD 124	3275	3266	0%	Between MD-118 on and off ramps	4480	5155	15%
Between MD-124 on and off ramps	3278	3269	0%	Between MD-118 and Middlebrook Rd	5032	5760	14%
Between Watkins Mill Rd and Middlebrook Rd	4082	4080	0%	Between Middlebrook Rd on and off ramps	5031	5770	15%
Between Middlebrook Rd on and off ramps	3784	3790	0%	Between Middlebrook Rd and MD-124	6737	7555	12%
Between Middlebrook Rd and MD 118	3344	3344	0%	Between MD-124 on and off ramps	5818	6578	13%
Between MD-118 on and off ramps	3008	3007	0%	Between MD-124 and MD-117	6930	7811	13%
Between MD 118 and MD 27	2831	2832	0%	Between MD-117 and I-370	8479	9491	12%
Between MD-27 on and off ramps	2232	2231	0%	Between I-370 on and off ramps	3024	3301	9%
Between MD 27 and MD 121	2515	2520	0%	Between I-370 on ramp to Shady Grove Rd	4111	4714	15%
Between MD-121 on and off ramps	2211	2223	1%	Between Shady Grove Rd and MD 28	3568	4329	21%
Between MD 121 and MD 109	2420	2428	0%	Between MD 28 on and off ramps	4420	5286	20%
Between MD-109 on and off ramps	2263	2264	0%	Between MD 28 and MD 189	3950	4734	20%
Between MD 109 and MD 80	2363	2369	0%	Between MD 189 and Montrose Rd	3941	4743	20%
Between MD-80 on and off ramps	2126	2123	0%	Between Montrose Rd on and off ramps	4968	5884	18%
Between MD 80 and MD 85	2656	2651	0%	Between Montose Rd and I-270 Spur	8098	9159	13%
Between MD-85 on and off ramps	2016	2018	0%	Between I-270 Spur and Rockledge Blvd	3901	4415	13%
Between MD 85 and I-70	2858	2861	0%	Between Rockledge Blvd on and off ramps	2845	3202	13%
North of I-70	1832	1832	0%	Between MD 187 on and off ramps	2986	3356	12%
				Between MD 187 and I-495	3083	3408	11%
I-270 Spur Northbound				**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	5178	5180	0%	Between I-270 Split and HOV on ramp	4233	4857	15%
Between Democracy Blvd on and off ramps	4035	4028	0%	Between HOV on ramp and Democracy Blvd	4165	4794	15%
Between Democracy Blvd and I-270 Split	4304	4294	0%	Between Democracy Blvd on and off ramps	3636	4169	15%
				Between Democracy Blvd and I-495	4140	4685	13%

Table A.9: AM Peak - Existing - I-270 Local Vehicle Throughput

I-270 Local Northbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change	I-270 Local Southbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	2355	2351	0%	Between I-370 on ramp and I-270 off ramp	4068	4904	21%
Between Montrose Rd EB on ramp and WB off ramp	2567	2562	0%	Between I-270 off ramp and Shady Grove off ramp	2942	3511	19%
Between Montrose Rd WB off ramp and on ramp	2151	2145	0%	Between Shady Grove off ramp and Shady Grove WB on ramp	1759	2050	17%
Between Montrose Rd WB on ramp and I-270 on ramp	3067	3070	0%	Between Shady Grove WB and EB on ramps	2398	2651	11%
Between I-270 on ramp and MD 189 off ramp	3387	3392	0%	Between Shady Grove on ramp and I-270 on ramp	2797	3008	8%
Between MD 189 ramps	2705	2710	0%	Between I-270 on ramp and I-270 off ramp1	3423	3768	10%
Between MD 189 off ramp and I-270 on ramp	3252	3261	0%	Between I-270 off ramp1 and I-270 off ramp2	2902	3208	11%
Between I-270 on ramp and I-270 off ramp	3988	3996	0%	Between I-270 off ramp2 and MD 28 off ramp	2031	2271	12%
Between I-270 off ramp and MD 28 EB off ramp	2948	2953	0%	Between MD 28 off ramp and MD 28 WB on ramp	1466	1636	12%
Between MD 28 EB off ramp to MD 28 EB on ramp	2599	2604	0%	Between MD 28 WB on ramp and MD 28 EB on ramp	1781	1925	8%
Between MD 28 EB on ramp and MD 28 WB off ramp	2664	2688	1%	Between MD 28 EB on ramp and I-270 on ramp	2841	3272	15%
Between MD 28 WB off ramp and MD 28 WB on ramp	1160	1181	2%	Between I-270 on ramp and MD 189 off ramp	3310	3769	14%
Between MD 28 WB on ramp and I-270 on ramp	1631	1652	1%	Between MD 189 on and off ramps	2671	3005	13%
Between I-270 on ramp and I-270 off ramp	2926	2951	1%	Between MD 189 on ramp and I-270 off ramp	3800	4047	7%
Between I-270 off ramp and Shady Grove off ramp	2518	2545	1%	Between I-270 off ramp and Montrose Rd off ramp	2573	2669	4%
Between Shady Grove off ramp and I-270 on ramp	321	322	0%	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2455	2519	3%
Between I-270 on ramp and Shady Grove WB on ramp	1562	1250	-20%	Between Montrose Rd WB on ramp and EB off ramp	3375	3420	1%
Between Shady Grove WB on ramp and I-270 off ramp	1887	1891	0%	Between Montrose Rd EB off and on ramps	2652	2684	1%
Between I-270 off ramp and I-370 off ramp	1609	1894	18%	Between Montrose Rd EB off ramp and I-270	3384	3414	1%
Between I-370 off ramp and I-370 EB on ramp	332	611	84%				
Between I-370 EB and WB on ramps	826	1107	34%				
Between I-370 WB on ramp and I-270 off ramp	2397	2675	12%				
Between I-270 off ramp and I-270 on ramp	1334	1336	0%				
Between I-270 on ramp and MD 117 off ramp	2251	2260	0%				
Between MD 117 off ramp and MD 124 off ramp	1034	1033	0%				
Between MD 124 off ramp and MD 124 EB on ramp	98	97	-1%				
Between MD 124 EB and WB on ramps	487	487	0%				
Between MD 124 on ramp I-270	815	813	0%				

Table A.10: AM Peak - Existing - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 189 C-D on ramp	0	0	0%	0	0	0%
MD 28 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	0	0	0%	0	0	0%
MD 124 C-D on ramp	0	0	0%	0	0	0%
MD 118 on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd EB on ramp	0	0	0%	0	0	0%
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Cabin John Pkwy on ramp	0	0	0%	0	0	0%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Montrose Rd EB on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 28 EB on ramp	0	0	0%	17	6	-65%
MD 28 WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
I-370 EB on ramp	0	0	0%	0	0	0%
I-370 WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 124 EB on ramp	0	0	0%	0	0	0%
MD 124 WB on ramp	0	0	0%	0	0	0%

Table A.11: AM Peak - Existing - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 187 off ramp NB	56	83	48%	347	397	14%
MD 187 off ramp SB	87	111	28%	439	543	24%
Rockledge Dr off ramp	5	10	100%	316	335	6%
Tower Oaks Blvd off ramp	14	15	7%	165	147	-11%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	11	11	0%	97	96	-1%
MD 189 off ramp EB	1	3	200%	131	274	109%
MD 28 off ramp EB	48	50	4%	296	290	-2%
MD 28 off ramp WB	1	0	-100%	119	0	-100%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	191	192	1%	620	690	11%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	218	249	14%	793	994	25%
MD 124 off ramp	340	422	24%	957	1237	29%
Watkins Mill Rd off ramp*						
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	19	4	-79%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	5	6	20%	83	94	13%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	0	0	0%	37	33	-11%
MD 121 off ramp EB	0	0	0%	0	0	0%
MD 109 off ramp EB	3	2	-33%	97	89	-8%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	5	5	0%	110	104	-5%
MD 80 off ramp WB	2	0	-100%	34	0	-100%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 85 SB off ramp	0	0	0%	66	38	-42%
I-270 Spur Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Clara Barton Pkwy off ramp EB	1	1	0%	157	157	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	1	0%	0	114	0%
MD 190 off ramp WB	0	0	0%	0	0	0%
Democracy Blvd off ramp WB	108	105	-3%	589	502	-15%
Democracy Blvd off ramp EB	16	15	-6%	149	123	-17%

* Ramp in Future Scenario

Table A.12: AM Peak - Existing - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	575	0	-100%	2307	0	-100%
MD 109 on ramp	66	0	-100%	841	0	-100%
MD 121 WB on ramp	8	0	-100%	263	0	-100%
MD 121 EB on ramp*						
MD 27 WB on ramp	145	0	-100%	1297	0	-100%
MD 27 EB on ramp	1	0	-100%	89	0	-100%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	0%	9	0	-100%
Middlebrook Rd on ramp	161	0	-100%	1641	0	-100%
MD 124 WB on ramp	254	0	-100%	2615	0	-100%
MD 117 on ramp	94	1	-99%	1640	88	-95%
I-370 C-D on ramp	805	0	-100%	1861	0	-100%
Shady Grove Rd C-D on ramp North	2	0	-100%	160	0	-100%
Shady Grove Rd C-D on ramp South	68	0	-100%	927	0	-100%
MD 189 C-D on ramp	1393	0	-100%	3991	0	-100%
Montrose Rd C-D on ramp	2	0	-100%	246	81	-67%
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd on ramp	0	0	0%	0	9	0%
I-495 Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 Spur on ramp	260	10	-96%	1015	240	-76%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 on ramp	2305	10	-100%	5053	478	-91%
I-370 on ramp	1241	0	-100%	2914	51	-98%
Shady Grove Rd WB on ramp	1	0	-100%	150	13	-91%
Shady Grove Rd EB on ramp	0	0	0%	29	32	10%
I-270 on ramp	0	0	0%	39	0	-100%
MD 28 WB on ramp	6	7	17%	121	56	-54%
MD 28 EB on ramp	3166	35	-99%	3877	125	-97%
I-270 on ramp	0	8	0%	55	315	473%
MD 189 on ramp	111	60	-46%	1104	499	-55%
Montrose Rd WB on ramp	8	28	250%	440	335	-24%
Montrose Rd EB on ramp	0	3	0%	95	117	23%

* Ramp in Future Scenario

Table A.13: AM Peak - Existing - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 SB off ramp	0	0	0%	0	0	0%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 80 off ramp	0	1	0%	69	101	46%
MD 109 off ramp WB	0	0	0%	7	6	-14%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	1	2	100%	93	108	16%
MD 121 off ramp WB	0	0	0%	0	0	0%
MD 27 off ramp EB	53	61	15%	279	264	-5%
MD 27 off ramp WB	45	7	-84%	289	175	-39%
MD 118 off ramp EB	31	34	10%	161	156	-3%
MD 118 off ramp WB	0	0	0%	0	0	0%
Watkins Mill Rd off ramp*						
MD 124 off ramp EB	75	92	23%	342	362	6%
MD 124 off ramp WB	18	24	33%	405	394	-3%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	6	11	83%	194	244	26%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	6	100%	132	162	23%
MD 189 off ramp EB	40	49	23%	296	324	9%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Rockledge Dr off ramp	18	55	206%	261	439	68%
I-270 Spur Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd off ramp EB	51	60	18%	230	254	10%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	995	1233	24%	2271	4295	89%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	0	0	0%

* Ramp in Future Scenario

Table A.14: AM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	18.8	B	NB Left	103	76	57	282	E	33.3	C
				NB Through	312	24	57	282	C		
				NB Right	581	6	6	284	A		
	SB	42.4	D	SB Left	110	57	123	552	E		
				SB Through	535	41	123	552	D		
				SB Right	52	24	123	552	C		
	EB	44.4	D	EB Left	81	70	42	165	E		
				EB Through	47	81	42	165	F		
				EB Right	102	7	42	165	A		
	WB	50.7	D	WB Left	204	72	75	302	E		
				WB Through	12	61	75	302	E		
				WB Right	100	6	75	302	A		
2- MD 85 at I-270 NB on and off ramp											
2	NB	42.6	D	NB Left	560	43	155	745	D	28.8	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	14.6	B	SB Left	0	0	0	0	A		
				SB Through	547	15	36	483	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	4.3	A	NB Left	0	0	0	0	A	10.2	B
				NB Through	812	4	12	316	A		
				NB Right	0	0	0	0	A		
	SB	41.3	D	SB Left	154	41	37	267	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	15.8	C	NB Left	10	57	34	262	E	19.8	B
				NB Through	585	15	34	262	B		
				NB U-Turn	0	0	0	0	A		
	SB	13.7	B	SB Left	57	68	23	146	E		
				SB Through	1657	14	55	477	B		
				SB Right	751	9	43	467	A		
	EB	49.1	D	EB Left	481	51	70	208	D		
				EB Through	19	62	70	208	E		
				EB Right	32	10	70	208	A		
	WB	43.1	D	WB Left	37	56	17	111	E		
				WB Through	15	59	17	111	E		
				WB Right	19	6	17	111	A		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.1	A	NB Left	3	0	0	0	A	16.1	B
				NB Through	2	0	0	0	A		
				NB Right	4	-2	0	0	A		
	SB	12.8	B	SB Left	183	15	12	115	B		
				SB Through	5	17	12	115	B		
				SB Right	52	4	1	16	A		
	EB	7.0	A	EB Left	38	8	6	165	A		
				EB Through	0	0	8	0	A		
				EB Right	7	4	13	196	A		
	WB	17.2	B	WB Left	31	13	1	48	B		
				WB Through	684	24	94	544	C		
				WB Right	504	8	6	182	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	4.1	A	NB Left	22	25	1	113	C	22.2	C
				NB Through	0	0	0	0	A		
				NB Right	262	2	1	113	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	23.0	C	EB Left	0	0	0	0	A		
				EB Through	241	22	26	226	C		
				EB Right	133	25	26	235	D		
	WB	47.1	E	WB Left	0	0	0	0	A		
				WB Through	194	47	126	641	E		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	2.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	8.3	A	SB Left	118	11	7	116	B		
				SB Through	0	0	0	0	A		
				SB Right	38	1	0	0	A		
	EB	3.2	A	EB Left	59	3	0	36	A		
				EB Through	0	0	0	0	A		
				EB Right	40	3	0	0	A		
	WB	0.4	A	WB Left	0	0	0	0	A		
				WB Through	462	0	0	54	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	2.5	A	NB Left	15	10	1	65	B	3.5	A
				NB Through	0	0	0	0	A		
				NB Right	41	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.4	A	EB Left	0	0	0	0	A		
				EB Through	59	0	0	34	A		
				EB Right	70	6	1	34	A		
	WB	3.6	A	WB Left	393	3	8	292	A		
				WB Through	109	5	8	269	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	8.4	A	NB Left	95	11	13	147	B	20.7	C
				NB Through	279	12	13	147	B		
				NB Right	198	2	17	173	A		
	SB	16.8	C	SB Left	47	11	31	312	B		
				SB Through	577	17	41	312	B		
				SB Right	6	13	46	333	B		
	EB	33.6	D	EB Left	7	37	86	427	D		
				EB Through	88	44	93	427	D		
				EB Right	547	32	117	459	C		
	WB	30.3	D	WB Left	96	35	19	123	D		
				WB Through	12	33	19	123	C		
				WB Right	21	7	13	142	A		
10- MD 121 at I-270 NB on and off ramp											
10	NB	1.7	A	NB Left	40	10	2	86	A	0.7	A
				NB Through	0	0	0	0	A		
				NB Right	253	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	318	0	0	0	A		
				EB Right	49	0	0	0	A		
	WB	0.6	A	WB Left	151	2	1	87	A		
				WB Through	1070	0	0	58	A		
				WB Right	0	0	0	0	A		

Table A.14: AM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	1.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.7	A	SB Left	123	10	6	120	B		
				SB Through	0	0	0	0	A		
				SB Right	46	1	0	0	A		
	EB	0.4	A	EB Left	25	2	0	35	A		
				EB Through	0	0	0	0	A		
				EB Right	833	0	0	0	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	277	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	48.0	D	NB U-Turn	0	0	0	0	A	19.3	B
				NB Through	34	63	10	64	E		
				NB Right	12	7	10	64	A		
	SB	40.9	D	SB Left	75	52	23	142	D		
				SB Through	43	60	30	226	E		
				SB Right	157	30	52	263	C		
	EB	13.0	B	EB Left	149	30	29	290	C		
				EB Through	1202	11	31	291	B		
				EB Right	50	9	38	329	A		
	WB	20.1	C	WB Left	83	15	138	788	B		
				WB Through	2047	21	138	788	C		
				WB Right	94	10	138	788	A		
13- MD 27 at I-270 NB off ramp											
13	NB	30.7	C	NB Left	89	31	12	90	C	11.6	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	891	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	15.7	B	WB Left	0	0	0	0	A		
				WB Through	2110	16	194	1341	B		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	24.7	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	49.6	D	SB Left	376	50	64	293	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	9.0	A	EB Left	0	0	0	0	A		
				EB Through	657	9	12	192	A		
				EB Right	0	0	0	0	A		
	WB	25.5	C	WB Left	0	0	0	0	A		
				WB Through	1263	25	195	645	C		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	17.8	B	NB Left	22	18	31	405	B	38.3	D
				NB Through	819	18	57	405	B		
				NB Right	72	16	60	418	B		
	SB	46.4	D	SB Left	407	69	356	1190	E		
				SB Through	1333	40	356	1190	D		
				SB Right	40	27	320	1184	C		
	EB	44.6	D	EB Left	177	49	47	169	D		
				EB Through	74	49	43	164	D		
				EB Right	60	27	44	196	C		
	WB	56.0	E	WB Left	8	63	85	273	E		
				WB Through	21	302	85	273	F		
				WB Right	104	6	85	273	A		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	3.4	A	NB Left	123	10	1	70	A	5.5	A
				NB Through	727	3	4	119	A		
				NB Right	79	1	8	171	A		
	SB	3.7	A	SB Left	25	5	5	169	A		
				SB Through	808	4	8	169	A		
				SB Right	32	2	9	202	A		
	EB	16.9	B	EB Left	15	64	8	69	E		
				EB Through	6	59	8	69	E		
				EB Right	96	7	8	69	A		
	WB	44.2	D	WB Left	30	65	12	94	E		
				WB Through	5	68	8	94	E		
				WB Right	21	9	11	113	A		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	11.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	33.0	C	EB Left	222	33	44	277	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	6.0	A	WB Left	0	0	0	0	A		
				WB Through	155	1	0	4	A		
				WB Right	778	7	16	276	A		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	7.4	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	41.5	D	SB Left	193	41.5	34	164	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	3.1	A	EB Left	0	0.0	0	0	A		
				EB Through	615	3.1	4	135	A		
				EB Right	0	0.0	0	0	A		
	WB	3.6	A	WB Left	0	0.0	0	0	A		
				WB Through	1036	3.6	7	209	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	45.2	D	NB Left	7	70	8	75	E	18.1	B
				NB Through	12	80	8	75	F		
				NB Right	14	3	0	22	A		
	SB	60.7	E	SB Left	241	58	98	368	E		
				SB Through	41	66	98	368	E		
				SB Right	81	67	98	368	E		
	EB	10.4	B	EB Left	102	13	28	310	B		
				EB Through	932	10	28	310	B		
				EB Right	27	9	28	310	A		
	WB	11.5	B	WB Left	73	17	31	246	B		
				WB Through	899	14	31	246	B		
				WB Right	277	4	31	246	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	16.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.7	B	SB Left	22	35	4	44	D		
				SB Through	0	0	0	0	A		
				SB Right	25	4	4	44	A		
	EB	14.2	B	EB Left	240	21	31	226	C		
				EB Through	865	12	31	226	B		
				EB Right	0	0	0	0	A		
	WB	17.7	B	WB Left	0	0	0	0	A		
				WB Through	1072	19	69	381	B		
				WB Right	215	13	92	431	B		

Table A.14: AM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	16.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.2	B	EB Left	0	0	0	0	A		
				EB Through	805	11	26	186	B		
				EB Right	0	0	0	0	A		
	WB	21.3	C	WB Left	743	21	64	867	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	63.1	E	NB Left	147	52	145	449	D	25.3	C
				NB Through	6	52	145	449	D		
				NB Right	342	68	145	449	E		
	SB	21.9	C	SB Left	3	37	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	3	7	2	67	A		
	EB	18.2	B	EB Left	28	12	124	845	B		
				EB Through	1483	19	124	845	B		
				EB Right	76	10	124	845	A		
	WB	16.1	B	WB Left	78	20	28	213	C		
				WB Through	682	16	28	213	B		
				WB Right	35	4	28	213	A		
23- MD 124 at MD 355											
23	NB	50.5	D	NB Left	229	69	72	198	E	83.6	F
				NB Through	306	42	70	196	D		
				NB Right	37	2	0	0	A		
	SB	33.5	C	SB Left	49	86	121	406	F		
				SB Through	966	50	121	406	D		
				SB Right	619	3	34	375	A		
	EB	99.1	F	EB Left	615	255	1024	1207	F		
				EB Through	528	22	1024	1207	C		
				EB Right	582	5	921	1184	A		
	WB	122.0	F	WB Left	0	0	0	0	A		
				WB Through	1884	123	727	1112	F		
				WB Right	42	68	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	65.0	F	NB Left	15	66	15	78	E	22.2	C
				NB Through	29	64	15	78	E		
				NB U-Turn	0	0	0	0	A		
	SB	27.6	C	SB Left	306	67	81	347	E		
				SB Through	4	87	81	347	F		
				SB Right	572	6	13	335	A		
	EB	15.7	B	EB Left	0	0	0	0	A		
				EB Through	904	16	41	321	B		
				EB Right	67	12	50	345	B		
	WB	22.0	C	WB Left	33	27	116	1390	C		
				WB Through	1193	22	116	1390	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	42.7	D	NB Left	16	65	95	577	E	43.0	D
				NB Through	421	58	95	577	E		
				NB Right	407	26	61	641	C		
	SB	37.8	D	SB Left	181	47	126	605	D		
				SB Through	839	40	126	605	D		
				SB Right	95	2	0	0	A		
	EB	48.4	D	EB Left	80	108	175	722	F		
				EB Through	1383	45	174	723	D		
				EB Right	66	44	187	750	D		
	WB	40.7	D	WB Left	314	73	108	332	E		
				WB Through	480	27	108	332	C		
				WB Right	95	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	52.3	D	NB Left	18	70	16	93	E	42.3	D
				NB Through	17	79	16	93	E		
				NB Right	25	21	16	93	C		
	SB	63.4	E	SB Left	191	70	80	297	E		
				SB Through	43	68	80	297	E		
				SB Right	28	13	80	297	B		
	EB	47.0	D	EB Left	28	36	314	962	D		
				EB Through	1928	47	322	962	D		
				EB Right	20	59	315	951	E		
	WB	31.8	C	WB Left	298	93	195	602	F		
				WB Through	852	19	195	603	B		
				WB Right	316	8	169	651	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.8	A	EB Left	0	0	0	0	A		
				EB Through	799	2	1	180	A		
				EB Right	0	0	0	0	A		
	WB	24.0	C	WB Left	310	24	45	344	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	30.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	49.1	D	SB Left	307	54	230	811	D		
				SB Through	0	0	0	0	A		
				SB Right	915	48	236	813	D		
	EB	19.4	B	EB Left	10	111	80	888	F		
				EB Through	782	18	80	888	B		
				EB Right	0	0	0	0	A		
	WB	14.2	B	WB Left	0	0	0	0	A		
				WB Through	860	14	51	343	B		
				WB Right	9	5	55	373	A		
29- MD 117 at Perry Pkwy											
29	NB	42.5	D	NB Left	35	67	14	97	E	13.6	B
				NB Through	6	61	14	96	E		
				NB Right	31	11	23	117	B		
	SB	33.8	C	SB Left	91	72	37	167	E		
				SB Through	13	72	37	167	E		
				SB Right	124	2	37	167	A		
	EB	10.3	B	EB Left	119	69	42	237	E		
				EB Through	957	3	42	237	A		
				EB Right	9	1	29	221	A		
	WB	9.9	A	WB Left	5	87	20	261	F		
				WB Through	709	10	20	261	A		
				WB Right	104	5	20	261	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	9.5	A	NB Left	0	0	0	0	A	24.6	C
				NB Through	917	9	21	216	A		
				NB Right	0	0	0	0	A		
	SB	10.1	B	SB Left	0	0	0	0	A		
				SB Through	1284	10	31	344	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	56.8	E	WB Left	1008	57	201	631	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.14: AM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	14.6	B	NB Left	0	0	0	0	A	21.0	C
				NB Through	920	15	41	379	B		
				NB Right	0	0	0	0	A		
	SB	11.4	B	SB Left	0	0	0	0	A		
				SB Through	1692	11	46	658	B		
				SB Right	0	0	0	0	A		
	EB	44.2	D	EB Left	313	37	42	360	D		
				EB Through	0	0	0	0	A		
				EB Right	642	48	102	463	D		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	32.6	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	35.9	D	SB Left	456	44	72	304	D		
				SB Through	0	0	0	0	A		
				SB Right	108	3	0	59	A		
	EB	57.4	E	EB Left	0	0	0	0	A		
				EB Through	1050	87	1521	2131	F		
				EB Right	663	11	1050	2134	B		
	WB	9.1	A	WB Left	0	0	0	0	A		
				WB Through	1879	9	32	405	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	34.9	C	NB Left	0	0	54	306	A	17.4	B
				NB Through	213	51	62	315	D		
				NB Right	139	11	62	315	B		
	SB	21.1	C	SB Left	25	60	19	169	E		
				SB Through	0	0	0	0	A		
				SB Right	260	17	19	169	B		
	EB	15.0	B	EB Left	224	28	46	333	C		
				EB Through	829	11	46	333	B		
				EB Right	0	0	0	0	A		
	WB	12.3	B	WB Left	22	11	41	286	B		
				WB Through	887	12	29	249	B		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	40.7	D	NB Left	62	45	16	111	D	10.0	B
				NB Through	6	42	13	110	D		
				NB Right	8	8	15	121	A		
	SB	5.2	A	SB Left	66	46	20	162	D		
				SB Through	7	40	20	162	D		
				SB Right	601	0	0	0	A		
	EB	10.2	B	EB Left	325	16	14	215	B		
				EB Through	920	8	18	229	A		
				EB Right	13	6	26	265	A		
	WB	12.1	B	WB Left	3	21	16	184	C		
				WB Through	315	12	16	184	B		
				WB Right	10	9	27	218	A		
35- MD 189 at I-270 Ramps											
35	NB	50.5	D	NB Left	133	51	25	119	D	41.6	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	48.3	D	SB Left	184	48	54	316	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	23.2	C	EB Left	384	20	81	458	B		
				EB Through	529	26	81	458	C		
				EB Right	0	0	0	0	A		
	WB	59.1	E	WB Left	533	50	137	497	D		
				WB Through	284	76	137	497	E		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	43.1	D	NB Left	129	52	52	178	D	58.1	E
				NB Through	100	80	52	178	E		
				NB Right	151	12	52	178	B		
	SB	91.5	F	SB Left	385	105	294	792	F		
				SB Through	516	81	218	720	F		
				SB Right	0	0	0	0	A		
	EB	48.8	D	EB Left	132	75	214	884	E		
				EB Through	958	48	214	884	D		
				EB Right	95	23	214	884	C		
	WB	42.6	D	WB Left	423	62	108	314	E		
				WB Through	390	27	108	314	C		
				WB Right	58	5	108	314	A		
37- Montrose Rd at Tower Oaks Blvd											
37	NB			NB Left	0	0	0	0	A	26.1	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	106.3	F	SB Left	126	40	201	957	D		
				SB Through	0	0	0	0	A		
				SB Right	521	122	323	955	F		
	EB	7.9	A	EB Left	28	16	25	421	B		
				EB Through	1424	8	25	421	A		
				EB Right	0	0	0	0	A		
	WB	9.2	A	WB Left	0	0	0	0	A		
				WB Through	1443	9	26	286	A		
				WB Right	62	4	26	286	A		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	15.7	B	NB Left	475	16	25	187	B	14.8	B
				NB Through	12	17.0	19	179	B		
				NB Right	26	4.9	25	187	A		
	SB	0.1	A	SB Left	2	-0.2	0	16	A		
				SB Through	0	0.0	0	16	A		
				SB Right	2	0.5	0	0	A		
	EB	14.6	B	EB Left	7	11.4	39	282	B		
				EB Through	621	15.1	39	282	B		
				EB Right	91	11.5	32	272	B		
	WB	11.9	B	WB Left	0	0.0	4	71	A		
				WB Through	84	12.6	4	71	B		
				WB Right	7	4.2	0	0	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	9.6	A	NB Left	26	45	21	127	D	61.8	E
				NB Through	188	30	21	127	C		
				NB Right	507	0	0	0	A		
	SB	38.9	D	SB Left	297	70	128	520	E		
				SB Through	605	26	127	519	C		
				SB Right	64	18	130	533	B		
	EB	144.4	F	EB Left	56	123	558	723	F		
				EB Through	816	146	559	724	F		
				EB Right	45	147	582	747	F		
	WB	39.8	D	WB Left	362	48	77	299	D		
				WB Through	231	46	77	299	D		
				WB Right	134	7	91	329	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB			NB Left	0	0	0	0	A	16.0	B
				NB Through	85	32	30	146	C		
				NB Right	195	34	30	146	C		
	SB	2.3	A	SB Left	0	0	6	75	A		
				SB Through	986	2	6	75	A		
				SB Right	0	0	0	0	A		
	EB	24.3	C	EB Left	5	35	109	424	C		
				EB Through	501	50	109	424	D		
				EB Right	550	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.14: AM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.6	A	NB Left	89	3	1	25	A	20.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	21.6	C	WB Left	986	23	98	664	C		
				WB Through	452	19	98	664	B		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	290.3	F	NB Left	184	172	1149	1512	F	195.3	F
				NB Through	1181	240	1149	1512	F		
				NB Right	143	859	1149	1512	F		
	SB	172.4	F	SB Left	60	147	2547	2696	F		
				SB Through	1511	171	2547	2696	F		
				SB Right	177	192	2547	2696	F		
	EB	65.2	E	EB Left	185	47	206	895	D		
				EB Through	548	73	207	896	E		
				EB Right	135	58	228	920	E		
	WB	203.3	F	WB Left	702	243	1957	2147	F		
				WB Through	354	165	1957	2147	F		
				WB Right	135	100	1957	2147	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	67.1	E	NB Left	153	90	240	435	F	44.4	D
				NB Through	1250	64	240	435	E		
				NB Right	0	0	0	0	A		
	SB	24.4	C	SB Left	0	0	0	0	A		
				SB Through	1718	24	91	590	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	64.9	E	WB Left	120	64	63	355	E		
				WB Through	10	75	63	355	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	131.6	F	NB Left	0	0	0	0	A	62.8	E
				NB Through	1241	132	392	892	F		
				NB Right	0	0	0	0	A		
	SB	7.5	A	SB Left	193	56	63	268	E		
				SB Through	1641	2	63	268	A		
				SB Right	0	0	0	0	A		
	EB	91.6	F	EB Left	190	98	179	700	F		
				EB Through	0	0	179	700	A		
				EB Right	370	88	218	693	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	19.7	B	NB Left	192	61	84	380	E	22.2	C
				NB Through	1193	13	84	381	B		
				NB Right	6	16	104	414	B		
	SB	21.0	C	SB Left	12	25	104	666	C		
				SB Through	1837	23	104	666	C		
				SB Right	160	1	74	661	A		
	EB	38.3	D	EB Left	160	64	45	180	E		
				EB Through	22	54	45	180	D		
				EB Right	197	16	45	180	B		
	WB	4.8	A	WB Left	1	14	0	19	B		
				WB Through	8	6	0	19	A		
				WB Right	4	-1	0	0	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	31.2	C	NB Left	212	31	26	165	C	14.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.5	B	EB Left	0	0	0	0	A		
				EB Through	1585	13	52	439	B		
				EB Right	0	0	0	0	A		
	WB	10.1	B	WB Left	0	0	0	0	A		
				WB Through	736	10	21	176	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.0	A	EB Left	0	0	0	0	A		
				EB Through	1691	5	20	274	A		
				EB Right	0	0	0	0	A		
	WB	8.6	A	WB Left	210	37	30	188	D		
				WB Through	733	1	19	167	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	12.4	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	33.1	C	SB Left	334	49	58	237	D		
				SB Through	0	0	0	0	A		
				SB Right	173	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	2.5	A	WB Left	0	0	0	0	A		
				WB Through	732	3	4	112	A		
				WB Right	323	2	0	103	A		
50- MD 190 at Burdette Rd											
50	NB	76.6	E	NB Left	19	69	12	111	E	11.8	B
				NB Through	3	74	12	111	E		
				NB Right	8	95	12	111	F		
	SB	33.2	C	SB Left	41	84	27	151	F		
				SB Through	13	84	27	151	F		
				SB Right	113	9	27	151	A		
	EB	9.6	A	EB Left	47	98	53	454	F		
				EB Through	1709	7	52	453	A		
				EB Right	15	5	42	477	A		
	WB	10.7	B	WB Left	0	87	45	661	F		
				WB Through	1437	11	46	662	B		
				WB Right	18	3	41	702	A		

Table A.14: AM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	37.1	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	81.7	F	EB Left	493	82	233	519	F		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	14.6	B	WB Left	0	0	0	0	A		
				WB Through	975	15	62	601	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	78.7	E	NB Left	251	79	996	2228	E	14.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.9	A	EB Left	0	0	0	0	A		
				EB Through	864	3	6	140	A		
				EB Right	0	0	0	0	A		
	WB	4.8	A	WB Left	0	0	0	0	A		
				WB Through	675	5	6	147	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	66.4	E	NB Left	17	67	16	123	E	43.0	D
				NB Through	44	66	19	123	E		
				NB Right	0	0	0	0	A		
	SB	67.6	E	SB Left	581	67	199	696	E		
				SB Through	145	68	199	696	E		
				SB Right	13	73	198	696	E		
	EB	29.4	C	EB Left	18	25	93	480	C		
				EB Through	781	29	93	480	C		
				EB Right	32	30	93	480	C		
	WB	34.1	C	WB Left	121	113	109	329	F		
				WB Through	642	27	112	331	C		
				WB Right	159	1	2	57	A		
54- MD 124 at I-270 NB off ramp											
54	NB	84.3	F	NB Left	0	0	0	0	A	95.4	F
				NB Through	0	0	0	0	A		
				NB Right	920	84	345	963	F		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	107.9	F	EB Left	0	0	0	0	A		
				EB Through	813	108	473	1086	F		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	37.9	D	NB Left	0	0	0	0	A	16.9	B
				NB Through	0	0	0	0	A		
				NB Right	926	38	117	601	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.6	A	EB Left	0	0	0	0	A		
				EB Through	1586	5	18	88	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	18.3	B	NB Left	102	73	54	237	E	33.0	C
				NB Through	311	23	54	237	C		
				NB Right	581	6	6	215	A		
	SB	42.7	D	SB Left	110	58	126	574	E		
				SB Through	534	41	126	574	D		
				SB Right	53	24	126	574	C		
	EB	44.5	D	EB Left	81	72	42	154	E		
				EB Through	48	76	42	154	E		
				EB Right	102	8	42	154	A		
	WB	49.2	D	WB Left	203	70	74	306	E		
				WB Through	12	67	74	306	E		
				WB Right	100	6	74	306	A		
2- MD 85 at I-270 NB on and off ramp											
2	NB	41.7	D	NB Left	554	42	150	800	D	28.3	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	14.8	B	SB Left	0	0	0	0	A		
				SB Through	548	15	37	532	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	4.5	A	NB Left	0	0	0	0	A	11.1	B
				NB Through	814	5	12	369	A		
				NB Right	0	0	0	0	A		
	SB	45.7	D	SB Left	154	46	42	271	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	15.7	C	NB Left	10	57	33	267	E	19.8	B
				NB Through	585	15	33	267	B		
				NB U-Turn	0	0	0	0	A		
	SB	13.8	B	SB Left	57	66	22	148	E		
				SB Through	1654	14	54	468	B		
				SB Right	751	9	44	458	A		
	EB	49.4	D	EB Left	482	52	70	234	D		
				EB Through	19	63	70	234	E		
				EB Right	32	9	70	234	A		
	WB	43.0	D	WB Left	37	56	16	111	E		
				WB Through	15	59	16	111	E		
				WB Right	19	6	16	111	A		
5- MD 80 at I-270 NB on and ramp											
5	NB	-2.0	A	NB Left	1	0	0	0	A	7.1	A
				NB Through	1	0	0	0	A		
				NB Right	5	-3	0	0	A		
	SB	11.8	B	SB Left	184	14	11	110	B		
				SB Through	6	18	11	110	B		
				SB Right	52	2	0	0	A		
	EB	7.4	A	EB Left	38	8	7	162	A		
				EB Through	0	0	8	0	A		
				EB Right	7	4	14	192	A		
	WB	6.2	A	WB Left	31	8	1	44	A		
				WB Through	681	10	30	340	A		
				WB Right	503	1	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.1	A	NB Left	21	10	1	136	B	9.1	A
				NB Through	0	0	0	0	A		
				NB Right	250	3	1	136	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.3	B	EB Left	0	0	0	0	A		
				EB Through	241	11	10	154	B		
				EB Right	133	11	10	163	B		
	WB	13.4	B	WB Left	0	0	0	0	A		
				WB Through	191	13	18	243	B		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	2.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.8	A	SB Left	119	10	7	107	B		
				SB Through	0	0	0	0	A		
				SB Right	38	1	0	16	A		
	EB	3.3	A	EB Left	59	3	0	38	A		
				EB Through	0	0	0	0	A		
				EB Right	40	3	0	0	A		
	WB	0.3	A	WB Left	0	0	0	0	A		
				WB Through	462	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	2.3	A	NB Left	14	10	1	68	B	2.3	A
				NB Through	0	0	0	0	A		
				NB Right	41	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	59	0	0	46	A		
				EB Right	70	5	0	46	A		
	WB	2.2	A	WB Left	393	2	2	126	A		
				WB Through	109	4	1	101	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	8.5	A	NB Left	95	12	14	130	B	21.4	C
				NB Through	277	13	14	130	B		
				NB Right	201	2	18	156	A		
	SB	16.2	C	SB Left	47	10	32	331	B		
				SB Through	580	17	41	331	B		
				SB Right	6	12	45	352	B		
	EB	35.5	E	EB Left	7	35	94	454	C		
				EB Through	88	44	101	454	D		
				EB Right	548	34	125	487	C		
	WB	34.1	D	WB Left	96	41	22	132	D		
				WB Through	12	29	22	132	C		
				WB Right	21	6	16	155	A		
10- MD 121 at I-270 NB on and off ramp											
10	NB	1.7	A	NB Left	40	10	2	84	B	0.9	A
				NB Through	0	0	0	0	A		
				NB Right	256	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	319	0	0	0	A		
				EB Right	49	0	0	0	A		
	WB	0.9	A	WB Left	151	2	1	94	A		
				WB Through	1074	1	0	64	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	6.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.8	A	SB Left	123	10	6	135	B		
				SB Through	0	0	0	0	A		
				SB Right	47	1	0	0	A		
	EB	9.0	A	EB Left	25	2	0	38	A		
				EB Through	0	0	0	0	A		
				EB Right	840	9	22	632	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	276	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	48.2	D	NB U-Turn	0	0	0	0	A	19.6	B
				NB Through	34	63	10	64	E		
				NB Right	12	8	10	64	A		
	SB	41.0	D	SB Left	75	52	23	142	D		
				SB Through	43	60	30	226	E		
				SB Right	158	31	52	263	C		
	EB	13.7	B	EB Left	156	32	32	277	C		
				EB Through	1247	11	33	278	B		
				EB Right	49	10	40	317	B		
	WB	20.3	C	WB Left	83	15	135	790	B		
				WB Through	2047	21	135	790	C		
				WB Right	94	11	135	790	B		
13- MD 27 at I-270 NB off ramp											
13	NB	30.2	C	NB Left	90	30	13	102	C	9.7	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	942	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	13.1	B	WB Left	0	0	0	0	A		
				WB Through	2111	13	204	1236	B		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	15.7	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	48.5	D	SB Left	427	49	73	278	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	9.5	A	EB Left	0	0	0	0	A		
				EB Through	656	10	13	205	A		
				EB Right	0	0	0	0	A		
	WB	7.9	A	WB Left	0	0	0	0	A		
				WB Through	1267	8	25	427	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	18.5	B	NB Left	22	22	33	387	C	32.9	C
				NB Through	820	18	59	387	B		
				NB Right	72	17	62	400	B		
	SB	36.4	D	SB Left	430	61	232	1244	E		
				SB Through	1400	29	232	1244	C		
				SB Right	42	15	193	1237	B		
	EB	44.3	D	EB Left	177	49	47	169	D		
				EB Through	73	50	43	164	D		
				EB Right	60	25	44	196	C		
	WB	56.2	E	WB Left	8	66	85	273	E		
				WB Through	21	302	85	273	F		
				WB Right	104	6	85	273	A		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	3.2	A	NB Left	123	10	1	70	A	5.4	A
				NB Through	749	2	4	134	A		
				NB Right	82	1	8	187	A		
	SB	3.8	A	SB Left	25	5	5	171	A		
				SB Through	808	4	8	171	A		
				SB Right	32	2	10	203	A		
	EB	16.9	B	EB Left	15	64	8	69	E		
				EB Through	6	59	8	69	E		
				EB Right	96	7	8	69	A		
	WB	43.6	D	WB Left	30	64	12	94	E		
				WB Through	5	69	8	93	E		
				WB Right	21	9	11	113	A		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	10.9	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	32.4	C	EB Left	222	32	43	286	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.8	A	WB Left	0	0	0	0	A		
				WB Through	155	1	0	4	A		
				WB Right	778	7	15	273	A		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	8.3	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	40.9	D	SB Left	219	40.9	37	159	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	3.5	A	EB Left	0	0.0	0	0	A		
				EB Through	615	3.5	5	178	A		
				EB Right	0	0.0	0	0	A		
	WB	4.3	A	WB Left	0	0.0	0	0	A		
				WB Through	1037	4.3	8	182	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	45.1	D	NB Left	7	70	8	75	E	17.8	B
				NB Through	12	80	8	75	F		
				NB Right	14	2	0	22	A		
	SB	60.7	E	SB Left	241	58	98	368	E		
				SB Through	41	66	98	368	E		
				SB Right	81	67	98	368	E		
	EB	10.4	B	EB Left	102	13	28	313	B		
				EB Through	932	10	28	313	B		
				EB Right	27	9	28	313	A		
	WB	11.1	B	WB Left	74	19	30	237	B		
				WB Through	924	13	30	237	B		
				WB Right	283	3	30	237	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	17.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.8	B	SB Left	22	35	4	43	D		
				SB Through	0	0	0	0	A		
				SB Right	25	4	4	43	A		
	EB	16.2	B	EB Left	238	22	35	276	C		
				EB Through	863	15	35	276	B		
				EB Right	0	0	0	0	A		
	WB	18.0	B	WB Left	0	0	0	0	A		
				WB Through	1072	19	69	380	B		
				WB Right	215	14	93	429	B		

Table A.15: AM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	24.2	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.7	B	EB Left	0	0	0	0	A		
				EB Through	804	14	33	189	B		
				EB Right	0	0	0	0	A		
	WB	35.7	D	WB Left	743	36	153	1132	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	87.6	F	NB Left	146	72	199	462	E	31.1	C
				NB Through	6	78	199	462	E		
				NB Right	337	95	199	462	F		
	SB	21.6	C	SB Left	3	37	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	3	7	2	67	A		
	EB	20.9	C	EB Left	28	12	144	823	B		
				EB Through	1490	22	144	823	C		
				EB Right	76	11	144	823	B		
	WB	16.8	B	WB Left	77	22	29	199	C		
				WB Through	681	17	29	199	B		
				WB Right	35	3	29	199	A		
23- MD 124 at MD 355											
23	NB	51.4	D	NB Left	230	71	73	204	E	84.9	F
				NB Through	306	42	71	202	D		
				NB Right	37	2	0	0	A		
	SB	33.2	C	SB Left	50	85	120	415	F		
				SB Through	965	50	120	415	D		
				SB Right	619	3	32	348	A		
	EB	103.3	F	EB Left	616	263	1064	1205	F		
				EB Through	532	26	1064	1205	C		
				EB Right	591	6	1047	1187	A		
	WB	122.0	F	WB Left	0	0	0	0	A		
				WB Through	1885	123	724	1116	F		
				WB Right	43	71	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	65.2	F	NB Left	15	66	15	78	E	21.6	C
				NB Through	29	65	15	78	E		
				NB U-Turn	0	0	0	0	A		
	SB	28.3	C	SB Left	339	72	98	367	E		
				SB Through	5	84	98	367	F		
				SB Right	643	5	17	324	A		
	EB	16.6	B	EB Left	0	0	0	0	A		
				EB Through	904	17	44	424	B		
				EB Right	67	13	53	448	B		
	WB	18.7	B	WB Left	33	24	80	692	C		
				WB Through	1205	19	80	692	B		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	34.4	C	NB Left	16	61	87	553	E	39.5	D
				NB Through	423	53	87	553	D		
				NB Right	411	14	19	463	B		
	SB	37.2	D	SB Left	181	45	125	573	D		
				SB Through	836	39	125	573	D		
				SB Right	95	3	0	0	A		
	EB	46.6	D	EB Left	80	106	169	676	F		
				EB Through	1386	44	168	677	D		
				EB Right	66	40	179	704	D		
	WB	35.3	D	WB Left	317	63	94	300	E		
				WB Through	479	24	94	300	C		
				WB Right	94	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	44.2	D	NB Left	18	73	14	93	E	32.4	C
				NB Through	18	61	14	93	E		
				NB Right	25	12	14	93	B		
	SB	61.2	E	SB Left	196	66	80	312	E		
				SB Through	44	71	80	312	E		
				SB Right	28	12	80	312	B		
	EB	34.5	C	EB Left	27	35	211	940	D		
				EB Through	1915	35	212	940	C		
				EB Right	20	29	205	929	C		
	WB	23.9	C	WB Left	301	66	133	477	E		
				WB Through	844	14	134	478	B		
				WB Right	314	9	111	526	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	11.7	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.5	A	EB Left	0	0	0	0	A		
				EB Through	800	4	2	148	A		
				EB Right	0	0	0	0	A		
	WB	32.3	D	WB Left	317	32	65	423	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	33.4	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.6	E	SB Left	307	61	263	1012	E		
				SB Through	0	0	0	0	A		
				SB Right	917	54	267	1014	D		
	EB	21.0	C	EB Left	9	114	93	958	F		
				EB Through	793	20	93	958	B		
				EB Right	0	0	0	0	A		
	WB	13.6	B	WB Left	0	0	0	0	A		
				WB Through	860	14	49	351	B		
				WB Right	9	5	53	382	A		
29- MD 117 at Perry Pkwy											
29	NB	43.1	D	NB Left	35	69	15	94	E	13.5	B
				NB Through	6	58	14	94	E		
				NB Right	31	11	24	114	B		
	SB	33.9	C	SB Left	90	73	37	160	E		
				SB Through	13	69	37	160	E		
				SB Right	124	2	37	160	A		
	EB	10.1	B	EB Left	120	69	42	307	E		
				EB Through	965	3	42	307	A		
				EB Right	9	2	29	291	A		
	WB	9.7	A	WB Left	5	97	20	264	F		
				WB Through	709	10	20	264	A		
				WB Right	104	5	20	264	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	27.3	C	NB Left	315	76	100	490	E	34.7	C
				NB Through	974	11	100	490	B		
				NB Right	0	0	0	0	A		
	SB	24.5	C	SB Left	0	0	0	0	A		
				SB Through	1286	24	81	557	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	57.1	E	WB Left	1016	57	202	701	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

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Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	18.7	B	NB Left	0	0	0	0	A	24.6	C
				NB Through	921	19	50	340	B		
				NB Right	0	0	0	0	A		
	SB	15.2	B	SB Left	0	0	0	0	A		
				SB Through	1700	15	67	611	B		
				SB Right	0	0	0	0	A		
	EB	43.5	D	EB Left	370	40	94	511	D		
				EB Through	0	0	0	0	A		
				EB Right	773	45	119	500	D		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	15.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	35.6	D	SB Left	511	43	78	334	D		
				SB Through	0	0	0	0	A		
				SB Right	119	3	0	43	A		
	EB	14.4	B	EB Left	0	0	0	0	A		
				EB Through	1381	18	159	684	B		
				EB Right	879	9	166	664	A		
	WB	9.6	A	WB Left	0	0	0	0	A		
				WB Through	1877	10	34	392	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	36.6	D	NB Left	0	0	56	300	A	20.3	C
				NB Through	211	52	64	309	D		
				NB Right	137	13	64	309	B		
	SB	21.0	C	SB Left	25	63	19	150	E		
				SB Through	0	0	0	0	A		
				SB Right	260	17	19	150	B		
	EB	21.6	C	EB Left	280	39	87	518	D		
				EB Through	1027	17	87	518	B		
				EB Right	0	0	0	0	A		
	WB	11.8	B	WB Left	22	11	39	307	B		
				WB Through	888	12	27	270	B		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	40.8	D	NB Left	62	45	16	111	D	10.7	B
				NB Through	6	42	13	110	D		
				NB Right	8	8	15	121	A		
	SB	5.4	A	SB Left	66	46	20	186	D		
				SB Through	7	40	20	186	D		
				SB Right	601	1	1	71	A		
	EB	11.0	B	EB Left	332	16	14	199	B		
				EB Through	938	9	19	238	A		
				EB Right	14	7	28	274	A		
	WB	13.4	B	WB Left	3	19	19	214	B		
				WB Through	316	13	19	213	B		
				WB Right	10	9	30	247	A		
35- MD 189 at I-270 Ramps											
35	NB	47.8	D	NB Left	133	48	25	118	D	44.5	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	51.0	D	SB Left	207	51	63	344	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	25.3	C	EB Left	384	23	89	453	C		
				EB Through	526	27	89	453	C		
				EB Right	0	0	0	0	A		
	WB	63.4	E	WB Left	541	54	148	700	D		
				WB Through	288	80	148	700	F		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	43.0	D	NB Left	129	52	52	183	D	59.0	E
				NB Through	101	79	52	183	E		
				NB Right	151	11	52	183	B		
	SB	95.9	F	SB Left	387	111	307	788	F		
				SB Through	521	85	242	775	F		
				SB Right	0	0	0	0	A		
	EB	49.3	D	EB Left	132	76	214	845	E		
				EB Through	962	48	214	845	D		
				EB Right	96	24	214	845	C		
	WB	42.1	D	WB Left	451	63	115	389	E		
				WB Through	420	26	115	389	C		
				WB Right	63	6	115	389	A		
37- Montrose Rd at Tower Oaks Blvd											
37	NB			NB Left	0	0	0	0	A	36.4	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	162.4	F	SB Left	126	48	541	1190	D		
				SB Through	0	0	0	0	A		
				SB Right	531	190	620	1210	F		
	EB	7.6	A	EB Left	28	15	24	367	B		
				EB Through	1441	7	24	367	A		
				EB Right	0	0	0	0	A		
	WB	9.5	A	WB Left	0	0	0	0	A		
				WB Through	1443	10	26	284	A		
				WB Right	62	4	26	284	A		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	16.6	B	NB Left	473	17	26	168	B	20.2	C
				NB Through	12	15.7	20	160	B		
				NB Right	26	9.0	26	168	A		
	SB	0.1	A	SB Left	2	0.0	0	13	A		
				SB Through	0	0.0	0	13	A		
				SB Right	2	0.2	0	0	A		
	EB	24.1	C	EB Left	7	17.1	65	286	B		
				EB Through	622	24.4	65	286	C		
				EB Right	91	22.6	58	276	C		
	WB	10.9	B	WB Left	0	0.0	4	58	A		
				WB Through	84	11.4	4	58	B		
				WB Right	7	5.0	0	0	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	9.7	A	NB Left	26	43	22	135	D	61.7	E
				NB Through	188	30	22	135	C		
				NB Right	507	0	0	0	A		
	SB	36.7	D	SB Left	297	66	118	478	E		
				SB Through	604	25	117	478	C		
				SB Right	63	16	118	518	B		
	EB	145.5	F	EB Left	57	124	554	733	F		
				EB Through	809	147	556	734	F		
				EB Right	46	139	577	758	F		
	WB	41.5	D	WB Left	363	50	82	294	D		
				WB Through	233	48	82	294	D		
				WB Right	135	7	95	325	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB			NB Left	0	0	0	0	A	19.5	B
				NB Through	86	34	30	148	C		
				NB Right	195	34	30	148	C		
	SB	2.4	A	SB Left	0	0	6	66	A		
				SB Through	982	2	6	66	A		
				SB Right	0	0	0	0	A		
	EB	30.1	C	EB Left	5	59	166	601	E		
				EB Through	564	61	166	601	E		
				EB Right	629	2	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.3	A	NB Left	89	2	1	34	A	21.6	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	22.8	C	WB Left	981	24	107	722	C		
				WB Through	448	21	107	722	C		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	312.4	F	NB Left	181	181	1213	1561	F	199.6	F
				NB Through	1131	265	1213	1561	F		
				NB Right	140	867	1213	1561	F		
	SB	170.5	F	SB Left	60	140	2542	2704	F		
				SB Through	1521	169	2542	2704	F		
				SB Right	177	191	2542	2704	F		
	EB	66.5	E	EB Left	185	47	215	923	D		
				EB Through	547	75	217	925	E		
				EB Right	135	61	237	948	E		
	WB	202.0	F	WB Left	709	240	1949	2152	F		
				WB Through	349	165	1949	2152	F		
				WB Right	135	100	1949	2152	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	77.9	E	NB Left	147	89	264	423	F	48.0	D
				NB Through	1184	77	264	423	E		
				NB Right	0	0	0	0	A		
	SB	23.8	C	SB Left	0	0	0	0	A		
				SB Through	1734	24	88	623	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	65.7	E	WB Left	120	65	90	404	E		
				WB Through	10	70	90	404	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	189.1	F	NB Left	0	0	0	0	A	90.1	F
				NB Through	1155	189	536	983	F		
				NB Right	0	0	0	0	A		
	SB	8.0	A	SB Left	197	58	66	308	E		
				SB Through	1652	2	66	308	A		
				SB Right	0	0	0	0	A		
	EB	151.4	F	EB Left	207	120	512	1163	F		
				EB Through	0	0	512	1163	A		
				EB Right	402	168	567	1151	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	50.1	D	NB Left	185	82	209	629	F	33.2	C
				NB Through	1158	45	210	629	D		
				NB Right	6	57	232	663	E		
	SB	20.4	C	SB Left	13	31	103	705	C		
				SB Through	1867	22	103	705	C		
				SB Right	165	1	68	700	A		
	EB	43.5	D	EB Left	159	76	46	177	E		
				EB Through	22	55	46	177	D		
				EB Right	196	16	46	177	B		
	WB	5.8	A	WB Left	1	15	0	19	B		
				WB Through	8	6	0	19	A		
				WB Right	4	2	0	0	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	30.6	C	NB Left	211	31	25	139	C	14.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.6	B	EB Left	0	0	0	0	A		
				EB Through	1639	14	55	496	B		
				EB Right	0	0	0	0	A		
	WB	10.2	B	WB Left	0	0	0	0	A		
				WB Through	736	10	21	176	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.3	A	EB Left	0	0	0	0	A		
				EB Through	1744	5	22	269	A		
				EB Right	0	0	0	0	A		
	WB	8.6	A	WB Left	211	37	30	188	D		
				WB Through	732	1	19	168	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	13.9	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	33.3	C	SB Left	386	50	67	261	D		
				SB Through	0	0	0	0	A		
				SB Right	205	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	3.0	A	WB Left	0	0	0	0	A		
				WB Through	731	3	5	139	A		
				WB Right	324	2	0	108	A		
50- MD 190 at Burdette Rd											
50	NB	76.6	E	NB Left	19	69	12	111	E	12.5	B
				NB Through	3	74	12	111	E		
				NB Right	8	95	12	111	F		
	SB	33.6	C	SB Left	41	84	28	152	F		
				SB Through	13	84	28	152	F		
				SB Right	113	10	28	152	A		
	EB	10.8	B	EB Left	52	95	66	666	F		
				EB Through	1774	8	65	666	A		
				EB Right	16	4	56	689	A		
	WB	10.8	B	WB Left	0	87	47	703	F		
				WB Through	1434	11	48	703	B		
				WB Right	18	3	41	744	A		

Table A.15: AM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	35.8	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	79.1	E	EB Left	494	79	229	539	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	13.8	B	WB Left	0	0	0	0	A		
				WB Through	974	14	59	603	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	80.4	F	NB Left	268	80	1235	4298	F	15.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.0	A	EB Left	0	0	0	0	A		
				EB Through	864	3	7	158	A		
				EB Right	0	0	0	0	A		
	WB	5.0	A	WB Left	0	0	0	0	A		
				WB Through	675	5	7	176	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	66.4	E	NB Left	17	67	16	123	E	43.5	D
				NB Through	44	66	19	123	E		
				NB Right	0	0	0	0	A		
	SB	67.6	E	SB Left	581	67	199	696	E		
				SB Through	145	68	199	696	E		
				SB Right	13	73	198	696	E		
	EB	29.4	C	EB Left	18	25	93	480	C		
				EB Through	781	29	93	480	C		
				EB Right	32	30	93	480	C		
	WB	35.6	D	WB Left	121	122	115	356	F		
				WB Through	655	28	117	359	C		
				WB Right	164	1	1	64	A		
54- MD 124 at I-270 NB off ramp											
54	NB	95.6	F	NB Left	0	0	0	0	A	104.2	F
				NB Through	0	0	0	0	A		
				NB Right	899	96	428	1243	F		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	113.4	F	EB Left	0	0	0	0	A		
				EB Through	840	113	509	1068	F		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	37.2	D	NB Left	0	0	0	0	A	16.5	B
				NB Through	0	0	0	0	A		
				NB Right	926	37	114	514	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.8	A	EB Left	0	0	0	0	A		
				EB Through	1639	5	19	96	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.16: AM Peak - Existing - I-270 Vehicle Network Performance

	Existing (Delay Total)	Alternative (Total Total)	% Change
Total Delay	21,906,753	12,776,149	-42%
Average Delay per Vehicle	227	133	-41%
Total Travel Time	51,252,838	43,578,158	-15%
Vehicles (Arrived)	81,275	83,801	3%
Latent Demand	4,969	3,878	-22%
Latent Delay	13,122,672	11,064,927	-16%
Total Distance	467,210	488,881	5%
Average Speed	33	40	23%

PM Peak

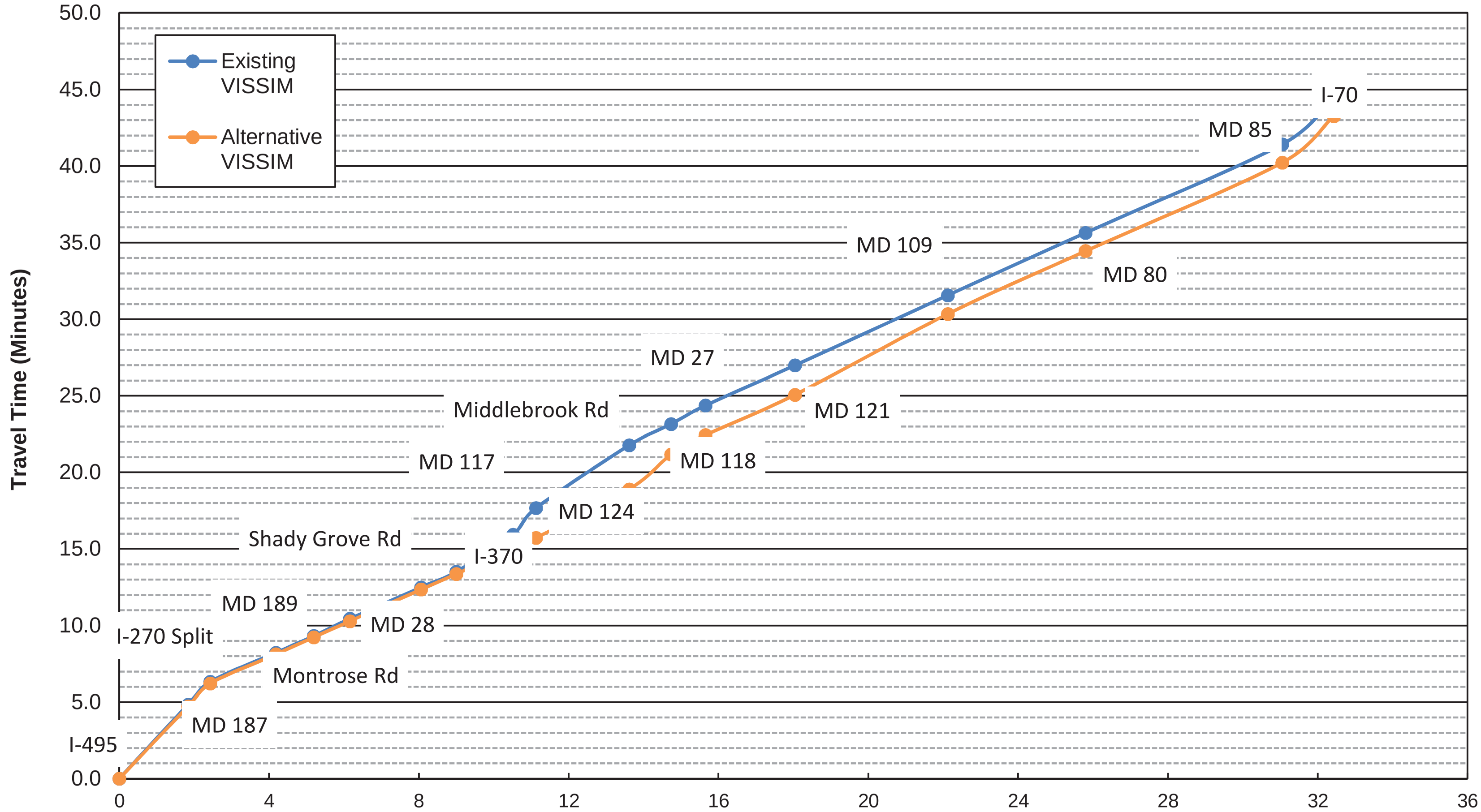
Table B.1: PM Peak - Existing - I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	290.1	282.7	-2.4%	to MD 85	1.7	92.4	92.4	0.0%
to I-270 Split	0.6	89.3	89.9	1.1%	to MD 80	5.4	301.4	301.2	0.0%
to Montrose Rd	1.8	113.6	114.1	0.0%	to MD 109	3.7	207.9	207.8	0.0%
to MD 189	1.0	66.0	66.9	1.5%	to MD 121	3.6	201.4	202.4	0.5%
to MD 28	1.0	67.1	63.2	-6.0%	to MD 27	2.5	133.7	133.8	0.0%
to Shady Grove Rd	1.9	123.3	124.1	0.8%	to MD 118	1.1	57.6	57.7	0.0%
to I-370	0.9	61.3	60.7	0.0%	to Middlebrook Rd	1.1	60.4	60.4	0.0%
to MD 117	1.5	145.0	101.9	-29.7%	to MD 124	2.2	120.9	121.5	0.8%
to MD 124	0.6	104.3	39.6	-61.5%	to MD 117	0.9	66.4	48.1	-27.3%
to Middlebrook Rd	2.5	246.0	190.1	-22.8%	to I-370	1.0	55.8	65.4	16.1%
to MD 118	1.1	83.6	136.2	61.9%	to Shady Grove Rd	1.5	79.7	80.1	0.0%
to MD 27	0.9	72.2	76.4	5.6%	to MD 28	1.9	109.5	109.7	0.9%
to MD 121	2.4	157.6	157.9	0.0%	to MD 189	1.0	60.1	60.1	0.0%
to MD 109	4.1	274.2	316.3	15.3%	to Montrose Rd	1.0	62.9	62.9	0.0%
to MD 80	3.7	244.9	246.6	0.8%	to I-270 Split	1.9	111.5	111.1	-0.9%
to MD 85	5.3	346.9	346.5	0.0%	to MD 187	0.4	22.8	23.1	0.0%
to I-70	1.4	180.2	181.3	0.6%	to I-495 interchange	1.9	154.8	155.4	0.0%
I-270 Total (miles/minutes)	**32.4**	**44.4**	**43.2**	**-2.3%**	**I-270 Total (miles/minutes)**	**32.6**	**31.7**	**31.6**	**0.0%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	105.6	91.1	-14.2%	to I-270 Split	30.3	1,721.6	1,714.6	-0.4%
to I-495	1.1	259.8	234.2	-10.0%	to Democracy Blvd	0.7	135.0	38.9	-71.1%
to Democracy Blvd	1.4	222.8	120.5	-46.2%	to I-495	1.3	466.2	108.5	-76.6%
to I-270 Split	0.9	76.3	56.5	-26.3%	to MD 190	1.3	196.3	199.5	1.5%
to I-70	30.0	2,286.1	2,222.0	-2.8%	to Cabin John Pkwy	0.6	158.2	157.3	-0.6%
I-270 Spur Total (miles/minutes)	**34.0**	**49.2**	**45.4**	**-8.2%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**44.6**	**37.0**	**-17.8%**

Table B.2: PM Peak - Existing - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	Existing VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	59.3	56.7	-3.4%	to Shady Grove	1.3	81.2	81.9	1.2%
to MD 189	1.3	159.8	105.0	-34.4%	to MD 28	1.8	119.8	119.4	-0.8%
to MD 28	1.0	87.2	74.9	-13.8%	to MD 189	1.1	77.1	72.6	-5.2%
to Shady Grove	2.0	388.8	125.1	-67.9%	to Montrose	1.2	86.4	84.0	-2.3%
to I-370	1.0	92.6	64.0	-31.2%	to I-270 mainline	0.9	59.4	59.5	1.7%
to MD 117	1.2	88.2	110.1	25.0%					
to MD 124	0.8	232.8	77.8	-66.5%					
to I-270 mainline	0.4	91.1	28.3	-69.2%					
I-270 Local Total (miles/minutes)	**8.5**	**20.0**	**10.7**	**-45.0%**	**I-270 Local Total (miles/minutes)**	**6.3**	**7.1**	**7.0**	**0.0%**

Figure B.1: PM Peak - Existing
I-270 Travel Time Graph - Northbound



Miles Along Corridor / *Direction of Traffic Flow*

Figure B.2: PM Peak - Existing
I-270 Travel Time Graph - Southbound

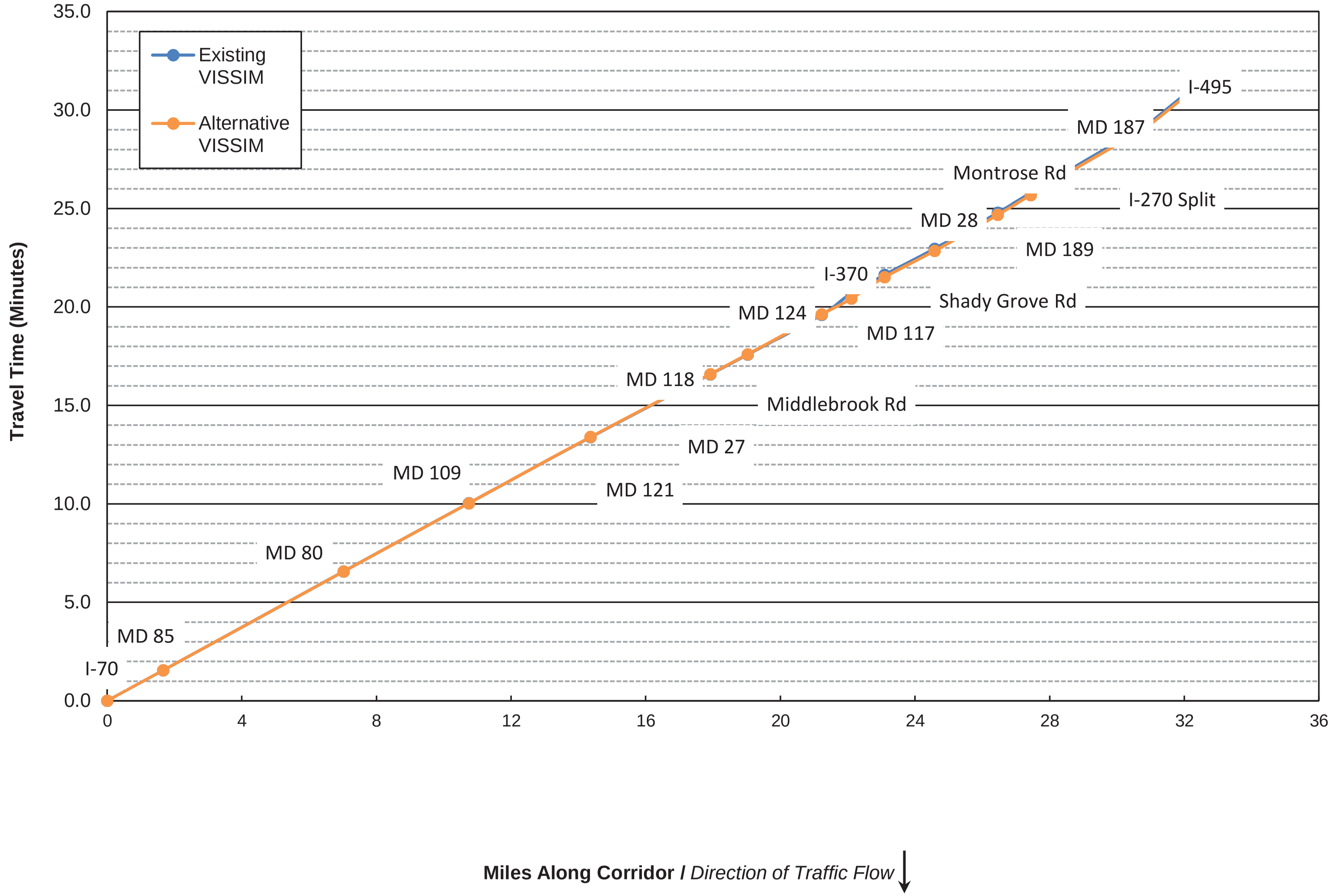
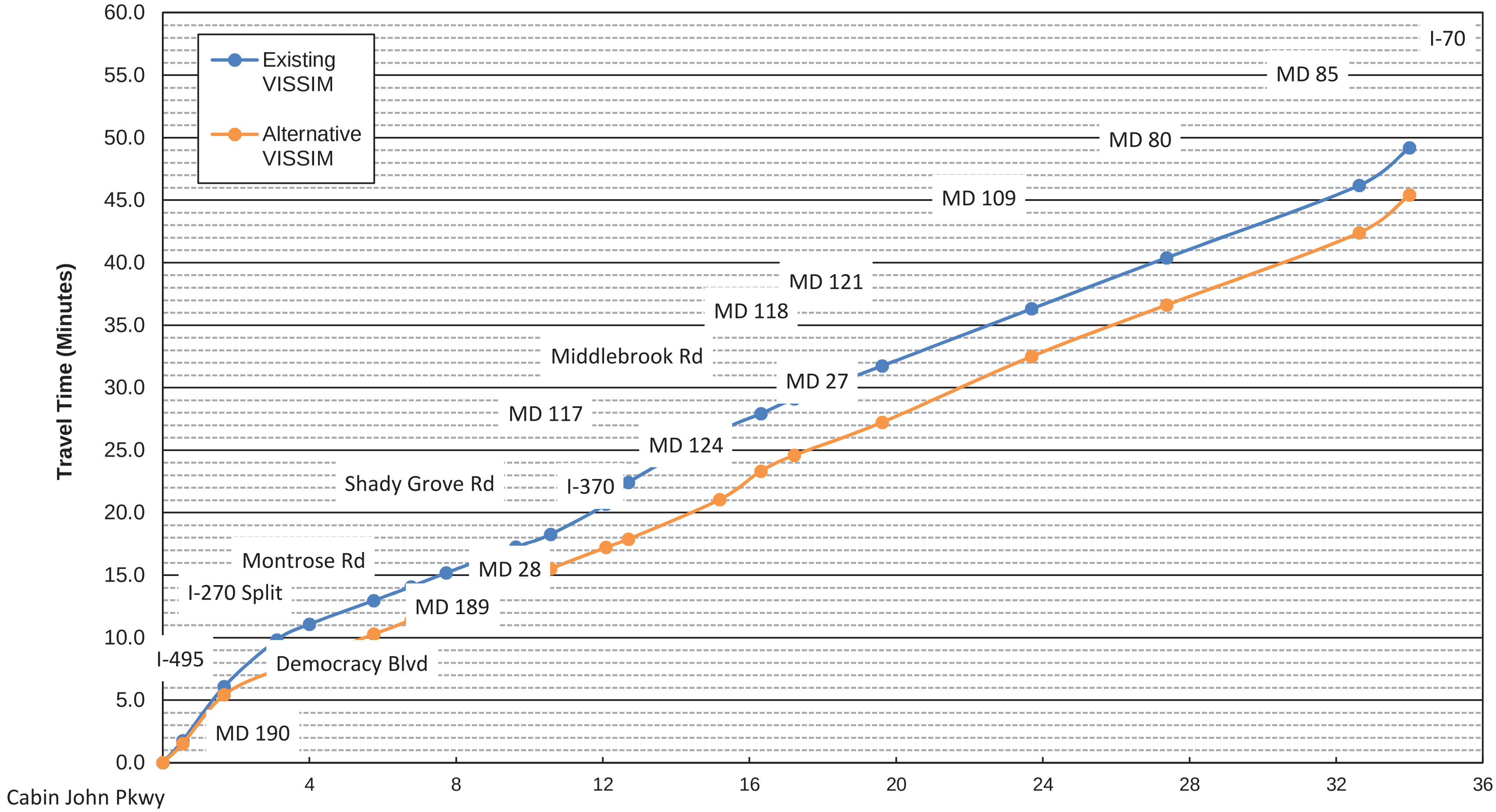


Figure B.3: PM Peak - Existing
I-270 Spur Travel Time Graph - Northbound



Miles Along Corridor / *Direction of Traffic Flow*

Figure B.4: PM Peak - Existing
I-270 Spur Travel Time Graph - Southbound

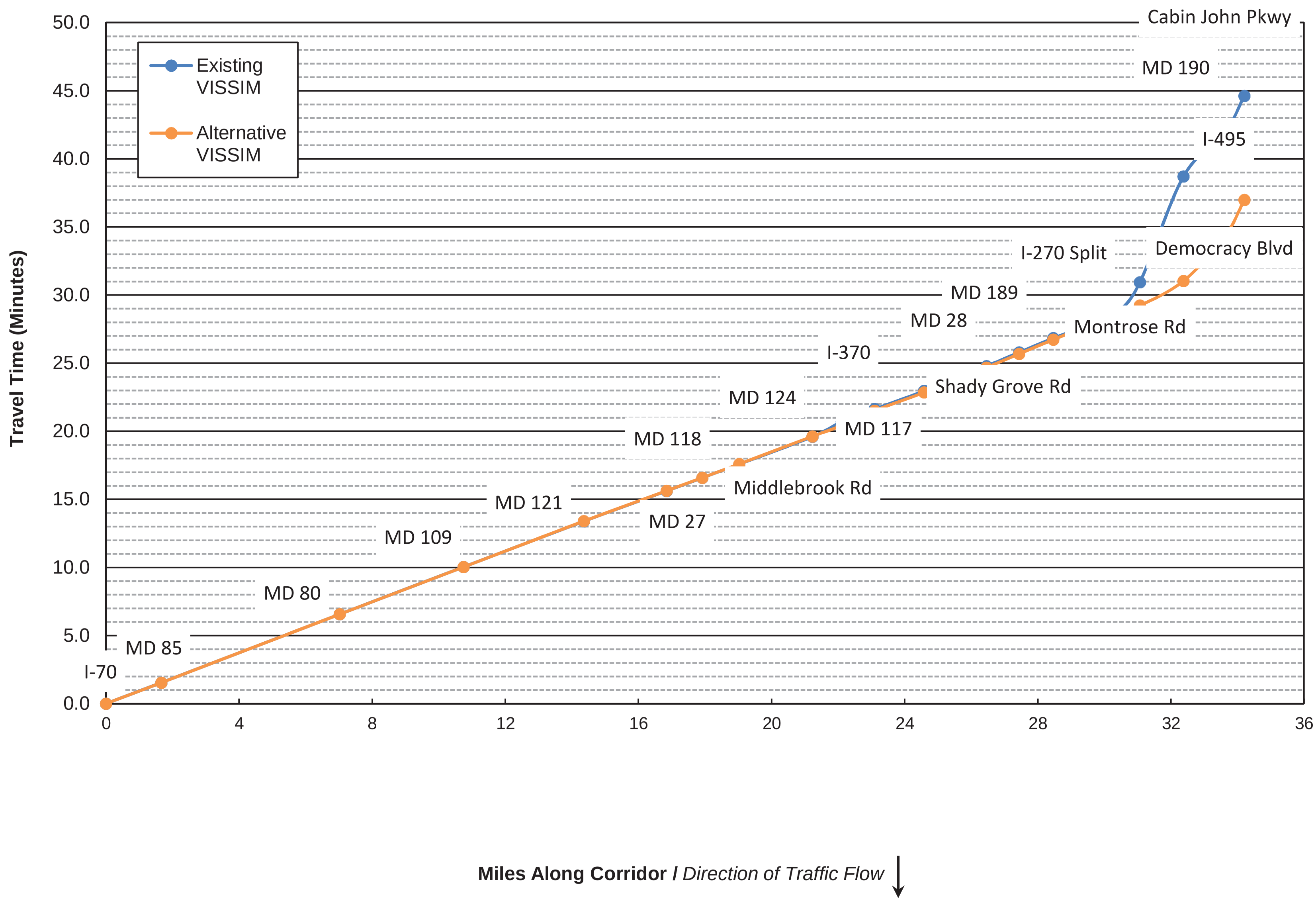


Figure B.5: PM Peak - Existing
I-270 Local Travel Time Graph - Northbound

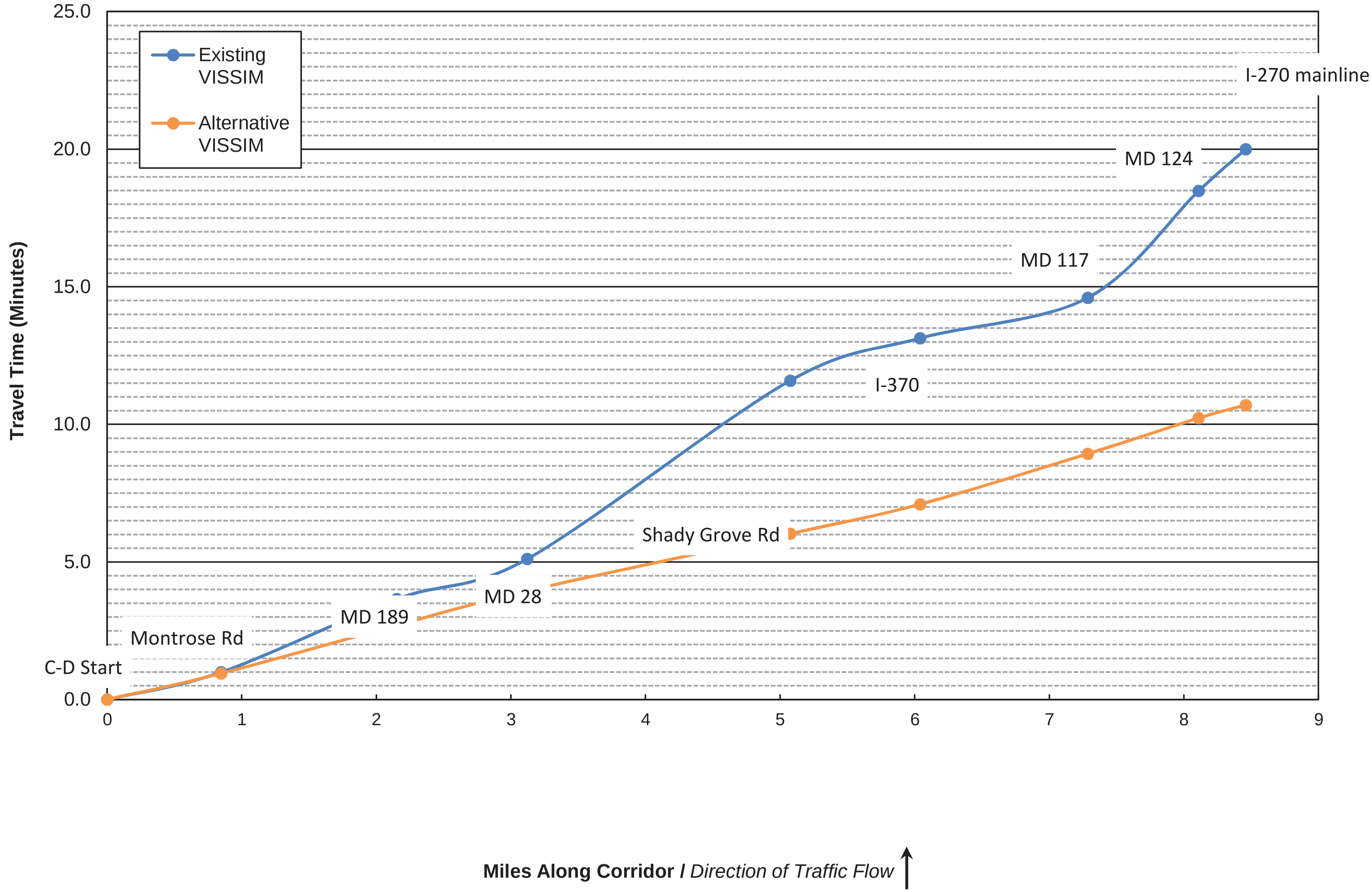
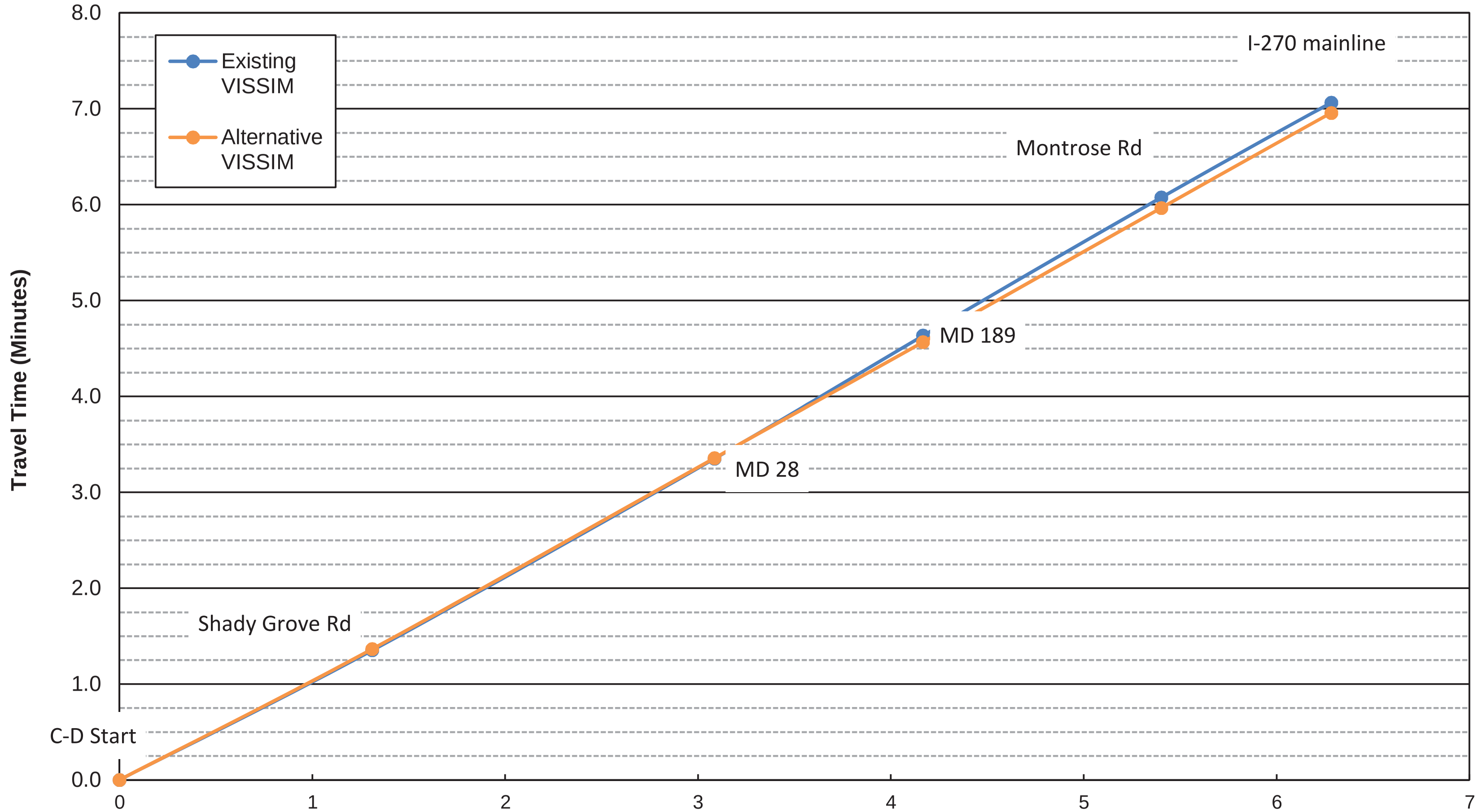


Figure B.6: PM Peak - Existing
I-270 Local Travel Time Graph - Southbound



Miles Along Corridor / *Direction of Traffic Flow*

Table B.3: PM Peak - Existing - I-270 Vehicle Speed

I-270 Northbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	22.8	23.3	0.0%	to MD 85	64.8	64.8	0.0%
to I-270 Split	23.8	23.6	0.0%	to MD 80	64.0	64.0	0.0%
to Montrose Rd	55.6	55.3	-1.8%	to MD 109	64.4	64.5	0.0%
to MD 189	55.3	54.5	0.0%	to MD 121	64.7	64.4	-1.5%
to MD 28	51.8	54.9	5.8%	to MD 27	66.9	66.8	0.0%
to Shady Grove Rd	55.4	55.1	0.0%	to MD 118	67.0	66.9	0.0%
to I-370	55.5	56.0	1.8%	to Middlebrook Rd	66.2	66.3	0.0%
to MD 117	37.6	53.5	39.5%	to MD 124	65.4	65.1	0.0%
to MD 124	21.1	55.7	166.7%	to MD 117	48.1	66.3	37.5%
to Middlebrook Rd	36.4	47.1	30.6%	to I-370	63.6	54.2	-15.6%
to MD 118	48.3	29.6	-37.5%	to Shady Grove Rd	67.2	66.9	0.0%
to MD 27	45.7	43.1	-6.5%	to MD 28	61.6	61.5	-1.6%
to MD 121	54.7	54.6	0.0%	to MD 189	58.6	58.5	0.0%
to MD 109	53.5	46.4	-14.8%	to Montrose Rd	59.1	59.1	0.0%
to MD 80	54.1	53.7	0.0%	to I-270 Split	60.4	60.7	1.7%
to MD 85	54.5	54.6	0.0%	to MD 187	66.4	65.6	0.0%
to I-70	27.4	27.2	0.0%	to I-495 interchange	44.0	43.8	0.0%
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	18.4	21.3	16.7%	to I-270 Split	63.4	63.7	1.6%
to I-495	15.7	17.4	6.3%	to Democracy Blvd	19.5	67.7	257.9%
to Democracy Blvd	23.2	42.8	87.0%	to I-495	10.1	43.4	330.0%
to I-270 Split	42.1	56.9	35.7%	to MD 190	23.0	22.6	0.0%
to I-70	47.2	48.6	4.3%	to Cabin John Pkwy	13.0	13.0	0.0%

Table B.4: PM Peak - Existing - I-270 Local Vehicle Speed

I-270 Northbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	Existing VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	51.3	53.7	5.9%	to Shady Grove	58.1	57.6	0.0%
to MD 189	29.4	44.8	55.2%	to MD 28	53.3	53.5	0.0%
to MD 28	40.0	46.5	15.0%	to MD 189	50.5	53.7	5.9%
to Shady Grove	18.1	56.3	211.1%	to Montrose	51.4	52.9	3.9%
to I-370	37.5	54.3	42.1%	to I-270 mainline	53.5	53.4	0.0%
to MD 117	50.9	40.8	-19.6%				
to MD 124	12.7	38.0	192.3%				
to I-270 mainline	13.8	44.6	221.4%				

Figure B.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table B.5: PM Peak - Existing - I-270 Vehicle Density

		Existing		Alternative					Existing		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	47	F	45	F	-4%	I-270	Freeway	16	B	16	B	0%
I-270 Diverge to MD 187	Diverge	69	F	65	F	-6%	I-270 Merge from WB I-70	Merge	13	B	13	B	0%
I-270	Freeway	73	F	72	F	-1%	I-270	Freeway	19	C	19	C	0%
I-270 Diverge to Rockledge Rd	Diverge	69	F	65	F	-6%	I-270 Merge from EB I-70	Merge	14	B	14	B	0%
I-270	Freeway	82	F	81	F	-1%	I-270	Freeway	18	C	18	C	0%
I-270 Weave from MD 187 to I-270 HOV	Weave	56	F	56	F	0%	I-270 Diverge to SB MD 85	Diverge	19	B	19	B	0%
I-270 Lane Drop	Merge	65	F	65	F	0%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	51	F	51	F	0%	I-270 Diverge to NB MD 85	Diverge	12	B	12	B	0%
I-270 Merge from I-270 Spur	Merge	37	E	32	D	-14%	I-270	Freeway	16	B	16	B	0%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	33	D	31	D	-6%	I-270 Merge from MD 85	Merge	14	B	14	B	0%
I-270	Freeway	32	D	27	D	-16%	I-270	Freeway	21	C	21	C	0%
I-270 Diverge to C-D (MD 189)	Diverge	37	E	32	D	-14%	I-270 Diverge to MD 80	Diverge	13	B	13	B	0%
I-270	Freeway	32	D	33	D	3%	I-270	Freeway	17	B	17	B	0%
I-270 Diverge to C-D (MD 28)	Diverge	38	E	40	E	5%	I-270 Merge from MD 80	Merge	11	B	9	A	-18%
I-270	Freeway	30	D	30	D	0%	I-270	Freeway	20	C	20	C	0%
I-270 Merge from C-D (MD 189)	Merge	41	F	28	C	-32%	I-270 Diverge to MD 109	Diverge	10	B	10	A	0%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	42	F	28	D	-33%	I-270	Freeway	19	C	19	C	0%
I-270	Freeway	30	D	30	D	0%	I-270 Merge from MD 109	Merge	11	B	10	B	-9%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	32	D	33	D	3%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	26	D	27	D	4%	I-270 Diverge to SB Weigh Station	Diverge	10	B	11	B	10%
I-270 Merge from C-D (Shady Grove Rd)	Merge	21	C	19	B	-10%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	33	D	29	D	-12%	I-270 Merge from SB Weigh Station	Merge	10	B	10	B	0%
I-270 Merge from C-D (I-370)	Merge	32	D	30	D	-6%	I-270	Freeway	19	C	19	C	0%
I-270 Diverge to C-D (MD 117)	Diverge	53	F	38	E	-28%	I-270 Diverge to MD 121	Diverge	7	A	7	A	0%
I-270	Freeway	74	F	30	D	-59%	I-270	Freeway	12	B	12	B	0%
I-270 Merge from C-D (MD 124)	Merge	101	F	30	D	-70%	I-270 Merge from MD 121	Merge	9	A	9	A	0%
I-270	Freeway	36	E	35	E	-3%	I-270	Freeway	14	B	14	B	0%
I-270 Diverge to EB Middlebrook Rd	Diverge	28	D	43	F	54%	I-270 Diverge to MD 27	Diverge	10	A	10	A	0%
I-270	Freeway	34	D	62	F	82%	I-270	Freeway	12	B	12	B	0%
I-270 Diverge to WB Middlebrook Rd	Diverge	30	D	78	F	160%	I-270 Merge from WB MD 27	Merge	11	B	11	B	0%
I-270	Freeway	27	D	54	F	100%	I-270	Freeway	15	B	15	B	0%
I-270 Diverge to EB MD 118	Diverge	24	C	60	F	150%	I-270 Weave from EB MD 27 to MD 118	Weave	12	B	12	B	0%
I-270 Diverge to WB MD 118	Diverge	42	F	82	F	95%	I-270	Freeway	14	B	14	B	0%
I-270	Freeway	33	D	39	E	18%	I-270 Merge from WB MD 118	Merge	12	B	12	B	0%
I-270 Weave from MD 118 to MD 27	Weave	46	F	55	F	20%	I-270	Freeway	17	B	16	B	-6%
I-270	Freeway	26	D	28	D	8%	I-270 Merge from EB MD 118	Merge	15	B	14	B	-7%
I-270 Merge from EB MD 27	Merge	46	F	55	F	20%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	26	C	26	D	0%	I-270 Merge from Middlebrook Rd	Merge	21	C	20	B	-5%
I-270 Merge from WB MD 27	Merge	20	C	21	C	5%	I-270	Freeway	21	C	20	C	-5%
I-270	Freeway	27	D	28	D	4%	I-270 Diverge to MD 124	Diverge	18	B	16	B	-11%
I-270 Diverge to MD 121	Diverge	21	C	22	C	5%	I-270	Freeway	22	C	14	B	-36%

Table B.5: PM Peak - Existing - I-270 Vehicle Density

I-270 Northbound	Type	Existing Density (pc/mi/ln)	Existing LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change	I-270 Southbound	Type	Existing Density (pc/mi/ln)	Existing LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change
I-270	Freeway	22	C	23	C	5%	I-270 Merge from WB MD 124	Merge	44	F	15	B	-66%
I-270 Merge from EB MD 121	Merge	16	B	17	B	6%	I-270	Freeway	21	C	19	C	-10%
I-270 Lane Drop	Merge	27	C	25	C	-7%	I-270 Merge from MD 117	Merge	25	C	23	C	-8%
I-270	Freeway	40	E	75	F	88%	I-270	Freeway	21	C	32	D	52%
I-270 Diverge to NB Weigh Station	Diverge	17	B	17	B	0%	I-270 Diverge to I-370	Diverge	19	B	20	C	5%
I-270	Freeway	35	D	35	E	0%	I-270	Freeway	16	B	16	B	0%
I-270 Merge from NB Weight Station	Merge	17	B	17	B	0%	I-270 Diverge to I-270 C-D	Diverge	13	B	12	B	-8%
I-270	Freeway	36	E	36	E	0%	I-270	Freeway	13	B	13	B	0%
I-270 Diverge to MD 109	Diverge	20	B	19	B	-5%	I-270 Merge from I-270 (I-370)	Merge	18	B	17	B	-6%
I-270	Freeway	33	D	33	D	0%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	22	C	21	C	-5%
I-270 Merge from MD 109	Merge	17	B	18	B	6%	I-270	Freeway	17	B	17	B	0%
I-270	Freeway	34	D	35	D	3%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	16	B	16	B	0%
I-270 Diverge to MD 80	Diverge	24	C	25	C	4%	I-270	Freeway	22	C	21	C	-5%
I-270	Freeway	29	D	29	D	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	17	B	17	B	0%
I-270 Merge from MD 80	Merge	16	B	17	B	6%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	23	C	23	C	0%
I-270	Freeway	33	D	34	D	3%	I-270	Freeway	20	C	20	C	0%
I-270 Diverge to Scenic View	Diverge	17	B	17	B	0%	I-270 Merge from I-270 C-D (MD 189)	Merge	18	B	18	B	0%
I-270	Freeway	33	D	34	D	3%	I-270	Freeway	24	C	18	C	-25%
I-270 Merge from Scenic View	Merge	17	B	17	B	0%	I-270 Merge from I-270 C-D	Merge	20	C	13	B	-35%
I-270	Freeway	33	D	34	D	3%	I-270 Diverge to I-270 HOV Lane	Diverge	17	B	23	C	35%
I-270 Diverge to NB MD 85	Diverge	19	B	19	B	0%	I-270 Diverge to I-270 Spur	Diverge	33	D	15	B	-55%
I-270	Freeway	32	D	32	D	0%	I-270	Freeway	13	B	13	B	0%
I-270 Diverge to SB MD 85	Diverge	18	B	18	B	0%	I-270 Diverge to Rockledge Dr / MD 187	Diverge	9	A	9	A	0%
I-270	Freeway	28	D	28	D	0%	I-270	Freeway	13	B	13	B	0%
I-270 Weave from MD 85 to I-70	Weave	21	C	21	C	0%	I-270 Merge from Rockledge Dr	Merge	11	B	11	B	0%
I-270	Freeway	59	F	60	F	2%	I-270	Freeway	16	B	16	B	0%
						0%	I-270 Merge from Rockledge Dr / MD 187	Merge	14	B	14	B	0%
						0%	I-270	Freeway	35	D	35	D	0%

Table B.6: PM Peak - Existing - I-270 Spur Vehicle Density

		Existing		Alternative					Existing		Alternative		
I-270 Spur Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270 Spur	Freeway	45	F	36	E	-20%	I-270 Spur	Freeway	53	F	12	B	-77%
I-270 Spur Merge from Clara Barton Parkway	Merge	51	F	46	F	-10%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	76	F	13	B	-83%
I-270 Spur	Freeway	66	F	59	F	-11%	I-270 Spur	Freeway	95	F	15	B	-84%
I-270 Diverge to MD 190	Diverge	43	F	38	E	-12%	I-270 Merge from Democracy Blvd	Merge	134	F	16	B	-88%
I-270 Spur	Freeway	78	F	71	F	-9%	I-270 Spur Lane Drop	Merge	131	F	24	C	-82%
I-270 Spur Merge from Cabin John Parkway	Merge	95	F	89	F	-6%	I-270 Spur	Freeway	123	F	40	E	-67%
I-270 Spur Merge from MD 190	Merge	94	F	91	F	-3%	I-270 Spur Merge from I-495	Merge	124	F	131	F	6%
I-270 Spur	Freeway	83	F	78	F	-6%	I-270 Spur	Freeway	48	F	49	F	2%
I-270 Spur Diverge to I-495	Merge	65	F	62	F	-5%	I-270 Spur Diverve to EB MD 190	Diverge	49	F	49	F	0%
I-270 Spur	Freeway	45	E	33	D	-27%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	66	F	69	F	5%
I-270 Spur Diverge to Democracy Blvd	Diverge	49	F	24	C	-51%	I-270 Spur	Freeway	93	F	93	F	0%
I-270 Spur	Freeway	58	F	26	D	-55%	I-270 Merge from MD 190	Merge	111	F	115	F	4%
I-270 Spur Merge from EB Democracy Blvd	Merge	98	F	22	C	-78%	I-270 Spur	Freeway	94	F	94	F	0%
I-270 Spur	Freeway	58	F	29	D	-50%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	60	F	60	F	0%
I-270 Spur Merge from WB Democracy Blvd	Merge	65	F	26	C	-60%	I-270 Spur	Freeway	83	F	83	F	0%
I-270 Spur	Freeway	39	E	25	C	-36%	I-270 Merge from Clara Barton Pkwy	Merge	72	F	72	F	0%
I-270 Spur Merge from Westlake Terrace	Merge	31	D	24	C	-23%							0%
I-270 Spur	Freeway	35	D	26	D	-26%							0%

Table B.7: PM Peak - Existing - I-270 Local Vehicle Density

		Existing		Alternative					Existing		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Souhbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270 C-D	Freeway	29	D	30	D	3%	I-270 C-D	Freeway	8	A	8	A	0%
I-270 C-D Diverge to EB Montrose Rd	Diverge	20	B	21	C	5%	I-270 C-D Weave from I-370 EB to I-270	Weave	15	B	15	B	0%
I-270 C-D	Freeway	17	B	17	B	0%	I-270 C-D Diverge to Shady Grove Rd	Diverge	10	A	11	B	10%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	12	A	12	B	0%	I-270 C-D	Freeway	7	A	7	A	0%
I-270 C-D	Freeway	20	C	19	C	-5%	I-270 C-D Merge from WB Shady Grove Rd	Merge	9	A	9	A	0%
I-270 C-D Merge from WB Montrose Rd	Merge	52	F	34	D	-35%	I-270 C-D	Freeway	15	B	14	B	-7%
I-270 C-D	Freeway	51	F	42	E	-18%	I-270 C-D Merge from EB Shady Grove Rd	Merge	11	B	11	B	0%
I-270 C-D Merge from I-270	Merge	66	F	51	F	-23%	I-270 C-D	Freeway	21	C	21	C	0%
I-270 C-D	Freeway	51	F	43	E	-16%	I-270 C-D Merge from I-270	Merge	25	C	17	B	-32%
I-270 C-D Diverge to MD 189	Diverge	31	D	21	C	-32%	I-270 C-D Diverge to I-270	Diverge	26	C	17	B	-35%
I-270 C-D	Freeway	67	F	27	D	-60%	I-270 C-D Diverge to I-270	Diverge	18	B	17	B	-6%
I-270 C-D Merge from MD 189	Merge	94	F	21	C	-78%	I-270 C-D	Freeway	16	B	16	B	0%
I-270 C-D	Freeway	49	F	20	C	-59%	I-270 C-D Diverge to MD 28	Diverge	12	B	11	B	-8%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	57	F	30	C	-47%	I-270 C-D	Freeway	11	A	10	A	-9%
I-270 C-D	Freeway	48	F	37	E	-23%	I-270 C-D Merge from WB MD 28	Merge	13	B	12	B	-8%
I-270 C-D Diverge to MD 28	Diverge	20	B	48	F	140%	I-270 C-D	Freeway	13	B	13	B	0%
I-270 C-D	Freeway	31	D	38	E	23%	I-270 C-D Merge from EB MD 28	Merge	25	C	22	C	-12%
I-270 C-D Weave between MD 28 Ramps	Weave	28	C	30	C	7%	I-270 C-D	Freeway	29	D	18	B	-38%
I-270 C-D	Freeway	18	C	19	C	6%	I-270 C-D Merge from I-270	Merge	35	E	19	B	-46%
I-270 C-D Merge from MD 28 WB	Merge	13	B	14	B	8%	I-270 C-D	Freeway	40	E	22	C	-45%
I-270 C-D Merge from I-270 and Drop Lane	Merge	18	B	17	B	-6%	I-270 C-D Diverge to MD 189	Diverge	24	C	23	C	-4%
I-270 C-D Diverge to I-270	Diverge	25	C	25	C	0%	I-270 C-D	Freeway	25	C	25	C	0%
I-270 C-D	Freeway	39	E	20	C	-49%	I-270 C-D Merge from MD 189	Merge	23	C	20	C	-13%
I-270 C-D Diverge to Shady Grove Rd	Diverge	14	B	13	B	-7%	I-270 C-D Diverge to I-270	Diverge	32	D	20	C	-38%
I-270 C-D	Freeway	111	F	14	B	-87%	I-270 C-D	Freeway	22	C	22	C	0%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	116	F	12	B	-90%	I-270 C-D Diverge to WB Montrose Rd	Diverge	16	B	15	B	-6%
I-270 C-D	Freeway	112	F	17	B	-85%	I-270 C-D	Freeway	20	C	20	C	0%
I-270 C-D Merge from WB Shady Grove Rd	Merge	108	F	26	C	-76%	I-270 Weave between Montrose Rd Loops	Weave	35	D	31	C	-11%
I-270 C-D Diverge to I-270	Diverge	90	F	30	D	-67%	I-270 C-D	Freeway	15	B	15	B	0%
I-270 C-D	Freeway	60	F	32	D	-47%	I-270 C-D Merge from EB Montrose Rd	Merge	9	A	9	A	0%
I-270 C-D Diverge to I-370	Diverge	28	C	33	D	18%	I-270 C-D	Freeway	18	B	17	B	-6%
I-270 C-D	Freeway	10	A	14	B	40%							
I-270 Merge from I-370 EB	Merge	11	B	13	B	18%							
I-270 C-D	Freeway	19	C	23	C	21%							
I-270 C-D Weave from I-370 to I-270	Weave	27	C	29	C	7%							
I-270 C-D	Freeway	22	C	30	D	36%							
I-270 C-D Weave from I-270 to MD 117	Weave	33	D	50	F	52%							
I-270 C-D Diverge to MD 124	Diverge	39	E	41	F	5%							
I-270 C-D	Freeway	55	F	10	A	-82%							
I-270 C-D Merge from EB MD 124	Merge	96	F	12	B	-88%							
I-270 C-D Merge From WB MD 124	Merge	81	F	20	B	-75%							

Table B.8: PM Peak - Existing - I-270 Vehicle Throughput

I-270 Northbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change	Data Collection Measurement	I-270 Southbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between I-495 and MD 187	4350	4346	0%	100	North of I-70	1975	1976	0%
Between MD 187 on and off ramps	3888	3879	0%	102	Between I-70 on ramps	2287	2288	0%
Between Rockledge Blvd on and off ramps	3666	3652	0%	105	From I-70 interchange to MD-85	3429	3428	0%
Between Rockledge Dr and I-270 Spur	3880	3866	0%	108	Between MD-85 on and off ramps	2006	2006	0%
Between I-270 Spur and Montrose Rd	8718	8917	2%	110	Between MD-85 and MD-80	2633	2632	0%
Between Montrose Rd on and off ramps	5750	5870	2%	112	Between MD-80 on and off ramps	2093	2094	0%
Between Montrose Rd and MD 189	5477	5595	2%	114	Between MD-80 and Md-109	2457	2457	0%
Between MD 189 and MD 28	5905	6021	2%	116	Between MD-109 on and off ramps	2395	2396	0%
Between MD 28 on and off ramps	6240	6360	2%	118	Between MD-109 and MD-121	2521	2519	0%
Between MD 28 and Shady Grove Rd	5494	5605	2%	120	Between MD-121 on and off ramps	2351	2348	0%
Between Shady Grove Rd and I-370	4789	4882	2%	123	Between MD-121 and MD-27	2723	2727	0%
Between I-370 on and off ramps	4814	4564	-5%	126	Between MD-27 on and off ramps	2890	2897	0%
Between I-370 and MD 117	6142	6408	4%	129	Between MD-27 and MD-118	3164	3164	0%
Between MD 117 and MD 124	4713	5147	9%	133	Between MD-118 on and off ramps	3197	3196	0%
Between MD-124 on and off ramps	4706	5238	11%	136	Between MD-118 and Middlebrook Rd	3798	3792	0%
Between Watkins Mill Rd and Middlebrook Rd	6115	6749	10%	139	Between Middlebrook Rd on and off ramps	3796	3796	0%
Between Middlebrook Rd on and off ramps	5713	6204	9%	142	Between Middlebrook Rd and MD-124	4826	4792	-1%
Between Middlebrook Rd and MD 118	4798	5166	8%	146	Between MD-124 on and off ramps	3765	3739	-1%
Between MD-118 on and off ramps	4409	4696	7%	150	Between MD-124 and MD-117	4938	4939	0%
Between MD 118 and MD 27	4456	4703	6%	154	Between MD-117 and I-370	6461	6452	0%
Between MD-27 on and off ramps	2842	3003	6%	159	Between I-370 on and off ramps	3327	3326	0%
Between MD 27 and MD 121	3330	3493	5%	163	Between I-370 on ramp to Shady Grove Rd	4663	4659	0%
Between MD-121 on and off ramps	2574	2704	5%	167	Between Shady Grove Rd and MD 28	4984	4964	0%
Between MD 121 and MD 109	3787	3827	1%	171	Between MD 28 on and off ramps	5158	5136	0%
Between MD-109 on and off ramps	3547	3569	1%	175	Between MD 28 and MD 189	4536	4514	0%
Between MD 109 and MD 80	3657	3681	1%	179	Between MD 189 and Montrose Rd	4527	4505	0%
Between MD-80 on and off ramps	3096	3134	1%	183	Between Montrose Rd on and off ramps	5414	5383	-1%
Between MD 80 and MD 85	3596	3614	1%	187	Between Montose Rd and I-270 Spur	7201	7213	0%
Between MD-85 on and off ramps	3046	3069	1%	193	Between I-270 Spur and Rockledge Blvd	3293	3281	0%
Between MD 85 and I-70	4867	4881	0%	197	Between Rockledge Blvd on and off ramps	2549	2541	0%
North of I-70	2562	2583	1%	200	Between MD 187 on and off ramps	3017	2991	-1%
				203	Between MD 187 and I-495	3372	3348	-1%
I-270 Spur Northbound					**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	4608	4885	6%	600	Between I-270 Split and HOV on ramp	3113	3355	8%
Between Democracy Blvd on and off ramps	4128	4393	6%	603	Between HOV on ramp and Democracy Blvd	2461	3334	35%
Between Democracy Blvd and I-270 Split	4849	5114	5%	607	Between Democracy Blvd on and off ramps	1970	3009	53%
				610	Between Democracy Blvd and I-495	2297	3621	58%

Table B.9: PM Peak - Existing - I-270 Local Vehicle Throughput

I-270 Local Northbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change	Data Collection Measurement	I-270 Local Southbound	Existing VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	1881	1921	2%	800	Between I-370 on ramp and I-270 off ramp	2740	2736	0%
Between Montrose Rd EB on ramp and WB off ramp	2172	2212	2%	804	Between I-270 off ramp and Shady Grove off ramp	1420	1414	0%
Between Montrose Rd WB off ramp and on ramp	1921	1950	2%	807	Between Shady Grove off ramp and Shady Grove WB on ramp	764	762	0%
Between Montrose Rd WB on ramp and I-270 on ramp	3366	3427	2%	809	Between Shady Grove WB and EB on ramps	1543	1507	-2%
Between I-270 on ramp and MD 189 off ramp	3611	3712	3%	811	Between Shady Grove on ramp and I-270 on ramp	2168	2133	-2%
Between MD 189 ramps	2908	2999	3%	813	Between I-270 on ramp and I-270 off ramp1	2660	2620	-2%
Between MD 189 off ramp and I-270 on ramp	3782	3885	3%	815	Between I-270 off ramp1 and I-270 off ramp2	1854	1829	-1%
Between I-270 on ramp and I-270 off ramp	4472	4591	3%	817	Between I-270 off ramp2 and MD 28 off ramp	1681	1658	-1%
Between I-270 off ramp and MD 28 EB off ramp	3481	3588	3%	819	Between MD 28 off ramp and MD 28 WB on ramp	1149	1132	-1%
Between MD 28 EB off ramp to MD 28 EB on ramp	3133	3224	3%	821	Between MD 28 WB on ramp and MD 28 EB on ramp	1401	1386	-1%
Between MD 28 EB on ramp and MD 28 WB off ramp	3262	3354	3%	823	Between MD 28 EB on ramp and I-270 on ramp	2908	2874	-1%
Between MD 28 WB off ramp and MD 28 WB on ramp	2023	2073	2%	825	Between I-270 on ramp and MD 189 off ramp	3530	3504	-1%
Between MD 28 WB on ramp and I-270 on ramp	2725	2774	2%	827	Between MD 189 on and off ramps	2601	2583	-1%
Between I-270 on ramp and I-270 off ramp	3565	3634	2%	829	Between MD 189 on ramp and I-270 off ramp	3166	3141	-1%
Between I-270 off ramp and Shady Grove off ramp	2136	2222	4%	831	Between I-270 off ramp and Montrose Rd off ramp	2280	2264	-1%
Between Shady Grove off ramp and I-270 on ramp	673	791	18%	833	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2039	2026	-1%
Between I-270 on ramp and Shady Grove WB on ramp	3348	2926	-13%	835	Between Montrose Rd WB on ramp and EB off ramp	2605	2587	-1%
Between Shady Grove WB on ramp and I-270 off ramp	4148	4366	5%	838	Between Montrose Rd EB off and on ramps	1525	1510	-1%
Between I-270 off ramp and I-370 off ramp	3663	4254	16%	840	Between Montrose Rd EB off ramp and I-270	1846	1833	-1%
Between I-370 off ramp and I-370 EB on ramp	1138	1592	40%					
Between I-370 EB and WB on ramps	2096	2549	22%					
Between I-370 WB on ramp and I-270 off ramp	3687	4140	12%					
Between I-270 off ramp and I-270 on ramp	2254	2292	2%					
Between I-270 on ramp and MD 117 off ramp	3661	3721	2%					
Between MD 117 off ramp and MD 124 off ramp	2448	2487	2%					
Between MD 124 off ramp and MD 124 EB on ramp	479	500	4%					
Between MD 124 EB and WB on ramps	943	1014	8%					
Between MD 124 on ramp I-270	1427	1513	6%					

Table B.10: PM Peak - Existing - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
Rockledge Dr on ramp	1	1	0%	181	183	1%
MD 189 C-D on ramp	0	0	0%	33	0	-100%
MD 28 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	2	16	700%	233	162	-30%
MD 124 C-D on ramp	2459	0	-100%	3978	0	-100%
MD 118 on ramp	0	1	0%	37	130	251%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd EB on ramp	0	0	0%	0	0	0%
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Cabin John Pkwy on ramp	16	4	-75%	661	373	-44%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Montrose Rd EB on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	265	112	-58%	1386	650	-53%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	15	0	-100%	555	0	-100%
I-270 on ramp	0	0	0%	23	0	-100%
MD 28 EB on ramp	0	0	0%	0	3	0%
MD 28 WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	78	0	-100%	836	0	-100%
I-270 on ramp	178	0	-100%	1103	0	-100%
Shady Grove Rd WB on ramp	12	0	-100%	340	36	-89%
I-370 EB on ramp	0	0	0%	0	0	0%
I-370 WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	12	433	3508%	658	1507	129%
MD 124 EB on ramp	257	0	-100%	1230	0	-100%
MD 124 WB on ramp	1	0	-100%	63	0	-100%

Table B.11: PM Peak - Existing - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 187 off ramp NB	42	38	-10%	278	241	-13%
MD 187 off ramp SB	0	0	0%	0	0	0%
Rockledge Dr off ramp	1	1	0%	73	71	-3%
Tower Oaks Blvd off ramp	32	34	6%	235	237	1%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	29	32	10%	168	189	13%
MD 189 off ramp EB	1	1	0%	122	138	13%
MD 28 off ramp EB	37	46	24%	231	243	5%
MD 28 off ramp WB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	49	50	2%	248	248	0%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	205	975	376%	859	2343	173%
MD 124 off ramp	799	1012	27%	2471	3371	36%
Watkins Mill Rd off ramp*						
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	20	0	-100%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	56	59	5%	290	276	-5%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	0	0	0%	0	8	0%
MD 121 off ramp EB	0	0	0%	0	0	0%
MD 109 off ramp EB	9	8	-11%	158	123	-22%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	15	16	7%	140	160	14%
MD 80 off ramp WB	0	0	0%	11	9	-18%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 85 SB off ramp	0	0	0%	72	45	-38%
I-270 Spur Northbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Clara Barton Pkwy off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	0%	0	0	0%
MD 190 off ramp WB	2	4	100%	287	317	10%
Democracy Blvd off ramp WB	42	44	5%	188	196	4%
Democracy Blvd off ramp EB	18	18	0%	143	123	-14%

* Ramp in Future Scenario

Table B.12: PM Peak - Existing - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 121 WB on ramp	0	0	0%	0	0	0%
MD 121 EB on ramp*						
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	0%	0	0	0%
Middlebrook Rd on ramp	0	0	0%	0	0	0%
MD 124 WB on ramp	5	0	-100%	332	0	-100%
MD 117 on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp North	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp South	0	0	0%	0	0	0%
MD 189 C-D on ramp	0	0	0%	0	0	0%
Montrose Rd C-D on ramp	0	0	0%	0	0	0%
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd on ramp	335	3	-99%	1366	214	-84%
I-495 Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 Spur on ramp	4212	318	-92%	5058	2354	-53%
MD 190 on ramp	1	13	1200%	107	381	256%
I-270 C-D Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 on ramp	0	0	0%	0	0	0%
I-370 on ramp	0	0	0%	0	0	0%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 28 WB on ramp	0	0	0%	14	0	-100%
MD 28 EB on ramp	2	0	-100%	219	0	-100%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	1	0	-100%	107	8	-93%
Montrose Rd EB on ramp	0	0	0%	0	0	0%

* Ramp in Future Scenario

Table B.13: PM Peak - Existing - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	Existing VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	Existing VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 SB off ramp	0	0	0%	0	0	0%
MD 85 NB off ramp	0	0	0%	114	96	-16%
MD 80 off ramp	1	0	-100%	154	91	-41%
MD 109 off ramp WB	0	0	0%	58	41	-29%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	2	2	0%	98	102	4%
MD 121 off ramp WB	0	0	0%	0	0	0%
MD 27 off ramp EB	23	23	0%	149	167	12%
MD 27 off ramp WB	0	0	0%	0	0	0%
MD 118 off ramp EB	19	20	5%	110	138	25%
MD 118 off ramp WB	0	0	0%	0	0	0%
Watkins Mill Rd off ramp*						
MD 124 off ramp EB	310	530	71%	1658	2588	56%
MD 124 off ramp WB	147	144	-2%	1129	1695	50%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	1	3	200%	42	130	210%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	3	0%	127	150	18%
MD 189 off ramp EB	123	115	-7%	849	495	-42%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	0	1	0%	0	247	0%
Rockledge Dr off ramp	51	50	-2%	295	348	18%
I-270 Spur Southbound	**Existing VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**Existing VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd off ramp EB	24	28	17%	157	153	-3%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	85	69	-19%	826	509	-38%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	0	0	0%

* Ramp in Future Scenario

Table B.14: PM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	28.2	C	NB Left	115	79	116	611	E	53.2	D
				NB Through	503	33	116	611	C		
				NB Right	824	18	55	634	B		
	SB	82.9	F	SB Left	142	77	401	1055	E		
				SB Through	875	84	401	1055	F		
				SB Right	67	87	401	1055	F		
	EB	33.5	C	EB Left	43	83	26	115	F		
				EB Through	20	91	26	115	F		
				EB Right	144	11	26	115	B		
	WB	63.9	E	WB Left	508	77	221	686	E		
				WB Through	27	67	221	686	E		
				WB Right	192	29	221	686	C		
2- MD 85 at I-270 NB on and off ramp											
2	NB	36.0	D	NB Left	977	36	187	908	D	32.7	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	27.9	C	SB Left	0	0	0	0	A		
				SB Through	671	28	100	634	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	6.0	A	NB Left	0	0	0	0	A	9.4	A
				NB Through	1699	6	41	829	A		
				NB Right	0	0	0	0	A		
	SB	43.8	D	SB Left	170	44	46	320	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	33.3	D	NB Left	60	70	154	653	E	33.5	C
				NB Through	1255	32	154	654	C		
				NB U-Turn	0	0	0	0	A		
	SB	22.0	C	SB Left	91	80	45	208	E		
				SB Through	810	25	59	445	C		
				SB Right	796	12	45	436	B		
	EB	54.8	D	EB Left	802	57	133	610	E		
				EB Through	31	44	133	610	D		
				EB Right	22	0	133	610	A		
	WB	43.4	D	WB Left	36	75	39	162	E		
				WB Through	61	65	39	162	E		
				WB Right	81	13	39	162	B		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.8	A	NB Left	1	0	0	0	A	8.6	A
				NB Through	2	0	0	0	A		
				NB Right	8	-3	0	0	A		
	SB	12.2	B	SB Left	385	15	21	145	B		
				SB Through	17	17	21	145	B		
				SB Right	122	2	0	0	A		
	EB	8.9	A	EB Left	70	9	13	171	A		
				EB Through	0	0	8	0	A		
				EB Right	6	5	24	202	A		
	WB	6.9	A	WB Left	16	10	0	40	B		
				WB Through	510	12	28	281	B		
				WB Right	482	1	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	2.3	A	NB Left	47	3	1	190	A	4.2	A
				NB Through	0	0	0	0	A		
				NB Right	491	2	1	190	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.0	A	EB Left	0	0	0	0	A		
				EB Through	271	5	2	61	A		
				EB Right	53	3	1	69	A		
	WB	6.6	A	WB Left	0	0	0	0	A		
				WB Through	316	7	1	89	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	5.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	10.2	B	SB Left	224	11	14	175	B		
				SB Through	0	0	0	0	A		
				SB Right	17	2	0	67	A		
	EB	2.2	A	EB Left	56	1	0	37	A		
				EB Through	0	0	0	0	A		
				EB Right	59	3	0	0	A		
	WB	0.3	A	WB Left	0	0	0	0	A		
				WB Through	160	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	4.0	A	NB Left	44	7	2	115	A	1.6	A
				NB Through	0	0	0	0	A		
				NB Right	29	0	0	43	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.8	A	EB Left	0	0	0	0	A		
				EB Through	114	0	0	0	A		
				EB Right	24	4	0	0	A		
	WB	1.2	A	WB Left	98	1	0	42	A		
				WB Through	78	1	0	19	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	10.6	B	NB Left	471	13	31	242	B	17.0	B
				NB Through	638	10	31	242	A		
				NB Right	54	2	36	268	A		
	SB	17.8	C	SB Left	20	13	5	143	B		
				SB Through	169	19	14	163	B		
				SB Right	8	4	13	184	A		
	EB	16.6	C	EB Left	2	50	3	93	D		
				EB Through	19	51	11	170	D		
				EB Right	142	12	21	202	B		
	WB	34.8	D	WB Left	214	46	57	220	D		
				WB Through	56	41	57	219	D		
				WB Right	140	16	71	244	B		
10- MD 121 at I-270 NB on and off ramp											
10	NB	0.8	A	NB Left	25	9	1	67	A	0.6	A
				NB Through	0	0	0	0	A		
				NB Right	718	1	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	447	0	0	0	A		
				EB Right	58	0	0	0	A		
	WB	0.8	A	WB Left	100	3	1	73	A		
				WB Through	423	0	0	48	A		
				WB Right	0	0	0	0	A		

Table B.14: PM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	2.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.7	A	SB Left	136	10	8	125	A		
				SB Through	0	0	0	0	A		
				SB Right	36	0	0	0	A		
	EB	0.3	A	EB Left	29	1	0	23	A		
				EB Through	0	0	0	0	A		
				EB Right	349	0	0	0	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	99	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	40.1	D	NB U-Turn	0	0	0	0	A	22.2	C
				NB Through	73	57	19	86	E		
				NB Right	47	13	19	86	B		
	SB	39.7	D	SB Left	114	46	31	182	D		
				SB Through	41	62	35	244	E		
				SB Right	173	30	57	281	C		
	EB	16.8	B	EB Left	208	27	68	502	C		
				EB Through	2223	16	70	503	B		
				EB Right	106	15	82	541	B		
	WB	25.8	C	WB Left	31	22	123	627	C		
				WB Through	1503	26	123	627	C		
				WB Right	54	9	123	627	A		
13- MD 27 at I-270 NB off ramp											
13	NB	44.8	D	NB Left	390	45	63	297	D	8.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1284	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.5	A	WB Left	0	0	0	0	A		
				WB Through	1582	6	41	680	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.2	D	SB Left	171	52	35	162	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	1351	2	4	149	A		
				EB Right	0	0	0	0	A		
	WB	2.7	A	WB Left	0	0	0	0	A		
				WB Through	1433	3	7	257	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	22.6	C	NB Left	58	20	55	379	C	29.8	C
				NB Through	965	23	68	379	C		
				NB Right	43	20	72	391	B		
	SB	33.9	C	SB Left	140	57	185	770	E		
				SB Through	1310	35	185	770	D		
				SB Right	196	9	164	764	A		
	EB	43.0	D	EB Left	103	54	28	120	D		
				EB Through	37	46	25	115	D		
				EB Right	47	17	17	141	B		
	WB	27.6	C	WB Left	83	49	70	297	D		
				WB Through	102	43	70	297	D		
				WB Right	552	22	70	297	C		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	4.0	A	NB Left	90	12	1	82	B	8.2	A
				NB Through	1174	3	7	154	A		
				NB Right	0	0	15	207	A		
	SB	6.5	A	SB Left	11	6	14	270	A		
				SB Through	1091	7	18	270	A		
				SB Right	9	3	21	302	A		
	EB	13.1	B	EB Left	18	55	12	130	E		
				EB Through	1	76	12	130	E		
				EB Right	275	10	12	130	B		
	WB	53.5	D	WB Left	93	64	37	199	E		
				WB Through	6	61	33	198	E		
				WB Right	25	13	42	218	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	16.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	33.9	C	EB Left	435	34	90	501	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	10.8	B	WB Left	0	0	0	0	A		
				WB Through	246	2	1	116	A		
				WB Right	1216	13	46	480	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	6.1	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	37.1	D	SB Left	129	37.1	22	114	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	4.8	A	EB Left	0	0.0	0	0	A		
				EB Through	1182	4.8	10	322	A		
				EB Right	0	0.0	0	0	A		
	WB	4.5	A	WB Left	0	0.0	0	0	A		
				WB Through	1465	4.5	8	237	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	24.0	C	NB Left	42	69	33	176	E	27.5	C
				NB Through	43	70	33	176	E		
				NB Right	196	4	3	77	A		
	SB	90.2	F	SB Left	381	90	221	577	F		
				SB Through	12	82	221	577	F		
				SB Right	97	91	221	577	F		
	EB	17.8	B	EB Left	98	22	60	395	C		
				EB Through	1215	17	60	395	B		
				EB Right	17	15	60	395	B		
	WB	17.6	B	WB Left	12	17	66	441	B		
				WB Through	1324	21	66	441	C		
				WB Right	351	5	66	441	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	8.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.0	B	SB Left	96	35	18	131	D		
				SB Through	0	0	0	0	A		
				SB Right	179	9	18	131	A		
	EB	6.4	A	EB Left	15	9	17	155	A		
				EB Through	1180	6	17	155	A		
				EB Right	0	0	0	0	A		
	WB	8.4	A	WB Left	0	0	0	0	A		
				WB Through	1238	8	24	251	A		
				WB Right	12	6	39	300	A		

Table B.14: PM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	4.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	686	3	4	96	A		
				EB Right	0	0	0	0	A		
	WB	7.1	A	WB Left	429	7	4	194	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	48.4	D	NB Left	156	45	75	316	D	12.5	B
				NB Through	0	0	75	316	A		
				NB Right	219	51	75	316	D		
	SB	30.6	C	SB Left	30	44	7	66	D		
				SB Through	2	37	7	66	D		
				SB Right	19	9	18	104	A		
	EB	7.3	A	EB Left	3	10	23	262	B		
				EB Through	1035	7	23	262	A		
				EB Right	160	7	23	262	A		
	WB	8.3	A	WB Left	242	20	33	332	C		
				WB Through	1650	7	33	332	A		
				WB Right	4	2	33	332	A		
23- MD 124 at MD 355											
23	NB	51.6	D	NB Left	507	63	186	529	E	63.0	E
				NB Through	942	46	183	527	D		
				NB Right	6	12	0	0	B		
	SB	30.7	C	SB Left	141	71	99	395	E		
				SB Through	554	53	99	395	D		
				SB Right	736	6	20	339	A		
	EB	42.4	D	EB Left	468	93	363	1176	F		
				EB Through	2720	41	363	1176	D		
				EB Right	575	7	160	1150	A		
	WB	153.9	F	WB Left	0	0	0	0	A		
				WB Through	1481	156	718	950	F		
				WB Right	65	101	0	0	F		
24- MD 124 at I-270 SB on and off											
24	NB	64.4	F	NB Left	55	65	23	98	E	40.8	D
				NB Through	23	64	23	98	E		
				NB U-Turn	0	0	0	0	A		
	SB	57.0	E	SB Left	572	94	316	1663	F		
				SB Through	10	80	316	1663	F		
				SB Right	452	9	141	1059	A		
	EB	43.4	D	EB Left	0	0	0	0	A		
				EB Through	1738	44	307	1098	D		
				EB Right	31	34	323	1121	C		
	WB	18.7	B	WB Left	4	66	77	588	E		
				WB Through	1046	19	77	588	B		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	36.4	D	NB Left	45	63	116	666	E	40.6	D
				NB Through	545	54	116	666	D		
				NB Right	447	13	4	216	B		
	SB	32.8	C	SB Left	119	44	98	447	D		
				SB Through	762	37	98	447	D		
				SB Right	144	2	0	0	A		
	EB	46.1	D	EB Left	120	82	142	477	F		
				EB Through	1092	42	142	478	D		
				EB Right	43	39	149	506	D		
	WB	43.5	D	WB Left	402	70	280	1027	E		
				WB Through	1338	39	280	1027	D		
				WB Right	129	2	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	45.7	D	NB Left	78	79	65	281	E	38.8	D
				NB Through	27	75	65	281	E		
				NB Right	260	33	65	281	C		
	SB	71.9	E	SB Left	274	83	109	351	F		
				SB Through	17	82	109	351	F		
				SB Right	65	21	109	351	C		
	EB	31.4	C	EB Left	41	80	156	829	F		
				EB Through	1593	30	157	829	C		
				EB Right	3	13	151	818	B		
	WB	37.7	D	WB Left	19	43	337	1058	D		
				WB Through	1703	40	337	1059	D		
				WB Right	292	26	368	1107	C		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	13.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.6	A	EB Left	0	0	0	0	A		
				EB Through	896	5	10	466	A		
				EB Right	0	0	0	0	A		
	WB	39.8	E	WB Left	294	40	140	1068	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	30.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.1	D	SB Left	256	46	214	871	D		
				SB Through	0	0	0	0	A		
				SB Right	951	54	214	870	D		
	EB	27.6	C	EB Left	3	125	152	980	F		
				EB Through	897	27	152	980	C		
				EB Right	0	0	0	0	A		
	WB	13.3	B	WB Left	0	0	0	0	A		
				WB Through	1359	13	87	383	B		
				WB Right	0	0	87	383	A		
29- MD 117 at Perry Pkwy											
29	NB	42.6	D	NB Left	18	69	13	110	E	37.0	D
				NB Through	21	50	13	109	D		
				NB Right	23	15	21	129	B		
	SB	57.1	E	SB Left	194	85	89	332	F		
				SB Through	14	84	89	332	F		
				SB Right	112	6	89	332	A		
	EB	20.8	C	EB Left	240	69	84	355	E		
				EB Through	864	8	84	355	A		
				EB Right	32	6	69	339	A		
	WB	44.4	D	WB Left	36	105	245	752	F		
				WB Through	1228	46	245	752	D		
				WB Right	300	33	245	752	C		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	7.1	A	NB Left	0	0	0	0	A	13.8	B
				NB Through	1025	7	16	209	A		
				NB Right	0	0	0	0	A		
	SB	9.5	A	SB Left	0	0	0	0	A		
				SB Through	1280	9	41	481	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	52.9	D	WB Left	317	53	58	260	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.14: PM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	6.8	A	NB Left	0	0	0	0	A	15.9	B
				NB Through	1463	7	28	378	A		
				NB Right	0	0	0	0	A		
	SB	5.5	A	SB Left	0	0	0	0	A		
				SB Through	817	5	8	156	A		
				SB Right	0	0	0	0	A		
	EB	57.5	E	EB Left	229	55	44	200	D		
				EB Through	0	0	0	0	A		
				EB Right	295	60	63	241	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	36.5	D	SB Left	440	44	74	300	D		
				SB Through	0	0	0	0	A		
				SB Right	98	3	1	70	A		
	EB	2.7	A	EB Left	0	0	0	0	A		
				EB Through	1505	1	0	0	A		
				EB Right	830	6	14	245	A		
	WB	6.1	A	WB Left	0	0	0	0	A		
				WB Through	1693	6	18	227	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	34.9	C	NB Left	0	0	43	241	A	21.5	C
				NB Through	208	47	51	250	D		
				NB Right	134	16	51	250	B		
	SB	33.6	C	SB Left	11	101	175	288	F		
				SB Through	0	0	0	0	A		
				SB Right	164	29	175	288	C		
	EB	12.7	B	EB Left	254	38	53	287	D		
				EB Through	885	5	53	287	A		
				EB Right	0	0	0	0	A		
	WB	24.1	C	WB Left	36	20	96	383	B		
				WB Through	1241	24	77	346	C		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	38.6	D	NB Left	45	44	12	86	D	13.4	B
				NB Through	11	50	8	84	D		
				NB Right	12	10	8	94	A		
	SB	3.3	A	SB Left	14	51	7	73	D		
				SB Through	11	51	7	73	D		
				SB Right	401	0	0	0	A		
	EB	12.0	B	EB Left	425	24	38	464	C		
				EB Through	669	5	5	161	A		
				EB Right	58	4	9	198	A		
	WB	18.4	B	WB Left	11	18	48	405	B		
				WB Through	827	18	48	405	B		
				WB Right	14	17	63	439	B		
35- MD 189 at I-270 Ramps											
35	NB	46.1	D	NB Left	250	46	44	190	D	41.7	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.4	E	SB Left	350	55	139	869	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	27.5	C	EB Left	480	31	89	371	C		
				EB Through	367	23	89	371	C		
				EB Right	0	0	0	0	A		
	WB	48.9	D	WB Left	440	54	106	299	D		
				WB Through	417	43	106	299	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	45.1	D	NB Left	187	57	113	410	E	43.8	D
				NB Through	536	52	113	410	D		
				NB Right	174	10	113	410	B		
	SB	62.3	E	SB Left	247	79	151	606	E		
				SB Through	729	57	154	631	E		
				SB Right	0	0	0	0	A		
	EB	34.6	C	EB Left	118	71	101	438	E		
				EB Through	543	34	101	438	C		
				EB Right	160	10	101	438	B		
	WB	34.5	C	WB Left	160	71	123	603	E		
				WB Through	781	35	123	603	C		
				WB Right	317	15	123	603	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	16.2	B
				NB Through	0	0	0	0	A		
				NB Right	490	0	0	0	A		
	SB	71.2	E	SB Left	68	48	37	256	D		
				SB Through	0	0	0	0	A		
				SB Right	270	77	97	348	E		
	EB	6.1	A	EB Left	0	0	0	0	A		
				EB Through	1685	6	30	360	A		
				EB Right	0	0	0	0	A		
	WB	18.3	B	WB Left	69	35	30	360	C		
				WB Through	2563	18	105	727	B		
				WB Right	244	12	105	727	B		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	22.9	C	NB Left	650	23	46	257	C	17.4	B
				NB Through	0	0.0	39	249	A		
				NB Right	21	6.3	46	257	A		
	SB	15.4	B	SB Left	8	24.8	1	43	C		
				SB Through	0	0.0	1	43	A		
				SB Right	7	4.7	0	30	A		
	EB	11.1	B	EB Left	1	11.0	14	153	B		
				EB Through	310	11.6	14	153	B		
				EB Right	33	6.4	9	144	A		
	WB	12.7	B	WB Left	121	15.9	14	122	B		
				WB Through	192	10.8	14	122	B		
				WB Right	1	3.7	2	78	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	17.3	B	NB Left	76	34	62	288	C	55.3	E
				NB Through	606	30	62	288	C		
				NB Right	572	1	0	0	A		
	SB	30.3	C	SB Left	193	62	61	206	E		
				SB Through	394	20	59	205	C		
				SB Right	105	11	54	250	B		
	EB	216.7	F	EB Left	81	178	517	714	F		
				EB Through	458	222	518	715	F		
				EB Right	32	240	542	739	F		
	WB	35.5	D	WB Left	565	44	110	402	D		
				WB Through	473	41	111	402	D		
				WB Right	330	13	130	433	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	124.2	F	NB Left	0	0	0	0	A	98.5	F
				NB Through	335	113	520	837	F		
				NB Right	854	129	520	837	F		
	SB	86.6	F	SB Left	0	0	86	220	A		
				SB Through	346	87	86	220	F		
				SB Right	0	0	0	0	A		
	EB	62.2	E	EB Left	5	127	169	458	F		
				EB Through	428	103	169	458	F		
				EB Right	297	2	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.14: PM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41				NB Left	341	30	76	261	C	49.5	D
	NB	30.2	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	345	59	193	786	E		
	WB	54.7	D	WB Through	894	53	193	786	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42				NB Left	198	21	316	1253	C	120.3	F
	NB	43.7	D	NB Through	2133	43	316	1253	D		
				NB Right	188	73	316	1253	E		
				SB Left	185	168	2553	2702	F		
	SB	201.4	F	SB Through	1122	201	2553	2702	F		
				SB Right	270	226	2553	2702	F		
				EB Left	238	52	94	407	D		
	EB	51.7	D	EB Through	409	54	95	408	D		
				EB Right	103	43	113	432	D		
				WB Left	459	211	1918	2138	F		
	WB	215.4	F	WB Through	614	233	1918	2138	F		
				WB Right	151	158	1918	2138	F		
43- MD 187 at I-270 NB on and off ramps											
43				NB Left	552	34	103	399	C	18.5	B
	NB	14.8	B	NB Through	2291	10	103	399	B		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	22.7	C	SB Through	1247	23	57	248	C		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	65	60	50	290	E		
	WB	61.4	E	WB Through	65	63	50	290	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44				NB Left	0	0	0	0	A	33.3	C
	NB	32.2	D	NB Through	2211	32	103	485	C		
				NB Right	0	0	0	0	A		
				SB Left	150	59	74	305	E		
	SB	20.4	C	SB Through	1163	15	74	305	B		
				SB Right	0	0	0	0	A		
				EB Left	636	57	137	558	E		
	EB	57.1	E	EB Through	0	0	137	558	A		
				EB Right	185	57	77	519	E		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45				NB Left	383	34	90	614	C	23.8	C
	NB	16.8	B	NB Through	2000	14	91	614	B		
				NB Right	14	12	111	647	B		
				SB Left	20	47	82	400	D		
	SB	26.7	C	SB Through	1160	30	82	400	C		
				SB Right	172	1	54	356	A		
				EB Left	396	59	98	362	E		
	EB	40.2	D	EB Through	37	63	98	362	E		
				EB Right	375	18	98	362	B		
				WB Left	5	32	3	77	C		
	WB	11.6	B	WB Through	12	25	3	77	C		
				WB Right	32	4	1	67	A		
47-Democracy Blvd at I-270 NB off ramp											
47				NB Left	152	46	29	159	D	3.0	A
	NB	45.7	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	1.2	A	EB Through	1114	1	3	51	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	0.9	A	WB Through	2129	1	2	62	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48				NB Left	0	0	0	0	A	6.3	A
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	5.0	A	EB Through	1326	5	17	250	A		
				EB Right	0	0	0	0	A		
				WB Left	531	24	39	287	C		
	WB	7.0	A	WB Through	1748	2	30	266	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49				NB Left	0	0	0	0	A	7.4	A
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	159	53	31	164	D		
	SB	38.9	D	SB Through	0	0	0	0	A		
				SB Right	60	2	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	3.8	A	WB Through	1748	4	16	274	A		
				WB Right	168	3	12	305	A		
50- MD 190 at Burdette Rd											
50				NB Left	26	74	15	100	E	31.1	C
	NB	72.8	E	NB Through	4	84	15	100	F		
				NB Right	5	56	15	100	E		
				SB Left	34	78	19	122	E		
	SB	32.1	C	SB Through	7	56	19	122	E		
				SB Right	118	18	19	122	B		
				EB Left	122	85	82	513	F		
	EB	17.6	B	EB Through	1151	11	82	513	B		
				EB Right	28	4	68	540	A		
				WB Left	11	113	334	1111	F		
	WB	38.3	D	WB Through	2146	38	334	1111	D		
				WB Right	52	28	334	1111	C		

Table B.14: PM Peak - Existing - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
51				SB Right	0	0	0	0	A	16.9	B
				EB Left	233	70	101	369	E		
	EB	70.2	E	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	8.4	A	WB Through	1464	8	42	713	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
				NB Left	222	74	89	830	E		
	NB	73.8	E	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
52				SB Right	0	0	0	0	A	12.4	B
				EB Left	0	0	0	0	A		
	EB	2.9	A	EB Through	840	3	6	143	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	9.1	A	WB Through	1705	9	26	545	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
				NB Left	21	1	0	0	A		
	NB	0.3	A	NB Through	243	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	306	56	103	375	E		
	SB	55.7	E	SB Through	180	56	103	375	E		
53				SB Right	17	56	103	375	E	24.7	C
				EB Left	22	33	66	355	C		
	EB	27.1	C	EB Through	664	27	66	355	C		
				EB Right	34	25	66	355	C		
				WB Left	262	75	125	534	E		
	WB	19.0	B	WB Through	935	15	125	534	B		
				WB Right	715	4	125	534	A		
54- MD 124 at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	59.5	E	NB Through	0	0	0	0	A		
				NB Right	1911	59	802	2475	E		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
54				SB Right	0	0	0	0	A	64.0	E
				EB Left	0	0	0	0	A		
	EB	68.6	E	EB Through	1874	69	579	1267	E		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	47.0	D	NB Through	0	0	0	0	A		
				NB Right	314	47	51	199	D		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
55				SB Right	0	0	0	0	A	11.5	B
				EB Left	0	0	0	0	A		
	EB	1.5	A	EB Through	1113	2	4	65	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	26.0	C	NB Left	114	76	97	530	E	53.9	D
				NB Through	500	32	97	530	C		
				NB Right	829	15	41	553	B		
	SB	89.8	F	SB Left	142	82	443	1107	F		
				SB Through	874	91	443	1107	F		
				SB Right	67	95	443	1107	F		
	EB	33.8	C	EB Left	43	83	26	114	F		
				EB Through	20	91	26	114	F		
				EB Right	144	11	26	114	B		
	WB	61.6	E	WB Left	507	75	215	711	E		
				WB Through	27	65	215	711	E		
				WB Right	191	25	215	711	C		
2- MD 85 at I-270 NB on and off ramp											
2	NB	36.8	D	NB Left	975	37	197	899	D	32.3	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	25.8	C	SB Left	0	0	0	0	A		
				SB Through	677	26	88	703	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	6.0	A	NB Left	0	0	0	0	A	9.5	A
				NB Through	1700	6	45	814	A		
				NB Right	0	0	0	0	A		
	SB	43.3	D	SB Left	173	43	46	342	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	33.2	D	NB Left	60	69	157	637	E	33.5	C
				NB Through	1255	32	156	637	C		
				NB U-Turn	0	0	0	0	A		
	SB	21.9	C	SB Left	90	77	43	185	E		
				SB Through	812	26	57	408	C		
				SB Right	801	12	43	400	B		
	EB	54.7	D	EB Left	802	57	133	606	E		
				EB Through	31	44	133	606	D		
				EB Right	22	0	133	606	A		
	WB	43.6	D	WB Left	36	75	39	162	E		
				WB Through	61	65	39	162	E		
				WB Right	81	13	39	162	B		
5- MD 80 at I-270 NB on and ramp											
5	NB	-2.1	A	NB Left	1	0	0	0	A	8.8	A
				NB Through	2	0	0	0	A		
				NB Right	8	-3	0	0	A		
	SB	12.8	B	SB Left	391	16	22	165	B		
				SB Through	17	17	22	165	B		
				SB Right	122	3	0	0	A		
	EB	10.7	B	EB Left	70	11	14	182	B		
				EB Through	0	0	8	0	A		
				EB Right	6	5	25	213	A		
	WB	6.6	A	WB Left	16	12	1	42	B		
				WB Through	509	12	26	259	B		
				WB Right	482	1	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	2.1	A	NB Left	47	2	1	126	A	4.2	A
				NB Through	0	0	0	0	A		
				NB Right	491	2	1	126	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.3	A	EB Left	0	0	0	0	A		
				EB Through	271	6	2	82	A		
				EB Right	54	3	1	89	A		
	WB	6.7	A	WB Left	0	0	0	0	A		
				WB Through	318	7	1	85	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	5.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	9.8	A	SB Left	226	10	13	139	B		
				SB Through	0	0	0	0	A		
				SB Right	17	2	0	33	A		
	EB	2.2	A	EB Left	56	1	0	37	A		
				EB Through	0	0	0	0	A		
				EB Right	59	3	0	0	A		
	WB	0.3	A	WB Left	0	0	0	0	A		
				WB Through	160	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	3.8	A	NB Left	44	7	2	85	A	1.6	A
				NB Through	0	0	0	0	A		
				NB Right	29	0	0	12	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.8	A	EB Left	0	0	0	0	A		
				EB Through	114	0	0	0	A		
				EB Right	24	4	0	0	A		
	WB	1.2	A	WB Left	98	1	0	41	A		
				WB Through	78	1	0	18	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	11.2	B	NB Left	486	13	34	235	B	16.9	B
				NB Through	660	11	34	235	B		
				NB Right	57	2	39	261	A		
	SB	17.9	C	SB Left	20	13	5	155	B		
				SB Through	168	19	15	159	B		
				SB Right	8	12	13	171	B		
	EB	11.0	B	EB Left	2	32	2	70	C		
				EB Through	18	32	6	117	C		
				EB Right	142	8	14	149	A		
	WB	35.9	E	WB Left	210	46	58	215	D		
				WB Through	57	44	59	215	D		
				WB Right	140	18	72	239	B		
10- MD 121 at I-270 NB on and off ramp											
10	NB	0.8	A	NB Left	26	9	1	79	A	0.6	A
				NB Through	0	0	0	0	A		
				NB Right	754	1	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	448	0	0	0	A		
				EB Right	58	0	0	0	A		
	WB	0.8	A	WB Left	100	3	1	71	A		
				WB Through	423	0	0	40	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	2.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.1	A	SB Left	136	9	7	128	A		
				SB Through	0	0	0	0	A		
				SB Right	36	0	0	0	A		
	EB	0.3	A	EB Left	29	1	0	28	A		
				EB Through	0	0	0	0	A		
				EB Right	349	0	0	0	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	100	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	40.9	D	NB U-Turn	0	0	0	0	A	21.9	C
				NB Through	73	57	19	86	E		
				NB Right	47	15	19	86	B		
	SB	39.9	D	SB Left	114	46	31	182	D		
				SB Through	41	62	36	244	E		
				SB Right	173	30	58	281	C		
	EB	16.8	B	EB Left	214	27	71	526	C		
				EB Through	2282	16	73	527	B		
				EB Right	109	16	86	565	B		
	WB	25.1	C	WB Left	31	23	119	567	C		
				WB Through	1503	26	119	567	C		
				WB Right	54	8	119	567	A		
13- MD 27 at I-270 NB off ramp											
13	NB	44.6	D	NB Left	410	45	66	284	D	8.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1283	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	6.1	A	WB Left	0	0	0	0	A		
				WB Through	1581	6	45	678	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	50.4	D	SB Left	170	50	34	180	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	1351	2	4	122	A		
				EB Right	0	0	0	0	A		
	WB	2.7	A	WB Left	0	0	0	0	A		
				WB Through	1452	3	8	259	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	22.5	C	NB Left	58	20	55	385	C	30.2	C
				NB Through	966	23	68	384	C		
				NB Right	43	20	72	397	B		
	SB	34.9	C	SB Left	141	60	192	823	E		
				SB Through	1328	36	192	823	D		
				SB Right	200	9	171	817	A		
	EB	42.9	D	EB Left	103	54	28	120	D		
				EB Through	37	46	25	115	D		
				EB Right	47	17	17	141	B		
	WB	27.6	C	WB Left	83	49	70	297	D		
				WB Through	102	43	70	297	D		
				WB Right	552	22	70	297	C		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	4.0	A	NB Left	93	12	1	65	B	8.0	A
				NB Through	1194	3	7	161	A		
				NB Right	0	0	14	214	A		
	SB	6.4	A	SB Left	11	7	13	275	A		
				SB Through	1091	6	17	275	A		
				SB Right	9	3	20	308	A		
	EB	13.1	B	EB Left	18	55	11	127	E		
				EB Through	1	76	11	127	E		
				EB Right	275	10	11	127	B		
	WB	53.6	D	WB Left	93	64	37	199	E		
				WB Through	6	61	33	198	E		
				WB Right	25	13	42	218	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	16.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	33.5	C	EB Left	434	34	89	503	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	10.8	B	WB Left	0	0	0	0	A		
				WB Through	246	2	0	65	A		
				WB Right	1215	13	45	477	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	6.5	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	38.4	D	SB Left	129	38.4	23	141	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	4.9	A	EB Left	0	0.0	0	0	A		
				EB Through	1182	4.9	11	329	A		
				EB Right	0	0.0	0	0	A		
	WB	5.1	A	WB Left	0	0.0	0	0	A		
				WB Through	1505	5.1	9	217	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	24.2	C	NB Left	42	68	33	176	E	28.2	C
				NB Through	43	71	33	176	E		
				NB Right	196	5	3	83	A		
	SB	94.0	F	SB Left	382	93	226	583	F		
				SB Through	12	93	226	583	F		
				SB Right	97	100	226	583	F		
	EB	17.7	B	EB Left	98	22	60	391	C		
				EB Through	1215	17	60	391	B		
				EB Right	16	15	60	391	B		
	WB	18.2	B	WB Left	13	17	73	613	B		
				WB Through	1354	22	73	613	C		
				WB Right	360	6	73	613	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	8.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.3	B	SB Left	96	35	18	129	D		
				SB Through	0	0	0	0	A		
				SB Right	179	9	18	129	A		
	EB	6.6	A	EB Left	15	9	17	168	A		
				EB Through	1222	7	17	168	A		
				EB Right	0	0	0	0	A		
	WB	8.3	A	WB Left	0	0	0	0	A		
				WB Through	1238	8	24	242	A		
				WB Right	12	6	38	291	A		

Table B.15: PM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	4.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	686	3	4	100	A		
				EB Right	0	0	0	0	A		
	WB	7.1	A	WB Left	429	7	4	183	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	48.3	D	NB Left	156	45	75	316	D	12.8	B
				NB Through	0	0	75	316	A		
				NB Right	219	51	75	316	D		
	SB	31.0	C	SB Left	30	45	7	66	D		
				SB Through	2	37	7	66	D		
				SB Right	19	8	19	104	A		
	EB	7.4	A	EB Left	3	14	22	249	B		
				EB Through	1035	7	22	249	A		
				EB Right	160	7	22	249	A		
	WB	8.8	A	WB Left	253	22	36	390	C		
				WB Through	1722	7	36	390	A		
				WB Right	4	3	36	390	A		
23- MD 124 at MD 355											
23	NB	51.2	D	NB Left	508	63	185	517	E	63.9	E
				NB Through	944	45	183	515	D		
				NB Right	6	10	0	0	A		
	SB	31.0	C	SB Left	140	73	99	373	E		
				SB Through	559	53	99	373	D		
				SB Right	736	6	21	294	A		
	EB	44.6	D	EB Left	462	93	397	1196	F		
				EB Through	2709	44	397	1196	D		
				EB Right	571	8	170	1162	A		
	WB	152.5	F	WB Left	0	0	0	0	A		
				WB Through	1489	155	710	943	F		
				WB Right	66	99	0	0	F		
24- MD 124 at I-270 SB on and off											
24	NB	66.0	F	NB Left	55	66	24	105	E	48.6	D
				NB Through	22	67	24	105	E		
				NB U-Turn	0	0	0	0	A		
	SB	82.9	F	SB Left	541	135	535	2593	F		
				SB Through	9	157	535	2593	F		
				SB Right	436	17	135	1624	B		
	EB	47.2	D	EB Left	0	0	0	0	A		
				EB Through	1750	47	341	1090	D		
				EB Right	31	35	355	1114	D		
	WB	17.5	B	WB Left	4	56	72	606	E		
				WB Through	1052	17	72	606	B		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	33.4	C	NB Left	45	59	104	614	E	39.9	D
				NB Through	542	50	104	614	D		
				NB Right	446	11	3	173	B		
	SB	32.7	C	SB Left	119	43	99	460	D		
				SB Through	763	37	99	460	D		
				SB Right	144	2	0	0	A		
	EB	46.1	D	EB Left	119	85	142	497	F		
				EB Through	1096	42	141	498	D		
				EB Right	42	41	150	525	D		
	WB	43.3	D	WB Left	396	70	276	1032	E		
				WB Through	1332	39	276	1032	D		
				WB Right	130	1	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	35.5	D	NB Left	77	73	54	238	E	38.7	D
				NB Through	27	74	54	238	E		
				NB Right	259	20	54	238	C		
	SB	77.0	E	SB Left	273	89	116	372	F		
				SB Through	17	86	116	372	F		
				SB Right	66	26	116	372	C		
	EB	29.7	C	EB Left	42	84	132	742	F		
				EB Through	1608	28	132	742	C		
				EB Right	3	11	126	732	B		
	WB	39.8	D	WB Left	19	41	356	1072	D		
				WB Through	1710	42	357	1072	D		
				WB Right	292	28	388	1121	C		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	14.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.8	A	EB Left	0	0	0	0	A		
				EB Through	899	6	13	523	A		
				EB Right	0	0	0	0	A		
	WB	43.1	E	WB Left	289	43	156	1035	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	38.5	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	72.5	E	SB Left	259	63	1055	2355	E		
				SB Through	0	0	0	0	A		
				SB Right	964	75	1054	2354	E		
	EB	28.3	C	EB Left	4	127	162	987	F		
				EB Through	896	28	162	987	C		
				EB Right	0	0	0	0	A		
	WB	14.5	B	WB Left	0	0	0	0	A		
				WB Through	1345	14	95	383	B		
				WB Right	0	0	95	383	A		
29- MD 117 at Perry Pkwy											
29	NB	43.3	D	NB Left	18	67	13	112	E	41.0	D
				NB Through	21	55	13	111	D		
				NB Right	24	15	22	131	B		
	SB	51.4	D	SB Left	197	76	79	324	E		
				SB Through	15	77	79	324	E		
				SB Right	112	5	79	324	A		
	EB	21.0	C	EB Left	241	70	88	358	E		
				EB Through	866	8	88	358	A		
				EB Right	31	7	73	342	A		
	WB	53.4	D	WB Left	36	115	293	747	F		
				WB Through	1214	55	293	747	D		
				WB Right	296	40	293	747	D		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	38.6	D	NB Left	668	88	327	938	F	67.3	E
				NB Through	1026	6	327	938	A		
				NB Right	0	0	0	0	A		
	SB	111.6	F	SB Left	0	0	0	0	A		
				SB Through	1216	112	842	1111	F		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	51.3	D	WB Left	329	51	59	260	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	9.8	A	NB Left	0	0	0	0	A	18.2	B
				NB Through	1463	10	44	460	A		
				NB Right	0	0	0	0	A		
	SB	7.3	A	SB Left	0	0	0	0	A		
				SB Through	806	7	11	195	A		
				SB Right	0	0	0	0	A		
	EB	58.4	E	EB Left	229	60	85	397	E		
				EB Through	0	0	0	0	A		
				EB Right	294	57	62	241	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	8.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	38.9	D	SB Left	434	47	77	322	D		
				SB Through	0	0	0	0	A		
				SB Right	97	3	0	21	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	1505	0	0	0	A		
				EB Right	830	6	14	202	A		
	WB	7.0	A	WB Left	0	0	0	0	A		
				WB Through	1734	7	21	252	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	39.1	D	NB Left	0	0	53	253	A	24.1	C
				NB Through	220	52	60	262	D		
				NB Right	138	18	60	262	B		
	SB	36.5	D	SB Left	11	101	177	314	F		
				SB Through	0	0	0	0	A		
				SB Right	164	32	177	314	C		
	EB	13.0	B	EB Left	250	40	54	276	D		
				EB Through	879	5	54	276	A		
				EB Right	0	0	0	0	A		
	WB	28.1	C	WB Left	35	25	111	382	C		
				WB Through	1241	28	91	345	C		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	38.1	D	NB Left	45	43	11	86	D	13.6	B
				NB Through	11	48	8	84	D		
				NB Right	12	10	8	94	A		
	SB	3.3	A	SB Left	14	51	7	73	D		
				SB Through	11	51	7	73	D		
				SB Right	401	0	0	0	A		
	EB	12.0	B	EB Left	431	24	40	449	C		
				EB Through	675	5	6	182	A		
				EB Right	58	4	10	218	A		
	WB	19.0	B	WB Left	11	19	49	340	B		
				WB Through	827	19	49	340	B		
				WB Right	14	17	65	374	B		
35- MD 189 at I-270 Ramps											
35	NB	45.5	D	NB Left	260	46	47	211	D	41.8	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	56.3	E	SB Left	346	56	131	515	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	26.9	C	EB Left	479	30	89	350	C		
				EB Through	367	23	89	350	C		
				EB Right	0	0	0	0	A		
	WB	49.6	D	WB Left	439	54	108	260	D		
				WB Through	417	45	108	260	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	44.7	D	NB Left	187	56	112	406	E	43.5	D
				NB Through	535	52	112	406	D		
				NB Right	174	10	112	406	A		
	SB	62.0	E	SB Left	247	78	153	673	E		
				SB Through	729	57	154	664	E		
				SB Right	0	0	0	0	A		
	EB	34.5	C	EB Left	118	71	101	437	E		
				EB Through	540	34	101	437	C		
				EB Right	160	10	101	437	B		
	WB	34.3	C	WB Left	161	69	123	612	E		
				WB Through	784	35	123	612	C		
				WB Right	316	16	123	612	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	14.5	B
				NB Through	0	0	0	0	A		
				NB Right	503	0	0	0	A		
	SB	51.8	D	SB Left	67	48	18	184	D		
				SB Through	0	0	0	0	A		
				SB Right	272	53	66	224	D		
	EB	6.5	A	EB Left	0	0	0	0	A		
				EB Through	1670	7	32	391	A		
				EB Right	0	0	0	0	A		
	WB	17.2	B	WB Left	69	36	32	391	D		
				WB Through	2569	17	92	658	B		
				WB Right	245	12	92	658	B		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	23.3	C	NB Left	664	24	47	258	C	17.6	B
				NB Through	0	0.0	41	250	A		
				NB Right	23	6.5	47	258	A		
	SB	14.3	B	SB Left	8	23.9	1	39	C		
				SB Through	0	0.0	1	38	A		
				SB Right	7	3.4	0	22	A		
	EB	11.1	B	EB Left	1	14.5	14	158	B		
				EB Through	310	11.5	14	157	B		
				EB Right	33	6.7	9	148	A		
	WB	12.6	B	WB Left	122	16.3	14	127	B		
				WB Through	192	10.4	14	127	B		
				WB Right	1	3.8	2	83	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	17.4	B	NB Left	76	33	63	273	C	56.9	E
				NB Through	606	31	63	273	C		
				NB Right	572	1	0	0	A		
	SB	29.6	C	SB Left	192	60	59	195	E		
				SB Through	394	20	57	194	B		
				SB Right	105	11	50	230	B		
	EB	231.3	F	EB Left	81	192	556	732	F		
				EB Through	454	237	557	733	F		
				EB Right	30	252	581	756	F		
	WB	34.8	C	WB Left	571	43	109	383	D		
				WB Through	474	40	109	383	D		
				WB Right	330	13	129	413	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	129.2	F	NB Left	0	0	0	0	A	99.9	F
				NB Through	331	117	533	842	F		
				NB Right	841	134	533	842	F		
	SB	84.7	F	SB Left	0	0	83	215	A		
				SB Through	343	85	83	215	F		
				SB Right	0	0	0	0	A		
	EB	60.0	E	EB Left	5	114	162	511	F		
				EB Through	432	99	162	511	F		
				EB Right	296	2	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	32.2	C	NB Left	337	32	81	268	C	49.0	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	53.6	D	WB Left	340	57	192	772	E		
				WB Through	890	52	192	772	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	43.0	D	NB Left	197	19	309	1203	B	121.2	F
				NB Through	2139	43	309	1203	D		
				NB Right	186	72	309	1203	E		
	SB	208.3	F	SB Left	180	180	2575	2699	F		
				SB Through	1102	207	2575	2699	F		
				SB Right	266	234	2575	2699	F		
	EB	51.7	D	EB Left	238	52	94	407	D		
				EB Through	409	54	95	408	D		
				EB Right	103	43	113	432	D		
	WB	214.5	F	WB Left	464	209	1909	2135	F		
				WB Through	616	233	1909	2135	F		
				WB Right	151	157	1909	2135	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	13.5	B	NB Left	551	31	97	393	C	17.8	B
				NB Through	2287	9	97	393	A		
				NB Right	0	0	0	0	A		
	SB	23.2	C	SB Left	0	0	0	0	A		
				SB Through	1238	23	57	236	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	58.2	E	WB Left	65	57	47	253	E		
				WB Through	65	59	47	253	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	31.6	D	NB Left	0	0	0	0	A	33.1	C
				NB Through	2214	32	101	432	C		
				NB Right	0	0	0	0	A		
	SB	20.3	C	SB Left	147	62	76	320	E		
				SB Through	1156	15	76	320	B		
				SB Right	0	0	0	0	A		
	EB	58.0	E	EB Left	626	59	139	569	E		
				EB Through	0	0	139	569	A		
				EB Right	180	55	80	498	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	16.9	B	NB Left	383	35	90	613	C	24.0	C
				NB Through	2003	14	91	614	B		
				NB Right	14	13	110	647	B		
	SB	27.4	C	SB Left	20	53	84	438	D		
				SB Through	1147	31	84	438	C		
				SB Right	170	1	54	433	A		
	EB	40.0	D	EB Left	396	59	98	361	E		
				EB Through	37	63	98	361	E		
				EB Right	375	18	98	361	B		
	WB	11.5	B	WB Left	5	30	3	77	C		
				WB Through	12	25	3	77	C		
				WB Right	32	4	1	67	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	44.8	D	NB Left	161	45	29	139	D	3.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.3	A	EB Left	0	0	0	0	A		
				EB Through	1135	1	3	43	A		
				EB Right	0	0	0	0	A		
	WB	0.9	A	WB Left	0	0	0	0	A		
				WB Through	2129	1	2	62	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.1	A	EB Left	0	0	0	0	A		
				EB Through	1355	5	18	228	A		
				EB Right	0	0	0	0	A		
	WB	6.9	A	WB Left	534	23	38	282	C		
				WB Through	1757	2	30	261	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	7.8	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	37.7	D	SB Left	180	51	36	160	D		
				SB Through	0	0	0	0	A		
				SB Right	68	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	3.9	A	WB Left	0	0	0	0	A		
				WB Through	1757	4	19	274	A		
				WB Right	175	1	0	23	A		
50- MD 190 at Burdette Rd											
50	NB	72.7	E	NB Left	26	74	15	100	E	29.5	C
				NB Through	4	84	15	100	F		
				NB Right	5	56	15	100	E		
	SB	31.3	C	SB Left	33	76	19	125	E		
				SB Through	7	56	19	125	E		
				SB Right	118	17	19	125	B		
	EB	19.0	B	EB Left	121	94	89	546	F		
				EB Through	1153	11	89	546	B		
				EB Right	27	4	75	573	A		
	WB	34.8	C	WB Left	11	121	306	1102	F		
				WB Through	2160	35	306	1102	C		
				WB Right	51	25	306	1102	C		

Table B.15: PM Peak - Existing - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	17.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	69.6	E	EB Left	233	70	100	358	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.1	A	WB Left	0	0	0	0	A		
				WB Through	1475	9	47	714	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	70.7	E	NB Left	226	71	74	512	E	12.9	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.9	A	EB Left	0	0	0	0	A		
				EB Through	840	3	6	136	A		
				EB Right	0	0	0	0	A		
	WB	10.3	B	WB Left	0	0	0	0	A		
				WB Through	1728	10	30	624	B		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	0.3	A	NB Left	21	1	0	0	A	25.1	C
				NB Through	243	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.9	E	SB Left	306	56	104	375	E		
				SB Through	180	56	104	375	E		
				SB Right	17	56	104	375	E		
	EB	27.4	C	EB Left	22	34	66	366	C		
				EB Through	664	27	66	366	C		
				EB Right	34	25	66	366	C		
	WB	19.7	B	WB Left	268	79	132	465	E		
				WB Through	947	15	132	465	B		
				WB Right	730	4	132	465	A		
54- MD 124 at I-270 NB off ramp											
54	NB	67.2	E	NB Left	0	0	0	0	A	71.4	E
				NB Through	0	0	0	0	A		
				NB Right	1945	67	1020	3475	E		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	75.8	E	EB Left	0	0	0	0	A		
				EB Through	1835	76	607	1279	E		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	46.7	D	NB Left	0	0	0	0	A	11.8	B
				NB Through	0	0	0	0	A		
				NB Right	330	47	53	207	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.6	A	EB Left	0	0	0	0	A		
				EB Through	1135	2	4	66	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.16: PM Peak - Existing - I-270 Vehicle Network Performance

	Existing (Delay Total)	Alternative (Total Total)	% Change
Total Delay	21,792,153	18,725,155	-14%
Average Delay per Vehicle	206	179	-13%
Total Travel Time	53,628,278	51,038,133	-5%
Vehicles (Arrived)	88,401	89,277	1%
Latent Demand	1,544	2,344	52%
Latent Delay	2,650,217	3,580,739	35%
Total Distance	484,473	492,403	2%
Average Speed	33	35	5%

2040 Conditions

AM Peak

Table C.1: AM Peak - No Build - I-270 Vehicle Travel Time

I-270 Northbound	RITIS Segment Number	Segment Length (miles)	Cumulative Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	Cumulative Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From I-495 interchange			0.0				From I-70		0.0			
to MD 187	6001+6002	1.8	1.8	115.4	110.9	-3.5%	to MD 85	1.7	1.7	268.0	99.9	-62.7%
to I-270 Split	6003+6004	0.6	2.4	55.7	40.7	-26.8%	to MD 80	5.4	7.0	1392.5	938.5	-32.6%
to Montrose Rd	6005+6006	1.8	4.2	140.4	102.9	-26.4%	to MD 109	3.7	10.7	591.1	473.5	-19.8%
to MD 189	6007+6008	1.0	5.2	63.7	61.7	-3.1%	to MD 121	3.6	14.4	283.8	289.1	1.8%
to MD 28	6009+6010	1.0	6.2	57.8	56.4	-3.4%	to MD 27	2.5	16.8	275.0	179.6	-34.5%
to Shady Grove Rd	6011+6012	1.9	8.1	109.1	109.0	0.0%	to MD 118	1.1	17.9	248.9	82.1	-67.1%
to I-370	6013+6014	0.9	9.0	53.1	53.0	0.0%	to Middlebrook Rd	1.1	19.0	211.7	111.4	-47.6%
to MD 117	6015+6016	1.5	10.5	85.6	85.7	0.0%	to MD 124	2.2	21.2	532.9	154.5	-70.9%
to MD 124	6017+6018	0.6	11.1	34.5	34.5	2.9%	to MD 117	0.9	22.1	182.7	81.5	-55.7%
to Middlebrook Rd	6019+6020	2.5	13.6	140.9	140.8	0.0%	to I-370	1.0	23.1	92.3	110.5	19.6%
to MD 118	6021+6022	1.1	14.7	64.6	65.7	1.5%	to Shady Grove Rd	1.5	24.6	118.5	119.2	0.0%
to MD 27	6023+6024	0.9	15.7	51.9	52.6	1.9%	to MD 28	1.9	26.5	144.5	149.7	3.4%
to MD 121	6025+6026	2.4	18.0	135.7	135.4	-0.7%	to MD 189	1.0	27.4	155.0	70.6	-54.2%
to MD 109	6027+6028	4.1	22.1	235.2	234.8	0.0%	to Montrose Rd	1.0	28.5	233.5	74.4	-68.4%
to MD 80	6029+6030	3.7	25.8	214.2	214.8	0.5%	to I-270 Split	1.9	30.3	264.0	154.5	-41.7%
to MD 85	6031+6032	5.3	31.1	311.8	310.8	-0.3%	to MD 187	0.4	30.8	30.9	31.2	0.0%
to I-70	6033+6034	1.4	32.4	80.3	80.5	1.3%	to I-495 interchange	1.9	32.7	133.9	135.9	1.5%
I-270 Total (miles/minutes)		**32.4**		**32.5**	**31.5**	**0.0%**	**I-270 Total (miles/minutes)**	**32.7**		**86.0**	**54.3**	**-37.2%**
I-270 Spur Northbound							**I-270 Spur Southbound**					
From Cabin John Pkwy			0.0				From I-70		0.0			
to MD 190	6045	0.5	0.5	32.4	32.4	0.0%	to I-270 Split	30.3	30.3	4994.6	3,089.1	-38.2%
to I-495	6044	1.1	1.7	67.1	66.9	0.0%	to Democracy Blvd	0.7	31.1	164.6	141.0	-14.5%
to Democracy Blvd	6042+6043	1.4	3.1	98.7	93.7	-5.1%	to I-495	1.3	32.4	204.1	205.6	1.0%
to I-270 Split	6040+6041	0.9	4.0	72.5	51.4	-29.2%	to MD 190	1.3	33.6	87.9	112.4	27.3%
to I-70	6005 - 6034	30.0	34.0	1778.7	1,738.6	-2.2%	to Cabin John Pkwy	0.6	34.2	34.9	35.4	0.0%
I-270 Spur Total (miles/minutes)		**34.0**		**34.2**	**33.1**	**-2.9%**	**I-270 Spur Total (miles/minutes)**	**34.2**		**91.4**	**59.7**	**-34.1%**

Table C.2: AM Peak - No Build - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	185.1	67.2	-63.8%	to Shady Grove	1.3	445.2	289.2	-35.1%
to MD 189	1.3	338.8	124.6	-63.1%	to MD 28	1.8	435.5	506.6	16.3%
to MD 28	1.0	220.2	145.4	-34.1%	to MD 189	1.1	460.3	580.7	26.3%
to Shady Grove	2.0	117.2	120.2	2.6%	to Montrose	1.2	341.0	384.7	12.9%
to I-370	1.0	56.4	56.1	0.0%	to I-270 mainline	0.9	190.0	196.9	3.7%
to MD 117	1.2	72.6	73.7	1.4%					
to MD 124	0.8	49.0	49.4	0.0%					
to I-270 mainline	0.8	49.5	49.9	0.0%					
I-270 Local Total (miles/minutes)	**8.9**	**18.1**	**11.4**	**-38.9%**	**I-270 Local Total (miles/minutes)**	**6.3**	**31.2**	**32.6**	**6.5%**

Figure C.1: AM Peak - No Build
I-270 Travel Time Graph - Northbound

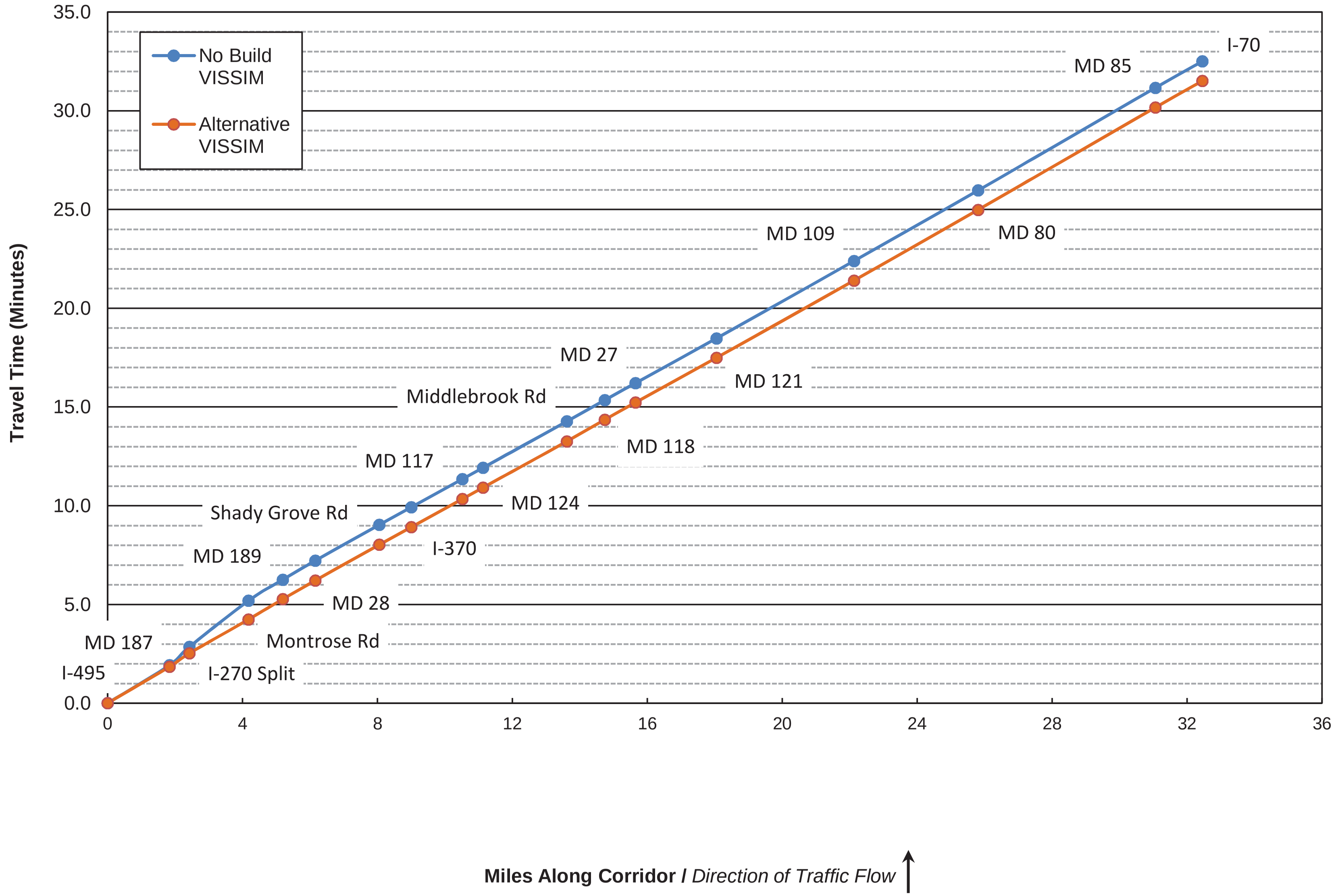


Figure C.2: AM Peak - No Build
I-270 Travel Time Graph - Southbound

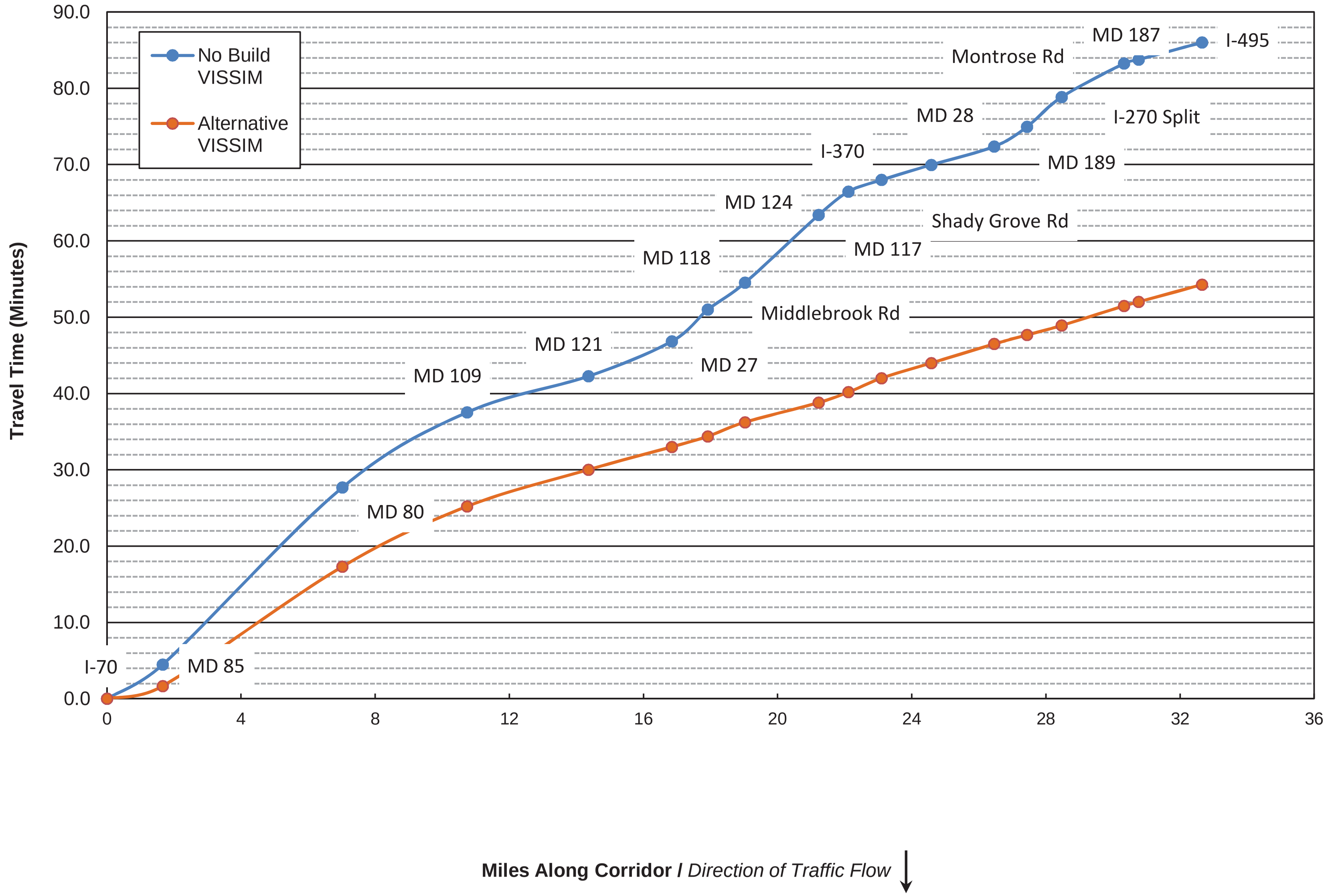


Figure C.3: AM Peak - No Build
I-270 Spur Travel Time Graph - Northbound

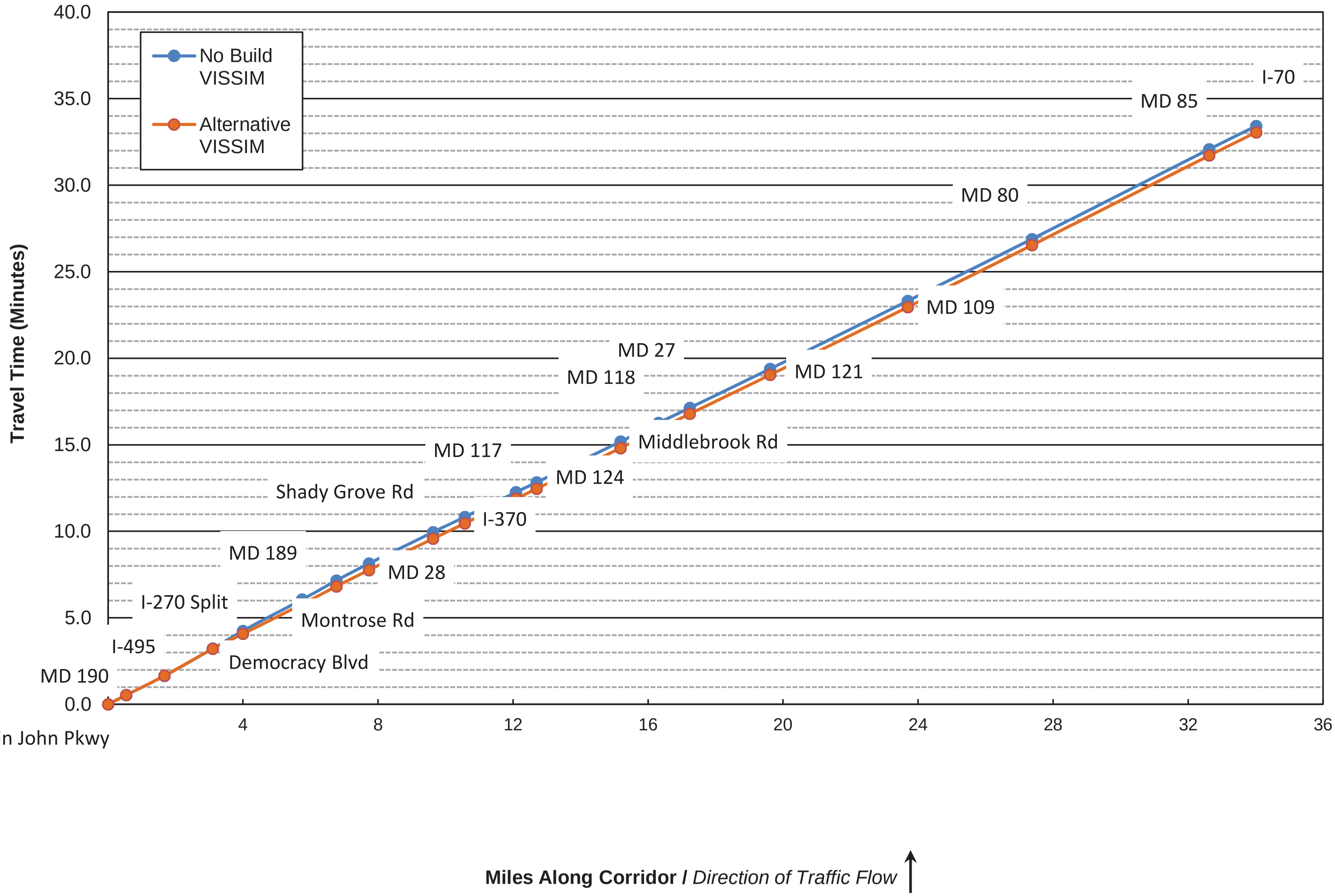


Figure C.4: AM Peak - No Build
I-270 Spur Travel Time Graph - Southbound

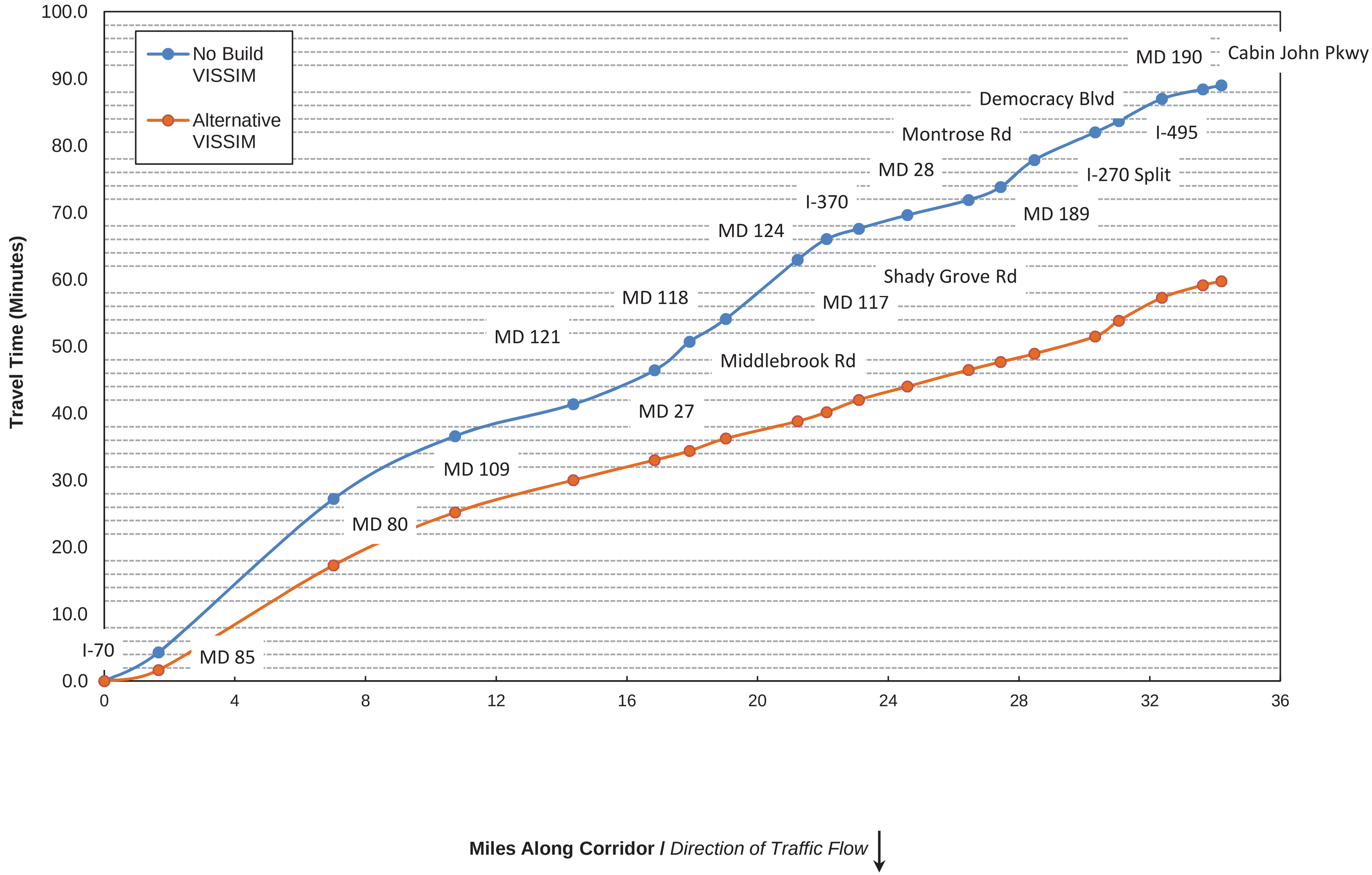


Figure C.5: AM Peak - No Build
I-270 Local Travel Time Graph - Northbound

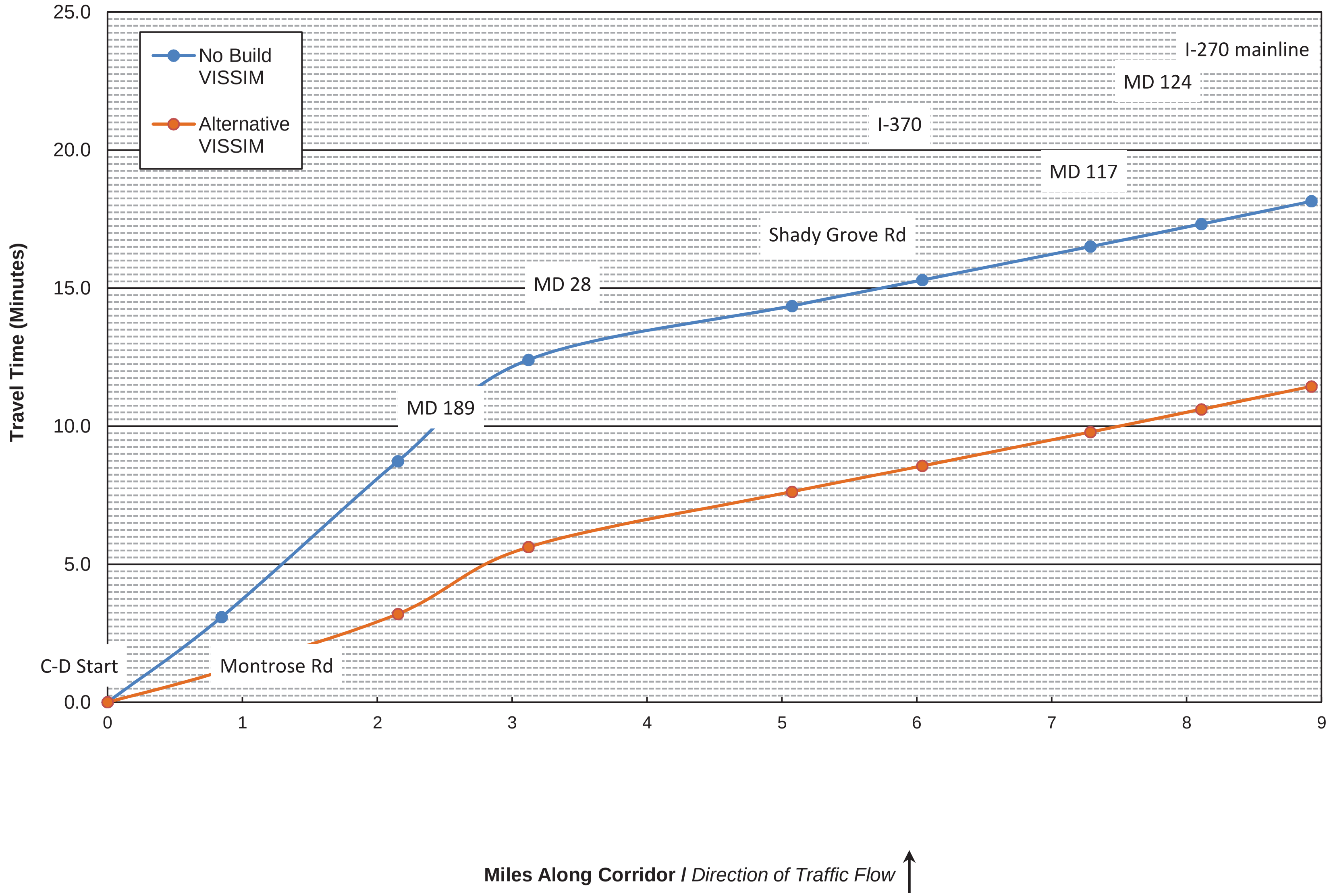


Figure C.6: AM Peak - No Build
I-270 Local Travel Time Graph - Southbound

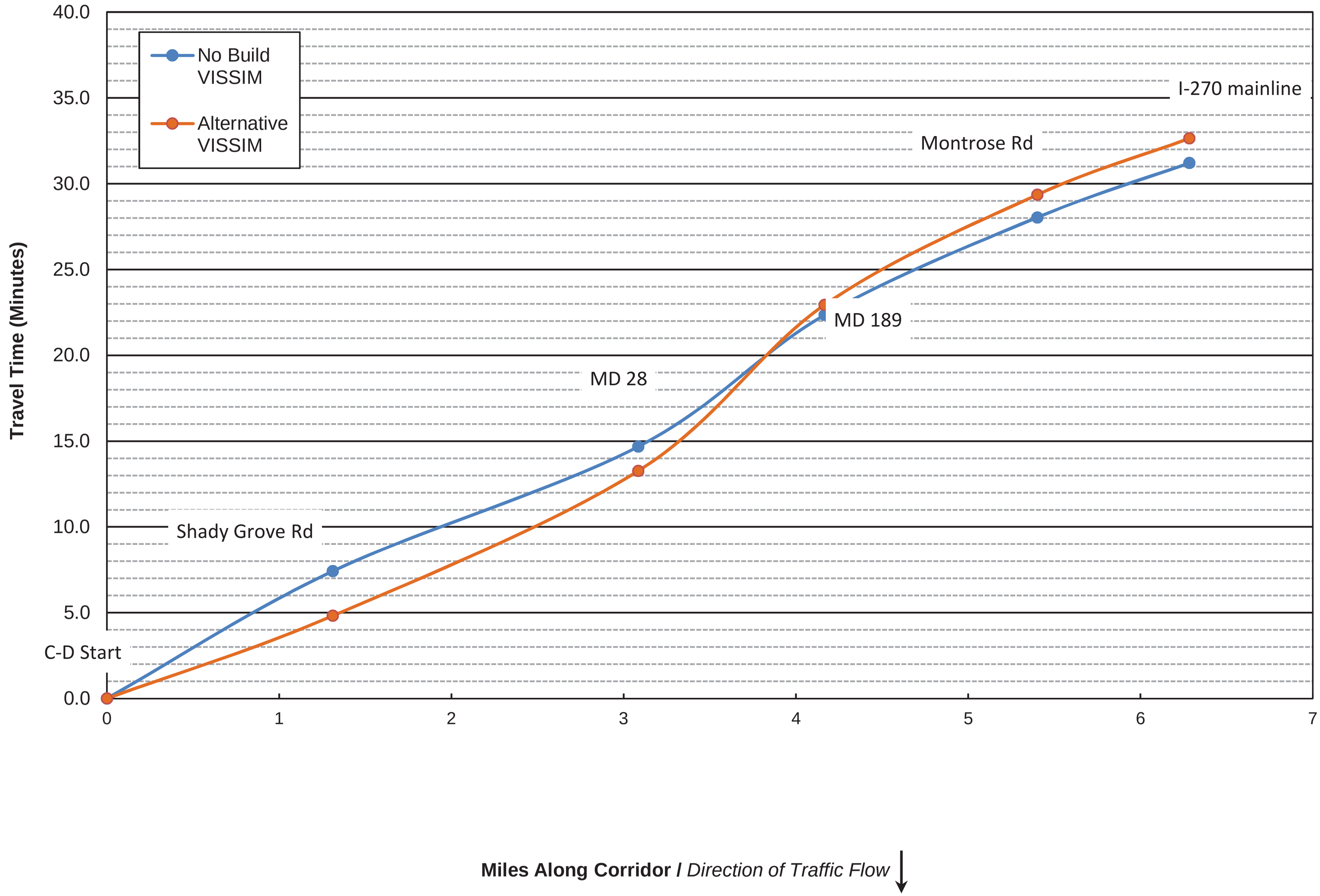


Table C.3: AM Peak - No Build - I-270 Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	57.2	59.5	5.3%	to MD 85	22.3	59.9	172.7%
to I-270 Split	38.2	52.2	36.8%	to MD 80	13.8	20.5	50.0%
to Montrose Rd	45.0	61.3	35.6%	to MD 109	22.7	28.3	21.7%
to MD 189	57.2	59.2	3.5%	to MD 121	45.9	45.1	-2.2%
to MD 28	60.1	61.5	3.3%	to MD 27	32.5	49.8	51.5%
to Shady Grove Rd	62.6	62.7	0.0%	to MD 118	15.5	47.0	193.8%
to I-370	64.1	64.1	0.0%	to Middlebrook Rd	18.9	35.8	89.5%
to MD 117	63.7	63.7	0.0%	to MD 124	14.8	51.3	240.0%
to MD 124	64.0	63.9	0.0%	to MD 117	17.4	39.1	129.4%
to Middlebrook Rd	63.5	63.6	0.0%	to I-370	38.4	32.1	-15.8%
to MD 118	62.5	61.4	-1.6%	to Shady Grove Rd	45.2	44.9	0.0%
to MD 27	63.6	63.3	-1.6%	to MD 28	46.7	45.1	-4.3%
to MD 121	63.5	63.4	-1.6%	to MD 189	22.7	49.9	117.4%
to MD 109	62.4	62.5	1.6%	to Montrose Rd	15.9	49.9	212.5%
to MD 80	61.8	61.6	0.0%	to I-270 Split	25.3	43.3	72.0%
to MD 85	60.7	60.9	0.0%	to MD 187	50.7	50.2	-2.0%
to I-70	62.4	62.2	0.0%	to I-495 interchange	50.8	50.1	-2.0%
I-270 Total (miles/minutes)	**59.9**	**61.8**	**3.3%**	**I-270 Total (miles/minutes)**	**22.8**	**36.1**	**56.5%**
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	59.9	59.9	0.0%	to I-270 Split	21.9	35.3	59.1%
to I-495	60.8	61.0	0.0%	to Democracy Blvd	16.0	18.6	18.8%
to Democracy Blvd	52.3	55.0	5.8%	to I-495	23.1	22.9	0.0%
to I-270 Split	44.3	62.5	40.9%	to MD 190	51.3	40.2	-21.6%
to I-70	60.8	62.2	1.6%	to Cabin John Pkwy	58.7	58.0	-1.7%

Table C.4: AM Peak - No Build - I-270 Local Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	16.4	45.3	181.3%	to Shady Grove	10.6	16.3	45.5%
to MD 189	13.9	37.8	171.4%	to MD 28	14.7	12.6	-13.3%
to MD 28	15.8	24.0	50.0%	to MD 189	8.5	6.7	-12.5%
to Shady Grove	60.1	58.5	-1.7%	to Montrose	13.0	11.6	-7.7%
to I-370	61.7	62.0	0.0%	to I-270 mainline	16.7	16.1	-5.9%
to MD 117	61.8	60.9	-1.6%				
to MD 124	60.5	59.9	0.0%				
to I-270 mainline	59.3	59.0	0.0%				
I-270 Local Total (miles/minutes)	**29.5**	**46.8**	**0.6**	**I-270 Local Total (miles/minutes)**	**12.1**	**11.6**	**0.0**

Figure C.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table C.5: AM Peak - No Build - I-270 Vehicle Density

		No Build		Alternative					No Build		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	35	E	27	D	-23%	I-270	Freeway	51	F	22	C	-57%
I-270 Diverge to MD 187	Diverge	31	D	21	C	-32%	I-270 Merge from WB I-70	Merge	67	F	14	B	-79%
I-270	Freeway	40	E	24	C	-40%	I-270	Freeway	68	F	26	D	-62%
I-270 Diverge to Rockledge Rd	Diverge	31	D	21	C	-32%	I-270 Merge from EB I-70	Merge	60	F	22	C	-63%
I-270	Freeway	40	E	22	C	-45%	I-270	Freeway	67	F	32	D	-52%
I-270 Weave from MD 187 to I-270 HOV	Weave	25	C	14	B	-44%	I-270 Diverge to SB MD 85	Diverge	70	F	37	E	-47%
I-270 Lane Drop	Merge	40	F	20	B	-50%	I-270	Freeway	96	F	29	D	-70%
I-270	Freeway	55	F	34	D	-38%	I-270 Diverge to NB MD 85	Diverge	58	F	17	B	-71%
I-270 Merge from I-270 Spur	Merge	54	F	27	C	-50%	I-270	Freeway	117	F	25	C	-79%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	61	F	34	D	-44%	I-270 Merge from MD 85	Merge	95	F	19	B	-80%
I-270	Freeway	35	E	26	D	-26%	I-270	Freeway	114	F	92	F	-19%
I-270 Diverge to C-D (MD 189)	Diverge	25	C	21	C	-16%	I-270 Diverge to MD 80	Diverge	61	F	51	F	-16%
I-270	Freeway	20	C	21	C	5%	I-270	Freeway	108	F	98	F	-9%
I-270 Diverge to C-D (MD 28)	Diverge	38	E	31	D	-18%	I-270 Merge from MD 80	Merge	106	F	52	F	-51%
I-270	Freeway	14	B	16	B	14%	I-270	Freeway	76	F	64	F	-16%
I-270 Merge from C-D (MD 189)	Merge	15	B	18	B	20%	I-270 Diverge to MD 109	Diverge	40	E	32	D	-20%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	19	B	15	B	-21%	I-270	Freeway	80	F	66	F	-18%
I-270	Freeway	13	B	15	B	15%	I-270 Merge from MD 109	Merge	69	F	38	E	-45%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	11	B	13	B	18%	I-270	Freeway	45	E	55	F	22%
I-270	Freeway	11	A	13	B	18%	I-270 Diverge to SB Weigh Station	Diverge	18	B	22	C	22%
I-270 Merge from C-D (Shady Grove Rd)	Merge	9	A	8	A	-11%	I-270	Freeway	38	E	41	E	8%
I-270	Freeway	12	B	13	B	8%	I-270 Merge from SB Weigh Station	Merge	20	C	22	C	10%
I-270 Merge from C-D (I-370)	Merge	11	B	12	B	9%	I-270	Freeway	41	E	43	E	5%
I-270 Diverge to C-D (MD 117)	Diverge	17	B	19	B	12%	I-270 Diverge to MD 121	Diverge	21	C	19	B	-10%
I-270	Freeway	13	B	14	B	8%	I-270	Freeway	32	D	25	C	-22%
I-270 Merge from C-D (MD 124)	Merge	14	B	15	B	7%	I-270 Merge from WB MD 121	Merge	38	E	22	C	-42%
I-270	Freeway	17	B	14	B	-18%	I-270	Freeway	46	F	33	D	-28%
I-270 Diverge to EB Middlebrook Rd	Diverge	11	B	9	A	-18%	I-270 Merge from EB MD 121	Merge	39	E	28	D	-28%
I-270	Freeway	15	B	11	B	-27%	I-270	Freeway	56	F	36	E	-36%
I-270 Diverge to WB Middlebrook Rd	Diverge	10	A	12	B	20%	I-270 Diverge to MD 27	Diverge	58	F	27	C	-53%
I-270	Freeway	14	B	15	B	7%	I-270	Freeway	82	F	26	C	-68%
I-270 Diverge to EB MD 118	Diverge	11	B	13	B	18%	I-270 Merge from WB MD 27	Merge	88	F	23	C	-74%
I-270 Diverge to WB MD 118	Diverge	15	B	17	B	13%	I-270	Freeway	81	F	35	E	-57%
I-270	Freeway	13	B	15	B	15%	I-270 Weave from EB MD 27 to MD 118	Weave	79	F	33	D	-58%
I-270 Weave from MD 118 to MD 27	Weave	13	B	14	B	8%	I-270	Freeway	92	F	48	F	-48%
I-270	Freeway	12	B	14	B	17%	I-270 Merge from WB MD 118	Merge	76	F	42	F	-45%
I-270 Merge from EB MD 27	Merge	13	B	14	B	8%	I-270	Freeway	87	F	58	F	-33%
I-270	Freeway	14	B	15	B	7%	I-270 Merge from EB MD 118	Merge	75	F	46	F	-39%
I-270 Merge from WB MD 27	Merge	11	B	11	B	0%	I-270	Freeway	72	F	42	E	-42%
I-270	Freeway	15	B	16	B	7%	I-270 Merge from Middlebrook Rd	Merge	112	F	39	E	-65%
I-270 Diverge to MD 121	Diverge	12	B	12	B	0%	I-270	Freeway	86	F	39	E	-55%

Table C.5: AM Peak - No Build - I-270 Vehicle Density

		No Build		Alternative					No Build		Alternative		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270	Freeway	11	A	12	B	9%	I-270 Diverge to Watkins Mill Rd	Diverge	79	F	27	C	-66%
I-270 Merge from EB MD 121	Merge	10	A	10	B	0%	I-270	Freeway	117	F	32	D	-73%
I-270 Lane Drop	Merge	13	B	15	B	15%	I-270 Diverge to MD 124	Diverge	83	F	18	B	-78%
I-270	Freeway	19	C	15	B	-21%	I-270	Freeway	132	F	30	D	-77%
I-270 Diverge to NB Weigh Station	Diverge	10	B	11	B	10%	I-270 Merge from Watkins Mill	Merge	158	F	27	C	-83%
I-270	Freeway	21	C	22	C	5%	I-270	Freeway	99	F	42	E	-58%
I-270 Merge from NB Weight Station	Merge	11	B	11	B	0%	I-270 Merge from WB MD 124	Merge	131	F	41	F	-69%
I-270	Freeway	21	C	22	C	5%	I-270	Freeway	54	F	54	F	0%
I-270 Diverge to MD 109	Diverge	12	B	12	B	0%	I-270 Merge from MD 117	Merge	50	F	65	F	30%
I-270	Freeway	19	C	20	C	5%	I-270	Freeway	44	E	60	F	36%
I-270 Merge from MD 109	Merge	11	B	11	B	0%	I-270 Diverge to I-370	Diverge	37	E	44	F	19%
I-270	Freeway	21	C	22	C	5%	I-270	Freeway	42	E	50	F	19%
I-270 Diverge to MD 80	Diverge	12	B	13	B	8%	I-270 Diverge to I-270 C-D	Diverge	85	F	60	F	-29%
I-270	Freeway	19	C	19	C	0%	I-270	Freeway	20	C	22	C	10%
I-270 Merge from MD 80	Merge	14	B	14	B	0%	I-270 Merge from I-270 (I-370)	Merge	21	C	22	C	5%
I-270	Freeway	25	C	25	C	0%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	27	C	33	D	22%
I-270 Diverge to Scenic View	Diverge	13	B	13	B	0%	I-270	Freeway	21	C	24	C	14%
I-270	Freeway	25	C	25	C	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	18	B	22	C	22%
I-270 Merge from Scenic View	Merge	12	B	13	B	8%	I-270	Freeway	27	D	32	D	19%
I-270	Freeway	25	C	25	C	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	35	E	35	E	0%
I-270 Diverge to NB MD 85	Diverge	14	B	15	B	7%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	48	F	35	E	-27%
I-270	Freeway	24	C	24	C	0%	I-270	Freeway	78	F	28	D	-64%
I-270 Diverge to SB MD 85	Diverge	19	B	18	B	-5%	I-270 Merge from I-270 C-D (MD 189)	Merge	99	F	27	C	-73%
I-270	Freeway	20	C	20	C	0%	I-270	Freeway	74	F	33	D	-55%
I-270 Weave from MD 85 to I-70	Weave	14	B	14	B	0%	I-270 Merge from I-270 C-D	Merge	53	F	29	D	-45%
I-270	Freeway	17	B	17	B	0%	I-270 Diverge to I-270 HOV Lane	Diverge	21	C	31	D	48%
						0%	I-270 Diverge to I-270 Spur	Diverge	71	F	42	F	-41%
						0%	I-270	Freeway	23	C	26	D	13%
						0%	I-270 Diverge to Rockledge Dr / MD 187	Diverge	17	B	19	B	12%
						0%	I-270	Freeway	23	C	26	D	13%
						0%	I-270 Merge from Rockledge Dr	Merge	19	B	22	C	16%
						0%	I-270	Freeway	24	C	28	D	17%
						0%	I-270 Merge from Rockledge Dr / MD 187	Merge	22	C	25	C	14%
						0%	I-270	Freeway	26	C	29	D	12%

Table C.6: AM Peak - No Build - I-270 Spur Vehicle Density

I-270 Spur Northbound	Type	No Build Density (pc/mi/ln)	No Build LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change	I-270 Southbound	Type	No Build Density (pc/mi/ln)	No Build LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change
I-270 Spur	Freeway	57	F	57	F	0%	I-270 Spur	Freeway	94	F	61	F	-35%
I-270 Spur Merge from Clara Barton Parkway	Merge	25	C	25	C	0%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	74	F	84	F	14%
I-270 Spur	Freeway	39	E	39	E	0%	I-270 Spur	Freeway	61	F	110	F	80%
I-270 Diverge to MD 190	Diverge	28	D	28	D	0%	I-270 Merge from Democracy Blvd	Merge	32	D	50	F	56%
I-270 Spur	Freeway	34	D	34	D	0%	I-270 Spur Lane Drop	Merge	56	F	46	F	-18%
I-270 Spur Merge from Cabin John Parkway	Merge	25	C	25	C	0%	I-270 Spur	Freeway	78	F	35	E	-55%
I-270 Spur Merge from MD 190	Merge	24	C	24	C	0%	I-270 Spur Merge from I-495	Merge	33	D	72	F	118%
I-270 Spur	Freeway	32	D	32	D	0%	I-270 Spur	Freeway	38	E	51	F	34%
I-270 Spur Diverge to I-495	Merge	35	E	34	D	-3%	I-270 Spur Diverve to EB MD 190	Diverge	41	F	64	F	56%
I-270 Spur	Freeway	36	E	33	D	-8%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	28	C	29	D	4%
I-270 Spur Diverge to Democracy Blvd	Diverge	32	D	28	C	-13%	I-270 Spur	Freeway	29	D	31	D	7%
I-270 Spur	Freeway	31	D	26	C	-16%	I-270 Merge from MD 190	Merge	27	C	28	C	4%
I-270 Spur Merge from EB Democracy Blvd	Merge	24	C	16	B	-33%	I-270 Spur	Freeway	35	D	36	E	3%
I-270 Spur	Freeway	33	D	24	C	-27%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	23	C	24	C	4%
I-270 Spur Merge from WB Democracy Blvd	Merge	25	C	16	B	-36%	I-270 Spur	Freeway	34	D	35	E	3%
I-270 Spur	Freeway	38	E	16	B	-58%	I-270 Merge from Clara Barton Pkwy	Merge	31	D	31	D	0%
I-270 Spur Merge from Westlake Terrace	Merge	40	F	17	B	-58%							
I-270 Spur	Freeway	44	E	19	C	-57%							

Table C.7: AM Peak - No Build - I-270 Local Vehicle Density

I-270 Northbound	Type	No Build Density (pc/mi/ln)	No Build LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change	I-270 Southbound	Type	No Build Density (pc/mi/ln)	No Build LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change
I-270 C-D	Freeway	75	F	46	F	-39%	I-270 C-D	Freeway	103	F	61	F	-41%
I-270 C-D Diverge to EB Montrose Rd	Diverge	45	F	29	D	-36%	I-270 C-D Weave from I-370 EB to I-270	Weave	123	F	76	F	-38%
I-270 C-D	Freeway	75	F	33	D	-56%	I-270 C-D Diverge to Shady Grove Rd	Diverge	109	F	75	F	-31%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	68	F	26	C	-62%	I-270 C-D	Freeway	133	F	85	F	-36%
I-270 C-D	Freeway	83	F	34	D	-59%	I-270 C-D Merge from WB Shady Grove Rd	Merge	101	F	76	F	-25%
I-270 C-D Merge from WB Montrose Rd	Merge	87	F	42	F	-52%	I-270 C-D	Freeway	110	F	85	F	-23%
I-270 C-D	Freeway	92	F	47	F	-49%	I-270 C-D Merge from EB Shady Grove Rd	Merge	73	F	65	F	-11%
I-270 C-D Merge from I-270	Merge	91	F	47	F	-48%	I-270 C-D	Freeway	90	F	81	F	-10%
I-270 C-D	Freeway	98	F	49	F	-50%	I-270 C-D Merge from I-270	Merge	95	F	89	F	-6%
I-270 C-D Diverge to MD 189	Diverge	54	F	27	C	-50%	I-270 C-D Diverge to I-270	Diverge	48	F	89	F	85%
I-270 C-D	Freeway	106	F	44	E	-58%	I-270 C-D Diverge to I-270	Diverge	52	F	88	F	69%
I-270 C-D Merge from MD 189	Merge	96	F	35	D	-64%	I-270 C-D	Freeway	67	F	90	F	34%
I-270 C-D	Freeway	107	F	36	E	-66%	I-270 C-D Diverge to MD 28	Diverge	56	F	61	F	9%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	103	F	41	F	-60%	I-270 C-D	Freeway	122	F	128	F	5%
I-270 C-D	Freeway	96	F	52	F	-46%	I-270 C-D Merge from WB MD 28	Merge	156	F	136	F	-13%
I-270 C-D Diverge to MD 28	Diverge	61	F	58	F	-5%	I-270 C-D	Freeway	129	F	137	F	6%
I-270 C-D	Freeway	84	F	48	F	-43%	I-270 C-D Merge from EB MD 28	Merge	151	F	141	F	-7%
I-270 C-D Weave between MD 28 Ramps	Weave	103	F	57	F	-45%	I-270 C-D	Freeway	122	F	142	F	16%
I-270 C-D	Freeway	7	A	10	A	43%	I-270 C-D Merge from I-270	Merge	124	F	115	F	-7%
I-270 C-D Merge from MD 28 WB	Merge	7	A	7	A	0%	I-270 C-D	Freeway	94	F	86	F	-9%
I-270 C-D Merge from I-270 and Drop Lane	Merge	8	A	9	A	13%	I-270 C-D Diverge to MD 189	Diverge	62	F	105	F	69%
I-270 C-D Diverge to I-270	Diverge	12	B	15	B	25%	I-270 C-D	Freeway	121	F	117	F	-3%
I-270 C-D	Freeway	20	C	24	C	20%	I-270 C-D Merge from MD 189	Merge	121	F	104	F	-14%
I-270 C-D Diverge to Shady Grove Rd	Diverge	16	B	19	B	19%	I-270 C-D Diverge to I-270	Diverge	79	F	110	F	39%
I-270 C-D	Freeway	5	A	6	A	20%	I-270 C-D	Freeway	86	F	109	F	27%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	8	A	6	A	-25%	I-270 C-D Diverge to WB Montrose Rd	Diverge	52	F	58	F	12%
I-270 C-D	Freeway	8	A	7	A	-13%	I-270 C-D	Freeway	95	F	104	F	9%
I-270 C-D Merge from WB Shady Grove Rd	Merge	10	B	12	B	20%	I-270 Weave between Montrose Rd Loops	Weave	86	F	91	F	6%
I-270 C-D Diverge to I-270	Diverge	15	B	15	B	0%	I-270 C-D	Freeway	75	F	85	F	13%
I-270 C-D	Freeway	13	B	14	B	8%	I-270 C-D Merge from EB Montrose Rd	Merge	57	F	61	F	7%
I-270 C-D Diverge to I-370	Diverge	13	B	16	B	23%	I-270 C-D	Freeway	56	F	52	F	-7%
I-270 C-D	Freeway	2	A	5	A	150%							
I-270 Merge from I-370 EB	Merge	7	A	8	A	14%							
I-270 C-D	Freeway	8	A	10	A	25%							
I-270 C-D Weave from I-370 to I-270	Weave	19	B	20	B	5%							
I-270 C-D	Freeway	14	B	14	B	0%							
I-270 C-D Weave from I-270 to MD 117	Weave	16	B	19	B	19%							
I-270 C-D Diverge to MD 124	Diverge	13	B	14	B	8%							
I-270 C-D	Freeway	13	B	14	B	8%							
I-270 C-D Merge from EB MD 124	Merge	12	B	12	B	0%							
I-270 C-D Merge From WB MD 124	Merge	13	B	14	B	8%							
I-270 C-D	Freeway	9	A	10	A	11%							
I-270 C-D Merge fromWatkins Mill	Merge	9	A	12	B	33%							

Table C.8: AM Peak - No Build - I-270 Vehicle Throughput

I-270 Northbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change	Data Collection Measurement	I-270 Southbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between I-495 and MD 187	4603	4861	6%	100	North of I-70	2549	2637	3%
Between MD 187 on and off ramps	3999	4320	8%	102	Between I-70 on ramps	2877	3038	6%
Between Rockledge Blvd on and off ramps	3273	3589	10%	105	From I-70 interchange to MD-85	4925	5380	9%
Between Rockledge Dr and I-270 Spur	2868	3214	12%	108	Between MD-85 on and off ramps	2537	2903	14%
Between I-270 Spur and Montrose Rd	7806	8660	11%	110	Between MD-85 and MD-80	2945	3325	13%
Between Montrose Rd on and off ramps	4509	5007	11%	112	Between MD-80 on and off ramps	2704	3030	12%
Between Montrose Rd and MD 189	4222	4677	11%	114	Between MD-80 and Md-109	3545	3836	8%
Between MD 189 and MD 28	4178	4638	11%	116	Between MD-109 on and off ramps	3487	3782	8%
Between MD 28 on and off ramps	4324	4958	15%	118	Between MD-109 and MD-121	4138	4423	7%
Between MD 28 and Shady Grove Rd	3141	3648	16%	120	Between MD-121 on and off ramps	3559	3850	8%
Between Shady Grove Rd and I-370	2697	3134	16%	123	Between MD-121 and MD-27	4828	5307	10%
Between I-370 on and off ramps	2999	3136	5%	126	Between MD-27 on and off ramps	4179	4891	17%
Between I-370 and MD 117	4135	4561	10%	129	Between MD-27 and MD-118	4644	5471	18%
Between MD 117 and MD 124	3115	3409	9%	133	Between MD-118 on and off ramps	4466	5325	19%
Between MD-124 on and off ramps	3121	3411	9%	136	Between MD-118 and Middlebrook Rd	5121	6005	17%
Between Watkins Mill Rd and Middlebrook Rd	4072	4546	12%	139	Between Middlebrook Rd on and off ramps	5104	6007	18%
Between Middlebrook Rd on and off ramps	3786	4203	11%	142	Between Middlebrook Rd and MD-124	6729	7769	15%
Between Middlebrook Rd and MD 118	3366	3733	11%	146	Between MD-124 on and off ramps	5419	6180	14%
Between MD-118 on and off ramps	3041	3370	11%	150	Between MD-124 and MD-117	6498	7221	11%
Between MD 118 and MD 27	2870	3128	9%	154	Between MD-117 and I-370	8204	8735	6%
Between MD-27 on and off ramps	2320	2520	9%	159	Between I-370 on and off ramps	3014	3071	2%
Between MD 27 and MD 121	2735	2928	7%	163	Between I-370 on ramp to Shady Grove Rd	3952	4264	8%
Between MD-121 on and off ramps	1997	2137	7%	167	Between Shady Grove Rd and MD 28	3616	3897	8%
Between MD 121 and MD 109	2533	2645	4%	171	Between MD 28 on and off ramps	4432	4702	6%
Between MD-109 on and off ramps	2354	2454	4%	175	Between MD 28 and MD 189	4003	4210	5%
Between MD 109 and MD 80	2508	2599	4%	179	Between MD 189 and Montrose Rd	4016	4246	6%
Between MD-80 on and off ramps	2242	2316	3%	183	Between Montrose Rd on and off ramps	4980	5329	7%
Between MD 80 and MD 85	2947	2997	2%	187	Between Montose Rd and I-270 Spur	8012	8685	8%
Between MD-85 on and off ramps	2238	2276	2%	193	Between I-270 Spur and Rockledge Blvd	3804	4143	9%
Between MD 85 and I-70	3256	3296	1%	197	Between Rockledge Blvd on and off ramps	2715	2977	10%
North of I-70	2102	2122	1%	200	Between MD 187 on and off ramps	2863	3156	10%
				203	Between MD 187 and I-495	2883	3151	9%
I-270 Spur Northbound					**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	5379	5480	2%	600	Between I-270 Split and HOV on ramp	4167	4601	10%
Between Democracy Blvd on and off ramps	4176	4282	3%	603	Between HOV on ramp and Democracy Blvd	4137	4559	10%
Between Democracy Blvd and I-270 Split	4346	4567	5%	607	Between Democracy Blvd on and off ramps	3639	4047	11%
				610	Between Democracy Blvd and I-495	4200	4652	11%

Table C.9: AM Peak - No Build - I-270 Local Vehicle Throughput

I-270 Local Northbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change	Data Collection Measurement	I-270 Local Southbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	1815	2217	22%	800	Between I-370 on ramp and I-270 off ramp	3840	4131	8%
Between Montrose Rd EB on ramp and WB off ramp	2007	2444	22%	804	Between I-270 off ramp and Shady Grove off ramp	2913	2880	-1%
Between Montrose Rd WB off ramp and on ramp	1649	2045	24%	807	Between Shady Grove off ramp and Shady Grove WB on ramp	1675	1584	-5%
Between Montrose Rd WB on ramp and I-270 on ramp	2320	3035	31%	809	Between Shady Grove WB and EB on ramps	2305	2113	-8%
Between I-270 on ramp and MD 189 off ramp	2458	3311	35%	811	Between Shady Grove on ramp and I-270 on ramp	2682	2464	-8%
Between MD 189 ramps	1893	2642	40%	813	Between I-270 on ramp and I-270 off ramp1	3367	3195	-5%
Between MD 189 off ramp and I-270 on ramp	2277	2719	19%	815	Between I-270 off ramp1 and I-270 off ramp2	2823	2665	-6%
Between I-270 on ramp and I-270 off ramp	2830	3282	16%	817	Between I-270 off ramp2 and MD 28 off ramp	1971	1892	-4%
Between I-270 off ramp and MD 28 EB off ramp	2023	2793	38%	819	Between MD 28 off ramp and MD 28 WB on ramp	1440	1354	-6%
Between MD 28 EB off ramp to MD 28 EB on ramp	1762	2450	39%	821	Between MD 28 WB on ramp and MD 28 EB on ramp	1721	1612	-6%
Between MD 28 EB on ramp and MD 28 WB off ramp	1787	2510	40%	823	Between MD 28 EB on ramp and I-270 on ramp	2412	2668	11%
Between MD 28 WB off ramp and MD 28 WB on ramp	822	1144	39%	825	Between I-270 on ramp and MD 189 off ramp	2892	3190	10%
Between MD 28 WB on ramp and I-270 on ramp	1332	1666	25%	827	Between MD 189 on and off ramps	2371	2611	10%
Between I-270 on ramp and I-270 off ramp	2543	2983	17%	829	Between MD 189 on ramp and I-270 off ramp	3526	3794	8%
Between I-270 off ramp and Shady Grove off ramp	2227	2563	15%	831	Between I-270 off ramp and Montrose Rd off ramp	2472	2585	5%
Between Shady Grove off ramp and I-270 on ramp	337	385	14%	833	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2376	2470	4%
Between I-270 on ramp and Shady Grove WB on ramp	1497	1338	-11%	835	Between Montrose Rd WB on ramp and EB off ramp	3157	3449	9%
Between Shady Grove WB on ramp and I-270 off ramp	1837	1994	9%	838	Between Montrose Rd EB off and on ramps	2446	2703	11%
Between I-270 off ramp and I-370 off ramp	1559	1997	28%	840	Between Montrose Rd EB off ramp and I-270	3250	3514	8%
Between I-370 off ramp and I-370 EB on ramp	296	610	106%					
Between I-370 EB and WB on ramps	927	1242	34%					
Between I-370 WB on ramp and I-270 off ramp	2795	3110	11%					
Between I-270 off ramp and I-270 on ramp	1678	1691	1%					
Between I-270 on ramp and MD 117 off ramp	2709	2847	5%					
Between MD 117 off ramp and MD 124 off ramp	1537	1604	4%					
Between MD 124 off ramp and MD 124 EB on ramp	804	838	4%					
Between MD 124 EB and WB on ramps	1196	1230	3%					
Between MD 124 on ramp I-270	567	594	5%					

Table C.10: AM Peak - No Build - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
Rockledge Dr on ramp	28	0	-100%	342	0	-100%
MD 189 C-D on ramp	0	0	0%	0	0	0%
MD 28 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	0	0	0%	0	0	0%
MD 124 C-D on ramp	0	0	0%	0	0	0%
MD 118 on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd EB on ramp	2	0	-100%	32	0	-100%
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Cabin John Pkwy on ramp	0	0	0%	0	0	0%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Montrose Rd EB on ramp	257	15	-94%	1142	56	-95%
Montrose Rd WB on ramp	1064	19	-98%	3063	132	-96%
I-270 on ramp	243	73	-70%	1305	248	-81%
MD 189 on ramp	1090	21	-98%	2900	53	-98%
I-270 on ramp	888	456	-49%	3101	1004	-68%
MD 28 EB on ramp	1	1	0%	34	29	-15%
MD 28 WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
Shady Grove Rd WB on ramp	0	0	0%	0	21	0%
I-370 EB on ramp	0	0	0%	0	0	0%
I-370 WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 124 EB on ramp	0	0	0%	0	0	0%
MD 124 WB on ramp	0	0	0%	0	0	0%
Watkins Mill Rd on ramp	0	0	0%	0	0	0%

Table C.11: AM Peak - No Build - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 187 off ramp NB	32	33	3%	250	236	-6%
MD 187 off ramp SB	0	0	0%	0	0	0%
Rockledge Dr off ramp	7	9	29%	364	355	-2%
Tower Oaks Blvd off ramp	19	24	26%	178	201	13%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	20	0%
MD 189 off ramp WB	8	12	50%	101	118	17%
MD 189 off ramp EB	2	2	0%	227	201	-11%
MD 28 off ramp EB	37	48	30%	252	317	26%
MD 28 off ramp WB	2600	802	-69%	5049	1717	-66%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	158	198	25%	607	719	18%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	221	375	70%	755	1214	61%
MD 124 off ramp	93	97	4%	386	405	5%
Watkins Mill Rd off ramp	81	95	17%	407	419	3%
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	0	12	0%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	8	9	13%	94	94	0%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	62	64	3%	232	284	22%
MD 121 off ramp EB	0	0	0%	0	0	0%
MD 109 off ramp EB	7	9	29%	170	162	-5%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	8	8	0%	118	103	-13%
MD 80 off ramp WB	1	0	-100%	41	7	-83%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 85 SB off ramp	1	1	0%	115	179	56%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Clara Barton Pkwy off ramp EB	1	1	0%	214	214	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	0%	71	66	-7%
MD 190 off ramp WB	0	0	0%	0	0	0%
Democracy Blvd off ramp WB	110	110	0%	589	576	-2%
Democracy Blvd off ramp EB	16	16	0%	126	136	8%

Table C.12: AM Peak - No Build - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 on ramp	23	0	-100%	380	13	-97%
MD 80 on ramp	874	0	-100%	2154	0	-100%
MD 109 on ramp	122	0	-100%	1183	0	-100%
MD 121 WB on ramp	132	0	-100%	1270	0	-100%
MD 121 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	578	0	-100%	2774	0	-100%
MD 27 EB on ramp	4	0	-100%	238	0	-100%
MD 118 WB on ramp	1	0	-100%	25	0	-100%
MD 118 EB on ramp	3	0	-100%	111	0	-100%
Middlebrook Rd on ramp	2811	0	-100%	4362	0	-100%
Watkins Mill Rd on ramp	3063	2	-100%	3140	76	-98%
MD 124 WB on ramp	2771	14	-99%	3926	171	-96%
MD 117 on ramp	557	46	-92%	1944	383	-80%
I-370 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp North	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp South	5	0	-100%	182	0	-100%
MD 189 C-D on ramp	357	0	-100%	2256	0	-100%
Montrose Rd C-D on ramp	361	0	-100%	1274	18	-99%
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd on ramp	0	0	0%	0	89	0%
I-495 Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 Spur on ramp	139	8	-94%	1094	362	-67%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 on ramp	2551	1117	-56%	4640	4523	-3%
I-370 on ramp	2382	230	-90%	2936	879	-70%
Shady Grove Rd WB on ramp	14	55	293%	437	315	-28%
Shady Grove Rd EB on ramp	0	15	0%	49	275	461%
I-270 on ramp	0	91	0%	14	1195	8436%
MD 28 WB on ramp	1311	136	-90%	2132	330	-85%
MD 28 EB on ramp	3703	286	-92%	3878	470	-88%
I-270 on ramp	3	9	200%	189	334	77%
MD 189 on ramp	2664	184	-93%	4380	584	-87%
Montrose Rd WB on ramp	72	36	-50%	1105	349	-68%
Montrose Rd EB on ramp	5	0	-100%	299	6	-98%

Table C.13: AM Peak - No Build - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 SB off ramp	0	36	0%	0	918	0%
MD 85 NB off ramp	0	0	0%	63	35	-44%
MD 80 off ramp	9	0	-100%	229	101	-56%
MD 109 off ramp WB	0	0	0%	38	27	-29%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	339	300	-12%	1863	1072	-42%
MD 121 off ramp WB	25	16	-36%	447	719	61%
MD 27 off ramp EB	50	53	6%	244	246	1%
MD 27 off ramp WB	473	307	-35%	1573	1671	6%
MD 118 off ramp EB	33	34	3%	163	142	-13%
MD 118 off ramp WB	0	0	0%	0	0	0%
Watkins Mill Rd off ramp	2483	136	-95%	5059	847	-83%
MD 124 off ramp EB	65	75	15%	341	308	-10%
MD 124 off ramp WB	9	16	78%	302	312	3%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	4	9	125%	149	263	77%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	5	67%	159	157	-1%
MD 189 off ramp EB	34	39	15%	221	347	57%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	226	1	-100%	1344	63	-95%
Rockledge Dr off ramp	25	54	116%	279	370	33%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd off ramp EB	50	54	8%	236	303	28%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	493	1358	175%	2882	3344	16%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	5	0	-100%

Table C.14: AM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	22.9	C	NB Left	118	81	77	497	F	38.8	D
				NB Through	367	26	77	497	C		
				NB Right	664	11	23	401	B		
	SB	52.1	D	SB Left	136	61	178	784	E		
				SB Through	599	52	178	784	D		
				SB Right	68	33	178	784	C		
	EB	49.4	D	EB Left	106	77	54	184	E		
				EB Through	62	75	54	184	E		
				EB Right	113	10	54	184	A		
	WB	51.2	D	WB Left	233	74	88	363	E		
				WB Through	16	68	88	363	E		
				WB Right	127	7	88	363	A		
2- MD 85 at I-270 NB on and off ramp											
2	NB	49.7	D	NB Left	681	50	249	1172	D	35.0	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.6	B	SB Left	0	0	0	0	A		
				SB Through	615	19	51	505	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	5.3	A	NB Left	0	0	0	0	A	10.5	B
				NB Through	1066	5	19	515	A		
				NB Right	0	0	0	0	A		
	SB	42.7	D	SB Left	174	43	45	301	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	19.3	C	NB Left	13	52	54	391	D	25.1	C
				NB Through	762	19	54	391	B		
				NB U-Turn	0	0	0	0	A		
	SB	18.5	B	SB Left	65	73	27	163	E		
				SB Through	1803	18	82	739	B		
				SB Right	815	16	70	729	B		
	EB	54.8	D	EB Left	618	56	96	282	E		
				EB Through	28	75	96	282	E		
				EB Right	42	19	96	282	B		
	WB	44.2	D	WB Left	52	53	21	135	D		
				WB Through	18	55	21	135	E		
				WB Right	19	9	21	135	A		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.2	A	NB Left	4	0	0	0	A	32.5	C
				NB Through	2	0	0	0	A		
				NB Right	5	-3	0	0	A		
	SB	13.1	B	SB Left	206	16	14	124	B		
				SB Through	6	17	14	124	B		
				SB Right	61	2	0	6	A		
	EB	17.3	B	EB Left	55	19	11	172	B		
				EB Through	0	0	8	0	A		
				EB Right	5	4	19	203	A		
	WB	36.6	D	WB Left	37	36	1	61	D		
				WB Through	911	46	307	762	D		
				WB Right	657	24	56	365	C		
6- MD 80 at I-270 SB on and off ramp											
6	NB	8.7	A	NB Left	22	34	10	274	D	33.2	D
				NB Through	0	0	0	0	A		
				NB Right	258	7	10	274	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	36.0	E	EB Left	0	0	0	0	A		
				EB Through	369	35	67	346	D		
				EB Right	164	39	68	355	E		
	WB	52.3	F	WB Left	0	0	0	0	A		
				WB Through	280	52	175	543	F		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	4.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	13.0	B	SB Left	145	17	15	187	C		
				SB Through	0	0	0	0	A		
				SB Right	47	2	1	151	A		
	EB	5.2	A	EB Left	85	6	1	106	A		
				EB Through	0	0	0	0	A		
				EB Right	62	4	0	0	A		
	WB	1.2	A	WB Left	0	0	0	0	A		
				WB Through	653	1	2	219	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	5.0	A	NB Left	18	18	2	104	C	5.9	A
				NB Through	0	0	0	0	A		
				NB Right	50	0	0	41	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.2	A	EB Left	0	0	0	0	A		
				EB Through	89	1	2	71	A		
				EB Right	99	7	2	90	A		
	WB	6.5	A	WB Left	552	6	24	461	A		
				WB Through	152	8	23	438	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	18.0	C	NB Left	153	24	41	316	C	51.1	D
				NB Through	433	24	41	316	C		
				NB Right	331	8	52	343	A		
	SB	31.9	D	SB Left	57	20	107	503	C		
				SB Through	800	33	117	503	C		
				SB Right	8	29	128	524	C		
	EB	118.6	F	EB Left	9	102	412	512	F		
				EB Through	103	119	414	512	F		
				EB Right	663	119	443	544	F		
	WB	22.3	C	WB Left	138	26	19	138	C		
				WB Through	16	21	19	137	C		
				WB Right	28	5	16	161	A		
10- MD 121 at I-270 NB on and off ramp											
10	NB	27.6	D	NB Left	328	58	68	238	F	18.1	B
				NB Through	0	0	0	0	A		
				NB Right	410	3	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.7	B	EB Left	0	0	0	0	A		
				EB Through	513	18	34	332	C		
				EB Right	285	1	0	43	A		
	WB	16.9	C	WB Left	237	62	119	716	F		
				WB Through	1364	9	119	716	A		
				WB Right	0	0	0	0	A		

Table C.14: AM Peak - No Build - Intersection Delay and Level of Service

11- MD 121 at I-270 SB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	218	102	351	1869	F		
	SB	70.9	E	SB Through	0	0	0	0	A		
				SB Right	306	49	21	362	E		
11				EB Left	0	0	0	0	A	19.5	B
	EB	5.3	A	EB Through	578	5	12	212	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	8.4	A	WB Through	655	18	49	449	C		
				WB Right	1030	2	17	338	A		
12- MD 27 at Observation Dr											
				NB U-Turn	0	0	0	0	A		
	NB	48.6	D	NB Through	48	59	14	72	E		
				NB Right	12	7	14	72	A		
				SB Left	91	53	30	192	D		
	SB	43.1	D	SB Through	54	52	38	269	D		
				SB Right	178	35	62	306	D		
12				EB Left	154	39	41	327	D	34.9	C
	EB	17.2	B	EB Through	1217	15	42	328	B		
				EB Right	48	9	50	367	A		
				WB Left	105	36	322	842	D		
	WB	43.7	D	WB Through	2252	45	322	842	D		
				WB Right	115	26	322	842	C		
13- MD 27 at I-270 NB off ramp											
				NB Left	107	33	15	102	C		
	NB	33.0	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
13				EB Left	0	0	0	0	A	40.8	D
	EB	0.1	A	EB Through	964	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	58.0	E	WB Through	2320	58	824	2162	E		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	379	49	62	257	D		
	SB	48.9	D	SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
14				EB Left	0	0	0	0	A	66.9	E
	EB	2.4	A	EB Through	834	2	1	50	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	108.4	F	WB Through	1465	108	1119	1647	F		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
				NB Left	30	38	285	736	D		
	NB	63.4	E	NB Through	1040	64	310	735	E		
				NB Right	93	70	317	748	E		
				SB Left	531	108	1619	2395	F		
	SB	108.6	F	SB Through	1677	110	1619	2395	F		
				SB Right	52	68	1613	2390	E		
15				EB Left	224	50	58	207	D	86.3	F
	EB	43.9	D	EB Through	97	43	55	202	D		
				EB Right	76	27	60	236	C		
				WB Left	11	56	33	103	E		
	WB	47.7	D	WB Through	32	229	33	103	F		
				WB Right	142	6	33	103	A		
16- MD 118 at Seneca Meadows Pkwy											
				NB Left	111	11	1	75	B		
	NB	3.6	A	NB Through	729	3	4	131	A		
				NB Right	59	1	8	184	A		
				SB Left	31	4	8	256	A		
	SB	4.3	A	SB Through	948	4	11	256	A		
				SB Right	41	3	14	288	A		
16				EB Left	20	65	10	77	E	6.2	A
	EB	18.5	B	EB Through	6	82	10	77	F		
				EB Right	115	7	10	77	A		
				WB Left	35	71	16	102	E		
	WB	44.2	D	WB Through	6	55	11	101	D		
				WB Right	27	8	14	111	A		
17- MD 118 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
17				EB Left	274	30	30	196	C	10.2	B
	EB	29.5	C	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	5.4	A	WB Through	188	1	0	0	A		
				WB Right	911	6	15	268	A		
18- MD 118 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
				SB Left	212	39.7	36	166	D		
	SB	39.7	D	SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
18				EB Left	0	0.0	0	0	A	7.7	A
	EB	3.5	A	EB Through	631	3.5	5	175	A		
				EB Right	0	0.0	0	0	A		
				WB Left	0	0.0	0	0	A		
	WB	4.3	A	WB Through	1228	4.3	10	243	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
				NB Left	9	79	9	75	E		
	NB	46.2	D	NB Through	13	80	9	75	F		
				NB Right	17	3	0	24	A		
				SB Left	267	55	112	418	E		
	SB	60.4	E	SB Through	53	72	112	418	E		
				SB Right	96	68	112	418	E		
19				EB Left	132	16	37	329	B	20.3	C
	EB	12.3	B	EB Through	1019	12	37	329	B		
				EB Right	34	12	37	329	B		
				WB Left	84	24	45	317	C		
	WB	14.6	B	WB Through	1057	17	45	317	B		
				WB Right	326	5	45	317	A		
20- Middlebrook Rd at Observation Dr											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	26	36	5	63	D		
	SB	20.4	C	SB Through	0	0	0	0	A		
				SB Right	27	5	5	63	A		
20				EB Left	230	23	31	285	C	16.5	B
	EB	14.3	B	EB Through	816	12	31	285	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	17.9	B	WB Through	1148	19	73	405	B		
				WB Right	277	14	97	454	B		

Table C.14: AM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	23.2	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.2	B	EB Left	0	0	0	0	A		
				EB Through	742	13	30	211	B		
				EB Right	0	0	0	0	A		
	WB	33.0	C	WB Left	761	33	165	1266	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	175.2	F	NB Left	140	135	340	489	F	69.9	E
				NB Through	6	151	340	489	F		
				NB Right	260	198	340	489	F		
	SB	18.5	B	SB Left	3	39	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	5	6	2	67	A		
	EB	70.3	E	EB Left	30	27	642	1261	C		
				EB Through	1400	72	642	1261	E		
				EB Right	79	64	642	1261	E		
	WB	19.2	B	WB Left	81	24	35	229	C		
				WB Through	724	20	35	229	B		
				WB Right	42	5	35	229	A		
23- MD 124 at MD 355											
23	NB	53.7	D	NB Left	228	75	86	265	E	98.7	F
				NB Through	390	48	84	263	D		
				NB Right	54	3	0	0	A		
	SB	105.0	F	SB Left	63	159	481	799	F		
				SB Through	1170	119	481	799	F		
				SB Right	553	69	363	785	E		
	EB	50.2	D	EB Left	616	118	388	1078	F		
				EB Through	498	17	388	1078	B		
				EB Right	554	5	242	1060	A		
	WB	157.4	F	WB Left	0	0	0	0	A		
				WB Through	1650	160	775	1121	F		
				WB Right	49	78	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	66.8	F	NB Left	16	64	19	95	E	28.7	C
				NB Through	37	68	19	95	E		
				NB U-Turn	0	0	0	0	A		
	SB	24.5	C	SB Left	279	62	71	346	E		
				SB Through	11	66	71	346	E		
				SB Right	580	6	6	233	A		
	EB	17.0	B	EB Left	0	0	0	0	A		
				EB Through	1037	17	50	416	B		
				EB Right	68	14	60	440	B		
	WB	41.4	D	WB Left	42	40	1513	2415	D		
				WB Through	1110	41	1513	2415	D		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	61.6	E	NB Left	19	118	173	689	F	53.8	D
				NB Through	536	74	173	689	E		
				NB Right	420	43	103	663	D		
	SB	45.5	D	SB Left	182	68	213	816	E		
				SB Through	1077	46	213	816	D		
				SB Right	131	9	0	0	A		
	EB	63.6	E	EB Left	103	124	261	807	F		
				EB Through	1474	60	261	809	E		
				EB Right	83	58	275	836	E		
	WB	40.2	D	WB Left	317	71	106	318	E		
				WB Through	484	28	106	318	C		
				WB Right	98	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	52.7	D	NB Left	24	59	20	121	E	48.1	D
				NB Through	24	76	20	121	E		
				NB Right	25	24	20	121	C		
	SB	253.6	F	SB Left	194	256	314	429	F		
				SB Through	53	261	314	429	F		
				SB Right	31	226	314	429	F		
	EB	41.5	D	EB Left	33	31	301	974	C		
				EB Through	1998	42	305	974	D		
				EB Right	29	53	298	964	D		
	WB	18.3	B	WB Left	308	58	111	447	E		
				WB Through	852	9	111	448	A		
				WB Right	318	5	91	496	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	8.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	819	2	2	196	A		
				EB Right	0	0	0	0	A		
	WB	22.7	C	WB Left	329	23	44	313	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	32.7	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	51.4	D	SB Left	295	53	233	773	D		
				SB Through	0	0	0	0	A		
				SB Right	891	51	238	775	D		
	EB	23.7	C	EB Left	14	119	101	899	F		
				EB Through	803	22	101	899	C		
				EB Right	0	0	0	0	A		
	WB	16.7	B	WB Left	0	0	0	0	A		
				WB Through	909	17	65	372	B		
				WB Right	9	9	71	403	A		
29- MD 117 at Perry Pkwy											
29	NB	44.6	D	NB Left	36	76	17	125	E	16.2	B
				NB Through	7	63	17	124	E		
				NB Right	38	12	28	145	B		
	SB	50.5	D	SB Left	114	99	62	242	F		
				SB Through	14	105	62	242	F		
				SB Right	133	3	62	242	A		
	EB	10.4	B	EB Left	118	69	43	244	E		
				EB Through	969	3	43	244	A		
				EB Right	9	4	30	228	A		
	WB	10.9	B	WB Left	8	83	21	277	F		
				WB Through	749	11	21	277	B		
				WB Right	136	6	21	277	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	8.9	A	NB Left	0	0	0	0	A	22.3	C
				NB Through	971	9	21	237	A		
				NB Right	0	0	0	0	A		
	SB	10.4	B	SB Left	0	0	0	0	A		
				SB Through	1349	10	34	334	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	55.3	E	WB Left	882	55	168	618	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.14: AM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	13.4	B	NB Left	0	0	0	0	A	20.4	C
				NB Through	1004	13	38	348	B		
				NB Right	0	0	0	0	A		
	SB	10.2	B	SB Left	0	0	0	0	A		
				SB Through	1601	10	37	607	B		
				SB Right	0	0	0	0	A		
	EB	46.2	D	EB Left	298	40	41	255	D		
				EB Through	0	0	0	0	A		
				EB Right	602	49	100	418	D		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	61.7	E
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	35.4	D	SB Left	427	43	65	331	D		
				SB Through	0	0	0	0	A		
				SB Right	105	3	0	50	A		
	EB	122.9	F	EB Left	0	0	0	0	A		
				EB Through	698	186	1959	2133	F		
				EB Right	422	18	1907	2140	B		
	WB	21.2	C	WB Left	0	0	0	0	A		
				WB Through	1346	21	25	434	C		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	38.0	D	NB Left	0	0	41	262	A	28.9	C
				NB Through	144	56	48	271	E		
				NB Right	93	10	48	271	B		
	SB	55.0	D	SB Left	27	72	94	327	E		
				SB Through	0	0	0	0	A		
				SB Right	285	53	94	327	D		
	EB	19.2	B	EB Left	182	42	52	348	D		
				EB Through	607	12	52	348	B		
				EB Right	0	0	0	0	A		
	WB	26.1	C	WB Left	25	23	86	380	C		
				WB Through	942	26	70	344	C		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	40.0	D	NB Left	63	45	17	111	D	12.7	B
				NB Through	8	40	14	110	D		
				NB Right	10	8	15	121	A		
	SB	11.3	B	SB Left	71	51	38	218	D		
				SB Through	7	59	38	218	E		
				SB Right	524	5	41	212	A		
	EB	11.0	B	EB Left	266	17	14	243	B		
				EB Through	768	9	17	193	A		
				EB Right	12	4	26	229	A		
	WB	14.1	B	WB Left	4	16	44	301	B		
				WB Through	312	14	44	300	B		
				WB Right	11	8	56	334	A		
35- MD 189 at I-270 Ramps											
35	NB	54.6	D	NB Left	95	55	18	123	D	68.5	E
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	50.3	D	SB Left	156	50	48	241	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	79.7	E	EB Left	348	115	505	1580	F		
				EB Through	524	56	505	1580	E		
				EB Right	0	0	0	0	A		
	WB	61.1	E	WB Left	489	53	131	505	D		
				WB Through	250	77	131	505	E		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	46.9	D	NB Left	161	53	61	245	D	79.4	E
				NB Through	124	71	61	245	E		
				NB Right	159	22	61	245	C		
	SB	101.8	F	SB Left	420	127	415	804	F		
				SB Through	735	88	385	791	F		
				SB Right	0	0	0	0	A		
	EB	87.5	F	EB Left	159	104	397	1021	F		
				EB Through	936	90	397	1021	F		
				EB Right	121	48	397	1021	D		
	WB	50.6	D	WB Left	354	70	107	307	E		
				WB Through	334	37	107	307	D		
				WB Right	49	6	107	307	A		
37- Montrose Rd at Tower Oaks Blvd											
37	NB			NB Left	0	0	0	0	A	105.2	F
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	266.8	F	SB Left	124	43	1159	1410	D		
				SB Through	0	0	0	0	A		
				SB Right	424	332	1155	1405	F		
	EB	29.2	C	EB Left	30	48	188	1101	D		
				EB Through	1583	29	188	1101	C		
				EB Right	0	0	0	0	A		
	WB	129.8	F	WB Left	0	0	0	0	A		
				WB Through	1322	133	492	838	F		
				WB Right	63	64	492	838	E		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	22.1	C	NB Left	417	21	30	199	C	74.7	E
				NB Through	9	14.4	24	191	B		
				NB Right	24	39.0	30	199	D		
	SB	1.0	A	SB Left	0	216.7	0	25	F		
				SB Through	0	0.0	0	25	A		
				SB Right	4	1.0	0	0	A		
	EB	121.3	F	EB Left	7	159.8	335	461	F		
				EB Through	555	120.6	335	460	F		
				EB Right	81	122.9	326	451	F		
	WB	9.6	A	WB Left	0	0.0	3	85	A		
				WB Through	86	10.0	3	85	A		
				WB Right	6	4.2	0	15	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	15.5	B	NB Left	37	72	38	165	E	50.1	D
				NB Through	240	42	38	165	D		
				NB Right	560	0	0	0	A		
	SB	40.4	D	SB Left	335	53	162	637	D		
				SB Through	776	36	162	636	D		
				SB Right	77	28	125	641	C		
	EB	90.4	F	EB Left	77	77	417	726	E		
				EB Through	980	92	422	727	F		
				EB Right	63	87	440	751	F		
	WB	42.6	D	WB Left	313	51	71	314	D		
				WB Through	195	49	71	314	D		
				WB Right	114	7	81	345	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	32.5	C	NB Left	0	0	0	0	A	17.7	B
				NB Through	93	34	31	152	C		
				NB Right	214	32	31	152	C		
	SB	2.1	A	SB Left	0	0	4	67	A		
				SB Through	947	2	4	67	A		
				SB Right	0	0	0	0	A		
	EB	27.1	C	EB Left	7	52	123	441	D		
				EB Through	530	54	123	441	D		
				EB Right	563	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.14: AM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41				NB Left	99	2	1	31	A	20.7	C
	NB	2.4	A	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	947	23	97	672	C		
	WB	22.0	C	WB Through	416	20	97	672	C		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42				NB Left	230	21	232	687	C	149.0	F
	NB	51.5	D	NB Through	1461	49	232	687	D		
				NB Right	217	103	232	687	F		
				SB Left	62	155	2594	2703	F		
	SB	217.2	F	SB Through	1243	217	2594	2703	F		
				SB Right	165	243	2594	2703	F		
				EB Left	220	133	1863	1978	F		
	EB	185.4	F	EB Through	629	203	1864	1979	F		
				EB Right	129	191	1888	2003	F		
				WB Left	723	229	1921	2143	F		
	WB	188.2	F	WB Through	396	151	1921	2143	F		
				WB Right	157	94	1921	2143	F		
43- MD 187 at I-270 NB on and off ramps											
43				NB Left	164	86	63	254	F	19.2	B
	NB	12.0	B	NB Through	1537	4	63	254	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	24.5	C	SB Through	1548	24	79	501	C		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	118	52	39	258	D		
	WB	51.5	D	WB Through	10	44	39	258	D		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44				NB Left	0	0	0	0	A	25.3	C
	NB	23.3	C	NB Through	1477	23	66	397	C		
				NB Right	0	0	0	0	A		
				SB Left	181	56	62	301	E		
	SB	8.5	A	SB Through	1482	3	62	301	A		
				SB Right	0	0	0	0	A		
				EB Left	227	60	186	758	E		
	EB	77.4	E	EB Through	0	0	186	758	A		
				EB Right	367	88	223	746	F		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45				NB Left	255	57	68	252	E	20.9	C
	NB	15.0	B	NB Through	1384	7	69	252	A		
				NB Right	10	6	93	285	A		
				SB Left	13	32	99	674	C		
	SB	22.1	C	SB Through	1684	24	99	674	C		
				SB Right	147	1	65	669	A		
				EB Left	191	60	55	222	E		
	EB	37.4	D	EB Through	26	54	55	222	D		
				EB Right	252	19	55	222	B		
				WB Left	1	7	1	29	A		
	WB	7.2	A	WB Through	9	11	1	29	B		
				WB Right	5	0	0	7	A		
47-Democracy Blvd at I-270 NB off ramp											
47				NB Left	225	31	26	142	C	13.6	B
	NB	30.9	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	12.8	B	EB Through	1650	13	50	451	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	10.3	B	WB Through	779	10	23	188	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48				NB Left	0	0	0	0	A	6.4	A
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	5.2	A	EB Through	1761	5	22	274	A		
				EB Right	0	0	0	0	A		
				WB Left	222	37	31	172	D		
	WB	8.6	A	WB Through	779	1	20	152	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49				NB Left	0	0	0	0	A	12.1	B
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	327	50	57	243	D		
	SB	33.9	C	SB Through	0	0	0	0	A		
				SB Right	165	2	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	2.5	A	WB Through	779	3	4	124	A		
				WB Right	334	2	1	136	A		
50- MD 190 at Burdette Rd											
50				NB Left	20	80	15	118	E	13.4	B
	NB	73.2	E	NB Through	4	59	15	118	E		
				NB Right	11	67	15	118	E		
				SB Left	50	78	31	150	E		
	SB	34.5	C	SB Through	17	64	31	150	E		
				SB Right	120	12	31	150	B		
				EB Left	52	97	63	544	F		
	EB	10.9	B	EB Through	1817	9	62	544	A		
				EB Right	15	5	55	567	A		
				WB Left	1	106	61	830	F		
	WB	12.5	B	WB Through	1497	13	62	830	B		
				WB Right	21	2	57	870	A		

Table C.14: AM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
51				SB Right	0	0	0	0	A	51.9	D
				EB Left	533	119	338	698	F		
	EB	118.7	F	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	16.1	B	WB Through	994	16	77	757	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
				NB Left	260	80	497	2884	F		
	NB	80.2	F	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
52				SB Right	0	0	0	0	A	14.4	B
				EB Left	0	0	0	0	A		
	EB	3.0	A	EB Through	982	3	7	151	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	5.4	A	WB Through	667	5	7	151	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
				NB Left	21	67	23	149	E		
	NB	68.2	E	NB Through	59	69	25	148	E		
				NB Right	0	0	0	0	A		
				SB Left	625	56	183	769	E		
	SB	56.7	E	SB Through	183	59	184	770	E		
53				SB Right	18	54	183	769	D	44.4	D
				EB Left	24	30	135	584	C		
	EB	37.5	D	EB Through	846	37	135	584	D		
				EB Right	42	42	135	584	D		
				WB Left	122	117	116	358	F		
	WB	38.2	D	WB Through	642	32	118	360	C		
				WB Right	158	1	1	87	A		
54- MD 124 at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	39.8	D	NB Through	0	0	0	0	A		
				NB Right	732	40	98	391	D		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
54				SB Right	0	0	0	0	A	26.3	C
				EB Left	0	0	0	0	A		
	EB	15.7	B	EB Through	931	16	41	427	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	37.9	D	NB Through	0	0	0	0	A		
				NB Right	950	38	119	601	D		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
55				SB Right	0	0	0	0	A	16.7	B
				EB Left	0	0	0	0	A		
	EB	4.5	A	EB Through	1651	5	18	93	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
				NB Left	47	231	677	725	F		
	NB	763.2	F	NB Through	0	0	0	0	A		
				NB Right	86	1054	677	725	F		
				SB Left	540	102	2475	5059	F		
	SB	76.2	E	SB Through	132	96	2475	5059	F		
56				SB Right	442	38	2475	5059	D	173.6	F
				EB Left	0	0	0	0	A		
	EB	463.5	F	EB Through	507	463	1159	1235	F		
				EB Right	2	547	1159	1235	F		
				WB Left	116	79	118	468	E		
	WB	41.1	D	WB Through	769	35	115	467	D		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
				NB Left	396	52	95	425	D		
	NB	35.7	D	NB Through	0	0	0	0	A		
				NB Right	485	23	95	425	C		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
57				SB Right	0	0	0	0	A	70.7	E
				EB Left	197	62	50	295	E		
	EB	20.0	C	EB Through	741	9	50	295	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	140.5	F	WB Through	951	152	648	852	F		
				WB Right	172	76	648	852	E		
58- Watkins Mill Rd at I-270 SB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
58				SB Right	0	0	0	0	A	60.2	E
				EB Left	0	0	0	0	A		
	EB	72.5	E	EB Through	937	31	478	614	C		
				EB Right	184	282	478	614	F		
				WB Left	455	142	274	519	F		
	WB	49.9	D	WB Through	884	3	274	519	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	22.7	C	NB Left	127	77	82	515	E	37.2	D
				NB Through	391	26	82	515	C		
				NB Right	708	11	24	450	B		
	SB	48.9	D	SB Left	137	63	167	759	E		
				SB Through	600	48	167	759	D		
				SB Right	68	27	167	759	C		
	EB	49.9	D	EB Left	104	77	55	187	E		
				EB Through	63	78	55	187	E		
				EB Right	113	9	55	187	A		
	WB	49.9	D	WB Left	231	73	86	331	E		
				WB Through	16	63	86	331	E		
				WB Right	126	6	86	331	A		
2- MD 85 at I-270 NB on and off ramp											
2	NB	50.8	D	NB Left	681	51	261	1272	D	36.0	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	19.6	B	SB Left	0	0	0	0	A		
				SB Through	610	20	56	586	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	5.5	A	NB Left	0	0	0	0	A	11.0	B
				NB Through	1069	6	20	440	A		
				NB Right	0	0	0	0	A		
	SB	45.0	D	SB Left	171	45	85	1116	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	19.0	C	NB Left	13	52	53	396	D	25.3	C
				NB Through	762	18	53	396	B		
				NB U-Turn	0	0	0	0	A		
	SB	19.4	B	SB Left	68	70	28	153	E		
				SB Through	1907	18	89	843	B		
				SB Right	858	18	77	832	B		
	EB	54.1	D	EB Left	619	56	96	280	E		
				EB Through	28	74	96	280	E		
				EB Right	42	18	96	280	B		
	WB	44.1	D	WB Left	52	53	21	139	D		
				WB Through	18	55	21	139	E		
				WB Right	19	9	21	139	A		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.0	A	NB Left	4	0	0	0	A	10.3	B
				NB Through	2	0	0	0	A		
				NB Right	4	-3	0	0	A		
	SB	12.7	B	SB Left	214	16	14	109	B		
				SB Through	6	16	14	109	B		
				SB Right	62	2	0	0	A		
	EB	10.5	B	EB Left	54	11	11	183	B		
				EB Through	0	0	8	0	A		
				EB Right	5	5	20	213	A		
	WB	9.9	A	WB Left	35	11	1	54	B		
				WB Through	871	15	77	647	B		
				WB Right	634	3	0	58	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.9	A	NB Left	25	16	1	134	C	14.1	B
				NB Through	0	0	0	0	A		
				NB Right	293	3	1	134	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	16.0	C	EB Left	0	0	0	0	A		
				EB Through	360	16	22	197	C		
				EB Right	160	16	23	206	C		
	WB	22.5	C	WB Left	0	0	0	0	A		
				WB Through	271	22	53	495	C		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	3.8	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	13.6	B	SB Left	152	17	17	179	C		
				SB Through	0	0	0	0	A		
				SB Right	49	2	1	132	A		
	EB	4.6	A	EB Left	85	5	1	104	A		
				EB Through	0	0	0	0	A		
				EB Right	62	4	0	0	A		
	WB	0.5	A	WB Left	0	0	0	0	A		
				WB Through	653	1	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	4.9	A	NB Left	19	19	2	99	C	3.7	A
				NB Through	0	0	0	0	A		
				NB Right	52	0	0	26	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.2	A	EB Left	0	0	0	0	A		
				EB Through	89	1	0	55	A		
				EB Right	99	6	1	67	A		
	WB	3.7	A	WB Left	551	3	8	296	A		
				WB Through	152	6	7	273	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	19.1	C	NB Left	162	29	49	326	C	59.9	E
				NB Through	460	24	49	326	C		
				NB Right	341	8	60	352	A		
	SB	41.6	E	SB Left	58	23	137	613	C		
				SB Through	815	43	152	613	D		
				SB Right	8	36	165	634	D		
	EB	167.1	F	EB Left	6	119	442	513	F		
				EB Through	76	158	442	513	F		
				EB Right	502	169	474	545	F		
	WB	20.5	C	WB Left	137	24	17	138	C		
				WB Through	17	18	17	138	B		
				WB Right	28	6	13	162	A		
10- MD 121 at I-270 NB on and off ramp											
10	NB	27.0	D	NB Left	346	57	70	289	F	36.5	D
				NB Through	0	0	0	0	A		
				NB Right	445	3	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.1	B	EB Left	0	0	0	0	A		
				EB Through	521	17	32	325	C		
				EB Right	285	0	0	0	A		
	WB	55.8	F	WB Left	213	70	417	1040	F		
				WB Through	1244	53	417	1040	F		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - No Build - Alternative Intersection Delay and Level of Service

11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	39.4	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	73.0	E	SB Left	227	102	306	1079	F		
				SB Through	0	0	0	0	A		
				SB Right	318	52	26	664	F		
	EB	5.4	A	EB Left	0	0	0	0	A		
				EB Through	578	5	12	241	A		
				EB Right	0	0	0	0	A		
	WB	40.3	D	WB Left	0	0	0	0	A		
				WB Through	644	20	97	877	C		
				WB Right	950	54	238	871	F		
12- MD 27 at Observation Dr											
12	NB	48.7	D	NB U-Turn	0	0	0	0	A	37.2	D
				NB Through	48	59	14	72	E		
				NB Right	12	6	14	72	A		
	SB	44.2	D	SB Left	92	52	29	192	D		
				SB Through	54	52	40	269	D		
				SB Right	179	38	65	306	D		
	EB	17.4	B	EB Left	163	44	45	315	D		
				EB Through	1291	14	46	316	B		
				EB Right	51	10	51	354	B		
	WB	48.4	D	WB Left	103	36	341	839	D		
				WB Through	2164	50	341	839	D		
				WB Right	110	31	341	839	C		
13- MD 27 at I-270 NB off ramp											
13	NB	35.6	D	NB Left	117	36	15	102	D	53.3	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1009	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	78.5	E	WB Left	0	0	0	0	A		
				WB Through	2212	78	1230	2347	E		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	67.2	E
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	45.9	D	SB Left	424	46	64	259	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.5	A	EB Left	0	0	0	0	A		
				EB Through	834	2	1	56	A		
				EB Right	0	0	0	0	A		
	WB	111.6	F	WB Left	0	0	0	0	A		
				WB Through	1417	112	1124	1455	F		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	61.2	E	NB Left	30	36	277	735	D	85.3	F
				NB Through	1040	61	301	734	E		
				NB Right	92	67	311	747	E		
	SB	107.9	F	SB Left	536	108	1439	2419	F		
				SB Through	1696	109	1439	2419	F		
				SB Right	53	75	1433	2414	E		
	EB	44.2	D	EB Left	224	50	59	203	D		
				EB Through	97	44	55	198	D		
				EB Right	76	28	60	228	C		
	WB	46.8	D	WB Left	11	56	32	103	E		
				WB Through	32	224	32	103	F		
				WB Right	142	6	32	103	A		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	3.7	A	NB Left	122	10	1	73	B	6.1	A
				NB Through	775	3	5	124	A		
				NB Right	65	1	9	177	A		
	SB	4.1	A	SB Left	31	5	7	218	A		
				SB Through	948	4	10	218	A		
				SB Right	41	3	13	251	A		
	EB	18.5	B	EB Left	20	65	10	77	E		
				EB Through	6	82	10	77	F		
				EB Right	115	7	10	77	A		
	WB	46.2	D	WB Left	35	72	17	102	E		
				WB Through	6	69	12	101	E		
				WB Right	27	8	15	111	A		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	10.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	29.3	C	EB Left	274	29	30	196	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.4	A	WB Left	0	0	0	0	A		
				WB Through	188	1	0	0	A		
				WB Right	911	6	15	261	A		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	8.3	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	39.3	D	SB Left	239	39.3	37	145	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	3.9	A	EB Left	0	0.0	0	0	A		
				EB Through	631	3.9	5	173	A		
				EB Right	0	0.0	0	0	A		
	WB	4.7	A	WB Left	0	0.0	0	0	A		
				WB Through	1295	4.7	11	233	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	46.3	D	NB Left	9	79	9	75	E	20.3	C
				NB Through	13	80	9	75	F		
				NB Right	17	3	0	24	A		
	SB	60.4	E	SB Left	267	55	112	418	E		
				SB Through	53	72	112	418	E		
				SB Right	96	68	112	418	E		
	EB	12.4	B	EB Left	132	17	37	329	B		
				EB Through	1019	12	37	329	B		
				EB Right	34	12	37	329	B		
	WB	14.9	B	WB Left	86	23	49	333	C		
				WB Through	1134	17	49	333	B		
				WB Right	348	6	49	333	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	18.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	20.4	C	SB Left	26	36	5	63	D		
				SB Through	0	0	0	0	A		
				SB Right	27	5	5	63	A		
	EB	17.3	B	EB Left	250	25	38	303	C		
				EB Through	895	15	38	303	B		
				EB Right	0	0	0	0	A		
	WB	18.9	B	WB Left	0	0	0	0	A		
				WB Through	1143	20	76	401	B		
				WB Right	275	15	102	451	B		

Table C.15: AM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	45.6	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	19.4	B	EB Left	0	0	0	0	A		
				EB Through	807	19	45	241	B		
				EB Right	0	0	0	0	A		
	WB	73.7	E	WB Left	752	74	593	1795	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	235.6	F	NB Left	141	193	420	498	F	81.3	F
				NB Through	5	187	420	498	F		
				NB Right	263	259	420	498	F		
	SB	18.5	B	SB Left	3	40	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	5	6	2	67	A		
	EB	77.2	E	EB Left	33	27	778	1292	C		
				EB Through	1562	79	778	1292	E		
				EB Right	87	71	778	1292	E		
	WB	19.0	B	WB Left	86	26	36	233	C		
				WB Through	761	19	36	233	B		
				WB Right	46	4	36	233	A		
23- MD 124 at MD 355											
23	NB	51.8	D	NB Left	228	69	87	265	E	80.6	F
				NB Through	390	49	84	263	D		
				NB Right	54	3	0	0	A		
	SB	75.1	E	SB Left	69	148	362	776	F		
				SB Through	1252	98	362	776	F		
				SB Right	594	18	173	730	B		
	EB	59.2	E	EB Left	635	142	524	1170	F		
				EB Through	520	18	524	1170	B		
				EB Right	576	5	317	1125	A		
	WB	114.4	F	WB Left	0	0	0	0	A		
				WB Through	1933	116	709	1119	F		
				WB Right	60	66	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	65.5	F	NB Left	16	62	18	95	E	20.9	C
				NB Through	37	67	18	95	E		
				NB U-Turn	0	0	0	0	A		
	SB	24.2	C	SB Left	313	63	81	313	E		
				SB Through	12	68	81	313	E		
				SB Right	652	5	9	243	A		
	EB	17.5	B	EB Left	0	0	0	0	A		
				EB Through	1036	18	53	432	B		
				EB Right	67	14	62	455	B		
	WB	19.4	B	WB Left	48	27	88	755	C		
				WB Through	1248	19	88	755	B		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	47.5	D	NB Left	20	116	167	703	F	46.6	D
				NB Through	538	64	167	703	E		
				NB Right	415	23	58	618	C		
	SB	46.1	D	SB Left	176	69	217	808	E		
				SB Through	1066	47	217	808	D		
				SB Right	130	9	0	0	A		
	EB	49.3	D	EB Left	99	111	209	763	F		
				EB Through	1435	45	208	764	D		
				EB Right	80	42	219	791	D		
	WB	41.6	D	WB Left	325	72	110	364	E		
				WB Through	494	30	110	364	C		
				WB Right	99	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	48.5	D	NB Left	25	59	20	126	E	38.0	D
				NB Through	24	72	20	126	E		
				NB Right	25	15	20	126	B		
	SB	208.6	F	SB Left	191	211	260	417	F		
				SB Through	52	217	260	417	F		
				SB Right	32	179	260	417	F		
	EB	30.4	C	EB Left	32	32	197	946	C		
				EB Through	1930	30	198	946	C		
				EB Right	28	27	192	936	C		
	WB	16.3	B	WB Left	303	49	95	377	D		
				WB Through	866	9	96	378	A		
				WB Right	322	6	67	426	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	13.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.2	A	EB Left	0	0	0	0	A		
				EB Through	804	4	1	201	A		
				EB Right	0	0	0	0	A		
	WB	38.5	E	WB Left	310	39	123	840	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	41.2	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	69.6	E	SB Left	310	63	388	1232	E		
				SB Through	0	0	0	0	A		
				SB Right	917	72	393	1234	E		
	EB	24.2	C	EB Left	14	125	107	889	F		
				EB Through	788	22	107	889	C		
				EB Right	0	0	0	0	A		
	WB	17.5	B	WB Left	0	0	0	0	A		
				WB Through	892	18	73	374	B		
				WB Right	9	5	80	404	A		
29- MD 117 at Perry Pkwy											
29	NB	46.5	D	NB Left	36	79	18	129	E	17.1	B
				NB Through	7	66	17	129	E		
				NB Right	38	12	28	149	B		
	SB	52.4	D	SB Left	112	105	66	255	F		
				SB Through	14	104	66	255	F		
				SB Right	133	3	66	255	A		
	EB	11.1	B	EB Left	118	76	48	271	E		
				EB Through	967	3	47	271	A		
				EB Right	9	2	33	255	A		
	WB	11.5	B	WB Left	8	91	25	320	F		
				WB Through	740	12	25	320	B		
				WB Right	136	6	25	320	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	26.7	C	NB Left	330	71	100	546	E	43.8	D
				NB Through	974	12	100	546	B		
				NB Right	0	0	0	0	A		
	SB	49.1	D	SB Left	0	0	0	0	A		
				SB Through	1298	49	211	729	D		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	59.0	E	WB Left	1005	59	209	731	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	14.5	B	NB Left	0	0	0	0	A	22.0	C
				NB Through	1005	14	40	336	B		
				NB Right	0	0	0	0	A		
	SB	13.4	B	SB Left	0	0	0	0	A		
				SB Through	1699	13	76	742	B		
				SB Right	0	0	0	0	A		
	EB	46.3	D	EB Left	301	45	80	518	D		
				EB Through	0	0	0	0	A		
				EB Right	610	47	96	532	D		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	52.7	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	36.3	D	SB Left	408	44	67	330	D		
				SB Through	0	0	0	0	A		
				SB Right	100	3	0	56	A		
	EB	99.5	F	EB Left	0	0	0	0	A		
				EB Through	1065	151	1571	2134	F		
				EB Right	700	22	1549	2141	C		
	WB	11.6	B	WB Left	0	0	0	0	A		
				WB Through	1806	12	37	464	B		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	36.7	D	NB Left	0	0	53	327	A	23.8	C
				NB Through	197	52	61	336	D		
				NB Right	128	14	61	336	B		
	SB	27.4	C	SB Left	30	64	34	273	E		
				SB Through	0	0	0	0	A		
				SB Right	316	24	34	273	C		
	EB	28.2	C	EB Left	249	56	98	574	E		
				EB Through	805	20	98	574	B		
				EB Right	0	0	0	0	A		
	WB	13.6	B	WB Left	26	13	48	320	B		
				WB Through	965	14	34	283	B		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	37.9	D	NB Left	65	42	15	107	D	11.3	B
				NB Through	8	42	12	107	D		
				NB Right	10	6	13	118	A		
	SB	7.6	A	SB Left	80	44	33	200	D		
				SB Through	8	47	33	200	D		
				SB Right	593	2	10	50	A		
	EB	10.9	B	EB Left	315	17	16	230	B		
				EB Through	918	9	19	257	A		
				EB Right	13	6	28	293	A		
	WB	13.8	B	WB Left	5	15	20	189	B		
				WB Through	328	14	20	188	B		
				WB Right	11	8	31	222	A		
35- MD 189 at I-270 Ramps											
35	NB	51.4	D	NB Left	125	51	25	140	D	50.1	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	54.5	D	SB Left	168	55	51	367	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	37.8	D	EB Left	400	45	212	1030	D		
				EB Through	563	33	212	1030	C		
				EB Right	0	0	0	0	A		
	WB	63.4	E	WB Left	541	53	148	525	D		
				WB Through	281	84	148	525	F		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	41.6	D	NB Left	161	54	59	240	D	64.2	E
				NB Through	124	58	59	240	E		
				NB Right	159	16	59	240	B		
	SB	85.7	F	SB Left	455	99	382	804	F		
				SB Through	806	78	342	791	E		
				SB Right	0	0	0	0	A		
	EB	58.4	E	EB Left	167	80	267	937	E		
				EB Through	980	58	267	937	E		
				EB Right	125	30	267	937	C		
	WB	52.4	D	WB Left	396	72	120	354	E		
				WB Through	358	38	120	354	D		
				WB Right	54	7	120	354	A		
37- Montrose Rd at Tower Oaks Blvd											
37	NB			NB Left	0	0	0	0	A	84.5	F
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	211.0	F	SB Left	146	48	1134	1396	D		
				SB Through	0	0	0	0	A		
				SB Right	541	255	1129	1392	F		
	EB	29.4	C	EB Left	30	45	210	1209	D		
				EB Through	1613	29	210	1209	C		
				EB Right	0	0	0	0	A		
	WB	86.7	F	WB Left	0	0	0	0	A		
				WB Through	1649	89	452	847	F		
				WB Right	79	34	452	847	C		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	22.5	C	NB Left	503	22	37	222	C	67.1	E
				NB Through	9	24.8	30	214	C		
				NB Right	26	23.5	37	222	C		
	SB	0.7	A	SB Left	0	38.6	0	25	D		
				SB Through	0	0.0	0	25	A		
				SB Right	4	0.7	0	0	A		
	EB	106.4	F	EB Left	7	85.8	341	464	F		
				EB Through	674	107.4	341	463	F		
				EB Right	97	101.2	332	454	F		
	WB	9.0	A	WB Left	0	0.0	3	75	A		
				WB Through	103	9.4	3	75	A		
				WB Right	7	3.2	0	5	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	16.4	B	NB Left	37	76	40	178	E	50.1	D
				NB Through	241	44	40	178	D		
				NB Right	560	1	0	0	A		
	SB	39.7	D	SB Left	335	51	158	626	D		
				SB Through	779	36	157	625	D		
				SB Right	78	29	122	627	C		
	EB	92.0	F	EB Left	77	80	429	724	F		
				EB Through	982	93	431	725	F		
				EB Right	63	91	450	749	F		
	WB	41.5	D	WB Left	383	51	83	304	D		
				WB Through	235	45	83	304	D		
				WB Right	137	7	95	335	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	33.0	C	NB Left	0	0	0	0	A	20.5	C
				NB Through	92	33	32	164	C		
				NB Right	212	33	32	164	C		
	SB	2.4	A	SB Left	0	0	5	67	A		
				SB Through	986	2	5	67	A		
				SB Right	0	0	0	0	A		
	EB	32.2	C	EB Left	8	60	168	533	E		
				EB Through	578	65	168	533	E		
				EB Right	620	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.5	A	NB Left	100	2	1	30	A	22.0	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	23.4	C	WB Left	986	24	106	651	C		
				WB Through	432	22	106	651	C		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	53.4	D	NB Left	232	21	247	673	C	150.1	F
				NB Through	1496	50	247	673	D		
				NB Right	222	113	247	673	F		
	SB	219.6	F	SB Left	60	161	2598	2706	F		
				SB Through	1228	219	2598	2706	F		
				SB Right	166	246	2598	2706	F		
	EB	186.6	F	EB Left	229	134	1866	1988	F		
				EB Through	630	204	1867	1989	F		
				EB Right	131	195	1891	2013	F		
	WB	191.1	F	WB Left	714	230	1925	2151	F		
				WB Through	390	157	1925	2151	F		
				WB Right	156	96	1925	2151	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	11.4	B	NB Left	163	85	64	260	F	18.6	B
				NB Through	1552	4	64	260	A		
				NB Right	0	0	0	0	A		
	SB	23.7	C	SB Left	0	0	0	0	A		
				SB Through	1538	24	75	524	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	51.2	D	WB Left	126	52	41	243	D		
				WB Through	10	45	41	243	D		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	23.2	C	NB Left	0	0	0	0	A	34.4	C
				NB Through	1478	23	66	408	C		
				NB Right	0	0	0	0	A		
	SB	8.1	A	SB Left	179	55	61	266	E		
				SB Through	1484	2	61	266	A		
				SB Right	0	0	0	0	A		
	EB	128.9	F	EB Left	239	60	529	1149	E		
				EB Through	0	0	529	1149	A		
				EB Right	396	170	552	1139	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	15.0	B	NB Left	255	57	68	263	E	21.1	C
				NB Through	1382	7	69	263	A		
				NB Right	10	6	92	297	A		
	SB	22.4	C	SB Left	12	31	102	634	C		
				SB Through	1707	24	102	634	C		
				SB Right	150	1	65	625	A		
	EB	38.0	D	EB Left	190	59	56	222	E		
				EB Through	26	54	56	222	D		
				EB Right	252	20	56	222	C		
	WB	7.2	A	WB Left	1	7	1	29	A		
				WB Through	9	11	1	29	B		
				WB Right	5	0	0	7	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	30.4	C	NB Left	226	30	25	152	C	14.5	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	14.0	B	EB Left	0	0	0	0	A		
				EB Through	1682	14	58	552	B		
				EB Right	0	0	0	0	A		
	WB	10.8	B	WB Left	0	0	0	0	A		
				WB Through	778	11	24	191	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.3	A	EB Left	0	0	0	0	A		
				EB Through	1793	5	23	284	A		
				EB Right	0	0	0	0	A		
	WB	8.5	A	WB Left	223	36	31	173	D		
				WB Through	780	1	20	152	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	12.6	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	32.5	C	SB Left	358	48	61	310	D		
				SB Through	0	0	0	0	A		
				SB Right	188	3	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	2.8	A	WB Left	0	0	0	0	A		
				WB Through	780	3	5	127	A		
				WB Right	336	2	1	160	A		
50- MD 190 at Burdette Rd											
50	NB	73.2	E	NB Left	20	80	15	118	E	14.3	B
				NB Through	4	59	15	118	E		
				NB Right	11	67	15	118	E		
	SB	34.0	C	SB Left	50	79	31	151	E		
				SB Through	17	65	31	151	E		
				SB Right	121	11	31	151	B		
	EB	12.6	B	EB Left	54	94	76	659	F		
				EB Through	1839	10	76	659	B		
				EB Right	15	8	69	682	A		
	WB	12.6	B	WB Left	1	106	62	845	F		
				WB Through	1495	13	63	845	B		
				WB Right	21	2	56	875	A		

Table C.15: AM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	44.7	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	99.1	F	EB Left	531	99	294	686	F		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	15.7	B	WB Left	0	0	0	0	A		
				WB Through	995	16	74	676	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	79.0	E	NB Left	262	79	1360	3346	E	14.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	982	3	6	146	A		
				EB Right	0	0	0	0	A		
	WB	5.4	A	WB Left	0	0	0	0	A		
				WB Through	667	5	7	171	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	68.2	E	NB Left	21	67	23	149	E	44.0	D
				NB Through	59	69	25	148	E		
				NB Right	0	0	0	0	A		
	SB	56.9	E	SB Left	624	56	184	777	E		
				SB Through	183	59	185	778	E		
				SB Right	18	54	184	777	D		
	EB	37.5	D	EB Left	24	30	135	584	C		
				EB Through	846	38	135	584	D		
				EB Right	42	42	135	584	D		
	WB	36.8	D	WB Left	122	110	112	387	F		
				WB Through	647	32	114	390	C		
				WB Right	160	1	0	83	A		
54- MD 124 at I-270 NB off ramp											
54	NB	40.3	D	NB Left	0	0	0	0	A	27.7	C
				NB Through	0	0	0	0	A		
				NB Right	772	40	102	410	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	17.7	B	EB Left	0	0	0	0	A		
				EB Through	963	18	44	399	B		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	37.4	D	NB Left	0	0	0	0	A	16.5	B
				NB Through	0	0	0	0	A		
				NB Right	964	37	120	588	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.5	A	EB Left	0	0	0	0	A		
				EB Through	1683	4	19	88	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
56	NB	48.2	D	NB Left	90	66	48	198	E	45.3	D
				NB Through	0	0	0	0	A		
				NB Right	166	39	48	198	D		
	SB	41.0	D	SB Left	611	52	140	852	D		
				SB Through	147	50	140	852	D		
				SB Right	506	25	140	852	C		
	EB	58.1	E	EB Left	0	0	0	0	A		
				EB Through	1068	58	252	932	E		
				EB Right	6	45	252	932	D		
	WB	34.6	C	WB Left	115	71	93	448	E		
				WB Through	742	29	90	447	C		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
57	NB	36.7	D	NB Left	409	45	108	437	D	70.8	E
				NB Through	0	0	0	0	A		
				NB Right	503	30	108	437	C		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	28.9	C	EB Left	382	79	121	411	E		
				EB Through	1039	10	121	411	B		
				EB Right	0	0	0	0	A		
	WB	157.9	F	WB Left	0	0	0	0	A		
				WB Through	882	170	676	856	F		
				WB Right	157	87	676	856	F		
58- Watkins Mill Rd at I-270 SB on ramp											
58	NB			NB Left	0	0	0	0	A	17.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	20.0	C	EB Left	0	0	0	0	A		
				EB Through	1416	19	152	559	B		
				EB Right	424	24	152	559	C		
	WB	14.5	B	WB Left	426	40	174	514	D		
				WB Through	862	2	174	514	A		
				WB Right	0	0	0	0	A		

Table C.16: AM Peak - No Build - I-270 Vehicle Network Performance

	No Build (Delay Total)	Alternative (Total Total)	% Change
Total Delay	33,996,630	24,588,482	-28%
Average Delay per Vehicle	313	223	-29%
Total Travel Time	63,609,822	56,416,942	-11%
Vehicles (Arrived)	89,132	93,941	5%
Latent Demand	43,736	39,343	-10%
Latent Delay	119,614,848	109,844,998	-8%
Total Distance	468,502	503,389	7%
Average Speed	27	32	21%

PM Peak

Table D.1: PM Peak - No Build - I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	430.8	426.8	-0.9%	to MD 85	1.7	94.6	94.6	0.0%
to I-270 Split	0.6	90.8	90.2	-1.1%	to MD 80	5.4	306.4	307.1	0.3%
to Montrose Rd	1.8	114.8	115.0	0.0%	to MD 109	3.7	211.1	210.9	0.0%
to MD 189	1.0	75.2	67.0	-10.7%	to MD 121	3.6	204.8	205.4	0.0%
to MD 28	1.0	90.9	63.0	-30.8%	to MD 27	2.5	146.4	146.6	0.7%
to Shady Grove Rd	1.9	227.7	140.7	-38.2%	to MD 118	1.1	65.2	65.3	0.0%
to I-370	0.9	205.0	103.8	-49.3%	to Middlebrook Rd	1.1	71.4	70.6	0.0%
to MD 117	1.5	143.5	127.2	-11.2%	to MD 124	2.2	138.3	132.1	-4.3%
to MD 124	0.6	41.5	39.3	-7.1%	to MD 117	0.9	121.9	52.9	-56.6%
to Middlebrook Rd	2.5	242.1	277.2	14.5%	to I-370	1.0	75.7	119.1	56.6%
to MD 118	1.1	87.2	160.0	83.9%	to Shady Grove Rd	1.5	83.5	83.5	0.0%
to MD 27	0.9	71.0	80.5	12.7%	to MD 28	1.9	114.2	114.4	0.0%
to MD 121	2.4	168.7	163.6	-3.0%	to MD 189	1.0	62.8	62.8	0.0%
to MD 109	4.1	354.7	386.3	8.7%	to Montrose Rd	1.0	64.8	64.8	0.0%
to MD 80	3.7	246.4	245.3	-0.4%	to I-270 Split	1.9	117.7	112.9	-4.2%
to MD 85	5.3	348.9	347.7	-0.3%	to MD 187	0.4	23.1	23.0	0.0%
to I-70	1.4	182.9	181.2	-1.1%	to I-495 interchange	1.9	156.1	154.9	-0.6%
I-270 Total (miles/minutes)	**32.4**	**52.0**	**50.2**	**-3.8%**	**I-270 Total (miles/minutes)**	**32.6**	**34.3**	**33.7**	**0.0%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	126.4	112.4	-11.1%	to I-270 Split	30.3	1,878.8	1,842.7	-1.9%
to I-495	1.1	272.6	237.8	-12.8%	to Democracy Blvd	0.7	189.8	39.0	-79.5%
to Democracy Blvd	1.4	228.1	114.1	-50.0%	to I-495	1.3	515.0	122.5	-76.3%
to I-270 Split	0.9	76.6	56.5	-27.3%	to MD 190	1.3	197.7	207.5	5.1%
to I-70	30.0	2,600.6	2,497.8	-4.0%	to Cabin John Pkwy	0.6	162.4	165.7	2.5%
I-270 Spur Total (miles/minutes)	**34.0**	**55.1**	**50.3**	**-9.1%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**49.1**	**39.6**	**-18.4%**

Table D.2: PM Peak - No Build - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Alternative VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	64.7	57.0	-12.3%	to Shady Grove	1.3	88.9	86.7	-2.2%
to MD 189	1.3	213.3	110.3	-48.4%	to MD 28	1.8	120.6	119.7	-0.8%
to MD 28	1.0	93.1	74.2	-20.4%	to MD 189	1.1	94.5	73.1	-23.2%
to Shady Grove	2.0	515.6	134.7	-73.8%	to Montrose	1.2	88.7	85.4	-4.5%
to I-370	1.0	521.1	168.9	-67.6%	to I-270 mainline	0.9	60.1	60.3	0.0%
to MD 117	1.2	528.7	220.0	-58.4%					
to MD 124	0.8	452.3	205.7	-54.4%					
to I-270 mainline	0.8	214.9	175.2	-18.6%					
I-270 Local Total (miles/minutes)	**8.9**	**43.4**	**19.1**	**-55.8%**	**I-270 Local Total (miles/minutes)**	**6.3**	**7.5**	**7.1**	**-12.5%**

Figure D.1: PM Peak - No Build
I-270 Travel Time Graph - Northbound

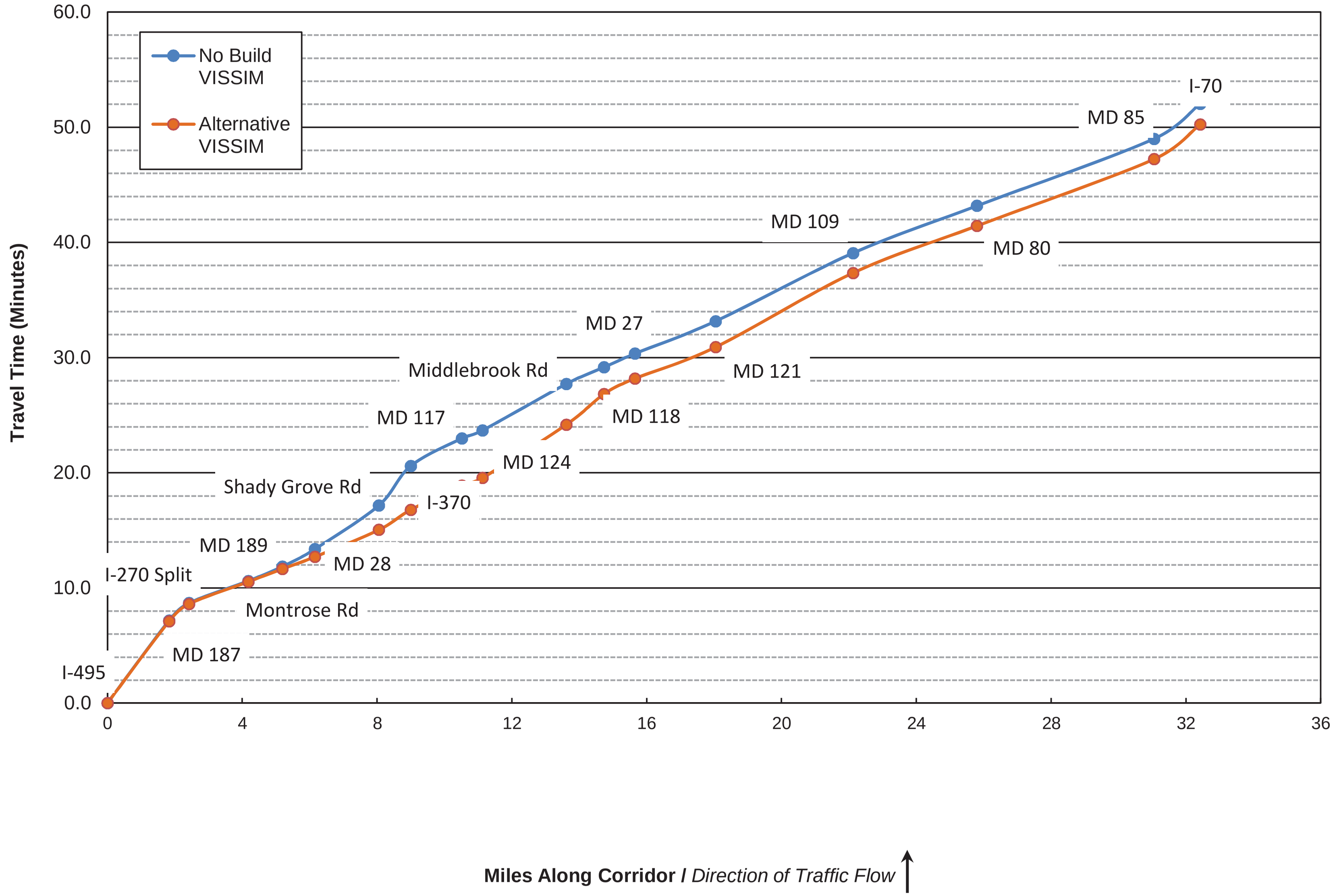
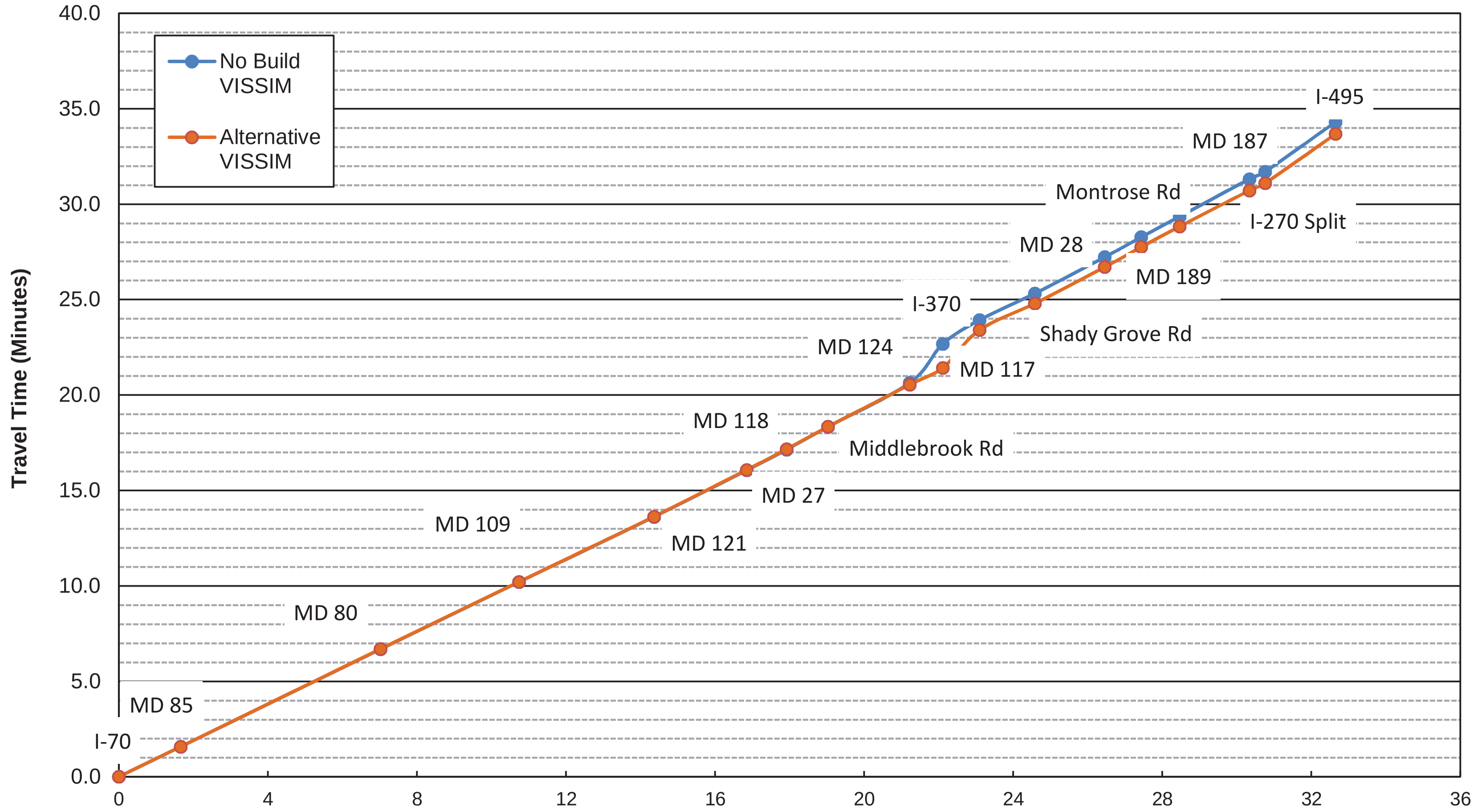


Figure D.2: PM Peak - No Build
I-270 Travel Time Graph - Southbound



Miles Along Corridor / *Direction of Traffic Flow* ↓

Figure D.3: PM Peak - No Build
I-270 Spur Travel Time Graph - Northbound

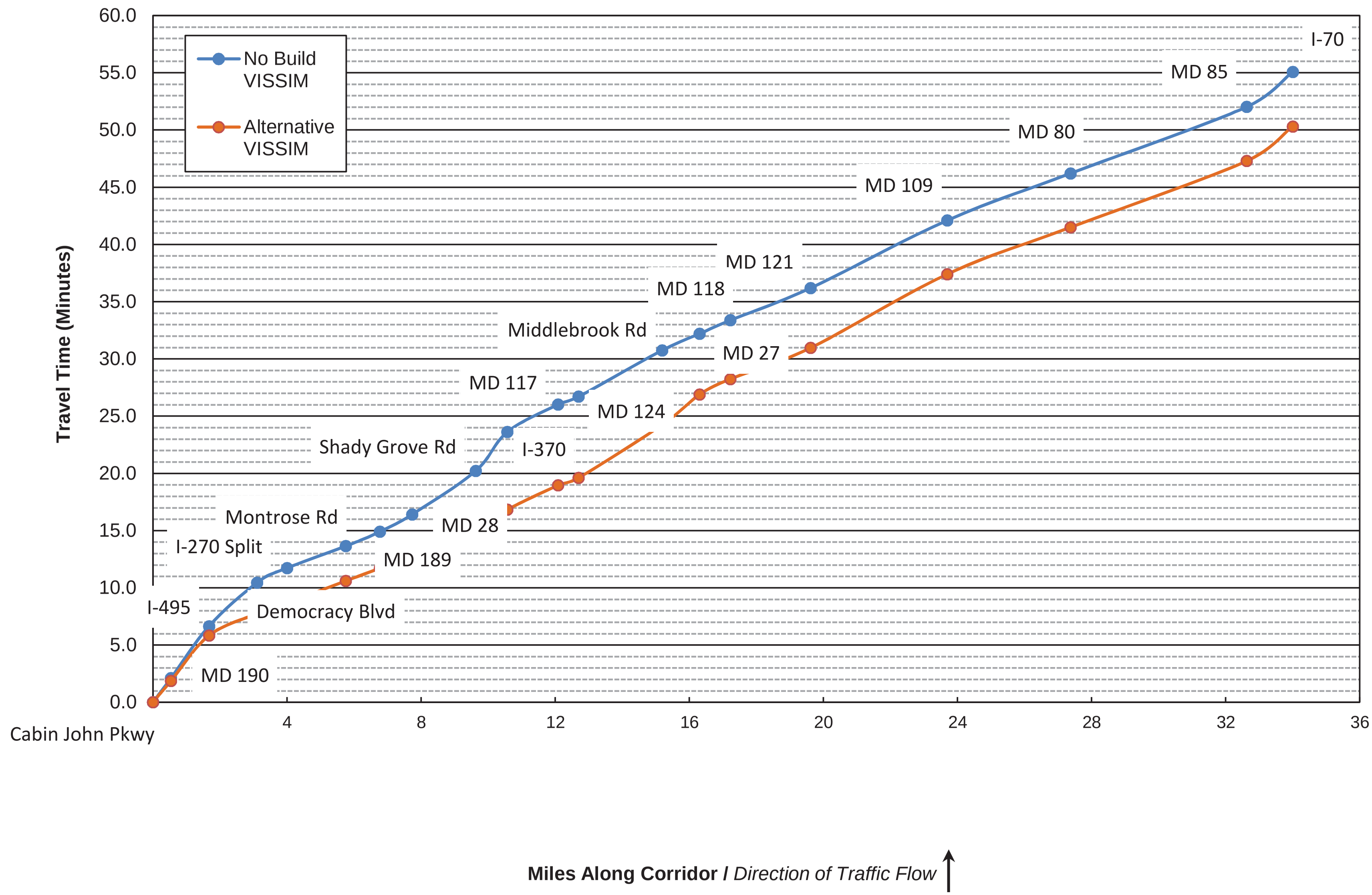
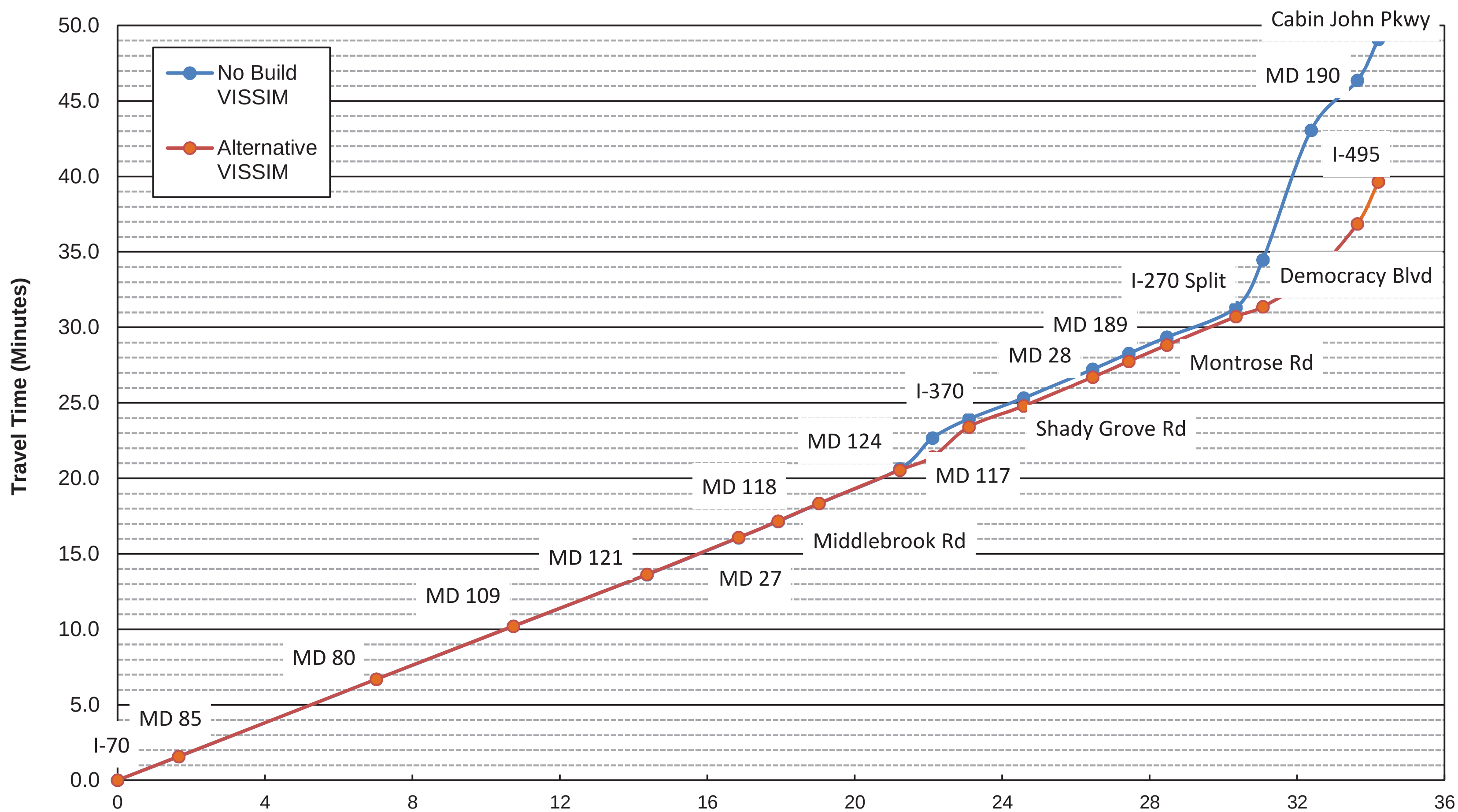


Figure D.4: PM Peak - No Build
I-270 Spur Travel Time Graph - Southbound



Miles Along Corridor / *Direction of Traffic Flow* ↓

Figure D.5: PM Peak - No Build
I-270 Local Travel Time Graph - Northbound

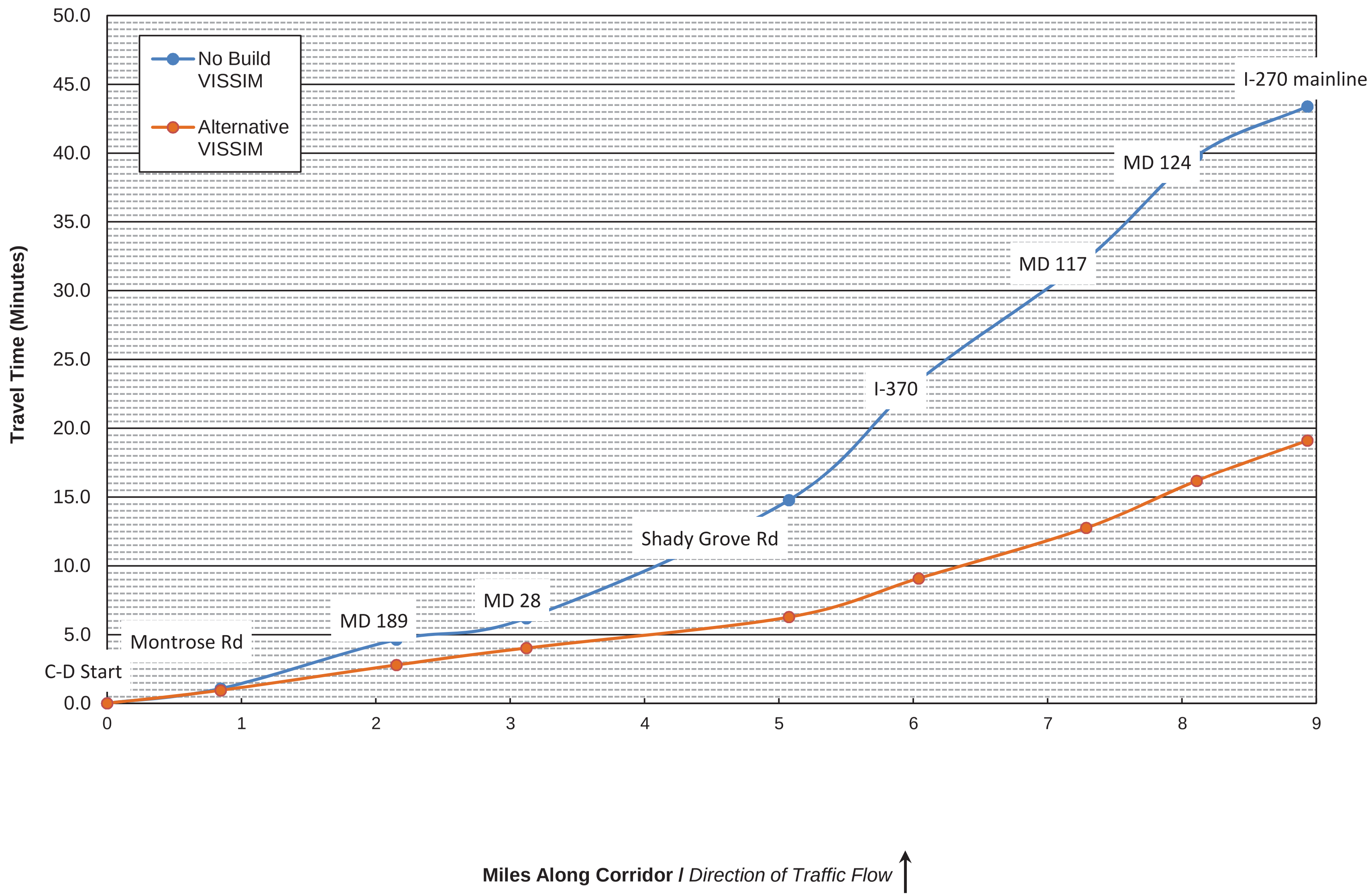


Figure D.6: PM Peak - No Build
I-270 Local Travel Time Graph - Southbound

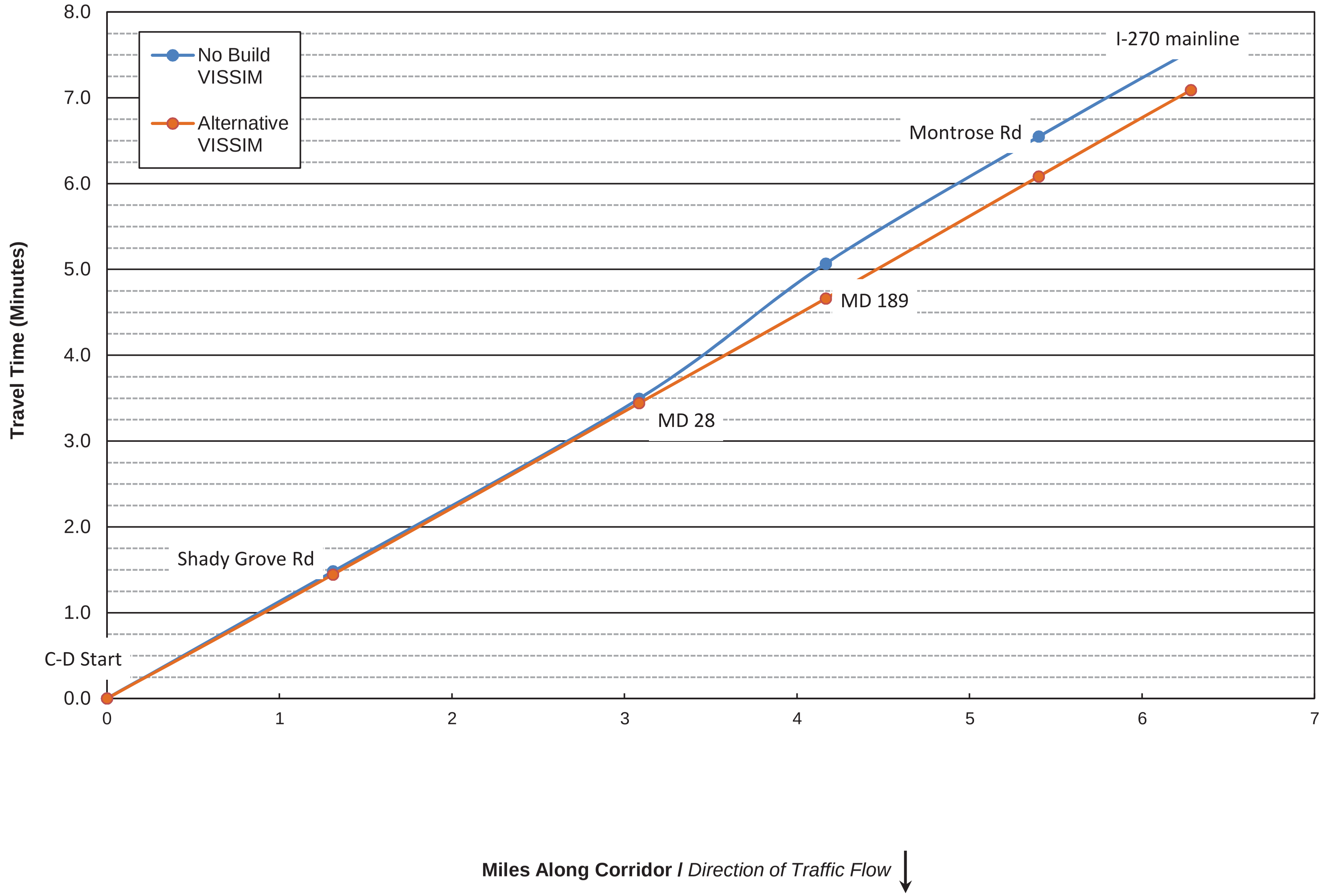


Table D.3: PM Peak - No Build - I-270 Vehicle Speed

I-270 Northbound	RITIS Segment Number	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From I-495 interchange					From I-70			
to MD 187	6001+6002	15.3	15.5	0.0%	to MD 85	63.3	63.3	0.0%
to I-270 Split	6003+6004	23.4	23.6	4.3%	to MD 80	62.9	62.8	0.0%
to Montrose Rd	6005+6006	55.0	54.9	0.0%	to MD 109	63.4	63.5	1.6%
to MD 189	6007+6008	48.5	54.5	10.2%	to MD 121	63.6	63.5	-1.6%
to MD 28	6009+6010	38.2	55.1	44.7%	to MD 27	61.1	61.0	0.0%
to Shady Grove Rd	6011+6012	30.0	48.6	63.3%	to MD 118	59.2	59.2	0.0%
to I-370	6013+6014	16.6	32.7	94.1%	to Middlebrook Rd	56.0	56.7	1.8%
to MD 117	6015+6016	38.0	42.9	13.2%	to MD 124	57.2	59.9	5.3%
to MD 124	6017+6018	53.1	56.2	5.7%	to MD 117	26.2	60.3	130.8%
to Middlebrook Rd	6019+6020	37.0	32.3	-13.5%	to I-370	46.9	29.8	-36.2%
to MD 118	6021+6022	46.3	25.2	-45.7%	to Shady Grove Rd	64.1	64.1	0.0%
to MD 27	6023+6024	46.4	41.0	-10.9%	to MD 28	59.1	59.0	0.0%
to MD 121	6025+6026	51.1	52.7	3.9%	to MD 189	56.0	56.1	0.0%
to MD 109	6027+6028	41.4	38.0	-7.3%	to Montrose Rd	57.4	57.4	0.0%
to MD 80	6029+6030	53.7	54.0	0.0%	to I-270 Split	57.2	59.7	5.3%
to MD 85	6031+6032	54.2	54.4	0.0%	to MD 187	65.5	65.8	1.5%
to I-70	6033+6034	27.0	27.2	0.0%	to I-495 interchange	43.6	44.0	0.0%
I-270 Total (miles/minutes)		**37.4**	**38.7**	**5.4%**	**I-270 Total (miles/minutes)**	**57.1**	**58.2**	**1.8%**
I-270 Spur Northbound					**I-270 Spur Southbound**			
From Cabin John Pkwy					From I-70			
to MD 190	6045	15.4	17.3	13.3%	to I-270 Split	58.1	59.3	1.7%
to I-495	6044	15.0	17.2	13.3%	to Democracy Blvd	13.9	67.5	378.6%
to Democracy Blvd	6042+6043	22.6	45.2	95.7%	to I-495	9.2	38.5	322.2%
to I-270 Split	6040+6041	41.9	56.9	35.7%	to MD 190	22.8	21.8	-4.3%
to I-70	6005 - 6034	41.5	43.2	2.4%	to Cabin John Pkwy	12.6	12.4	-7.7%
I-270 Spur Total (miles/minutes)		**37.0**	**40.5**	**10.8%**	**I-270 Spur Total (miles/minutes)**	**41.8**	**51.8**	**23.8%**

Table D.4: PM Peak - No Build - I-270 Local Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Alternative VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	47.0	53.4	12.8%	to Shady Grove	53.1	54.4	1.9%
to MD 189	22.1	42.7	95.5%	to MD 28	52.9	53.3	0.0%
to MD 28	37.4	46.9	27.0%	to MD 189	41.2	53.3	29.3%
to Shady Grove	13.6	52.2	271.4%	to Montrose	50.1	52.0	4.0%
to I-370	6.7	20.6	200.0%	to I-270 mainline	52.9	52.7	0.0%
to MD 117	8.5	20.4	150.0%				
to MD 124	6.5	14.4	100.0%				
to I-270 mainline	13.6	16.9	21.4%				
I-270 Local Total (miles/minutes)	**12.3**	**28.1**	**133.3%**	**I-270 Local Total (miles/minutes)**	**49.9**	**53.2**	**6.0%**

Figure D.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table D.5: PM Peak - No Build - I-270 Vehicle Density

I-270 Northbound	Type	No Build Density (pc/mi/ln)	No Build LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change	I-270 Southbound	Type	No Build Density (pc/mi/ln)	No Build LOS	Alternative Density (pc/mi/ln)	Alternative LOS	% Change
I-270	Freeway	90	F	90	F	0%	I-270	Freeway	19	C	19	C	0%
I-270 Diverge to MD 187	Diverge	78	F	78	F	0%	I-270 Merge from WB I-70	Merge	17	B	17	B	0%
I-270	Freeway	86	F	84	F	-2%	I-270	Freeway	24	C	24	C	0%
I-270 Diverge to Rockledge Rd	Diverge	78	F	78	F	0%	I-270 Merge from EB I-70	Merge	16	B	16	B	0%
I-270	Freeway	86	F	85	F	-1%	I-270	Freeway	22	C	22	C	0%
I-270 Weave from MD 187 to I-270 HOV	Weave	58	F	57	F	-2%	I-270 Diverge to SB MD 85	Diverge	23	C	23	C	0%
I-270 Lane Drop	Merge	65	F	65	F	0%	I-270	Freeway	24	C	24	C	0%
I-270	Freeway	51	F	51	F	0%	I-270 Diverge to NB MD 85	Diverge	15	B	15	B	0%
I-270 Merge from I-270 Spur	Merge	37	E	32	D	-14%	I-270	Freeway	19	C	19	C	0%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	33	D	31	D	-6%	I-270 Merge from MD 85	Merge	19	B	20	C	5%
I-270	Freeway	32	D	27	D	-16%	I-270	Freeway	25	C	25	C	0%
I-270 Diverge to C-D (MD 189)	Diverge	42	F	34	D	-19%	I-270 Diverge to MD 80	Diverge	16	B	17	B	6%
I-270	Freeway	42	E	33	D	-21%	I-270	Freeway	20	C	20	C	0%
I-270 Diverge to C-D (MD 28)	Diverge	58	F	39	E	-33%	I-270 Merge from MD 80	Merge	14	B	11	B	-21%
I-270	Freeway	52	F	29	D	-44%	I-270	Freeway	23	C	23	C	0%
I-270 Merge from C-D (MD 189)	Merge	71	F	28	C	-61%	I-270 Diverge to MD 109	Diverge	12	B	12	B	0%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	73	F	28	D	-62%	I-270	Freeway	22	C	22	C	0%
I-270	Freeway	62	F	36	E	-42%	I-270 Merge from MD 109	Merge	14	B	12	B	-14%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	82	F	38	E	-54%	I-270	Freeway	24	C	24	C	0%
I-270	Freeway	82	F	43	E	-48%	I-270 Diverge to SB Weigh Station	Diverge	12	B	13	B	8%
I-270 Merge from C-D (Shady Grove Rd)	Merge	113	F	47	F	-58%	I-270	Freeway	24	C	24	C	0%
I-270	Freeway	77	F	54	F	-30%	I-270 Merge from SB Weigh Station	Merge	12	B	12	B	0%
I-270 Merge from C-D (I-370)	Merge	127	F	89	F	-30%	I-270	Freeway	23	C	23	C	0%
I-270 Diverge to C-D (MD 117)	Diverge	133	F	84	F	-37%	I-270 Diverge to MD 121	Diverge	9	A	9	A	0%
I-270	Freeway	26	D	26	D	0%	I-270	Freeway	12	B	12	B	0%
I-270 Merge from C-D (MD 124)	Merge	58	F	49	F	-16%	I-270 Merge from WB MD 121	Merge	10	B	10	B	0%
I-270	Freeway	31	D	67	F	116%	I-270	Freeway	15	B	15	B	0%
I-270 Diverge to EB Middlebrook Rd	Diverge	23	C	67	F	191%	I-270 Merge from EB MD 121	Merge	13	B	13	B	0%
I-270	Freeway	28	D	93	F	232%	I-270	Freeway	20	C	20	C	0%
I-270 Diverge to WB Middlebrook Rd	Diverge	23	C	97	F	322%	I-270 Diverge to MD 27	Diverge	13	B	13	B	0%
I-270	Freeway	25	C	70	F	180%	I-270	Freeway	17	B	17	B	0%
I-270 Diverge to EB MD 118	Diverge	24	C	69	F	188%	I-270 Merge from WB MD 27	Merge	14	B	13	B	-7%
I-270 Diverge to WB MD 118	Diverge	43	F	89	F	107%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	31	D	42	E	35%	I-270 Weave from EB MD 27 to MD 118	Weave	15	B	15	B	0%
I-270 Weave from MD 118 to MD 27	Weave	41	F	61	F	49%	I-270	Freeway	19	C	19	C	0%
I-270	Freeway	27	D	31	D	15%	I-270 Merge from WB MD 118	Merge	15	B	14	B	-7%
I-270 Merge from EB MD 27	Merge	41	F	61	F	49%	I-270	Freeway	22	C	21	C	-5%
I-270	Freeway	28	D	30	D	7%	I-270 Merge from EB MD 118	Merge	19	B	19	B	0%
I-270 Merge from WB MD 27	Merge	24	C	26	C	8%	I-270	Freeway	28	D	28	D	0%
I-270	Freeway	30	D	32	D	7%	I-270 Merge from Middlebrook Rd	Merge	30	D	28	C	-7%
I-270 Diverge to MD 121	Diverge	27	C	26	C	-4%	I-270 Diverge to Watkins Mill Rd	Diverge	24	C	19	B	-21%

Table D.5: PM Peak - No Build - I-270 Vehicle Density

		No Build		Alternative					No Build		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	32	D	25	C	-22%	I-270	Freeway	20	C	19	C	-5%
I-270 Merge from EB MD 121	Merge	54	F	32	D	-41%	I-270 Diverge to MD 124	Diverge	17	B	12	B	-29%
I-270 Lane Drop	Merge	93	F	77	F	-17%	I-270	Freeway	14	B	14	B	0%
I-270	Freeway	43	E	104	F	142%	I-270 Merge from Watkins Mill	Merge	17	B	12	B	-29%
I-270 Diverge to NB Weigh Station	Diverge	19	B	18	B	-5%	I-270	Freeway	60	F	17	B	-72%
I-270	Freeway	38	E	37	E	-3%	I-270 Merge from WB MD 124	Merge	98	F	17	B	-83%
I-270 Merge from NB Weight Station	Merge	19	B	19	B	0%	I-270	Freeway	0	A	0	A	0%
I-270	Freeway	39	E	38	E	-3%	I-270 Merge from MD 117	Merge	42	F	54	F	29%
I-270 Diverge to MD 109	Diverge	22	C	22	C	0%	I-270	Freeway	29	D	65	F	124%
I-270	Freeway	34	D	34	D	0%	I-270 Diverge to I-370	Diverge	22	C	32	D	45%
I-270 Merge from MD 109	Merge	19	B	19	B	0%	I-270	Freeway	18	C	17	B	-6%
I-270	Freeway	37	E	36	E	-3%	I-270 Diverge to I-270 C-D	Diverge	14	B	13	B	-7%
I-270 Diverge to MD 80	Diverge	27	C	25	C	-7%	I-270	Freeway	14	B	13	B	-7%
I-270	Freeway	30	D	30	D	0%	I-270 Merge from I-270 (I-370)	Merge	21	C	20	B	-5%
I-270 Merge from MD 80	Merge	18	B	18	B	0%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	24	C	23	C	-4%
I-270	Freeway	36	E	36	E	0%	I-270	Freeway	19	C	18	C	-5%
I-270 Diverge to Scenic View	Diverge	18	B	18	B	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	19	B	18	B	-5%
I-270	Freeway	36	E	36	E	0%	I-270	Freeway	24	C	23	C	-4%
I-270 Merge from Scenic View	Merge	18	B	18	B	0%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	19	B	18	B	-5%
I-270	Freeway	36	E	36	E	0%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	26	C	25	C	-4%
I-270 Diverge to NB MD 85	Diverge	21	C	20	C	-5%	I-270	Freeway	22	C	21	C	-5%
I-270	Freeway	34	D	34	D	0%	I-270 Merge from I-270 C-D (MD 189)	Merge	21	C	19	B	-10%
I-270 Diverge to SB MD 85	Diverge	20	B	19	B	-5%	I-270	Freeway	26	D	20	C	-23%
I-270	Freeway	30	D	29	D	-3%	I-270 Merge from I-270 C-D	Merge	31	D	14	B	-55%
I-270 Weave from MD 85 to I-70	Weave	22	C	22	C	0%	I-270 Diverge to I-270 HOV Lane	Diverge	19	B	25	C	32%
I-270	Freeway	65	F	63	F	-3%	I-270 Diverge to I-270 Spur	Diverge	52	F	15	B	-71%
							I-270	Freeway	13	B	13	B	0%
							I-270 Diverge to Rockledge Dr / MD 187	Diverge	9	A	9	A	0%
							I-270	Freeway	13	B	13	B	0%
							I-270 Merge from Rockledge Dr	Merge	12	B	12	B	0%
							I-270	Freeway	16	B	16	B	0%
							I-270 Merge from Rockledge Dr / MD 187	Merge	14	B	14	B	0%
							I-270	Freeway	36	E	35	E	-3%

Table D.6: PM Peak - No Build - I-270 Spur Vehicle Density

		No Build		Alternative					No Build		Alternative		
I-270 Spur Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270 Spur	Freeway	62	F	58	F	-6%	I-270 Spur	Freeway	74	F	13	B	-82%
I-270 Spur Merge from Clara Barton Parkway	Merge	64	F	63	F	-2%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	94	F	13	B	-86%
I-270 Spur	Freeway	78	F	72	F	-8%	I-270 Spur	Freeway	109	F	16	B	-85%
I-270 Diverge to MD 190	Diverge	49	F	45	F	-8%	I-270 Merge from Democracy Blvd	Merge	154	F	20	C	-87%
I-270 Spur	Freeway	89	F	85	F	-4%	I-270 Spur Lane Drop	Merge	145	F	31	D	-79%
I-270 Spur Merge from Cabin John Parkway	Merge	106	F	98	F	-8%	I-270 Spur	Freeway	125	F	50	F	-60%
I-270 Spur Merge from MD 190	Merge	97	F	92	F	-5%	I-270 Spur Merge from I-495	Merge	125	F	133	F	6%
I-270 Spur	Freeway	84	F	77	F	-8%	I-270 Spur	Freeway	48	F	51	F	6%
I-270 Spur Diverge to I-495	Merge	66	F	55	F	-17%	I-270 Spur Diverve to EB MD 190	Diverge	50	F	51	F	2%
I-270 Spur	Freeway	46	F	33	D	-28%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	68	F	70	F	3%
I-270 Spur Diverge to Democracy Blvd	Diverge	50	F	24	C	-52%	I-270 Spur	Freeway	95	F	96	F	1%
I-270 Spur	Freeway	59	F	26	D	-56%	I-270 Merge from MD 190	Merge	118	F	116	F	-2%
I-270 Spur Merge from EB Democracy Blvd	Merge	99	F	22	C	-78%	I-270 Spur	Freeway	94	F	94	F	0%
I-270 Spur	Freeway	58	F	29	D	-50%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	61	F	60	F	-2%
I-270 Spur Merge from WB Democracy Blvd	Merge	66	F	26	C	-61%	I-270 Spur	Freeway	83	F	83	F	0%
I-270 Spur	Freeway	38	E	25	C	-34%	I-270 Merge from Clara Barton Pkwy	Merge	77	F	77	F	0%
I-270 Spur Merge from Westlake Terrace	Merge	32	D	24	C	-25%							
I-270 Spur	Freeway	35	D	26	D	-26%							

Table D.7: PM Peak - No Build - I-270 Local Vehicle Density

		No Build		Alternative					No Build		Alternative		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270 C-D	Freeway	29	D	30	D	3%	I-270 C-D	Freeway	9	A	8	A	-11%
I-270 C-D Diverge to EB Montrose Rd	Diverge	21	C	21	C	0%	I-270 C-D Weave from I-370 EB to I-270	Weave	23	B	19	B	-17%
I-270 C-D	Freeway	16	B	16	B	0%	I-270 C-D Diverge to Shady Grove Rd	Diverge	11	B	12	B	9%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	12	A	12	A	0%	I-270 C-D	Freeway	8	A	8	A	0%
I-270 C-D	Freeway	23	C	18	B	-22%	I-270 C-D Merge from WB Shady Grove Rd	Merge	9	A	9	A	0%
I-270 C-D Merge from WB Montrose Rd	Merge	79	F	39	E	-51%	I-270 C-D	Freeway	14	B	14	B	0%
I-270 C-D	Freeway	69	F	45	E	-35%	I-270 C-D Merge from EB Shady Grove Rd	Merge	11	B	11	B	0%
I-270 C-D Merge from I-270	Merge	91	F	56	F	-38%	I-270 C-D	Freeway	21	C	21	C	0%
I-270 C-D	Freeway	66	F	46	F	-30%	I-270 C-D Merge from I-270	Merge	26	C	18	B	-31%
I-270 C-D Diverge to MD 189	Diverge	44	F	21	C	-52%	I-270 C-D Diverge to I-270	Diverge	27	C	18	B	-33%
I-270 C-D	Freeway	90	F	28	D	-69%	I-270 C-D Diverge to I-270	Diverge	18	B	18	B	0%
I-270 C-D Merge from MD 189	Merge	112	F	22	C	-80%	I-270 C-D	Freeway	17	B	17	B	0%
I-270 C-D	Freeway	59	F	20	C	-66%	I-270 C-D Diverge to MD 28	Diverge	12	B	12	B	0%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	66	F	30	C	-55%	I-270 C-D	Freeway	11	B	11	B	0%
I-270 C-D	Freeway	43	E	38	E	-12%	I-270 C-D Merge from WB MD 28	Merge	14	B	13	B	-7%
I-270 C-D Diverge to MD 28	Diverge	18	B	48	F	167%	I-270 C-D	Freeway	14	B	14	B	0%
I-270 C-D	Freeway	29	D	39	E	34%	I-270 C-D Merge from EB MD 28	Merge	33	D	23	C	-30%
I-270 C-D Weave between MD 28 Ramps	Weave	27	C	32	D	19%	I-270 C-D	Freeway	45	E	19	C	-58%
I-270 C-D	Freeway	21	C	20	C	-5%	I-270 C-D Merge from I-270	Merge	61	F	21	C	-66%
I-270 C-D Merge from MD 28 WB	Merge	22	C	14	B	-36%	I-270 C-D	Freeway	48	F	23	C	-52%
I-270 C-D Merge from I-270 and Drop Lane	Merge	27	C	18	B	-33%	I-270 C-D Diverge to MD 189	Diverge	26	C	25	C	-4%
I-270 C-D Diverge to I-270	Diverge	47	F	26	C	-45%	I-270 C-D	Freeway	28	D	27	D	-4%
I-270 C-D	Freeway	45	E	21	C	-53%	I-270 C-D Merge from MD 189	Merge	27	C	22	C	-19%
I-270 C-D Diverge to Shady Grove Rd	Diverge	15	B	13	B	-13%	I-270 C-D Diverge to I-270	Diverge	35	D	22	C	-37%
I-270 C-D	Freeway	119	F	16	B	-87%	I-270 C-D	Freeway	24	C	24	C	0%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	129	F	15	B	-88%	I-270 C-D Diverge to WB Montrose Rd	Diverge	18	B	17	B	-6%
I-270 C-D	Freeway	125	F	26	D	-79%	I-270 C-D	Freeway	23	C	21	C	-9%
I-270 C-D Merge from WB Shady Grove Rd	Merge	128	F	41	F	-68%	I-270 Weave between Montrose Rd Loops	Weave	43	F	40	F	-7%
I-270 C-D Diverge to I-270	Diverge	110	F	43	F	-61%	I-270 C-D	Freeway	15	B	16	B	7%
I-270 C-D	Freeway	69	F	47	F	-32%	I-270 C-D Merge from EB Montrose Rd	Merge	9	A	10	A	11%
I-270 C-D Diverge to I-370	Diverge	55	F	51	F	-7%	I-270 C-D	Freeway	18	B	18	C	0%
I-270 C-D	Freeway	101	F	57	F	-44%							
I-270 Merge from I-370 EB	Merge	120	F	74	F	-38%							
I-270 C-D	Freeway	125	F	83	F	-34%							
I-270 C-D Weave from I-370 to I-270	Weave	122	F	79	F	-35%							
I-270 C-D	Freeway	84	F	51	F	-39%							
I-270 C-D Weave from I-270 to MD 117	Weave	84	F	74	F	-12%							
I-270 C-D Diverge to MD 124	Diverge	108	F	68	F	-37%							
I-270 C-D	Freeway	148	F	99	F	-33%							
I-270 C-D Merge from EB MD 124	Merge	131	F	79	F	-40%							
I-270 C-D Merge From WB MD 124	Merge	89	F	95	F	7%							
I-270 C-D	Freeway	82	F	53	F	-35%							
I-270 C-D Merge from Watkins Mill	Merge	23	C	23	C	0%							

Table D.8: PM Peak - No Build - I-270 Vehicle Throughput

I-270 Northbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change	Data Collection Measurement	I-270 Southbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between I-495 and MD 187	4133	4136	0%	100	North of I-70	2366	2366	0%
Between MD 187 on and off ramps	3716	3722	0%	102	Between I-70 on ramps	2705	2703	0%
Between Rockledge Blvd on and off ramps	3530	3554	1%	105	From I-70 interchange to MD-85	4048	4047	0%
Between Rockledge Dr and I-270 Spur	3863	3869	0%	108	Between MD-85 on and off ramps	2380	2379	0%
Between I-270 Spur and Montrose Rd	8715	8952	3%	110	Between MD-85 and MD-80	3079	3078	0%
Between Montrose Rd on and off ramps	5677	5901	4%	112	Between MD-80 on and off ramps	2420	2416	0%
Between Montrose Rd and MD 189	5192	5608	8%	114	Between MD-80 and Md-109	2866	2861	0%
Between MD 189 and MD 28	5185	5990	16%	116	Between MD-109 on and off ramps	2769	2766	0%
Between MD 28 on and off ramps	5167	6351	23%	118	Between MD-109 and MD-121	2936	2938	0%
Between MD 28 and Shady Grove Rd	4374	5592	28%	120	Between MD-121 on and off ramps	2411	2406	0%
Between Shady Grove Rd and I-370	3541	4873	38%	123	Between MD-121 and MD-27	3357	3359	0%
Between I-370 on and off ramps	3235	4305	33%	126	Between MD-27 on and off ramps	3449	3454	0%
Between I-370 and MD 117	3771	5661	50%	129	Between MD-27 and MD-118	3761	3763	0%
Between MD 117 and MD 124	2932	4244	45%	133	Between MD-118 on and off ramps	3716	3711	0%
Between MD-124 on and off ramps	3025	4353	44%	136	Between MD-118 and Middlebrook Rd	4379	4368	0%
Between Watkins Mill Rd and Middlebrook Rd	5346	6408	20%	139	Between Middlebrook Rd on and off ramps	4380	4374	0%
Between Middlebrook Rd on and off ramps	5022	5851	17%	142	Between Middlebrook Rd and MD-124	5489	5445	-1%
Between Middlebrook Rd and MD 118	4374	5025	15%	146	Between MD-124 on and off ramps	4298	4179	-3%
Between MD-118 on and off ramps	4034	4607	14%	150	Between MD-124 and MD-117	5448	5414	-1%
Between MD 118 and MD 27	4222	4667	11%	154	Between MD-117 and I-370	7014	6695	-5%
Between MD-27 on and off ramps	3068	3362	10%	159	Between I-370 on and off ramps	3506	3311	-6%
Between MD 27 and MD 121	3729	3979	7%	163	Between I-370 on ramp to Shady Grove Rd	5063	4866	-4%
Between MD-121 on and off ramps	2485	2634	6%	167	Between Shady Grove Rd and MD 28	5271	5122	-3%
Between MD 121 and MD 109	4076	4030	-1%	171	Between MD 28 on and off ramps	5451	5300	-3%
Between MD-109 on and off ramps	3755	3689	-2%	175	Between MD 28 and MD 189	4790	4637	-3%
Between MD 109 and MD 80	3914	3833	-2%	179	Between MD 189 and Montrose Rd	4781	4636	-3%
Between MD-80 on and off ramps	3235	3170	-2%	183	Between Montrose Rd on and off ramps	5712	5575	-2%
Between MD 80 and MD 85	3902	3849	-1%	187	Between Montose Rd and I-270 Spur	7393	7477	1%
Between MD-85 on and off ramps	3270	3208	-2%	193	Between I-270 Spur and Rockledge Blvd	3349	3341	0%
Between MD 85 and I-70	5245	5196	-1%	197	Between Rockledge Blvd on and off ramps	2564	2551	-1%
North of I-70	2745	2702	-2%	200	Between MD 187 on and off ramps	3037	3025	0%
				203	Between MD 187 and I-495	3410	3397	0%
I-270 Spur Northbound					**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	4577	4860	6%	600	Between I-270 Split and HOV on ramp	3177	3514	11%
Between Democracy Blvd on and off ramps	4108	4359	6%	603	Between HOV on ramp and Democracy Blvd	2321	3442	48%
Between Democracy Blvd and I-270 Split	4839	5112	6%	607	Between Democracy Blvd on and off ramps	1847	3076	67%
				610	Between Democracy Blvd and I-495	2196	3629	65%

Table D.9: PM Peak - No Build - I-270 Local Vehicle Throughput

I-270 Local Northbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change	Data Collection Measurement	I-270 Local Southbound	No Build VISSIM Throughput	Alternative VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	1771	1821	3%	800	Between I-370 on ramp and I-270 off ramp	3074	3027	-2%
Between Montrose Rd EB on ramp and WB off ramp	2092	2142	2%	804	Between I-270 off ramp and Shady Grove off ramp	1538	1486	-3%
Between Montrose Rd WB off ramp and on ramp	1835	1881	3%	807	Between Shady Grove off ramp and Shady Grove WB on ramp	819	793	-3%
Between Montrose Rd WB on ramp and I-270 on ramp	3265	3499	7%	809	Between Shady Grove WB and EB on ramps	1522	1485	-2%
Between I-270 on ramp and MD 189 off ramp	3446	3788	10%	811	Between Shady Grove on ramp and I-270 on ramp	2144	2142	0%
Between MD 189 ramps	2743	3097	13%	813	Between I-270 on ramp and I-270 off ramp1	2759	2731	-1%
Between MD 189 off ramp and I-270 on ramp	3571	4005	12%	815	Between I-270 off ramp1 and I-270 off ramp2	1919	1902	-1%
Between I-270 on ramp and I-270 off ramp	4101	4707	15%	817	Between I-270 off ramp2 and MD 28 off ramp	1743	1724	-1%
Between I-270 off ramp and MD 28 EB off ramp	3205	3668	14%	819	Between MD 28 off ramp and MD 28 WB on ramp	1216	1204	-1%
Between MD 28 EB off ramp to MD 28 EB on ramp	2899	3300	14%	821	Between MD 28 WB on ramp and MD 28 EB on ramp	1482	1472	-1%
Between MD 28 EB on ramp and MD 28 WB off ramp	3037	3433	13%	823	Between MD 28 EB on ramp and I-270 on ramp	3045	3023	-1%
Between MD 28 WB off ramp and MD 28 WB on ramp	1910	2159	13%	825	Between I-270 on ramp and MD 189 off ramp	3728	3692	-1%
Between MD 28 WB on ramp and I-270 on ramp	2599	2888	11%	827	Between MD 189 on and off ramps	2788	2765	-1%
Between I-270 on ramp and I-270 off ramp	3127	3747	20%	829	Between MD 189 on ramp and I-270 off ramp	3369	3341	-1%
Between I-270 off ramp and Shady Grove off ramp	1832	2244	22%	831	Between I-270 off ramp and Montrose Rd off ramp	2437	2415	-1%
Between Shady Grove off ramp and I-270 on ramp	587	801	36%	833	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2191	2167	-1%
Between I-270 on ramp and Shady Grove WB on ramp	2585	2864	11%	835	Between Montrose Rd WB on ramp and EB off ramp	2748	2773	1%
Between Shady Grove WB on ramp and I-270 off ramp	3241	4154	28%	838	Between Montrose Rd EB off and on ramps	1550	1583	2%
Between I-270 off ramp and I-370 off ramp	2834	4123	45%	840	Between Montrose Rd EB off ramp and I-270	1871	1900	2%
Between I-370 off ramp and I-370 EB on ramp	721	1399	94%					
Between I-370 EB and WB on ramps	1223	2237	83%					
Between I-370 WB on ramp and I-270 off ramp	2144	3646	70%					
Between I-270 off ramp and I-270 on ramp	1336	2018	51%					
Between I-270 on ramp and MD 117 off ramp	2289	3478	52%					
Between MD 117 off ramp and MD 124 off ramp	1622	2432	50%					
Between MD 124 off ramp and MD 124 EB on ramp	673	1002	49%					
Between MD 124 EB and WB on ramps	1177	1494	27%					
Between MD 124 on ramp I-270	1087	1153	6%					

Table D.10: PM Peak - No Build - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
Rockledge Dr on ramp	1	1	0%	129	194	50%
MD 189 C-D on ramp	550	0	-100%	5029	0	-100%
MD 28 C-D on ramp	837	2	-100%	3967	156	-96%
Shady Grove Rd C-D on ramp	1563	0	-100%	4941	0	-100%
I-370 C-D on ramp	3270	2344	-28%	5052	5056	0%
MD 124 C-D on ramp	3345	1179	-65%	5058	3851	-24%
MD 118 on ramp	0	4	0%	101	333	230%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	1	0	-100%	116	20	-83%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd EB on ramp	0	0	0%	28	0	-100%
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Cabin John Pkwy on ramp	28	17	-39%	750	646	-14%
MD 190 on ramp	0	0	0%	23	0	-100%
I-270 C-D Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Montrose Rd EB on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	876	176	-80%	2820	695	-75%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	100	0	-100%	1069	0	-100%
I-270 on ramp	1	0	-100%	86	0	-100%
MD 28 EB on ramp	0	0	0%	0	6	0%
MD 28 WB on ramp	15	0	-100%	382	0	-100%
Shady Grove Rd EB on ramp	884	0	-100%	3939	0	-100%
I-270 on ramp	1151	3	-100%	4164	195	-95%
Shady Grove Rd WB on ramp	580	204	-65%	1960	1863	-5%
I-370 EB on ramp	1262	631	-50%	2428	2431	0%
I-370 WB on ramp	1496	901	-40%	2556	2533	-1%
I-270 on ramp	4134	3488	-16%	5058	5054	0%
MD 124 EB on ramp	724	23	-97%	2768	513	-81%
MD 124 WB on ramp	47	21	-55%	484	456	-6%

Table D.11: PM Peak - No Build - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 187 off ramp NB	35	35	0%	274	247	-10%
MD 187 off ramp SB	0	0	0%	0	0	0%
Rockledge Dr off ramp	2	1	-50%	122	86	-30%
Tower Oaks Blvd off ramp	36	39	8%	217	238	10%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	26	28	8%	162	175	8%
MD 189 off ramp EB	1	1	0%	160	145	-9%
MD 28 off ramp EB	36	47	31%	204	312	53%
MD 28 off ramp WB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	40	52	30%	234	238	2%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	1	51	5000%	146	646	342%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	1364	2093	53%	3622	4508	24%
MD 124 off ramp	120	171	43%	795	877	10%
Watkins Mill Rd off ramp	2816	3442	22%	4911	5056	3%
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	0	0	0%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	48	53	10%	234	269	15%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	75	76	1%	326	295	-10%
MD 121 off ramp EB	1	0	-100%	94	0	-100%
MD 109 off ramp EB	24	22	-8%	214	210	-2%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	21	21	0%	235	174	-26%
MD 80 off ramp WB	0	0	0%	27	28	4%
MD 85 NB off ramp	0	0	0%	28	13	-54%
MD 85 SB off ramp	1	1	0%	102	97	-5%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Clara Barton Pkwy off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	0%	0	0	0%
MD 190 off ramp WB	8	5	-38%	521	453	-13%
Democracy Blvd off ramp WB	42	41	-2%	206	191	-7%
Democracy Blvd off ramp EB	17	18	6%	120	111	-8%

Table D.12: PM Peak - No Build - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 on ramp	0	0	0%	18	16	-11%
MD 80 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 121 WB on ramp	0	0	0%	0	0	0%
MD 121 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	0%	0	0	0%
Middlebrook Rd on ramp	0	0	0%	0	0	0%
Watkins Mill Rd on ramp	4	0	-100%	154	0	-100%
MD 124 WB on ramp	1137	0	-100%	3265	0	-100%
MD 117 on ramp	49	74	51%	910	301	-67%
I-370 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp North	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp South	0	0	0%	0	0	0%
MD 189 C-D on ramp	0	0	0%	0	0	0%
Montrose Rd C-D on ramp	0	0	0%	0	0	0%
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd on ramp	622	3	-100%	1832	203	-89%
I-495 Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 Spur on ramp	4587	579	-87%	5068	2636	-48%
MD 190 on ramp	59	9	-85%	734	504	-31%
I-270 C-D Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
I-270 on ramp	0	0	0%	5	0	-100%
I-370 on ramp	0	0	0%	62	0	-100%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 28 WB on ramp	0	0	0%	12	0	-100%
MD 28 EB on ramp	9	0	-100%	399	0	-100%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	1	0	-100%	117	32	-73%
Montrose Rd EB on ramp	0	0	0%	0	0	0%

Table D.13: PM Peak - No Build - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Alternative VISSIM Average Queue (feet)	% Change	No Build VISSIM Maximum Queue (feet)	Alternative VISSIM Maximum Queue (feet)	% Change
MD 85 SB off ramp	3	9	200%	164	152	-7%
MD 85 NB off ramp	19	18	-5%	354	318	-10%
MD 80 off ramp	1	1	0%	176	153	-13%
MD 109 off ramp WB	0	0	0%	70	66	-6%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	245	211	-14%	1058	948	-10%
MD 121 off ramp WB	1	0	-100%	148	52	-65%
MD 27 off ramp EB	23	22	-4%	143	139	-3%
MD 27 off ramp WB	0	0	0%	0	0	0%
MD 118 off ramp EB	24	23	-4%	125	128	2%
MD 118 off ramp WB	0	0	0%	16	0	-100%
Watkins Mill Rd off ramp	111	117	5%	436	413	-5%
MD 124 off ramp EB	156	133	-15%	578	619	7%
MD 124 off ramp WB	19	11	-42%	435	364	-16%
I-370 off ramp WB	9	1613	17822%	168	3944	2248%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	1	2	100%	51	109	114%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	3	0%	128	109	-15%
MD 189 off ramp EB	125	114	-9%	541	436	-19%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	11	7	-36%	573	371	-35%
Rockledge Dr off ramp	184	116	-37%	668	487	-27%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Alternative VISSIM Average Queue (feet)**	**% Change**	**No Build VISSIM Maximum Queue (feet)**	**Alternative VISSIM Maximum Queue (feet)**	**% Change**
Democracy Blvd off ramp EB	23	31	35%	169	164	-3%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	78	88	13%	652	684	5%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	0	17	0%

Table D.14: PM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	62.4	E	NB Left	131	79	480	891	E	116.5	F
				NB Through	566	35	480	891	C		
				NB Right	934	77	462	914	E		
	SB	172.8	F	SB Left	155	129	1005	1227	F		
				SB Through	890	178	1005	1227	F		
				SB Right	76	201	1005	1227	F		
	EB	34.9	C	EB Left	55	84	32	146	F		
				EB Through	24	81	32	146	F		
				EB Right	169	12	32	146	B		
	WB	173.4	F	WB Left	548	192	561	777	F		
				WB Through	28	167	561	777	F		
				WB Right	220	127	561	777	F		
2- MD 85 at I-270 NB on and off ramp											
2	NB	59.3	E	NB Left	1129	59	730	1854	E	47.5	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	29.5	C	SB Left	0	0	0	0	A		
				SB Through	745	30	114	609	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	19.9	B	NB Left	0	0	0	0	A	21.7	C
				NB Through	1960	20	215	1315	B		
				NB Right	0	0	0	0	A		
	SB	42.6	D	SB Left	174	43	50	436	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	57.0	F	NB Left	76	80	328	838	E	48.4	D
				NB Through	1453	56	328	839	E		
				NB U-Turn	0	0	0	0	A		
	SB	32.5	C	SB Left	106	79	50	251	E		
				SB Through	945	30	105	1054	C		
				SB Right	927	30	92	1046	C		
	EB	65.3	E	EB Left	946	68	207	720	E		
				EB Through	43	52	207	720	D		
				EB Right	28	2	207	720	A		
	WB	54.0	D	WB Left	45	78	61	238	E		
				WB Through	77	82	61	238	F		
				WB Right	94	20	61	238	C		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.3	A	NB Left	2	0	0	0	A	12.0	B
				NB Through	2	0	0	0	A		
				NB Right	6	-2	0	0	A		
	SB	12.6	B	SB Left	486	16	27	241	B		
				SB Through	23	14	27	241	B		
				SB Right	151	3	0	0	A		
	EB	14.2	B	EB Left	98	14	24	215	B		
				EB Through	0	0	8	0	A		
				EB Right	5	9	37	246	A		
	WB	11.6	B	WB Left	15	15	1	26	B		
				WB Through	671	20	74	510	B		
				WB Right	613	3	0	7	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.5	A	NB Left	56	5	3	211	A	6.2	A
				NB Through	0	0	0	0	A		
				NB Right	605	3	3	211	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	7.3	A	EB Left	0	0	0	0	A		
				EB Through	382	8	4	101	A		
				EB Right	66	5	3	109	A		
	WB	9.0	A	WB Left	0	0	0	0	A		
				WB Through	448	9	4	157	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	7.7	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	14.7	B	SB Left	324	15	33	230	C		
				SB Through	0	0	0	0	A		
				SB Right	24	5	0	126	A		
	EB	2.5	A	EB Left	80	2	0	50	A		
				EB Through	0	0	0	0	A		
				EB Right	83	3	0	0	A		
	WB	0.4	A	WB Left	0	0	0	0	A		
				WB Through	222	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	5.0	A	NB Left	63	8	3	123	A	1.9	A
				NB Through	0	0	0	0	A		
				NB Right	37	0	0	53	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.9	A	EB Left	0	0	0	0	A		
				EB Through	166	0	0	0	A		
				EB Right	34	4	0	0	A		
	WB	1.4	A	WB Left	137	1	0	51	A		
				WB Through	109	2	0	23	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	29.3	D	NB Left	613	34	120	664	C	53.3	D
				NB Through	839	27	120	664	C		
				NB Right	69	13	128	690	B		
	SB	21.3	C	SB Left	27	16	18	212	B		
				SB Through	303	22	29	212	C		
				SB Right	9	8	32	233	A		
	EB	14.8	B	EB Left	4	42	8	249	D		
				EB Through	24	39	15	259	D		
				EB Right	248	12	28	291	B		
	WB	148.6	F	WB Left	346	200	384	860	F		
				WB Through	76	96	384	860	F		
				WB Right	186	74	408	884	E		
10- MD 121 at I-270 NB on and off ramp											
10	NB	22.1	C	NB Left	399	60	81	332	F	18.7	B
				NB Through	0	0	0	0	A		
				NB Right	854	4	0	72	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	12.2	B	EB Left	0	0	0	0	A		
				EB Through	650	18	40	364	C		
				EB Right	336	1	0	6	A		
	WB	21.2	C	WB Left	217	62	92	468	F		
				WB Through	681	8	92	468	A		
				WB Right	0	0	0	0	A		

Table D.14: PM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	23.8	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	68.8	E	SB Left	270	91	252	1064	F		
				SB Through	0	0	0	0	A		
				SB Right	252	44	0	55	E		
	EB	6.3	A	EB Left	0	0	0	0	A		
				EB Through	717	6	16	202	A		
				EB Right	0	0	0	0	A		
	WB	13.7	B	WB Left	0	0	0	0	A		
				WB Through	544	27	49	381	D		
				WB Right	537	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	37.8	D	NB U-Turn	0	0	0	0	A	25.3	C
				NB Through	94	55	22	98	E		
				NB Right	61	11	22	98	B		
	SB	41.5	D	SB Left	146	44	38	216	D		
				SB Through	57	62	44	250	E		
				SB Right	188	33	69	287	C		
	EB	19.2	B	EB Left	198	32	77	525	C		
				EB Through	2108	18	78	526	B		
				EB Right	102	15	91	565	B		
	WB	28.7	C	WB Left	41	25	153	736	C		
				WB Through	1695	30	153	736	C		
				WB Right	69	10	153	736	A		
13- MD 27 at I-270 NB off ramp											
13	NB	45.8	D	NB Left	334	46	56	242	D	6.8	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1516	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.1	A	WB Left	0	0	0	0	A		
				WB Through	1789	5	42	790	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	50.0	D	SB Left	175	50	34	157	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.9	A	EB Left	0	0	0	0	A		
				EB Through	1681	2	5	100	A		
				EB Right	0	0	0	0	A		
	WB	3.4	A	WB Left	0	0	0	0	A		
				WB Through	1565	3	11	404	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	31.7	C	NB Left	76	32	110	566	C	68.3	E
				NB Through	1196	32	119	566	C		
				NB Right	55	30	125	579	C		
	SB	52.6	D	SB Left	159	71	338	1062	E		
				SB Through	1481	54	338	1062	D		
				SB Right	226	28	324	1055	C		
	EB	40.6	D	EB Left	125	53	34	128	D		
				EB Through	49	36	30	123	D		
				EB Right	62	19	23	157	B		
	WB	162.7	F	WB Left	104	95	1051	1516	F		
				WB Through	127	107	1051	1516	F		
				WB Right	665	184	1051	1516	F		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	4.9	A	NB Left	103	14	2	69	B	9.0	A
				NB Through	1347	4	11	181	A		
				NB Right	1	2	19	234	A		
	SB	7.4	A	SB Left	15	8	19	278	A		
				SB Through	1226	7	22	278	A		
				SB Right	11	5	26	311	A		
	EB	13.9	B	EB Left	23	59	14	134	E		
				EB Through	0	65	14	134	E		
				EB Right	312	11	14	134	B		
	WB	53.8	D	WB Left	103	65	43	243	E		
				WB Through	7	69	39	242	E		
				WB Right	30	13	48	262	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	13.5	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	25.5	C	EB Left	493	26	42	280	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.9	A	WB Left	0	0	0	0	A		
				WB Through	282	2	0	11	A		
				WB Right	1362	12	45	551	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	7.3	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	36.2	D	SB Left	168	36.2	26	128	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	6.0	A	EB Left	0	0.0	0	0	A		
				EB Through	1411	6.0	15	515	A		
				EB Right	0	0.0	0	0	A		
	WB	5.4	A	WB Left	0	0.0	0	0	A		
				WB Through	1573	5.4	12	253	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	26.0	C	NB Left	53	70	43	234	E	42.6	D
				NB Through	53	70	43	234	E		
				NB Right	227	5	4	90	A		
	SB	163.1	F	SB Left	440	152	421	651	F		
				SB Through	14	218	421	651	F		
				SB Right	126	196	421	651	F		
	EB	22.6	C	EB Left	125	33	89	544	C		
				EB Through	1415	22	89	544	C		
				EB Right	21	19	89	544	B		
	WB	24.7	C	WB Left	15	23	112	735	C		
				WB Through	1456	29	112	735	C		
				WB Right	380	8	112	735	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	8.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	20.5	C	SB Left	125	36	23	150	D		
				SB Through	0	0	0	0	A		
				SB Right	186	10	23	150	B		
	EB	6.0	A	EB Left	14	10	15	166	B		
				EB Through	1100	6	15	166	A		
				EB Right	0	0	0	0	A		
	WB	8.5	A	WB Left	0	0	0	0	A		
				WB Through	1313	9	27	271	A		
				WB Right	17	7	41	320	A		

Table D.14: PM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	4.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.6	A	EB Left	0	0	0	0	A		
				EB Through	742	3	4	109	A		
				EB Right	0	0	0	0	A		
	WB	7.9	A	WB Left	438	8	5	248	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	48.4	D	NB Left	200	46	83	309	D	13.7	B
				NB Through	1	55	83	309	D		
				NB Right	236	50	83	309	D		
	SB	30.5	C	SB Left	32	48	8	72	D		
				SB Through	2	38	8	72	D		
				SB Right	24	7	20	110	A		
	EB	8.0	A	EB Left	4	11	28	307	B		
				EB Through	1125	8	28	307	A		
				EB Right	198	7	28	307	A		
	WB	8.8	A	WB Left	221	22	32	307	C		
				WB Through	1506	7	32	307	A		
				WB Right	3	2	32	307	A		
23- MD 124 at MD 355											
23	NB	136.1	F	NB Left	479	118	690	1087	F	77.1	E
				NB Through	1137	144	688	1084	F		
				NB Right	6	94	0	0	F		
	SB	45.0	D	SB Left	183	92	149	462	F		
				SB Through	706	65	149	462	E		
				SB Right	720	14	55	401	B		
	EB	29.4	C	EB Left	364	77	151	724	E		
				EB Through	2082	26	151	724	C		
				EB Right	439	3	46	718	A		
	WB	133.4	F	WB Left	0	0	0	0	A		
				WB Through	1578	136	688	946	F		
				WB Right	86	90	0	0	F		
24- MD 124 at I-270 SB on and off											
24	NB	89.9	F	NB Left	53	85	46	162	F	43.7	D
				NB Through	21	102	46	162	F		
				NB U-Turn	0	0	0	0	A		
	SB	47.2	D	SB Left	553	81	161	583	F		
				SB Through	8	83	161	583	F		
				SB Right	454	6	15	365	A		
	EB	54.1	D	EB Left	0	0	0	0	A		
				EB Through	1839	54	411	1093	D		
				EB Right	35	69	426	1116	E		
	WB	20.8	C	WB Left	5	83	523	2016	F		
				WB Through	1157	21	523	2016	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	74.9	E	NB Left	55	135	314	743	F	49.6	D
				NB Through	685	90	314	743	F		
				NB Right	465	45	43	678	D		
	SB	38.3	D	SB Left	136	64	153	660	E		
				SB Through	969	41	153	660	D		
				SB Right	182	5	0	0	A		
	EB	45.9	D	EB Left	152	81	155	621	F		
				EB Through	1159	42	154	622	D		
				EB Right	57	38	162	650	D		
	WB	42.7	D	WB Left	339	72	226	1003	E		
				WB Through	1157	38	226	1003	D		
				WB Right	109	1	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	47.5	D	NB Left	99	74	77	283	E	38.0	D
				NB Through	34	74	77	283	E		
				NB Right	272	35	77	283	C		
	SB	89.8	F	SB Left	285	103	144	416	F		
				SB Through	23	95	144	416	F		
				SB Right	83	42	144	416	D		
	EB	31.4	C	EB Left	50	62	172	875	E		
				EB Through	1686	30	174	875	C		
				EB Right	6	21	167	865	C		
	WB	30.4	C	WB Left	16	32	199	1039	C		
				WB Through	1406	32	200	1040	C		
				WB Right	235	20	226	1088	C		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	13.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.7	A	EB Left	0	0	0	0	A		
				EB Through	947	4	9	569	A		
				EB Right	0	0	0	0	A		
	WB	42.8	E	WB Left	300	43	109	923	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	28.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	83.2	F	SB Left	150	84	3696	4643	F		
				SB Through	0	0	0	0	A		
				SB Right	558	83	3695	4642	F		
	EB	18.4	B	EB Left	3	120	86	975	F		
				EB Through	945	18	86	975	B		
				EB Right	0	0	0	0	A		
	WB	7.4	A	WB Left	0	0	0	0	A		
				WB Through	1381	7	50	374	A		
				WB Right	0	0	50	374	A		
29- MD 117 at Perry Pkwy											
29	NB	41.0	D	NB Left	19	60	17	127	E	48.0	D
				NB Through	26	58	16	127	E		
				NB Right	33	17	26	147	B		
	SB	152.0	F	SB Left	238	187	264	443	F		
				SB Through	20	214	264	443	F		
				SB Right	119	72	264	443	E		
	EB	22.0	C	EB Left	230	74	84	355	E		
				EB Through	817	8	84	355	A		
				EB Right	30	7	69	340	A		
	WB	41.5	D	WB Left	36	116	248	738	F		
				WB Through	1240	42	248	738	D		
				WB Right	378	32	248	738	C		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	6.9	A	NB Left	0	0	0	0	A	25.3	C
				NB Through	1026	7	35	342	A		
				NB Right	0	0	0	0	A		
	SB	35.7	D	SB Left	0	0	0	0	A		
				SB Through	1169	36	109	659	D		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	49.4	D	WB Left	279	49	49	246	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.14: PM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	17.2	B	NB Left	0	0	0	0	A	21.7	C
				NB Through	1444	17	202	1619	B		
				NB Right	0	0	0	0	A		
	SB	5.3	A	SB Left	0	0	0	0	A		
				SB Through	744	5	7	163	A		
				SB Right	0	0	0	0	A		
	EB	56.5	E	EB Left	232	55	47	206	E		
				EB Through	0	0	0	0	A		
				EB Right	306	58	62	266	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	8.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	36.6	D	SB Left	426	45	73	300	D		
				SB Through	0	0	0	0	A		
				SB Right	99	3	0	34	A		
	EB	2.9	A	EB Left	0	0	0	0	A		
				EB Through	1560	1	0	0	A		
				EB Right	932	6	16	238	A		
	WB	6.9	A	WB Left	0	0	0	0	A		
				WB Through	1733	7	21	272	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	37.6	D	NB Left	0	0	42	214	A	52.3	D
				NB Through	190	50	50	223	D		
				NB Right	125	19	50	223	B		
	SB	140.3	F	SB Left	20	163	350	425	F		
				SB Through	0	0	0	0	A		
				SB Right	291	139	350	425	F		
	EB	33.6	C	EB Left	280	116	175	457	F		
				EB Through	935	9	175	457	A		
				EB Right	0	0	0	0	A		
	WB	52.3	D	WB Left	40	47	210	432	D		
				WB Through	1284	52	184	395	D		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	36.5	D	NB Left	43	45	12	95	D	13.8	B
				NB Through	14	48	9	94	D		
				NB Right	19	8	9	105	A		
	SB	3.3	A	SB Left	18	41	7	83	D		
				SB Through	13	46	7	83	D		
				SB Right	414	0	0	0	A		
	EB	12.2	B	EB Left	415	24	40	415	C		
				EB Through	647	5	6	208	A		
				EB Right	56	4	10	244	A		
	WB	19.2	B	WB Left	15	20	51	392	B		
				WB Through	853	19	51	391	B		
				WB Right	18	13	67	425	B		
35- MD 189 at I-270 Ramps											
35	NB	47.3	D	NB Left	229	47	41	184	D	42.5	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	60.0	E	SB Left	352	60	142	561	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	27.5	C	EB Left	483	31	91	340	C		
				EB Through	374	23	91	340	C		
				EB Right	0	0	0	0	A		
	WB	48.9	D	WB Left	449	54	110	274	D		
				WB Through	434	44	110	274	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	46.2	D	NB Left	238	58	144	498	E	52.6	D
				NB Through	694	51	144	498	D		
				NB Right	176	12	144	498	B		
	SB	83.2	F	SB Left	251	104	281	808	F		
				SB Through	927	78	313	795	E		
				SB Right	0	0	0	0	A		
	EB	38.6	D	EB Left	153	73	121	432	E		
				EB Through	554	38	121	432	D		
				EB Right	205	15	121	432	B		
	WB	39.7	D	WB Left	160	71	140	639	E		
				WB Through	782	42	140	639	D		
				WB Right	317	19	140	639	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	30.7	C
				NB Through	0	0	0	0	A		
				NB Right	540	0	0	0	A		
	SB	135.5	F	SB Left	87	52	132	729	D		
				SB Through	0	0	0	0	A		
				SB Right	291	160	253	758	F		
	EB	7.5	A	EB Left	0	0	0	0	A		
				EB Through	1891	7	44	576	A		
				EB Right	0	0	0	0	A		
	WB	38.1	D	WB Left	79	39	44	576	D		
				WB Through	2493	39	248	784	D		
				WB Right	265	27	248	784	C		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	23.1	C	NB Left	706	24	50	238	C	17.5	B
				NB Through	0	0.0	43	230	A		
				NB Right	26	7.8	50	238	A		
	SB	11.3	B	SB Left	9	19.7	1	39	B		
				SB Through	0	0.0	1	39	A		
				SB Right	9	2.9	0	23	A		
	EB	11.5	B	EB Left	1	12.1	17	187	B		
				EB Through	363	11.9	17	187	B		
				EB Right	37	7.7	12	177	A		
	WB	13.1	B	WB Left	139	16.4	16	152	B		
				WB Through	204	11.1	16	152	B		
				WB Right	3	2.6	3	108	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	19.7	B	NB Left	97	40	82	379	D	42.8	D
				NB Through	773	31	82	379	C		
				NB Right	621	2	0	0	A		
	SB	32.5	C	SB Left	211	65	75	333	E		
				SB Through	506	23	74	332	C		
				SB Right	131	15	72	350	B		
	EB	117.2	F	EB Left	105	98	311	677	F		
				EB Through	525	120	313	678	F		
				EB Right	44	126	336	701	F		
	WB	37.5	D	WB Left	545	46	115	412	D		
				WB Through	455	43	116	412	D		
				WB Right	318	15	136	442	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	133.8	F	NB Left	0	0	0	0	A	115.2	F
				NB Through	341	119	568	843	F		
				NB Right	860	140	568	843	F		
	SB	86.8	F	SB Left	0	0	92	261	A		
				SB Through	354	87	92	261	F		
				SB Right	0	0	0	0	A		
	EB	99.1	F	EB Left	6	201	317	830	F		
				EB Through	460	155	317	830	F		
				EB Right	306	14	0	0	B		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.14: PM Peak - No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	30.3	C	NB Left	347	30	77	271	C	52.3	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	58.5	E	WB Left	351	64	221	877	E		
				WB Through	883	56	221	877	E		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	69.2	E	NB Left	215	42	598	1323	D	133.5	F
				NB Through	2291	71	598	1323	E		
				NB Right	200	78	598	1323	E		
	SB	189.2	F	SB Left	205	175	2559	2706	F		
				SB Through	1150	186	2559	2706	F		
				SB Right	302	210	2559	2706	F		
	EB	131.0	F	EB Left	300	68	651	1424	E		
				EB Through	527	162	652	1425	F		
				EB Right	118	151	675	1449	F		
	WB	198.5	F	WB Left	459	191	1943	2143	F		
				WB Through	666	216	1943	2143	F		
				WB Right	164	150	1943	2143	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	18.4	B	NB Left	563	33	122	410	C	21.2	C
				NB Through	2497	15	122	410	B		
				NB Right	0	0	0	0	A		
	SB	24.3	C	SB Left	0	0	0	0	A		
				SB Through	1289	24	64	259	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	57.6	E	WB Left	60	60	44	282	E		
				WB Through	68	56	44	282	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	46.1	E	NB Left	0	0	0	0	A	41.9	D
				NB Through	2411	46	200	843	D		
				NB Right	0	0	0	0	A		
	SB	18.6	B	SB Left	149	56	70	283	E		
				SB Through	1201	14	70	283	B		
				SB Right	0	0	0	0	A		
	EB	67.6	E	EB Left	646	69	171	613	E		
				EB Through	0	0	171	613	A		
				EB Right	178	64	91	521	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	19.9	B	NB Left	492	36	113	693	D	29.4	C
				NB Through	2178	16	114	694	B		
				NB Right	18	13	134	727	B		
	SB	34.9	C	SB Left	21	62	113	523	E		
				SB Through	1182	39	113	523	D		
				SB Right	173	1	71	506	A		
	EB	48.5	D	EB Left	432	59	139	506	E		
				EB Through	50	67	139	506	E		
				EB Right	484	37	139	506	D		
	WB	16.9	B	WB Left	7	29	6	108	C		
				WB Through	16	32	6	108	C		
				WB Right	36	8	3	97	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	45.3	D	NB Left	156	45	28	135	D	3.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.2	A	EB Left	0	0	0	0	A		
				EB Through	1157	1	3	57	A		
				EB Right	0	0	0	0	A		
	WB	1.0	A	WB Left	0	0	0	0	A		
				WB Through	2242	1	2	53	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	7.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.2	A	EB Left	0	0	0	0	A		
				EB Through	1370	5	19	258	A		
				EB Right	0	0	0	0	A		
	WB	8.9	A	WB Left	543	30	53	338	C		
				WB Through	1830	3	43	318	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	7.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	37.8	D	SB Left	153	52	29	176	D		
				SB Through	0	0	0	0	A		
				SB Right	60	3	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	4.7	A	WB Left	0	0	0	0	A		
				WB Through	1830	4	18	285	A		
				WB Right	162	16	69	662	B		
50- MD 190 at Burdette Rd											
50	NB	76.3	E	NB Left	27	80	18	118	E	37.0	D
				NB Through	7	69	18	118	E		
				NB Right	6	68	18	118	E		
	SB	34.4	C	SB Left	44	77	24	147	E		
				SB Through	9	70	24	147	E		
				SB Right	122	16	24	147	B		
	EB	24.7	C	EB Left	138	100	130	792	F		
				EB Through	1296	17	130	792	B		
				EB Right	32	6	122	819	A		
	WB	44.7	D	WB Left	13	124	393	1120	F		
				WB Through	2143	44	393	1120	D		
				WB Right	65	35	393	1120	C		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	17.6	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	66.5	E	EB Left	254	67	104	366	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.1	A	WB Left	0	0	0	0	A		
				WB Through	1460	9	47	758	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	70.3	E	NB Left	230	70	82	656	E	12.5	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.5	A	EB Left	0	0	0	0	A		
				EB Through	1062	3	8	185	A		
				EB Right	0	0	0	0	A		
	WB	10.2	B	WB Left	0	0	0	0	A		
				WB Through	1631	10	26	516	B		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	0.5	A	NB Left	28	1	0	0	A	27.6	C
				NB Through	314	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.9	D	SB Left	364	53	120	414	D		
				SB Through	232	53	120	414	D		
				SB Right	20	51	120	414	D		
	EB	31.6	C	EB Left	27	31	94	441	C		
				EB Through	800	32	94	441	C		
				EB Right	45	32	94	441	C		
	WB	22.2	C	WB Left	255	81	135	582	F		
				WB Through	907	19	135	582	B		
				WB Right	689	5	135	582	A		
54- MD 124 at I-270 NB off ramp											
54	NB	36.9	D	NB Left	0	0	0	0	A	29.8	C
				NB Through	0	0	0	0	A		
				NB Right	938	37	122	798	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	26.4	C	EB Left	0	0	0	0	A		
				EB Through	1963	26	245	1215	C		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	47.3	D	NB Left	0	0	0	0	A	11.3	B
				NB Through	0	0	0	0	A		
				NB Right	314	47	51	217	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.5	A	EB Left	0	0	0	0	A		
				EB Through	1157	1	4	63	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
56	NB	74.6	E	NB Left	144	54	177	625	D	94.0	F
				NB Through	0	0	0	0	A		
				NB Right	333	84	177	625	F		
	SB	44.7	D	SB Left	408	64	116	441	E		
				SB Through	111	63	116	441	E		
				SB Right	440	22	116	441	C		
	EB	172.2	F	EB Left	0	0	0	0	A		
				EB Through	1070	172	1001	1251	F		
				EB Right	3	119	1001	1251	F		
	WB	43.1	D	WB Left	90	87	77	317	F		
				WB Through	446	34	74	315	C		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
57	NB	90.5	F	NB Left	154	61	2824	4920	E	67.9	E
				NB Through	0	0	0	0	A		
				NB Right	373	103	2824	4920	F		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	38.9	D	EB Left	548	85	185	436	F		
				EB Through	992	14	185	436	B		
				EB Right	0	0	0	0	A		
	WB	90.6	F	WB Left	0	0	0	0	A		
				WB Through	944	101	547	872	F		
				WB Right	502	70	547	872	E		
58- Watkins Mill Rd at I-270 SB on ramp											
58	NB			NB Left	0	0	0	0	A	21.0	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	24.3	C	EB Left	0	0	0	0	A		
				EB Through	1560	26	207	601	C		
				EB Right	259	11	207	601	B		
	WB	15.7	B	WB Left	560	30	80	501	C		
				WB Through	536	1	80	501	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	60.1	E	NB Left	133	81	463	870	F	114.3	F
				NB Through	573	38	463	870	D		
				NB Right	935	71	425	893	E		
	SB	180.3	F	SB Left	152	129	1008	1230	F		
				SB Through	868	187	1008	1230	F		
				SB Right	72	211	1008	1230	F		
	EB	34.8	C	EB Left	55	84	32	151	F		
				EB Through	24	81	32	151	F		
				EB Right	169	12	32	151	B		
	WB	158.6	F	WB Left	570	175	528	757	F		
				WB Through	31	163	528	757	F		
				WB Right	225	116	528	757	F		
2- MD 85 at I-270 NB on and off ramp											
2	NB	56.7	E	NB Left	1137	57	682	1820	E	46.2	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	30.3	C	SB Left	0	0	0	0	A		
				SB Through	745	30	125	798	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	18.8	B	NB Left	0	0	0	0	A	20.8	C
				NB Through	1982	19	196	1307	B		
				NB Right	0	0	0	0	A		
	SB	42.9	D	SB Left	173	43	56	498	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	45.6	E	NB Left	76	71	263	804	E	43.3	D
				NB Through	1470	44	263	805	D		
				NB U-Turn	0	0	0	0	A		
	SB	30.4	C	SB Left	105	77	49	217	E		
				SB Through	942	30	97	864	C		
				SB Right	924	26	83	855	C		
	EB	62.5	E	EB Left	951	65	191	715	E		
				EB Through	43	49	191	715	D		
				EB Right	28	1	191	715	A		
	WB	54.3	D	WB Left	44	80	61	230	E		
				WB Through	78	82	61	230	F		
				WB Right	94	20	61	230	B		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.8	A	NB Left	1	0	0	0	A	11.6	B
				NB Through	2	0	0	0	A		
				NB Right	6	-3	0	0	A		
	SB	12.8	B	SB Left	473	16	27	179	B		
				SB Through	22	15	27	179	B		
				SB Right	148	3	0	0	A		
	EB	13.4	B	EB Left	97	14	24	249	B		
				EB Through	0	0	8	0	A		
				EB Right	5	6	36	280	A		
	WB	10.9	B	WB Left	15	12	0	40	B		
				WB Through	674	18	67	502	B		
				WB Right	612	3	0	88	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.4	A	NB Left	55	4	3	188	A	5.8	A
				NB Through	0	0	0	0	A		
				NB Right	606	3	3	188	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	6.8	A	EB Left	0	0	0	0	A		
				EB Through	382	7	3	96	A		
				EB Right	66	5	3	103	A		
	WB	8.3	A	WB Left	0	0	0	0	A		
				WB Through	444	8	3	140	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	7.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	14.4	B	SB Left	319	15	31	226	C		
				SB Through	0	0	0	0	A		
				SB Right	25	4	0	137	A		
	EB	2.5	A	EB Left	80	2	0	51	A		
				EB Through	0	0	0	0	A		
				EB Right	83	3	0	0	A		
	WB	0.4	A	WB Left	0	0	0	0	A		
				WB Through	222	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	5.1	A	NB Left	63	8	3	108	A	1.9	A
				NB Through	0	0	0	0	A		
				NB Right	37	0	0	64	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.9	A	EB Left	0	0	0	0	A		
				EB Through	166	0	0	0	A		
				EB Right	34	4	0	0	A		
	WB	1.5	A	WB Left	137	1	0	55	A		
				WB Through	110	2	0	27	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	29.8	D	NB Left	633	33	119	583	C	41.7	D
				NB Through	873	29	119	583	C		
				NB Right	71	14	127	609	B		
	SB	21.6	C	SB Left	27	15	19	215	B		
				SB Through	302	23	31	215	C		
				SB Right	9	9	32	236	A		
	EB	15.1	C	EB Left	4	42	8	249	D		
				EB Through	24	37	15	263	D		
				EB Right	248	13	28	295	B		
	WB	95.4	F	WB Left	352	133	238	581	F		
				WB Through	75	62	238	581	E		
				WB Right	185	38	261	605	D		
10- MD 121 at I-270 NB on and off ramp											
10	NB	21.5	C	NB Left	424	58	82	301	F	18.5	B
				NB Through	0	0	0	0	A		
				NB Right	907	4	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	12.3	B	EB Left	0	0	0	0	A		
				EB Through	651	18	42	360	C		
				EB Right	336	0	0	3	A		
	WB	20.8	C	WB Left	218	61	90	438	F		
				WB Through	681	8	90	438	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	22.2	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	61.0	E	SB Left	271	83	222	955	F		
				SB Through	0	0	0	0	A		
				SB Right	251	37	0	14	E		
	EB	6.4	A	EB Left	0	0	0	0	A		
				EB Through	717	6	16	208	A		
				EB Right	0	0	0	0	A		
	WB	14.1	B	WB Left	0	0	0	0	A		
				WB Through	565	27	51	390	D		
				WB Right	540	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	37.9	D	NB U-Turn	0	0	0	0	A	25.3	C
				NB Through	94	55	22	98	D		
				NB Right	61	12	22	98	B		
	SB	41.2	D	SB Left	146	44	38	216	D		
				SB Through	57	62	43	251	E		
				SB Right	188	33	68	288	C		
	EB	19.7	B	EB Left	204	34	83	518	C		
				EB Through	2176	18	85	519	B		
				EB Right	104	17	97	557	B		
	WB	28.3	C	WB Left	41	25	150	731	C		
				WB Through	1695	29	150	731	C		
				WB Right	69	9	150	731	A		
13- MD 27 at I-270 NB off ramp											
13	NB	45.9	D	NB Left	359	46	61	276	D	7.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1516	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.1	A	WB Left	0	0	0	0	A		
				WB Through	1794	5	43	798	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	50.4	D	SB Left	173	50	33	152	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.9	A	EB Left	0	0	0	0	A		
				EB Through	1680	2	4	88	A		
				EB Right	0	0	0	0	A		
	WB	3.5	A	WB Left	0	0	0	0	A		
				WB Through	1597	4	12	395	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	31.3	C	NB Left	77	32	109	549	C	69.0	E
				NB Through	1196	31	118	548	C		
				NB Right	55	29	124	561	C		
	SB	56.2	E	SB Left	160	76	386	1230	E		
				SB Through	1500	58	386	1230	E		
				SB Right	230	28	367	1223	C		
	EB	40.6	D	EB Left	125	53	35	127	D		
				EB Through	49	36	30	123	D		
				EB Right	62	18	23	156	B		
	WB	159.2	F	WB Left	105	93	1017	1481	F		
				WB Through	126	102	1017	1481	F		
				WB Right	667	181	1017	1481	F		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	4.9	A	NB Left	106	14	2	96	B	9.0	A
				NB Through	1389	4	11	191	A		
				NB Right	1	6	19	244	A		
	SB	7.5	A	SB Left	15	9	19	311	A		
				SB Through	1226	7	22	311	A		
				SB Right	11	5	26	344	A		
	EB	13.9	B	EB Left	23	58	14	135	E		
				EB Through	0	65	14	135	E		
				EB Right	312	11	14	135	B		
	WB	53.9	D	WB Left	103	65	43	243	E		
				WB Through	7	69	39	242	E		
				WB Right	30	13	48	262	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	13.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	26.5	C	EB Left	491	27	43	304	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.9	A	WB Left	0	0	0	0	A		
				WB Through	284	2	1	107	A		
				WB Right	1362	12	45	569	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	7.4	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	36.5	D	SB Left	169	36.5	26	131	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	5.4	A	EB Left	0	0.0	0	0	A		
				EB Through	1407	5.4	12	376	A		
				EB Right	0	0.0	0	0	A		
	WB	6.1	A	WB Left	0	0.0	0	0	A		
				WB Through	1652	6.1	13	261	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	26.1	C	NB Left	53	71	42	241	E	42.3	D
				NB Through	52	69	42	241	E		
				NB Right	227	6	5	111	A		
	SB	161.6	F	SB Left	437	149	410	639	F		
				SB Through	14	213	410	639	F		
				SB Right	126	200	410	639	F		
	EB	22.4	C	EB Left	125	32	88	532	C		
				EB Through	1415	22	88	532	C		
				EB Right	21	19	88	532	B		
	WB	25.4	C	WB Left	16	25	121	810	C		
				WB Through	1515	30	121	810	C		
				WB Right	397	9	121	810	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	8.8	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	20.4	C	SB Left	125	36	23	150	D		
				SB Through	0	0	0	0	A		
				SB Right	186	10	23	150	B		
	EB	6.1	A	EB Left	14	8	15	164	A		
				EB Through	1150	6	15	164	A		
				EB Right	0	0	0	0	A		
	WB	8.5	A	WB Left	0	0	0	0	A		
				WB Through	1313	9	26	264	A		
				WB Right	17	6	41	314	A		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	4.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.6	A	EB Left	0	0	0	0	A		
				EB Through	742	3	4	105	A		
				EB Right	0	0	0	0	A		
	WB	7.9	A	WB Left	438	8	5	206	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	48.4	D	NB Left	200	46	83	309	D	14.0	B
				NB Through	1	55	83	309	D		
				NB Right	236	50	83	309	D		
	SB	31.0	C	SB Left	32	47	8	72	D		
				SB Through	2	39	8	72	D		
				SB Right	24	8	20	110	A		
	EB	8.1	A	EB Left	4	15	27	281	B		
				EB Through	1125	8	27	281	A		
				EB Right	198	8	27	281	A		
	WB	9.6	A	WB Left	234	25	38	363	C		
				WB Through	1604	7	38	363	A		
				WB Right	3	3	38	363	A		
23- MD 124 at MD 355											
23	NB	144.9	F	NB Left	479	126	744	1107	F	75.6	E
				NB Through	1128	154	742	1104	F		
				NB Right	7	92	0	0	F		
	SB	45.7	D	SB Left	181	97	148	480	F		
				SB Through	699	67	148	480	E		
				SB Right	718	12	36	422	B		
	EB	29.8	C	EB Left	433	75	183	853	E		
				EB Through	2482	27	183	853	C		
				EB Right	517	3	70	803	A		
	WB	129.4	F	WB Left	0	0	0	0	A		
				WB Through	1645	132	677	945	F		
				WB Right	90	85	0	5	F		
24- MD 124 at I-270 SB on and off											
24	NB	62.7	F	NB Left	52	64	23	105	E	28.8	C
				NB Through	22	60	23	105	E		
				NB U-Turn	0	0	0	0	A		
	SB	41.0	D	SB Left	558	69	139	624	E		
				SB Through	8	72	139	624	E		
				SB Right	453	6	8	295	A		
	EB	24.8	C	EB Left	0	0	0	0	A		
				EB Through	1883	25	179	1060	C		
				EB Right	36	24	192	1084	C		
	WB	22.7	C	WB Left	5	55	105	608	D		
				WB Through	1174	23	105	608	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	85.3	F	NB Left	52	157	346	750	F	53.4	D
				NB Through	658	100	346	750	F		
				NB Right	442	55	68	706	E		
	SB	38.1	D	SB Left	132	64	154	674	E		
				SB Through	969	41	154	674	D		
				SB Right	182	5	0	0	A		
	EB	52.4	D	EB Left	151	84	182	642	F		
				EB Through	1133	49	182	643	D		
				EB Right	57	42	189	670	D		
	WB	44.5	D	WB Left	387	74	271	1022	E		
				WB Through	1301	40	271	1022	D		
				WB Right	127	2	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	55.4	E	NB Left	93	83	88	264	F	46.1	D
				NB Through	34	84	88	264	F		
				NB Right	256	42	88	264	D		
	SB	99.3	F	SB Left	275	114	159	422	F		
				SB Through	22	111	159	422	F		
				SB Right	81	46	159	422	D		
	EB	41.9	D	EB Left	49	84	217	892	F		
				EB Through	1625	41	218	891	D		
				EB Right	6	15	211	881	B		
	WB	37.4	D	WB Left	17	40	306	1051	D		
				WB Through	1626	39	307	1051	D		
				WB Right	275	26	337	1100	C		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	19.9	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	6.5	A	EB Left	0	0	0	0	A		
				EB Through	912	6	50	483	A		
				EB Right	0	0	0	0	A		
	WB	62.4	F	WB Left	289	62	180	987	F		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	53.3	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	141.1	F	SB Left	228	132	3194	4514	F		
				SB Through	0	0	0	0	A		
				SB Right	835	144	3194	4513	F		
	EB	18.0	B	EB Left	3	110	77	936	F		
				EB Through	911	18	77	936	B		
				EB Right	0	0	0	0	A		
	WB	9.0	A	WB Left	0	0	0	0	A		
				WB Through	1382	9	62	379	A		
				WB Right	0	0	62	379	A		
29- MD 117 at Perry Pkwy											
29	NB	42.3	D	NB Left	19	63	17	126	E	51.5	D
				NB Through	25	58	17	125	E		
				NB Right	33	19	27	146	B		
	SB	156.3	F	SB Left	240	193	271	451	F		
				SB Through	20	199	271	451	F		
				SB Right	121	77	271	451	E		
	EB	21.3	C	EB Left	241	69	87	360	E		
				EB Through	850	8	87	360	A		
				EB Right	32	8	72	344	A		
	WB	48.2	D	WB Left	36	121	293	741	F		
				WB Through	1244	49	293	741	D		
				WB Right	379	38	293	741	D		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	49.5	D	NB Left	685	116	476	957	F	84.4	F
				NB Through	1053	6	476	957	A		
				NB Right	0	0	0	0	A		
	SB	146.9	F	SB Left	0	0	0	0	A		
				SB Through	1141	147	997	1109	F		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	53.0	D	WB Left	334	53	62	250	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	16.1	B	NB Left	0	0	0	0	A	21.2	C
				NB Through	1525	16	102	636	B		
				NB Right	0	0	0	0	A		
	SB	7.6	A	SB Left	0	0	0	0	A		
				SB Through	793	8	11	192	A		
				SB Right	0	0	0	0	A		
	EB	57.0	E	EB Left	226	58	78	370	E		
				EB Through	0	0	0	0	A		
				EB Right	297	56	59	242	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	8.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	37.6	D	SB Left	419	46	74	281	D		
				SB Through	0	0	0	0	A		
				SB Right	99	3	0	74	A		
	EB	2.5	A	EB Left	0	0	0	0	A		
				EB Through	1560	0	0	0	A		
				EB Right	932	6	15	248	A		
	WB	7.3	A	WB Left	0	0	0	0	A		
				WB Through	1801	7	23	307	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	40.0	D	NB Left	0	0	53	323	A	40.2	D
				NB Through	216	53	61	332	D		
				NB Right	142	20	61	332	C		
	SB	141.6	F	SB Left	15	165	360	405	F		
				SB Through	0	0	0	0	A		
				SB Right	216	140	360	405	F		
	EB	19.9	B	EB Left	278	62	98	313	E		
				EB Through	930	7	98	313	A		
				EB Right	0	0	0	0	A		
	WB	41.1	D	WB Left	42	36	171	427	D		
				WB Through	1298	41	147	390	D		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	36.7	D	NB Left	43	45	12	95	D	14.5	B
				NB Through	14	48	9	95	D		
				NB Right	19	9	9	105	A		
	SB	3.4	A	SB Left	18	41	7	83	D		
				SB Through	13	48	7	83	D		
				SB Right	414	0	0	0	A		
	EB	12.8	B	EB Left	432	26	44	464	C		
				EB Through	677	5	6	172	A		
				EB Right	58	5	10	208	A		
	WB	20.6	C	WB Left	15	22	56	451	C		
				WB Through	853	21	55	451	C		
				WB Right	18	14	72	485	B		
35- MD 189 at I-270 Ramps											
35	NB	42.8	D	NB Left	251	43	43	197	D	41.4	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.4	E	SB Left	348	55	129	456	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	27.3	C	EB Left	483	31	91	341	C		
				EB Through	373	23	91	341	C		
				EB Right	0	0	0	0	A		
	WB	49.3	D	WB Left	448	54	111	290	D		
				WB Through	434	44	111	290	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	45.8	D	NB Left	237	57	141	497	E	52.8	D
				NB Through	694	51	141	497	D		
				NB Right	176	12	141	497	B		
	SB	83.8	F	SB Left	250	105	299	794	F		
				SB Through	928	78	316	781	E		
				SB Right	0	0	0	0	A		
	EB	39.7	D	EB Left	151	74	127	474	E		
				EB Through	554	40	127	474	D		
				EB Right	205	15	127	474	B		
	WB	39.4	D	WB Left	162	71	145	688	E		
				WB Through	792	41	145	688	D		
				WB Right	321	20	145	688	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	23.6	C
				NB Through	0	0	0	0	A		
				NB Right	555	0	0	0	A		
	SB	65.3	E	SB Left	88	50	31	256	D		
				SB Through	0	0	0	0	A		
				SB Right	315	70	95	279	E		
	EB	7.3	A	EB Left	0	0	0	0	A		
				EB Through	1874	7	44	531	A		
				EB Right	0	0	0	0	A		
	WB	32.4	C	WB Left	78	41	44	531	D		
				WB Through	2684	33	215	774	C		
				WB Right	286	25	215	774	C		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	23.7	C	NB Left	729	24	52	259	C	17.5	B
				NB Through	0	0.0	46	251	A		
				NB Right	27	6.9	52	259	A		
	SB	9.4	A	SB Left	9	15.9	1	39	B		
				SB Through	0	0.0	1	39	A		
				SB Right	9	2.9	0	23	A		
	EB	10.5	B	EB Left	1	12.1	16	185	B		
				EB Through	363	10.9	16	185	B		
				EB Right	37	6.8	11	175	A		
	WB	12.9	B	WB Left	149	16.7	17	162	B		
				WB Through	215	10.4	17	162	B		
				WB Right	3	4.4	4	119	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	20.2	C	NB Left	97	41	84	389	D	42.6	D
				NB Through	773	32	84	389	C		
				NB Right	621	2	0	0	A		
	SB	32.7	C	SB Left	210	65	76	337	E		
				SB Through	506	24	75	336	C		
				SB Right	132	16	74	382	B		
	EB	114.8	F	EB Left	105	97	305	666	F		
				EB Through	526	118	307	666	F		
				EB Right	45	122	329	690	F		
	WB	37.6	D	WB Left	582	46	118	424	D		
				WB Through	484	43	118	424	D		
				WB Right	334	14	140	454	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	136.7	F	NB Left	0	0	0	0	A	109.8	F
				NB Through	338	124	573	840	F		
				NB Right	858	142	573	840	F		
	SB	85.2	F	SB Left	0	0	87	226	A		
				SB Through	354	85	87	226	F		
				SB Right	0	0	0	0	A		
	EB	79.4	E	EB Left	6	132	243	648	F		
				EB Through	458	127	243	648	F		
				EB Right	307	7	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	31.2	C	NB Left	342	31	80	268	C	48.8	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	53.7	D	WB Left	351	59	190	733	E		
				WB Through	883	51	190	733	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	72.8	E	NB Left	215	44	628	1331	D	133.9	F
				NB Through	2288	75	628	1331	E		
				NB Right	201	79	628	1331	E		
	SB	188.6	F	SB Left	203	167	2560	2694	F		
				SB Through	1150	186	2560	2694	F		
				SB Right	307	212	2560	2694	F		
	EB	125.6	F	EB Left	301	72	597	1434	E		
				EB Through	532	153	599	1436	F		
				EB Right	118	142	622	1459	F		
	WB	197.3	F	WB Left	462	188	1939	2137	F		
				WB Through	665	215	1939	2137	F		
				WB Right	164	151	1939	2137	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	19.0	B	NB Left	564	35	131	419	D	21.7	C
				NB Through	2506	15	131	419	B		
				NB Right	0	0	0	0	A		
	SB	24.5	C	SB Left	0	0	0	0	A		
				SB Through	1284	24	64	263	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	59.0	E	WB Left	60	60	43	255	E		
				WB Through	68	58	43	255	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	48.4	E	NB Left	0	0	0	0	A	43.1	D
				NB Through	2415	48	209	765	D		
				NB Right	0	0	0	0	A		
	SB	18.4	B	SB Left	148	58	70	319	E		
				SB Through	1197	14	70	319	B		
				SB Right	0	0	0	0	A		
	EB	67.7	E	EB Left	652	69	172	628	E		
				EB Through	0	0	172	628	A		
				EB Right	180	62	94	557	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	21.5	C	NB Left	492	37	131	898	D	30.6	C
				NB Through	2181	18	131	899	B		
				NB Right	18	14	153	932	B		
	SB	35.8	D	SB Left	21	63	117	605	E		
				SB Through	1184	40	117	605	D		
				SB Right	173	1	74	590	A		
	EB	49.2	D	EB Left	430	59	145	529	E		
				EB Through	50	65	145	529	E		
				EB Right	485	39	145	529	D		
	WB	17.0	B	WB Left	7	28	6	108	C		
				WB Through	16	33	6	108	C		
				WB Right	36	8	3	97	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	44.8	D	NB Left	165	45	29	127	D	3.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.3	A	EB Left	0	0	0	0	A		
				EB Through	1190	1	3	56	A		
				EB Right	0	0	0	0	A		
	WB	0.9	A	WB Left	0	0	0	0	A		
				WB Through	2241	1	2	53	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.3	A	EB Left	0	0	0	0	A		
				EB Through	1420	5	20	257	A		
				EB Right	0	0	0	0	A		
	WB	7.3	A	WB Left	567	22	40	294	C		
				WB Through	1839	3	32	273	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	40.2	D	SB Left	184	55	39	171	E		
				SB Through	0	0	0	0	A		
				SB Right	72	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	3.9	A	WB Left	0	0	0	0	A		
				WB Through	1839	4	21	297	A		
				WB Right	184	1	0	21	A		
50- MD 190 at Burdette Rd											
50	NB	76.5	E	NB Left	27	79	18	118	E	38.2	D
				NB Through	7	69	18	118	E		
				NB Right	6	75	18	118	E		
	SB	35.7	D	SB Left	44	78	24	143	E		
				SB Through	9	72	24	143	E		
				SB Right	122	18	24	143	B		
	EB	28.3	C	EB Left	140	112	158	718	F		
				EB Through	1303	20	158	718	B		
				EB Right	32	8	152	745	A		
	WB	44.2	D	WB Left	13	129	387	1112	F		
				WB Through	2160	44	387	1112	D		
				WB Right	65	35	387	1112	D		

Table D.15: PM Peak - No Build - Alternative Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	18.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	66.7	E	EB Left	253	67	105	365	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.8	A	WB Left	0	0	0	0	A		
				WB Through	1474	10	55	745	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	73.8	E	NB Left	231	74	92	687	E	13.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.5	A	EB Left	0	0	0	0	A		
				EB Through	1062	3	8	167	A		
				EB Right	0	0	0	0	A		
	WB	10.8	B	WB Left	0	0	0	0	A		
				WB Through	1661	11	23	472	B		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	0.5	A	NB Left	28	1	0	0	A	26.9	C
				NB Through	314	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.5	D	SB Left	364	52	120	413	D		
				SB Through	232	53	120	413	D		
				SB Right	20	51	120	413	D		
	EB	32.1	C	EB Left	27	30	95	434	C		
				EB Through	800	32	95	434	C		
				EB Right	45	32	95	434	C		
	WB	20.9	C	WB Left	257	77	129	564	E		
				WB Through	920	18	129	564	B		
				WB Right	701	5	129	564	A		
54- MD 124 at I-270 NB off ramp											
54	NB	34.3	C	NB Left	0	0	0	0	A	32.8	C
				NB Through	0	0	0	0	A		
				NB Right	1394	34	173	880	C		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	31.8	C	EB Left	0	0	0	0	A		
				EB Through	2020	32	224	1104	C		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	44.4	D	NB Left	0	0	0	0	A	10.9	B
				NB Through	0	0	0	0	A		
				NB Right	334	44	50	201	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.5	A	EB Left	0	0	0	0	A		
				EB Through	1189	1	4	60	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
56	NB	92.1	F	NB Left	144	54	237	646	D	107.9	F
				NB Through	0	0	0	0	A		
				NB Right	331	108	237	646	F		
	SB	47.2	D	SB Left	397	70	121	417	E		
				SB Through	110	63	121	417	E		
				SB Right	440	23	121	417	C		
	EB	213.3	F	EB Left	0	0	0	0	A		
				EB Through	920	213	1045	1245	F		
				EB Right	3	155	1045	1245	F		
	WB	48.7	D	WB Left	91	82	82	319	F		
				WB Through	455	42	80	317	D		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
57	NB	153.6	F	NB Left	216	86	3447	5053	F	101.6	F
				NB Through	0	0	0	0	A		
				NB Right	545	180	3447	5053	F		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	59.5	E	EB Left	478	130	268	442	F		
				EB Through	913	22	268	442	C		
				EB Right	0	0	0	0	A		
	WB	117.2	F	WB Left	0	0	0	0	A		
				WB Through	800	135	618	869	F		
				WB Right	422	83	618	869	F		
58- Watkins Mill Rd at I-270 SB on ramp											
58	NB			NB Left	0	0	0	0	A	26.4	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	34.4	C	EB Left	0	0	0	0	A		
				EB Through	1415	38	279	583	D		
				EB Right	230	13	279	583	B		
	WB	13.4	B	WB Left	476	27	59	475	C		
				WB Through	539	1	59	475	A		
				WB Right	0	0	0	0	A		

Table D.16: PM Peak - No Build - I-270 Vehicle Network Performance

	No Build (Delay Total)	Alternative (Total Total)	% Change
Total Delay	34,577,788	28,435,004	-18%
Average Delay per Vehicle	289	238	-18%
Total Travel Time	67,049,773	62,282,973	-7%
Vehicles (Arrived)	97,505	100,111	3%
Latent Demand	7,347	7,399	1%
Latent Delay	11,699,627	12,857,414	10%
Total Distance	490,466	512,495	4%
Average Speed	26	30	12%

Submitted to:

State Highway Administration
Maryland Department of Transportation

Appendix H

INTERSTATE 270

HSM Safety Analysis Summary

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

H

Appendix H: HSM Safety Analysis Summary

Highway Safety Manual Analysis

The roadway improvements proposed by the CGI Team were evaluated using the quantitative methods for estimating change in crash frequency as described in the AASHTO Highway Safety Manual (HSM). Both the existing and proposed roadway conditions were modeled using the Enhanced Interchange Safety Analysis Tool (ISATe). The difference in the number of predicted crashes reflects the impact of the changes in geometry under the proposed improvement.

This appendix includes the detailed analysis output results for each improvement and a summary of the difference in predicted average annual crash frequency by crash severity for the present year (2015) and future year (2040).

Table: Predicted Average Crash Frequency - Existing (2015) No-Build

Total Crashes	Total	K	A	B	C	PDO
Northbound						
NB1	127.50	0.56	1.51	10.32	22.70	92.41
NB2A	20.07	0.18	0.54	2.92	8.48	7.95
NB2B	12.92	0.05	0.14	1.01	2.37	9.35
NB3A	18.92	0.05	0.29	1.72	5.93	10.93
NB3B	13.94	0.09	0.25	1.47	3.68	8.45
NB4	67.51	0.41	1.10	5.76	10.52	49.71
NB5	16.71	0.10	0.26	1.43	2.72	12.20
NB7	5.53	0.03	0.09	0.49	0.97	3.94
Subtotal NB Existing/No-Build	283.09	1.47	4.18	25.13	57.37	194.94
Southbound						
SB1A	24.01	0.17	0.46	2.32	3.94	17.11
SB1B	24.01	0.17	0.46	2.32	3.94	17.11
SB2	16.62	0.11	0.30	1.53	2.73	11.96
SB5A	14.49	0.07	0.20	1.25	2.60	10.36
SB6	9.66	0.07	0.22	1.21	3.53	4.62
SB7	25.87	0.25	0.75	4.07	11.82	8.99
SB8	22.02	0.22	0.68	3.65	9.30	8.17
SB10	19.32	0.08	0.23	1.55	3.41	14.05
SB12	137.33	0.60	1.63	11.10	24.21	99.79
Subtotal SB Existing/No-Build	293.33	1.76	4.92	29.00	65.48	192.16
Total Existing/No-Build Crashes	576.42	3.23	9.11	54.13	122.85	387.10

Table: Predicted Average Crash Frequency - Concepts Existing (2015) Build

Total Crashes	Total	K	A	B	C	PDO
Northbound						
NB1	118.94	0.62	1.48	10.37	22.42	84.04
NB2A	17.66	0.14	0.42	2.30	6.68	8.13
NB2B	13.84	0.06	0.15	1.10	2.55	9.97
NB3A	19.87	0.03	0.19	1.16	5.06	13.43
NB3B	12.40	0.07	0.21	1.23	3.07	7.82
NB4	66.00	0.49	1.16	6.16	10.99	47.21
NB5	16.85	0.12	0.27	1.52	2.80	12.13
NB7	5.25	0.03	0.09	0.47	0.93	3.73
Subtotal NB Proposed	270.81	1.57	3.97	24.32	54.49	186.46
Southbound						
SB1A	23.93	0.17	0.46	2.34	3.98	16.97
SB1B	23.64	0.17	0.45	2.28	3.87	16.88
SB2	16.66	0.11	0.30	1.55	2.78	11.91
SB5A	13.88	0.07	0.19	1.16	2.43	10.03
SB6	7.27	0.05	0.14	0.76	2.21	4.11
SB7	14.30	0.10	0.32	1.71	4.98	7.19
SB8	16.57	0.13	0.39	2.13	6.19	7.73
SB10	16.52	0.08	0.22	1.51	3.32	11.38
SB12	130.26	0.69	1.65	11.47	24.64	91.80
Subtotal SB Proposed	263.04	1.58	4.12	24.94	54.40	178.00
Total Proposed Crashes	533.85	3.15	8.09	49.26	108.89	364.46

Table: Predicted Average Annual Crash Frequency - Proposed Concepts Build to Existing No-Build Comparison (2015)

Total Crashes	Total	K	A	B	C	PDO
Northbound						
NB1	-8.56	0.06	-0.03	0.05	-0.28	-8.37
NB2A	-2.41	-0.04	-0.11	-0.62	-1.81	0.17
NB2B	0.92	0.01	0.01	0.09	0.18	0.62
NB3A	0.95	-0.02	-0.10	-0.56	-0.86	2.50
NB3B	-1.54	-0.01	-0.04	-0.24	-0.61	-0.63
NB4	-1.51	0.07	0.05	0.40	0.46	-2.50
NB5	0.14	0.02	0.01	0.09	0.08	-0.07
NB7	-0.28	0.00	0.00	-0.02	-0.04	-0.21
Subtotal Difference NB	-12.28	0.10	-0.22	-0.81	-2.88	-8.48
Southbound						
SB1A	-0.08	0.00	0.00	0.02	0.03	-0.14
SB1B	-0.36	0.00	-0.01	-0.04	-0.07	-0.23
SB2	0.04	0.00	0.01	0.03	0.06	-0.05
SB5A	-0.61	0.00	-0.01	-0.08	-0.17	-0.33
SB6	-2.39	-0.03	-0.08	-0.45	-1.31	-0.51
SB7	-11.57	-0.14	-0.43	-2.36	-6.84	-1.80
SB8	-5.45	-0.10	-0.29	-1.51	-3.12	-0.44
SB10	-2.80	0.00	-0.01	-0.04	-0.08	-2.67
SB12	-7.07	0.09	0.02	0.38	0.43	-7.98
Subtotal Difference SB	-30.29	-0.19	-0.80	-4.06	-11.08	-14.17
Total Difference Crashes	-42.57	-0.09	-1.02	-4.87	-13.95	-22.64

Output Summary

General Information

Project description:	I-270 @ MD 80 (SB 1A, SB 1B) - Existing (2015) No-Build				
Analyst:	MLV	Date:	1/5/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	24.0	0.2	0.5	2.3	3.9	17.1
Estimated average crash freq. during Study Period, crashes/yr:	24.0	0.2	0.5	2.3	3.9	17.1

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	3	24.0	0.2	0.5	2.3	3.9	17.1
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	24.0	0.2	0.5	2.3	3.9	17.1
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	10.9	0.1	0.2	1.1	1.9	7.6
	Sideswipe crashes:	3.7	0.0	0.1	0.3	0.5	2.9
	Other multiple-vehicle crashes:	0.4	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	15.4	0.1	0.3	1.5	2.5	11.0
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	6.2	0.0	0.1	0.6	1.0	4.4
	Crashes with other object:	1.0	0.0	0.0	0.0	0.1	0.9
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	1.2	0.0	0.0	0.2	0.3	0.6
	Total single-vehicle crashes:	8.6	0.1	0.2	0.9	1.5	6.1
Total crashes:		24.0	0.2	0.5	2.3	3.9	17.1

Output Summary							
General Information							
Project description:	I-270 SB Entrance Ramp from MD 80 - SB 1A Concept Existing (2015) Build						
Analyst:	MLV	Date:	1/5/2017	Area type:	Urban		
First year of analysis:	2015						
Last year of analysis:	2015						
Crash Data Description							
Freeway segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp terminals	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		23.9	0.2	0.5	2.3	4.0	17.0
Estimated average crash freq. during Study Period, crashes/yr:		23.9	0.2	0.5	2.3	4.0	17.0
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	3	23.9	0.2	0.5	2.3	4.0	17.0
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	23.9	0.2	0.5	2.3	4.0	17.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility							
Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	11.0	0.1	0.2	1.1	1.9	7.7
	Sideswipe crashes:	3.8	0.0	0.1	0.3	0.5	3.0
	Other multiple-vehicle crashes:	0.4	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	15.5	0.1	0.3	1.5	2.5	11.1
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	6.0	0.0	0.1	0.6	1.0	4.2
	Crashes with other object:	1.0	0.0	0.0	0.0	0.1	0.8
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	1.1	0.0	0.0	0.2	0.3	0.6
	Total single-vehicle crashes:	8.4	0.1	0.2	0.9	1.5	5.8
Total crashes:		23.9	0.2	0.5	2.3	4.0	17.0

Output Summary

General Information

Project description:	I-270 SB Exit Ramp to MD 80 - SB 1B Concept Existing (2015) Build				
Analyst:	MLV	Date:	1/5/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:		23.6	0.2	0.4	2.3	3.9	16.9
Estimated average crash freq. during Study Period, crashes/yr:		23.6	0.2	0.4	2.3	3.9	16.9
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	3	23.6	0.2	0.4	2.3	3.9	16.9
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	23.6	0.2	0.4	2.3	3.9	16.9
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	10.9	0.1	0.2	1.1	1.9	7.6
	Sideswipe crashes:	3.7	0.0	0.1	0.3	0.5	2.9
	Other multiple-vehicle crashes:	0.4	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	15.3	0.1	0.3	1.5	2.5	11.0
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	6.0	0.0	0.1	0.6	1.0	4.2
	Crashes with other object:	1.0	0.0	0.0	0.0	0.1	0.8
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	1.1	0.0	0.0	0.2	0.3	0.6
	Total single-vehicle crashes:	8.3	0.1	0.2	0.8	1.4	5.9
Total crashes:		23.6	0.2	0.4	2.3	3.9	16.9

Output Summary							
General Information							
Project description:	I-270 @ MD 109 (SB 2) - Existing (2015) No-Build						
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						
Crash Data Description							
Freeway segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp terminals	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		16.6	0.1	0.3	1.5	2.7	12.0
Estimated average crash freq. during Study Period, crashes/yr:		16.6	0.1	0.3	1.5	2.7	12.0
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	4	16.6	0.1	0.3	1.5	2.7	12.0
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	16.6	0.1	0.3	1.5	2.7	12.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	7.9	0.1	0.1	0.7	1.3	5.6
	Sideswipe crashes:	2.6	0.0	0.0	0.2	0.3	2.0
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	11.0	0.1	0.2	1.0	1.8	7.9
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.1	0.0	0.1	0.4	0.7	2.9
	Crashes with other object:	0.6	0.0	0.0	0.0	0.1	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:	5.6	0.0	0.1	0.5	0.9	4.0
Total crashes:		16.6	0.1	0.3	1.5	2.7	12.0

Output Summary

General Information									
Project description:	I-270 SB Entrance Ramp from MD 109 - SB 2 Concept Existing (2015) Build								
Analyst:	MLV	Date:	1/4/2017		Area type:		Urban		
First year of analysis:	2015								
Last year of analysis:	2015								
Crash Data Description									
Freeway segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp terminals	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Estimated Crash Statistics									
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**	
Estimated number of crashes during Study Period, crashes:			16.7	0.1	0.3	1.6	2.8	11.9	
Estimated average crash freq. during Study Period, crashes/yr:			16.7	0.1	0.3	1.6	2.8	11.9	
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**	
Freeway segments, crashes:		4	16.7	0.1	0.3	1.6	2.8	11.9	
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0	
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0	

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	16.7	0.1	0.3	1.6	2.8	11.9
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	7.9	0.1	0.1	0.7	1.3	5.6
	Sideswipe crashes:	2.7	0.0	0.0	0.2	0.3	2.1
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.0	0.2
	Total multiple-vehicle crashes:	11.0	0.1	0.2	1.0	1.8	8.0
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.1	0.0	0.1	0.4	0.7	2.8
	Crashes with other object:	0.6	0.0	0.0	0.0	0.1	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.8	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:	5.6	0.0	0.1	0.6	1.0	3.9
Total crashes:		16.7	0.1	0.3	1.6	2.8	11.9

Output Summary

General Information							
Project description:	I-270 @ I-370 (SB 5A) - Existing (2015) No-Build						
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		14.5	0.1	0.2	1.2	2.6	10.4
Estimated average crash freq. during Study Period, crashes/yr:		14.5	0.1	0.2	1.2	2.6	10.4
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	1	14.5	0.1	0.2	1.2	2.6	10.4
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	14.5	0.1	0.2	1.2	2.6	10.4
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	6.9	0.0	0.1	0.6	1.3	4.8
	Sideswipe crashes:	2.3	0.0	0.0	0.2	0.3	1.8
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	9.7	0.1	0.1	0.8	1.7	6.9
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.4	0.0	0.0	0.3	0.6	2.5
	Crashes with other object:	0.5	0.0	0.0	0.0	0.0	0.5
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:	4.8	0.0	0.1	0.4	0.9	3.4
Total crashes:		14.5	0.1	0.2	1.2	2.6	10.4

Output Summary

General Information

Project description:	I-270 SB Exit Ramp to I-370 - SB 5A Concept Existing (2015) Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		13.9	0.1	0.2	1.2	2.4	10.0
Estimated average crash freq. during Study Period, crashes/yr:		13.9	0.1	0.2	1.2	2.4	10.0
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	1	13.9	0.1	0.2	1.2	2.4	10.0
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	13.9	0.1	0.2	1.2	2.4	10.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	6.9	0.0	0.1	0.6	1.3	4.8
	Sideswipe crashes:	2.3	0.0	0.0	0.2	0.3	1.8
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	9.7	0.1	0.1	0.8	1.7	6.9
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.0	0.0	0.0	0.2	0.5	2.2
	Crashes with other object:	0.5	0.0	0.0	0.0	0.0	0.4
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.6	0.0	0.0	0.1	0.1	0.3
	Total single-vehicle crashes:	4.2	0.0	0.1	0.3	0.7	3.1
	Total crashes:	13.9	0.1	0.2	1.2	2.4	10.0

Output Summary

General Information

Project description:	I-270 SB Slip Ramps Between Shady Grove Rd and MD 28 (SB 6) - Existing (2015) No-Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	9.7	0.1	0.2	1.2	3.5	4.6
Estimated average crash freq. during Study Period, crashes/yr:	9.7	0.1	0.2	1.2	3.5	4.6

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	9.7	0.1	0.2	1.2	3.5	4.6
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	9.7	0.1	0.2	1.2	3.5	4.6
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Rear-end crashes:	5.5	0.0	0.1	0.8	2.3	2.2
	Sideswipe crashes:	2.0	0.0	0.0	0.1	0.4	1.4
	Other multiple-vehicle crashes:	1.1	0.0	0.0	0.2	0.5	0.4
	Total multiple-vehicle crashes:	8.7	0.1	0.2	1.1	3.3	4.0
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	0.7	0.0	0.0	0.1	0.2	0.5
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	0.9	0.0	0.0	0.1	0.3	0.6
Total crashes:		9.7	0.1	0.2	1.2	3.5	4.6

Output Summary

General Information

Project description:	I-270 SB Slip Ramps Between Shady Grove Rd and MD 28 - SB 6 Concept Existing (2015) Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	7.3	0.0	0.1	0.8	2.2	4.1
Estimated average crash freq. during Study Period, crashes/yr:	7.3	0.0	0.1	0.8	2.2	4.1

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	7.3	0.0	0.1	0.8	2.2	4.1
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	7.3	0.0	0.1	0.8	2.2	4.1
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Rear-end crashes:	3.9	0.0	0.1	0.5	1.4	2.0
	Sideswipe crashes:	1.5	0.0	0.0	0.1	0.3	1.2
	Other multiple-vehicle crashes:	0.7	0.0	0.0	0.1	0.3	0.4
	Total multiple-vehicle crashes:	6.3	0.0	0.1	0.7	2.0	3.6
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	0.7	0.0	0.0	0.1	0.2	0.5
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	0.9	0.0	0.0	0.1	0.3	0.6
Total crashes:		7.3	0.0	0.1	0.8	2.2	4.1

Output Summary

General Information

Project description:	I-270 SB Local Lanes Between MD 28 and MD 189 (SB 7) - Existing (2015) No-Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	25.9	0.2	0.7	4.1	11.8	9.0
Estimated average crash freq. during Study Period, crashes/yr:	25.9	0.2	0.7	4.1	11.8	9.0

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	4	25.9	0.2	0.7	4.1	11.8	9.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	25.9	0.2	0.7	4.1	11.8	9.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
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	2035						
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	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.2	0.1
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	15.8	0.2	0.5	2.8	8.0	4.4
	Sideswipe crashes:	4.7	0.0	0.1	0.5	1.5	2.7
	Other multiple-vehicle crashes:	3.0	0.0	0.1	0.5	1.6	0.8
	Total multiple-vehicle crashes:	24.1	0.2	0.7	3.9	11.3	8.0
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.4	0.0	0.0	0.1	0.4	0.9
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.8	0.0	0.0	0.2	0.5	1.0
Total crashes:		25.9	0.2	0.7	4.1	11.8	9.0

Output Summary

General Information

Project description:	I-270 SB Local Lanes Between MD 28 and MD 189 - SB 7 Concept Existing (2015) Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		14.3	0.1	0.3	1.7	5.0	7.2
Estimated average crash freq. during Study Period, crashes/yr:		14.3	0.1	0.3	1.7	5.0	7.2
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	4	14.3	0.1	0.3	1.7	5.0	7.2
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	14.3	0.1	0.3	1.7	5.0	7.2
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Rear-end crashes:	7.8	0.1	0.2	1.1	3.1	3.4
	Sideswipe crashes:	2.9	0.0	0.0	0.2	0.6	2.1
	Other multiple-vehicle crashes:	1.5	0.0	0.0	0.2	0.6	0.6
	Total multiple-vehicle crashes:	12.4	0.1	0.3	1.5	4.3	6.2
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.5	0.0	0.0	0.2	0.5	0.8
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.4	0.0	0.0	0.1	0.2	0.1
	Total single-vehicle crashes:	1.9	0.0	0.0	0.2	0.6	1.0
Total crashes:		14.3	0.1	0.3	1.7	5.0	7.2

Output Summary									
General Information									
Project description:	I-270 SB Local Lanes Between MD 189 and Montrose Rd (SB 8) - Existing (2015) No-Build								
Analyst:	MLV		Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2015								
Last year of analysis:	2015								
Crash Data Description									
Freeway segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp terminals	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		22.0	0.2	0.7	3.6	9.3	8.2
Estimated average crash freq. during Study Period, crashes/yr:		22.0	0.2	0.7	3.6	9.3	8.2
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	22.0	0.2	0.7	3.6	9.3	8.2
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	22.0	0.2	0.7	3.6	9.3	8.2
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	13.3	0.2	0.5	2.5	6.3	4.0
	Sideswipe crashes:	4.1	0.0	0.1	0.4	1.1	2.4
	Other multiple-vehicle crashes:	2.6	0.0	0.1	0.5	1.2	0.7
	Total multiple-vehicle crashes:	20.5	0.2	0.7	3.5	8.9	7.2
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.2	0.0	0.0	0.1	0.3	0.8
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.6	0.0	0.0	0.2	0.4	0.9
Total crashes:		22.0	0.2	0.7	3.6	9.3	8.2

Output Summary

General Information

Project description:	I-270 SB Local Lanes Between MD 189 and Montrose Rd - SB 8 Concept Existing (2015) Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	16.6	0.1	0.4	2.1	6.2	7.7
Estimated average crash freq. during Study Period, crashes/yr:	16.6	0.1	0.4	2.1	6.2	7.7

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	16.6	0.1	0.4	2.1	6.2	7.7
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	16.6	0.1	0.4	2.1	6.2	7.7
	2016						
	2017						
	2018						
	2019						
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	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	9.4	0.1	0.3	1.4	4.0	3.7
	Sideswipe crashes:	3.3	0.0	0.0	0.3	0.7	2.3
	Other multiple-vehicle crashes:	1.8	0.0	0.0	0.3	0.8	0.7
	Total multiple-vehicle crashes:	14.9	0.1	0.4	2.0	5.7	6.8
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.3	0.0	0.0	0.1	0.4	0.8
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.7	0.0	0.0	0.2	0.5	1.0
Total crashes:		16.6	0.1	0.4	2.1	6.2	7.7

Output Summary									
General Information									
Project description:	I-270 SB West Spur at Merge with I-495 Outer Loop (SB 10) - Existing (2015) No-Build								
Analyst:	MLV	Date:	1/4/2017		Area type:		Urban		
First year of analysis:	2015								
Last year of analysis:	2015								

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		19.3	0.1	0.2	1.5	3.4	14.1
Estimated average crash freq. during Study Period, crashes/yr:		19.3	0.1	0.2	1.5	3.4	14.1
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	3	19.3	0.1	0.2	1.5	3.4	14.1
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	19.3	0.1	0.2	1.5	3.4	14.1
	2016						
	2017						
	2018						
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Distribution of Crashes for Entire Facility							
Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	9.5	0.0	0.1	0.8	1.7	6.8
	Sideswipe crashes:	3.3	0.0	0.0	0.2	0.4	2.6
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	13.4	0.1	0.2	1.0	2.3	9.9
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.2	0.0	0.1	0.4	0.8	3.0
	Crashes with other object:	0.7	0.0	0.0	0.0	0.1	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.8	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:	5.9	0.0	0.1	0.5	1.1	4.2
Total crashes:		19.3	0.1	0.2	1.5	3.4	14.1

Output Summary

General Information

Project description:	I-270 SB West Spur at Merge with I-495 Outer Loop - SB 10 Concept Existing (2015) Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	16.5	0.1	0.2	1.5	3.3	11.4
Estimated average crash freq. during Study Period, crashes/yr:	16.5	0.1	0.2	1.5	3.3	11.4

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	3	16.5	0.1	0.2	1.5	3.3	11.4
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	16.5	0.1	0.2	1.5	3.3	11.4
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
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	2023						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	8.3	0.0	0.1	0.8	1.7	5.7
	Sideswipe crashes:	3.0	0.0	0.0	0.2	0.4	2.3
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	11.9	0.1	0.2	1.0	2.3	8.4
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.3	0.0	0.0	0.3	0.7	2.1
	Crashes with other object:	0.5	0.0	0.0	0.0	0.1	0.5
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	4.6	0.0	0.1	0.5	1.0	3.0
Total crashes:		16.5	0.1	0.2	1.5	3.3	11.4

Output Summary							
General Information							
Project description:	I-270 SB West Spur Between MD 189 and Democracy Blvd (SB 12) - Existing (2015) No-Build						
Analyst:	MLV, LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						
Crash Data Description							
Freeway segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp terminals	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		137.3	0.6	1.6	11.1	24.2	99.8
Estimated average crash freq. during Study Period, crashes/yr:		137.3	0.6	1.6	11.1	24.2	99.8
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	16	137.3	0.6	1.6	11.1	24.2	99.8
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	137.3	0.6	1.6	11.1	24.2	99.8
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
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	2023						
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	2025						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:	2.0	0.0	0.0	0.2	0.5	1.2
	Rear-end crashes:	66.5	0.3	0.8	5.7	12.4	47.2
	Sideswipe crashes:	23.0	0.1	0.2	1.4	3.0	18.3
	Other multiple-vehicle crashes:	2.4	0.0	0.0	0.2	0.5	1.6
	Total multiple-vehicle crashes:	94.2	0.4	1.1	7.6	16.6	68.5
Single vehicle	Crashes with animal:	0.7	0.0	0.0	0.0	0.0	0.7
	Crashes with fixed object:	30.9	0.1	0.4	2.5	5.5	22.4
	Crashes with other object:	5.0	0.0	0.0	0.2	0.4	4.4
	Crashes with parked vehicle:	0.7	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes	5.8	0.0	0.1	0.7	1.6	3.3
	Total single-vehicle crashes:	43.1	0.2	0.5	3.5	7.6	31.3
Total crashes:		137.3	0.6	1.6	11.1	24.2	99.8

Output Summary							
General Information							
Project description:	I-270 SB West Spur Between MD 189 and Democracy Blvd - SB 12 Concept Existing (2015) Build						
Analyst:	MLV, LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						
Crash Data Description							
Freeway segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp terminals	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		130.3	0.7	1.7	11.5	24.6	91.8
Estimated average crash freq. during Study Period, crashes/yr:		130.3	0.7	1.7	11.5	24.6	91.8
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	16	130.3	0.7	1.7	11.5	24.6	91.8
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	130.3	0.7	1.7	11.5	24.6	91.8
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
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	2023						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:	1.9	0.0	0.0	0.2	0.5	1.1
	Rear-end crashes:	60.5	0.3	0.8	5.6	12.0	41.8
	Sideswipe crashes:	20.8	0.1	0.2	1.3	2.9	16.3
	Other multiple-vehicle crashes:	2.2	0.0	0.0	0.2	0.5	1.4
	Total multiple-vehicle crashes:	85.6	0.4	1.1	7.4	16.0	60.7
Single vehicle	Crashes with animal:	0.7	0.0	0.0	0.0	0.0	0.7
	Crashes with fixed object:	32.0	0.2	0.4	2.9	6.3	22.2
	Crashes with other object:	5.1	0.0	0.0	0.2	0.5	4.4
	Crashes with parked vehicle:	0.7	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes	6.1	0.1	0.1	0.8	1.8	3.3
	Total single-vehicle crashes:	44.6	0.2	0.6	4.1	8.7	31.1
Total crashes:		130.3	0.7	1.7	11.5	24.6	91.8

Output Summary

General Information							
Project description:	I-270 NB West Spur Between Democracy Blvd and MD 189 (NB 1) - Existing (2015) No-Build						
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		127.5	0.6	1.5	10.3	22.7	92.4
Estimated average crash freq. during Study Period, crashes/yr:		127.5	0.6	1.5	10.3	22.7	92.4
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	12	127.5	0.6	1.5	10.3	22.7	92.4
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	127.5	0.6	1.5	10.3	22.7	92.4
	2016						
	2017						
	2018						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:	1.9	0.0	0.0	0.2	0.5	1.1
	Rear-end crashes:	61.3	0.3	0.8	5.2	11.5	43.4
	Sideswipe crashes:	21.1	0.1	0.2	1.3	2.8	16.8
	Other multiple-vehicle crashes:	2.2	0.0	0.0	0.2	0.5	1.5
	Total multiple-vehicle crashes:	86.8	0.4	1.0	7.0	15.4	63.0
Single vehicle	Crashes with animal:	0.7	0.0	0.0	0.0	0.0	0.6
	Crashes with fixed object:	29.2	0.1	0.4	2.4	5.3	21.0
	Crashes with other object:	4.7	0.0	0.0	0.2	0.4	4.1
	Crashes with parked vehicle:	0.6	0.0	0.0	0.0	0.1	0.5
	Other single-vehicle crashes	5.5	0.0	0.1	0.7	1.5	3.1
	Total single-vehicle crashes:	40.7	0.2	0.5	3.3	7.3	29.4
Total crashes:		127.5	0.6	1.5	10.3	22.7	92.4

Output Summary								
General Information								
Project description:	I-270 NB West Spur Between Democracy Blvd and MD 189 - NB 1 Concept Existing (2015) Build							
Analyst:	MLV	Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2015							
Last year of analysis:	2015							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			118.9	0.6	1.5	10.4	22.4	84.0
Estimated average crash freq. during Study Period, crashes/yr:			118.9	0.6	1.5	10.4	22.4	84.0
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		12	118.9	0.6	1.5	10.4	22.4	84.0
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2015	118.9	0.6	1.5	10.4	22.4	84.0
		2016						
		2017						
		2018						
		2019						
		2020						
		2021						
		2022						
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Distribution of Crashes for Entire Facility								
Crash Type	**Crash Type Category**		**Estimated Number of Crashes During the Study Period**					
			Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:		0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:		1.7	0.0	0.0	0.2	0.5	1.0
	Rear-end crashes:		55.6	0.3	0.7	5.1	11.1	38.3
	Sideswipe crashes:		19.0	0.1	0.2	1.2	2.7	14.9
	Other multiple-vehicle crashes:		2.0	0.0	0.0	0.2	0.5	1.3
	Total multiple-vehicle crashes:		78.6	0.4	1.0	6.8	14.8	55.6
Single vehicle	Crashes with animal:		0.7	0.0	0.0	0.0	0.0	0.6
	Crashes with fixed object:		28.9	0.2	0.4	2.6	5.5	20.3
	Crashes with other object:		4.6	0.0	0.0	0.2	0.4	4.0
	Crashes with parked vehicle:		0.6	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes		5.5	0.0	0.1	0.7	1.6	3.0
	Total single-vehicle crashes:		40.3	0.2	0.5	3.6	7.7	28.4
Total crashes:			118.9	0.6	1.5	10.4	22.4	84.0

Output Summary

General Information

Project description:	I-270 NB Local Lanes Between MD 189 and MD 28 (NB 2A) - Existing (2015) No-Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	20.1	0.2	0.5	2.9	8.5	8.0
Estimated average crash freq. during Study Period, crashes/yr:	20.1	0.2	0.5	2.9	8.5	8.0

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	20.1	0.2	0.5	2.9	8.5	8.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	20.1	0.2	0.5	2.9	8.5	8.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2035						
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	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	12.1	0.1	0.4	2.0	5.7	3.9
	Sideswipe crashes:	3.9	0.0	0.1	0.4	1.0	2.4
	Other multiple-vehicle crashes:	2.3	0.0	0.1	0.4	1.1	0.7
	Total multiple-vehicle crashes:	18.6	0.2	0.5	2.8	8.1	7.1
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.1	0.0	0.0	0.1	0.3	0.7
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.4	0.0	0.0	0.1	0.4	0.9
Total crashes:		20.1	0.2	0.5	2.9	8.5	8.0

Output Summary

General Information							
Project description:	I-270 NB Local Lanes Between MD 189 and MD 28 - NB 2A Concept Existing (2015) Build						
Analyst:	LW	Date:	1/4/2017	Area type:	Urban		
First year of analysis:	2015						
Last year of analysis:	2015						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	17.7	0.1	0.4	2.3	6.7	8.1
Estimated average crash freq. during Study Period, crashes/yr:	17.7	0.1	0.4	2.3	6.7	8.1

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	17.7	0.1	0.4	2.3	6.7	8.1
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	17.7	0.1	0.4	2.3	6.7	8.1
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
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	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	10.1	0.1	0.3	1.5	4.3	3.9
	Sideswipe crashes:	3.5	0.0	0.1	0.3	0.8	2.4
	Other multiple-vehicle crashes:	1.9	0.0	0.1	0.3	0.9	0.7
	Total multiple-vehicle crashes:	15.9	0.1	0.4	2.1	6.1	7.1
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.4	0.0	0.0	0.1	0.4	0.8
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.8	0.0	0.0	0.2	0.5	1.0
Total crashes:		17.7	0.1	0.4	2.3	6.7	8.1

Output Summary

General Information									
Project description:	I-270 NB Express Lanes at MD 28 Interchange (NB 2B) - Existing (2015) No-Build								
Analyst:	LW	Date:	1/4/2017		Area type:		Urban		
First year of analysis:	2015								
Last year of analysis:	2015								

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	12.9	0.1	0.1	1.0	2.4	9.4
Estimated average crash freq. during Study Period, crashes/yr:	12.9	0.1	0.1	1.0	2.4	9.4

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	5	12.9	0.1	0.1	1.0	2.4	9.4
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	12.9	0.1	0.1	1.0	2.4	9.4
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
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	2032						
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	2035						
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	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	6.3	0.0	0.1	0.5	1.2	4.5
	Sideswipe crashes:	2.2	0.0	0.0	0.1	0.3	1.7
	Other multiple-vehicle crashes:	0.2	0.0	0.0	0.0	0.0	0.2
	Total multiple-vehicle crashes:	8.9	0.0	0.1	0.7	1.6	6.5
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	2.9	0.0	0.0	0.2	0.5	2.1
	Crashes with other object:	0.5	0.0	0.0	0.0	0.0	0.4
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.5	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	4.0	0.0	0.0	0.3	0.7	2.9
Total crashes:		12.9	0.1	0.1	1.0	2.4	9.4

Output Summary

General Information

Project description:	I-270 NB Express Lanes at MD 28 Interchange - NB 2B Concept Existing (2015) Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	13.8	0.1	0.2	1.1	2.6	10.0
Estimated average crash freq. during Study Period, crashes/yr:	13.8	0.1	0.2	1.1	2.6	10.0

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	5	13.8	0.1	0.2	1.1	2.6	10.0
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	13.8	0.1	0.2	1.1	2.6	10.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	6.6	0.0	0.1	0.6	1.3	4.7
	Sideswipe crashes:	2.3	0.0	0.0	0.1	0.3	1.8
	Other multiple-vehicle crashes:	0.2	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	9.4	0.0	0.1	0.7	1.7	6.8
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.2	0.0	0.0	0.3	0.6	2.2
	Crashes with other object:	0.5	0.0	0.0	0.0	0.0	0.4
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.6	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	4.4	0.0	0.0	0.4	0.8	3.1
Total crashes:		13.8	0.1	0.2	1.1	2.6	10.0

Output Summary

General Information							
Project description:	I-270 NB Entrance Ramp from NB Shady Grove Rd - Loop Ramp (NB 3A) - Existing (2015) No-Build						
Analyst:	KEB	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						
Crash Data Description							
Freeway segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp terminals	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		

Estimated Crash Statistics

Crashes for Entire Facility		Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:		19.0	0.0	0.3	1.7	6.0	11.0
Estimated average crash freq. during Study Period, crashes/yr:		19.0	0.0	0.3	1.7	6.0	11.0
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	4	6.7	0.0	0.1	0.8	1.6	4.2
Crossroad ramp terminals, crashes:	1	12.2	0.0	0.2	1.0	4.4	6.7
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	19.0	0.0	0.3	1.7	6.0	11.0
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	2.9	0.0	0.0	0.3	1.1	1.5
	Rear-end crashes:	9.2	0.0	0.1	0.8	3.3	4.9
	Sideswipe crashes:	2.1	0.0	0.0	0.1	0.3	1.7
	Other multiple-vehicle crashes:	0.6	0.0	0.0	0.1	0.2	0.4
	Total multiple-vehicle crashes:	15.0	0.0	0.2	1.3	5.0	8.5
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	3.1	0.0	0.1	0.3	0.7	2.0
	Crashes with other object:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.3	0.3
	Total single-vehicle crashes:	3.9	0.0	0.1	0.5	0.9	2.4
Total crashes:		19.0	0.0	0.3	1.7	6.0	11.0

Output Summary

General Information							
Project description:	I-270 NB Entrance Ramp from NB Shady Grove Rd - Loop Ramp - NB 3A Concept Existing (2015) Build						
Analyst:	KEB	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	19.9	0.0	0.2	1.2	5.1	13.4
Estimated average crash freq. during Study Period, crashes/yr:	19.9	0.0	0.2	1.2	5.1	13.4

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	6	3.9	0.0	0.1	0.4	1.0	2.5
Crossroad ramp terminals, crashes:	1	15.9	0.0	0.1	0.7	4.1	11.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	19.9	0.0	0.2	1.2	5.1	13.4
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	3.7	0.0	0.0	0.2	1.1	2.4
	Rear-end crashes:	10.7	0.0	0.1	0.6	3.0	6.9
	Sideswipe crashes:	2.5	0.0	0.0	0.1	0.3	2.2
	Other multiple-vehicle crashes:	0.6	0.0	0.0	0.0	0.1	0.4
	Total multiple-vehicle crashes:	17.7	0.0	0.2	1.0	4.5	12.0
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.7	0.0	0.0	0.1	0.4	1.2
	Crashes with other object:	0.1	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.4	0.0	0.0	0.1	0.1	0.2
	Total single-vehicle crashes:	2.2	0.0	0.0	0.2	0.5	1.4
	Total crashes:	19.9	0.0	0.2	1.2	5.1	13.4

Output Summary

General Information								
Project description:	I-270 NB Slip Ramp to Express Lanes South of I-370 (NB 3B) - Existing (2015) No-Build							
Analyst:	LW	Date:	1/4/2017		Area type:	Urban		
First year of analysis:	2015							
Last year of analysis:	2015							

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	13.9	0.1	0.3	1.5	3.7	8.5
Estimated average crash freq. during Study Period, crashes/yr:	13.9	0.1	0.3	1.5	3.7	8.5

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	2	6.8	0.0	0.1	0.6	1.2	4.8
Ramp segments, crashes:	3	7.2	0.1	0.2	0.8	2.4	3.7
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	13.9	0.1	0.3	1.5	3.7	8.5
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	7.0	0.1	0.1	0.8	2.2	3.8
	Sideswipe crashes:	2.6	0.0	0.0	0.2	0.4	1.9
	Other multiple-vehicle crashes:	0.9	0.0	0.0	0.1	0.3	0.4
	Total multiple-vehicle crashes:	10.7	0.1	0.2	1.2	3.0	6.3
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	2.3	0.0	0.0	0.2	0.5	1.6
	Crashes with other object:	0.3	0.0	0.0	0.0	0.0	0.3
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.5	0.0	0.0	0.1	0.2	0.2
	Total single-vehicle crashes:	3.2	0.0	0.0	0.3	0.7	2.2
	Total crashes:	13.9	0.1	0.3	1.5	3.7	8.5

Output Summary

General Information									
Project description:	I-270 NB Slip Ramp to Express Lanes South of I-370 - NB 3B Concept Existing (2015) Build								
Analyst:	LW	Date:	1/4/2017		Area type:		Urban		
First year of analysis:	2015								
Last year of analysis:	2015								
Crash Data Description									
Freeway segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp terminals	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		12.4	0.1	0.2	1.2	3.1	7.8
Estimated average crash freq. during Study Period, crashes/yr:		12.4	0.1	0.2	1.2	3.1	7.8
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	2	6.3	0.0	0.1	0.6	1.1	4.5
Ramp segments, crashes:	2	6.1	0.0	0.1	0.7	1.9	3.3
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	12.4	0.1	0.2	1.2	3.1	7.8
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
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	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	5.8	0.0	0.1	0.7	1.7	3.2
	Sideswipe crashes:	2.1	0.0	0.0	0.1	0.3	1.6
	Other multiple-vehicle crashes:	0.7	0.0	0.0	0.1	0.3	0.3
	Total multiple-vehicle crashes:	8.8	0.1	0.2	0.9	2.4	5.3
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	2.6	0.0	0.0	0.2	0.5	1.9
	Crashes with other object:	0.3	0.0	0.0	0.0	0.0	0.3
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.5	0.0	0.0	0.1	0.1	0.3
	Total single-vehicle crashes:	3.6	0.0	0.1	0.3	0.7	2.5
	Total crashes:	12.4	0.1	0.2	1.2	3.1	7.8

Output Summary									
General Information									
Project description:	I-270 NB Entrance Ramp from MD 124 / Local Lanes (NB 4) - Existing (2015) No-Build								
Analyst:	LW		Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2015								
Last year of analysis:	2015								
Crash Data Description									
Freeway segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp terminals	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Estimated Crash Statistics									
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**	
Estimated number of crashes during Study Period, crashes:			67.5	0.4	1.1	5.8	10.5	49.7	
Estimated average crash freq. during Study Period, crashes/yr:			67.5	0.4	1.1	5.8	10.5	49.7	
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**	
Freeway segments, crashes:		6	67.5	0.4	1.1	5.8	10.5	49.7	
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0	
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0	
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**	
Estimated number of crashes during the Study Period, crashes:		2015	67.5	0.4	1.1	5.8	10.5	49.7	
		2016							
		2017							
		2018							
		2019							
		2020							
		2021							
		2022							
		2023							
		2024							
		2025							
		2026							
		2027							
		2028							
		2029							
		2030							
		2031							
		2032							
		2033							
		2034							
		2035							
		2036							
		2037							
		2038							

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	1.1	0.0	0.0	0.1	0.2	0.7
	Rear-end crashes:	35.9	0.2	0.6	3.3	6.1	25.5
	Sideswipe crashes:	12.1	0.1	0.2	0.8	1.5	9.6
	Other multiple-vehicle crashes:	1.3	0.0	0.0	0.1	0.2	0.9
	Total multiple-vehicle crashes:	50.6	0.3	0.9	4.5	8.2	36.8
Single vehicle	Crashes with animal:	0.3	0.0	0.0	0.0	0.0	0.3
	Crashes with fixed object:	12.2	0.1	0.2	0.9	1.7	9.3
	Crashes with other object:	2.0	0.0	0.0	0.1	0.1	1.8
	Crashes with parked vehicle:	0.3	0.0	0.0	0.0	0.0	0.2
	Other single-vehicle crashes	2.2	0.0	0.1	0.3	0.5	1.4
	Total single-vehicle crashes:	16.9	0.1	0.2	1.3	2.4	12.9
Total crashes:		67.5	0.4	1.1	5.8	10.5	49.7

Output Summary

General Information

Project description:	I-270 NB Entrance Ramp from MD 124 / Local Lanes - NB 4 Concept Existing (2015) Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	66.0	0.5	1.2	6.2	11.0	47.2
Estimated average crash freq. during Study Period, crashes/yr:	66.0	0.5	1.2	6.2	11.0	47.2

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	6	66.0	0.5	1.2	6.2	11.0	47.2
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	66.0	0.5	1.2	6.2	11.0	47.2
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
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	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	1.0	0.0	0.0	0.1	0.2	0.6
	Rear-end crashes:	33.3	0.3	0.6	3.4	6.0	23.0
	Sideswipe crashes:	11.2	0.1	0.2	0.8	1.5	8.7
	Other multiple-vehicle crashes:	1.2	0.0	0.0	0.1	0.2	0.8
	Total multiple-vehicle crashes:	46.8	0.4	0.8	4.5	8.0	33.1
Single vehicle	Crashes with animal:	0.3	0.0	0.0	0.0	0.0	0.3
	Crashes with fixed object:	13.8	0.1	0.2	1.2	2.1	10.1
	Crashes with other object:	2.2	0.0	0.0	0.1	0.2	1.9
	Crashes with parked vehicle:	0.3	0.0	0.0	0.0	0.0	0.2
	Other single-vehicle crashes	2.5	0.0	0.1	0.3	0.6	1.5
	Total single-vehicle crashes:	19.2	0.1	0.3	1.7	3.0	14.1
	Total crashes:	66.0	0.5	1.2	6.2	11.0	47.2

Output Summary

General Information						
Project description:	I-270 NB from MD 121 to MD 109 (NB 5) - Existing (2015) No-Build					
Analyst:	LW	Date:	1/4/2017	Area type:	Urban	
First year of analysis:	2015					
Last year of analysis:	2015					

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	16.7	0.1	0.3	1.4	2.7	12.2
Estimated average crash freq. during Study Period, crashes/yr:	16.7	0.1	0.3	1.4	2.7	12.2

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	4	16.7	0.1	0.3	1.4	2.7	12.2
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	16.7	0.1	0.3	1.4	2.7	12.2
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	7.6	0.1	0.1	0.7	1.4	5.3
	Sideswipe crashes:	2.6	0.0	0.0	0.2	0.3	2.0
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	10.8	0.1	0.2	1.0	1.9	7.7
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.3	0.0	0.1	0.3	0.6	3.2
	Crashes with other object:	0.7	0.0	0.0	0.0	0.0	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.8	0.0	0.0	0.1	0.2	0.5
	Total single-vehicle crashes:	5.9	0.0	0.1	0.4	0.8	4.5
Total crashes:		16.7	0.1	0.3	1.4	2.7	12.2

Output Summary

General Information							
Project description:	I-270 NB from MD 121 to MD 109 - NB 5 Concept Existing (2015) Build						
Analyst:	LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2015						
Last year of analysis:	2015						
Crash Data Description							
Freeway segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp terminals	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		

Estimated Crash Statistics

Crashes for Entire Facility		Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:		16.9	0.1	0.3	1.5	2.8	12.1
Estimated average crash freq. during Study Period, crashes/yr:		16.9	0.1	0.3	1.5	2.8	12.1
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	4	16.9	0.1	0.3	1.5	2.8	12.1
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2015	16.9	0.1	0.3	1.5	2.8	12.1
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	7.5	0.1	0.1	0.8	1.4	5.1
	Sideswipe crashes:	2.6	0.0	0.0	0.2	0.3	2.0
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	10.6	0.1	0.2	1.0	1.9	7.4
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.5	0.0	0.1	0.3	0.6	3.4
	Crashes with other object:	0.7	0.0	0.0	0.0	0.0	0.7
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.8	0.0	0.0	0.1	0.2	0.5
	Total single-vehicle crashes:	6.2	0.0	0.1	0.5	0.9	4.7
Total crashes:		16.9	0.1	0.3	1.5	2.8	12.1

Output Summary

General Information					
Project description:	I-270 NB at MD 118 Interchange (NB 7) - Existing (2015) No-Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2015				
Last year of analysis:	2015				

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	5.5	0.0	0.1	0.5	1.0	3.9
Estimated average crash freq. during Study Period, crashes/yr:	5.5	0.0	0.1	0.5	1.0	3.9

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	1	5.5	0.0	0.1	0.5	1.0	3.9
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	5.5	0.0	0.1	0.5	1.0	3.9
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	2.9	0.0	0.0	0.3	0.5	2.0
	Sideswipe crashes:	1.0	0.0	0.0	0.1	0.1	0.8
	Other multiple-vehicle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Total multiple-vehicle crashes:	4.1	0.0	0.1	0.4	0.7	2.9
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.0	0.0	0.0	0.1	0.2	0.8
	Crashes with other object:	0.2	0.0	0.0	0.0	0.0	0.1
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.4	0.0	0.0	0.1	0.2	1.0
Total crashes:		5.5	0.0	0.1	0.5	1.0	3.9

Output Summary

Output Summary							
General Information							
Project description:	I-270 NB at MD 118 Interchange - NB 7 Concept Existing (2015) Build						
Analyst:	LW	Date:	1/4/2017	Area type:	Urban		
First year of analysis:	2015						
Last year of analysis:	2015						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	5.2	0.0	0.1	0.5	0.9	3.7
Estimated average crash freq. during Study Period, crashes/yr:	5.2	0.0	0.1	0.5	0.9	3.7

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	1	5.2	0.0	0.1	0.5	0.9	3.7
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2015	5.2	0.0	0.1	0.5	0.9	3.7
	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
	2024						
	2025						
	2026						
	2027						
	2028						
	2029						
	2030						
	2031						
	2032						
	2033						
	2034						
	2035						
	2036						
	2037						
	2038						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	2.8	0.0	0.0	0.3	0.5	2.0
	Sideswipe crashes:	0.9	0.0	0.0	0.1	0.1	0.7
	Other multiple-vehicle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Total multiple-vehicle crashes:	3.9	0.0	0.1	0.3	0.7	2.8
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.0	0.0	0.0	0.1	0.2	0.7
	Crashes with other object:	0.2	0.0	0.0	0.0	0.0	0.1
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.3	0.0	0.0	0.1	0.2	0.9
Total crashes:		5.2	0.0	0.1	0.5	0.9	3.7

Table: Predicted Average Crash Frequency - Future (2040) No-Build

Total Crashes	Total	K	A	B	C	PDO
Northbound						
NB1	148.17	0.63	1.70	11.68	25.68	108.47
NB2A	24.63	0.23	0.71	3.87	11.23	8.58
NB2B	15.04	0.06	0.16	1.15	2.70	10.98
NB3A	31.89	0.18	0.70	3.96	12.06	15.00
NB3B	16.90	0.12	0.34	1.92	4.92	9.60
NB4	84.84	0.50	1.35	7.02	12.59	63.38
NB5	21.22	0.12	0.32	1.76	3.29	15.73
NB7	6.83	0.04	0.11	0.61	1.19	4.89
Subtotal NB Existing/No-Build	349.53	1.89	5.39	31.96	73.66	236.63
Southbound						
SB1A	29.40	0.21	0.55	2.80	4.66	21.18
SB1B	29.40	0.21	0.55	2.80	4.66	21.18
SB2	20.40	0.13	0.36	1.84	3.23	14.84
SB5A	16.74	0.08	0.23	1.41	2.91	12.11
SB6	11.56	0.09	0.29	1.56	4.54	5.07
SB7	33.17	0.34	1.03	5.61	16.29	9.91
SB8	28.59	0.32	0.96	5.14	13.10	9.07
SB10	22.01	0.09	0.25	1.73	3.76	16.18
SB12	156.98	0.67	1.82	12.36	26.93	115.20
Subtotal SB Existing/No-Build	348.24	2.15	6.04	35.25	80.07	224.73
Total Existing/No-Build Crashes	697.77	4.04	11.43	67.21	153.73	461.36

Table: Predicted Average Crash Frequency - Concepts Future (2040) Build

Total Crashes	Total	K	A	B	C	PDO
Northbound						
NB1	136.15	0.70	1.66	11.61	25.01	97.17
NB2A	20.99	0.18	0.54	2.94	8.52	8.82
NB2B	16.16	0.07	0.17	1.25	2.91	11.76
NB3A	28.76	0.14	0.51	2.89	9.30	15.93
NB3B	14.85	0.09	0.27	1.57	4.00	8.91
NB4	82.35	0.59	1.40	7.46	13.07	59.83
NB5	21.34	0.15	0.33	1.87	3.38	15.60
NB7	6.38	0.04	0.10	0.58	1.13	4.53
Subtotal NB Proposed	326.99	1.96	4.99	30.17	67.31	222.55
Southbound						
SB1A	29.22	0.21	0.56	2.83	4.71	20.90
SB1B	28.91	0.20	0.54	2.74	4.57	20.85
SB2	20.34	0.14	0.37	1.88	3.31	14.64
SB5A	16.08	0.08	0.22	1.32	2.72	11.74
SB6	7.55	0.05	0.15	0.81	2.35	4.20
SB7	16.70	0.13	0.39	2.12	6.15	7.91
SB8	20.65	0.18	0.53	2.89	8.39	8.65
SB10	18.63	0.09	0.25	1.69	3.66	12.95
SB12	147.82	0.77	1.84	12.75	27.20	105.28
Subtotal SB Proposed	305.90	1.84	4.83	29.03	63.07	207.12
Total Proposed Crashes	632.88	3.81	9.82	59.21	130.38	429.67

Table: Predicted Average Annual Crash Frequency - Proposed Concepts Build to Future No-Build Comparison (2040)

Total Crashes	Total	K	A	B	C	PDO
Northbound						
NB1	-12.02	0.07	-0.05	-0.06	-0.68	-11.30
NB2A	-3.64	-0.06	-0.17	-0.93	-2.71	0.23
NB2B	1.12	0.01	0.01	0.11	0.21	0.78
NB3A	-3.13	-0.04	-0.19	-1.07	-2.76	0.93
NB3B	-2.05	-0.02	-0.06	-0.35	-0.93	-0.69
NB4	-2.49	0.09	0.06	0.44	0.48	-3.55
NB5	0.12	0.03	0.01	0.11	0.10	-0.13
NB7	-0.45	0.00	-0.01	-0.03	-0.06	-0.35
Subtotal Difference NB	-22.54	0.07	-0.40	-1.79	-6.35	-14.08
Southbound						
SB1A	-0.18	0.00	0.01	0.03	0.05	-0.28
SB1B	-0.49	0.00	-0.01	-0.05	-0.09	-0.34
SB2	-0.06	0.00	0.01	0.04	0.09	-0.20
SB5A	-0.66	-0.01	-0.01	-0.09	-0.18	-0.37
SB6	-4.01	-0.05	-0.14	-0.76	-2.19	-0.87
SB7	-16.48	-0.21	-0.64	-3.49	-10.14	-1.99
SB8	-7.94	-0.14	-0.43	-2.25	-4.71	-0.42
SB10	-3.38	0.00	-0.01	-0.04	-0.10	-3.23
SB12	-9.16	0.10	0.02	0.39	0.27	-9.93
Subtotal Difference SB	-42.34	-0.31	-1.21	-6.22	-17.00	-17.61
Total Difference Crashes	-64.89	-0.23	-1.61	-8.00	-23.35	-31.69

Output Summary									
General Information									
Project description:	I-270 @ MD 80 (SB 1A, SB 1B) - Future (2040) No-Build								
Analyst:	MLV	Date:	1/5/2017		Area type:		Urban		
First year of analysis:	2040								
Last year of analysis:	2040								
Crash Data Description									
Freeway segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp terminals	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		29.4	0.2	0.5	2.8	4.7	21.2
Estimated average crash freq. during Study Period, crashes/yr:		29.4	0.2	0.5	2.8	4.7	21.2
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	3	29.4	0.2	0.5	2.8	4.7	21.2
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	29.4	0.2	0.5	2.8	4.7	21.2
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
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	2059						
	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.4	0.0	0.0	0.1	0.1	0.3
	Rear-end crashes:	13.8	0.1	0.3	1.4	2.3	9.8
	Sideswipe crashes:	4.8	0.0	0.1	0.3	0.6	3.8
	Other multiple-vehicle crashes:	0.5	0.0	0.0	0.1	0.1	0.3
	Total multiple-vehicle crashes:	19.5	0.1	0.4	1.8	3.0	14.1
Single vehicle	Crashes with animal:	0.2	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	7.1	0.1	0.1	0.7	1.2	5.1
	Crashes with other object:	1.2	0.0	0.0	0.1	0.1	1.0
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	1.3	0.0	0.0	0.2	0.3	0.7
	Total single-vehicle crashes:	9.9	0.1	0.2	1.0	1.6	7.0
Total crashes:		29.4	0.2	0.5	2.8	4.7	21.2

Output Summary

General Information					
Project description:	I-270 SB Entrance Ramp from MD 80 - SB 1A Concept Future (2040) Build				
Analyst:	MLV	Date:	1/5/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	29.2	0.2	0.6	2.8	4.7	20.9
Estimated average crash freq. during Study Period, crashes/yr:	29.2	0.2	0.6	2.8	4.7	20.9

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	3	29.2	0.2	0.6	2.8	4.7	20.9
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	29.2	0.2	0.6	2.8	4.7	20.9
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
	2051						
	2052						
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	2054						
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	2056						
	2057						
	2058						
	2059						
	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.4	0.0	0.0	0.1	0.1	0.3
	Rear-end crashes:	13.8	0.1	0.3	1.4	2.3	9.7
	Sideswipe crashes:	4.8	0.0	0.1	0.3	0.6	3.8
	Other multiple-vehicle crashes:	0.5	0.0	0.0	0.1	0.1	0.3
	Total multiple-vehicle crashes:	19.5	0.1	0.4	1.8	3.1	14.1
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	6.9	0.1	0.1	0.7	1.2	4.9
	Crashes with other object:	1.1	0.0	0.0	0.1	0.1	1.0
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	1.3	0.0	0.0	0.2	0.3	0.7
	Total single-vehicle crashes:	9.7	0.1	0.2	1.0	1.6	6.8
Total crashes:		29.2	0.2	0.6	2.8	4.7	20.9

Output Summary

General Information							
Project description:	I-270 SB Exit Ramp to MD 80 - SB 1B Concept Future (2040) Build						
Analyst:	MLV	Date:	1/5/2017		Area type:	Urban	
First year of analysis:	2040						
Last year of analysis:	2040						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	28.9	0.2	0.5	2.7	4.6	20.8
Estimated average crash freq. during Study Period, crashes/yr:	28.9	0.2	0.5	2.7	4.6	20.8

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	3	28.9	0.2	0.5	2.7	4.6	20.8
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	28.9	0.2	0.5	2.7	4.6	20.8
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
	2051						
	2052						
	2053						
	2054						
	2055						
	2056						
	2057						
	2058						
	2059						
	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.4	0.0	0.0	0.1	0.1	0.3
	Rear-end crashes:	13.7	0.1	0.3	1.4	2.3	9.7
	Sideswipe crashes:	4.7	0.0	0.1	0.3	0.6	3.7
	Other multiple-vehicle crashes:	0.5	0.0	0.0	0.1	0.1	0.3
	Total multiple-vehicle crashes:	19.3	0.1	0.4	1.8	3.0	14.0
Single vehicle	Crashes with animal:	0.2	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	6.9	0.1	0.1	0.7	1.1	4.9
	Crashes with other object:	1.1	0.0	0.0	0.1	0.1	1.0
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	1.3	0.0	0.0	0.2	0.3	0.7
	Total single-vehicle crashes:	9.6	0.1	0.2	0.9	1.6	6.8
Total crashes:		28.9	0.2	0.5	2.7	4.6	20.8

Output Summary

General Information								
Project description:	I-270 @ MD 109 (SB 2) - Future (2040) No-Build							
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban		
First year of analysis:	2040							
Last year of analysis:	2040							

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	20.4	0.1	0.4	1.8	3.2	14.8
Estimated average crash freq. during Study Period, crashes/yr:	20.4	0.1	0.4	1.8	3.2	14.8

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	4	20.4	0.1	0.4	1.8	3.2	14.8
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	20.4	0.1	0.4	1.8	3.2	14.8
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
	2051						
	2052						
	2053						
	2054						
	2055						
	2056						
	2057						
	2058						
	2059						
	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	9.9	0.1	0.2	0.9	1.6	7.1
	Sideswipe crashes:	3.3	0.0	0.0	0.2	0.4	2.6
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	13.9	0.1	0.2	1.2	2.2	10.2
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.7	0.0	0.1	0.4	0.8	3.4
	Crashes with other object:	0.7	0.0	0.0	0.0	0.1	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.9	0.0	0.0	0.1	0.2	0.5
	Total single-vehicle crashes:	6.5	0.0	0.1	0.6	1.1	4.7
	Total crashes:	20.4	0.1	0.4	1.8	3.2	14.8

Output Summary							
General Information							
Project description:	I-270 SB Entrance Ramp from MD 109 - SB 2 Concept Future (2040) Build						
Analyst:	MLV	Date:	1/4/2017	Area type:		Urban	
First year of analysis:	2040						
Last year of analysis:	2040						
Crash Data Description							
Freeway segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp terminals	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		20.3	0.1	0.4	1.9	3.3	14.6
Estimated average crash freq. during Study Period, crashes/yr:		20.3	0.1	0.4	1.9	3.3	14.6
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	4	20.3	0.1	0.4	1.9	3.3	14.6
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	20.3	0.1	0.4	1.9	3.3	14.6
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
	2051						
	2052						
	2053						
	2054						
	2055						
	2056						
	2057						
	2058						
	2059						
	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	9.8	0.1	0.2	0.9	1.6	7.0
	Sideswipe crashes:	3.3	0.0	0.0	0.2	0.4	2.6
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	13.8	0.1	0.2	1.2	2.2	10.1
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.7	0.0	0.1	0.5	0.8	3.3
	Crashes with other object:	0.8	0.0	0.0	0.0	0.1	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.9	0.0	0.0	0.1	0.2	0.5
	Total single-vehicle crashes:	6.5	0.0	0.1	0.6	1.1	4.6
Total crashes:		20.3	0.1	0.4	1.9	3.3	14.6

Output Summary

General Information

Project description:	I-270 @ I-370 (SB 5A) - Future (2040) No-Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	16.7	0.1	0.2	1.4	2.9	12.1
Estimated average crash freq. during Study Period, crashes/yr:	16.7	0.1	0.2	1.4	2.9	12.1

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	1	16.7	0.1	0.2	1.4	2.9	12.1
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	16.7	0.1	0.2	1.4	2.9	12.1
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
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	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	8.1	0.0	0.1	0.7	1.5	5.7
	Sideswipe crashes:	2.8	0.0	0.0	0.2	0.4	2.2
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	11.5	0.1	0.2	1.0	2.0	8.3
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.8	0.0	0.1	0.3	0.7	2.7
	Crashes with other object:	0.6	0.0	0.0	0.0	0.0	0.5
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:	5.2	0.0	0.1	0.4	0.9	3.8
Total crashes:		16.7	0.1	0.2	1.4	2.9	12.1

Output Summary								
General Information								
Project description:	I-270 SB Exit Ramp to I-370 - SB 5A Concept Future (2040) Build							
Analyst:	MLV	Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			16.1	0.1	0.2	1.3	2.7	11.7
Estimated average crash freq. during Study Period, crashes/yr:			16.1	0.1	0.2	1.3	2.7	11.7
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		1	16.1	0.1	0.2	1.3	2.7	11.7
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2040	16.1	0.1	0.2	1.3	2.7	11.7
		2041						
		2042						
		2043						
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		2046						
		2047						
		2048						
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		2061						
		2062						
		2063						
Distribution of Crashes for Entire Facility								
Crash Type	**Crash Type Category**		**Estimated Number of Crashes During the Study Period**					
			Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:		0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:		0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:		8.1	0.0	0.1	0.7	1.5	5.7
	Sideswipe crashes:		2.8	0.0	0.0	0.2	0.4	2.2
	Other multiple-vehicle crashes:		0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:		11.5	0.1	0.2	1.0	2.0	8.3
Single vehicle	Crashes with animal:		0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:		3.3	0.0	0.0	0.3	0.5	2.5
	Crashes with other object:		0.5	0.0	0.0	0.0	0.0	0.5
	Crashes with parked vehicle:		0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes		0.6	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:		4.6	0.0	0.1	0.4	0.7	3.4
Total crashes:			16.1	0.1	0.2	1.3	2.7	11.7

Output Summary

General Information							
Project description:	I-270 SB Slip Ramps Between Shady Grove Rd and MD 28 (SB 6) - Future (2040) No-Build						
Analyst:	LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2040						
Last year of analysis:	2040						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		11.6	0.1	0.3	1.6	4.5	5.1
Estimated average crash freq. during Study Period, crashes/yr:		11.6	0.1	0.3	1.6	4.5	5.1
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	11.6	0.1	0.3	1.6	4.5	5.1
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	11.6	0.1	0.3	1.6	4.5	5.1
	2041						
	2042						
	2043						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.1	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Rear-end crashes:	6.8	0.1	0.2	1.0	3.0	2.5
	Sideswipe crashes:	2.3	0.0	0.0	0.2	0.6	1.5
	Other multiple-vehicle crashes:	1.3	0.0	0.0	0.2	0.6	0.5
	Total multiple-vehicle crashes:	10.6	0.1	0.3	1.5	4.3	4.5
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	0.8	0.0	0.0	0.1	0.2	0.5
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.0	0.0	0.0	0.1	0.3	0.6
Total crashes:		11.6	0.1	0.3	1.6	4.5	5.1

Output Summary

General Information

Project description:	I-270 SB Slips Ramps Between Shady Grove Rd and MD 28 - SB 6 Concept Future (2040) Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	7.6	0.0	0.1	0.8	2.3	4.2
Estimated average crash freq. during Study Period, crashes/yr:	7.6	0.0	0.1	0.8	2.3	4.2

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	7.6	0.0	0.1	0.8	2.3	4.2
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	7.6	0.0	0.1	0.8	2.3	4.2
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
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	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Rear-end crashes:	4.1	0.0	0.1	0.5	1.5	2.0
	Sideswipe crashes:	1.6	0.0	0.0	0.1	0.3	1.2
	Other multiple-vehicle crashes:	0.8	0.0	0.0	0.1	0.3	0.4
	Total multiple-vehicle crashes:	6.6	0.0	0.1	0.7	2.1	3.6
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	0.7	0.0	0.0	0.1	0.2	0.5
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	0.9	0.0	0.0	0.1	0.3	0.6
Total crashes:		7.6	0.0	0.1	0.8	2.3	4.2

Output Summary								
General Information								
Project description:	I-270 SB Local Lanes Between MD 28 and MD 189 (SB 7) - Future (2040) No-Build							
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban		
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			33.2	0.3	1.0	5.6	16.3	9.9
Estimated average crash freq. during Study Period, crashes/yr:			33.2	0.3	1.0	5.6	16.3	9.9
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:		4	33.2	0.3	1.0	5.6	16.3	9.9
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2040	33.2	0.3	1.0	5.6	16.3	9.9
		2041						
		2042						
		2043						
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		2046						
		2047						
		2048						
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Distribution of Crashes for Entire Facility								
Crash Type	**Crash Type Category**		**Estimated Number of Crashes During the Study Period**					
			Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:		0.4	0.0	0.0	0.1	0.2	0.1
	Right-angle crashes:		0.3	0.0	0.0	0.1	0.2	0.0
	Rear-end crashes:		20.7	0.2	0.7	3.8	11.1	4.8
	Sideswipe crashes:		5.9	0.0	0.1	0.7	2.0	3.0
	Other multiple-vehicle crashes:		4.0	0.0	0.1	0.8	2.2	0.9
	Total multiple-vehicle crashes:		31.3	0.3	1.0	5.4	15.7	8.8
Single vehicle	Crashes with animal:		0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:		1.5	0.0	0.0	0.1	0.4	0.9
	Crashes with other object:		0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:		0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes		0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:		1.9	0.0	0.0	0.2	0.5	1.1
Total crashes:			33.2	0.3	1.0	5.6	16.3	9.9

Output Summary

General Information								
Project description:	I-270 SB Local Lanes Between MD 28 and MD 189 - SB 7 Concept Future (2040) Build							
Analyst:	MLV	Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	16.7	0.1	0.4	2.1	6.1	7.9
Estimated average crash freq. during Study Period, crashes/yr:	16.7	0.1	0.4	2.1	6.1	7.9

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	4	16.7	0.1	0.4	2.1	6.1	7.9
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	16.7	0.1	0.4	2.1	6.1	7.9
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
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	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	9.3	0.1	0.2	1.3	3.9	3.8
	Sideswipe crashes:	3.3	0.0	0.0	0.2	0.7	2.3
	Other multiple-vehicle crashes:	1.8	0.0	0.0	0.3	0.8	0.7
	Total multiple-vehicle crashes:	14.7	0.1	0.3	1.9	5.5	6.8
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.6	0.0	0.0	0.2	0.5	0.9
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.4	0.0	0.0	0.1	0.2	0.1
	Total single-vehicle crashes:	2.0	0.0	0.0	0.2	0.7	1.1
	Total crashes:	16.7	0.1	0.4	2.1	6.1	7.9

Output Summary								
General Information								
Project description:	I-270 SB Local Lanes Between MD 189 and Montrose Rd (SB 8) - Future (2040) No-Build							
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban		
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			22.0	0.2	0.7	3.6	9.3	8.2
Estimated average crash freq. during Study Period, crashes/yr:			22.0	0.2	0.7	3.6	9.3	8.2
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:		3	22.0	0.2	0.7	3.6	9.3	8.2
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2040	22.0	0.2	0.7	3.6	9.3	8.2
		2041						
		2042						
		2043						
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		2046						
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Distribution of Crashes for Entire Facility								
Crash Type	**Crash Type Category**		**Estimated Number of Crashes During the Study Period**					
			Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:		0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:		0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:		13.3	0.2	0.5	2.5	6.3	4.0
	Sideswipe crashes:		4.1	0.0	0.1	0.4	1.1	2.4
	Other multiple-vehicle crashes:		2.6	0.0	0.1	0.5	1.2	0.7
	Total multiple-vehicle crashes:		20.5	0.2	0.7	3.5	8.9	7.2
Single vehicle	Crashes with animal:		0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:		1.2	0.0	0.0	0.1	0.3	0.8
	Crashes with other object:		0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:		0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes		0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:		1.6	0.0	0.0	0.2	0.4	0.9
Total crashes:			22.0	0.2	0.7	3.6	9.3	8.2

Output Summary								
General Information								
Project description:	I-270 SB Local Lanes Between MD 189 and Montrose Rd - SB 8 Concept Future (2040) Build							
Analyst:	MLV	Date:	1/5/2017		Area type:		Urban	
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?		No		First year of crash data:			
	Project-level crash data available?		No		Last year of crash data:			
Ramp segments	Segment crash data available?		No		First year of crash data:			
	Project-level crash data available?		No		Last year of crash data:			
Ramp terminals	Segment crash data available?		No		First year of crash data:			
	Project-level crash data available?		No		Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			20.6	0.2	0.5	2.9	8.4	8.7
Estimated average crash freq. during Study Period, crashes/yr:			20.6	0.2	0.5	2.9	8.4	8.7
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:		3	20.6	0.2	0.5	2.9	8.4	8.7
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2040	20.6	0.2	0.5	2.9	8.4	8.7
		2041						
		2042						
		2043						
		2044						
		2045						
		2046						
		2047						
		2048						
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		2063						
Distribution of Crashes for Entire Facility								
Crash Type	**Crash Type Category**		**Estimated Number of Crashes During the Study Period**					
			Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:		0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:		0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:		12.1	0.1	0.4	1.9	5.5	4.2
	Sideswipe crashes:		4.0	0.0	0.1	0.3	1.0	2.5
	Other multiple-vehicle crashes:		2.3	0.0	0.1	0.4	1.1	0.8
	Total multiple-vehicle crashes:		18.8	0.2	0.5	2.7	7.8	7.6
Single vehicle	Crashes with animal:		0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:		1.4	0.0	0.0	0.1	0.4	0.9
	Crashes with other object:		0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:		0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes		0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:		1.8	0.0	0.0	0.2	0.6	1.0
Total crashes:			20.6	0.2	0.5	2.9	8.4	8.7

Output Summary

General Information								
Project description:	I-270 SB West Spur at Merge with I-495 Outer Loop (SB 10) - Future (2040) No-Build							
Analyst:	MLV	Date:	1/4/2017		Area type:	Urban		
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?		No	First year of crash data:				
	Project-level crash data available?		No	Last year of crash data:				
Ramp segments	Segment crash data available?		No	First year of crash data:				
	Project-level crash data available?		No	Last year of crash data:				
Ramp terminals	Segment crash data available?		No	First year of crash data:				
	Project-level crash data available?		No	Last year of crash data:				
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			22.0	0.1	0.3	1.7	3.8	16.2
Estimated average crash freq. during Study Period, crashes/yr:			22.0	0.1	0.3	1.7	3.8	16.2
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		3	22.0	0.1	0.3	1.7	3.8	16.2
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2040	22.0	0.1	0.3	1.7	3.8	16.2
		2041						
		2042						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	11.0	0.0	0.1	0.9	1.9	8.0
	Sideswipe crashes:	3.8	0.0	0.0	0.2	0.5	3.1
	Other multiple-vehicle crashes:	0.4	0.0	0.0	0.0	0.1	0.3
	Total multiple-vehicle crashes:	15.6	0.1	0.2	1.2	2.6	11.6
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.6	0.0	0.1	0.4	0.9	3.3
	Crashes with other object:	0.7	0.0	0.0	0.0	0.1	0.6
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.9	0.0	0.0	0.1	0.2	0.5
	Total single-vehicle crashes:	6.4	0.0	0.1	0.5	1.2	4.5
Total crashes:		22.0	0.1	0.3	1.7	3.8	16.2

Output Summary

General Information

Project description:	I-270 SB West Spur at Merge with I-495 Outer Loop - SB 10 Concept Future (2040) Build				
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	18.6	0.1	0.2	1.7	3.7	12.9
Estimated average crash freq. during Study Period, crashes/yr:	18.6	0.1	0.2	1.7	3.7	12.9

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	3	18.6	0.1	0.2	1.7	3.7	12.9
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	18.6	0.1	0.2	1.7	3.7	12.9
	2041						
	2042						
	2043						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	9.5	0.0	0.1	0.9	1.9	6.5
	Sideswipe crashes:	3.4	0.0	0.0	0.2	0.5	2.7
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	13.6	0.1	0.2	1.2	2.6	9.7
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.6	0.0	0.1	0.4	0.8	2.3
	Crashes with other object:	0.6	0.0	0.0	0.0	0.1	0.5
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	5.0	0.0	0.1	0.5	1.1	3.3
Total crashes:		18.6	0.1	0.2	1.7	3.7	12.9

Output Summary

Output Summary							
General Information							
Project description:	I-270 SB West Spur Between MD 189 and Democracy Blvd (SB 12) - Future (2040) No-Build						
Analyst:	MLV, LW	Date:	1/5/2017		Area type:	Urban	
First year of analysis:	2040						
Last year of analysis:	2040						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		157.0	0.7	1.8	12.4	26.9	115.2
Estimated average crash freq. during Study Period, crashes/yr:		157.0	0.7	1.8	12.4	26.9	115.2
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	16	157.0	0.7	1.8	12.4	26.9	115.2
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	157.0	0.7	1.8	12.4	26.9	115.2
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	2042						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.4	0.0	0.0	0.1	0.1	0.2
	Right-angle crashes:	2.4	0.0	0.0	0.3	0.6	1.5
	Rear-end crashes:	78.0	0.4	1.0	6.5	14.2	56.0
	Sideswipe crashes:	27.1	0.1	0.2	1.6	3.4	21.8
	Other multiple-vehicle crashes:	2.8	0.0	0.0	0.3	0.6	1.9
	Total multiple-vehicle crashes:	110.6	0.5	1.3	8.6	18.9	81.4
Single vehicle	Crashes with animal:	0.8	0.0	0.0	0.0	0.0	0.7
	Crashes with fixed object:	33.3	0.1	0.4	2.7	5.8	24.2
	Crashes with other object:	5.4	0.0	0.0	0.2	0.4	4.8
	Crashes with parked vehicle:	0.7	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes	6.2	0.0	0.1	0.8	1.7	3.6
	Total single-vehicle crashes:	46.4	0.2	0.5	3.7	8.1	33.8
Total crashes:		157.0	0.7	1.8	12.4	26.9	115.2

Output Summary

General Information							
Project description:	I-270 SB West Spur Between MD 189 and Democracy Blvd - SB 12 Concept Future (2040) Build						
Analyst:	MLV, LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2040						
Last year of analysis:	2040						
Crash Data Description							
Freeway segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp segments	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		
Ramp terminals	Segment crash data available?			No	First year of crash data:		
	Project-level crash data available?			No	Last year of crash data:		

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		147.8	0.8	1.8	12.7	27.2	105.3
Estimated average crash freq. during Study Period, crashes/yr:		147.8	0.8	1.8	12.7	27.2	105.3
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	16	147.8	0.8	1.8	12.7	27.2	105.3
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	147.8	0.8	1.8	12.7	27.2	105.3
	2041						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.4	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:	2.2	0.0	0.0	0.3	0.6	1.3
	Rear-end crashes:	70.4	0.4	0.9	6.3	13.5	49.3
	Sideswipe crashes:	24.3	0.1	0.2	1.5	3.3	19.2
	Other multiple-vehicle crashes:	2.5	0.0	0.0	0.3	0.5	1.7
	Total multiple-vehicle crashes:	99.8	0.5	1.2	8.4	18.0	71.6
Single vehicle	Crashes with animal:	0.8	0.0	0.0	0.0	0.0	0.7
	Crashes with fixed object:	34.5	0.2	0.4	3.1	6.6	24.1
	Crashes with other object:	5.5	0.0	0.0	0.2	0.5	4.7
	Crashes with parked vehicle:	0.7	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes	6.6	0.1	0.1	0.9	1.9	3.6
	Total single-vehicle crashes:	48.1	0.3	0.6	4.3	9.2	33.7
Total crashes:		147.8	0.8	1.8	12.7	27.2	105.3

Output Summary								
General Information								
Project description:	I-270 NB West Spur Between Democracy Blvd and MD 189 (NB 1) - Future (2040) No-Build							
Analyst:	MLV	Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		148.2	0.6	1.7	11.7	25.7	108.5
Estimated average crash freq. during Study Period, crashes/yr:		148.2	0.6	1.7	11.7	25.7	108.5
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	12	148.2	0.6	1.7	11.7	25.7	108.5
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	148.2	0.6	1.7	11.7	25.7	108.5
	2041						
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Distribution of Crashes for Entire Facility							
Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.4	0.0	0.0	0.1	0.1	0.2
	Right-angle crashes:	2.2	0.0	0.0	0.2	0.5	1.4
	Rear-end crashes:	73.3	0.3	0.9	6.1	13.4	52.7
	Sideswipe crashes:	25.3	0.1	0.2	1.5	3.2	20.4
	Other multiple-vehicle crashes:	2.7	0.0	0.0	0.2	0.5	1.8
	Total multiple-vehicle crashes:	103.9	0.4	1.2	8.1	17.8	76.4
Single vehicle	Crashes with animal:	0.7	0.0	0.0	0.0	0.0	0.7
	Crashes with fixed object:	31.7	0.1	0.4	2.6	5.7	23.0
	Crashes with other object:	5.1	0.0	0.0	0.2	0.4	4.5
	Crashes with parked vehicle:	0.7	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes	6.0	0.0	0.1	0.7	1.6	3.4
	Total single-vehicle crashes:	44.2	0.2	0.5	3.6	7.8	32.1
Total crashes:		148.2	0.6	1.7	11.7	25.7	108.5

Output Summary

General Information						
Project description:	I-270 NB West Spur Between Democracy Blvd and MD 189 - NB 1 Concept Future (2040) Build					
Analyst:	MLV	Date:	1/4/2017	Area type:	Urban	
First year of analysis:	2040					
Last year of analysis:	2040					

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:		136.1	0.7	1.7	11.6	25.0	97.2
Estimated average crash freq. during Study Period, crashes/yr:		136.1	0.7	1.7	11.6	25.0	97.2
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	12	136.1	0.7	1.7	11.6	25.0	97.2
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	136.1	0.7	1.7	11.6	25.0	97.2
	2041						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.1	0.1
	Right-angle crashes:	2.0	0.0	0.0	0.2	0.5	1.2
	Rear-end crashes:	65.4	0.4	0.8	5.9	12.7	45.7
	Sideswipe crashes:	22.4	0.1	0.2	1.4	3.0	17.7
	Other multiple-vehicle crashes:	2.4	0.0	0.0	0.2	0.5	1.6
	Total multiple-vehicle crashes:	92.5	0.5	1.1	7.8	16.9	66.3
Single vehicle	Crashes with animal:	0.7	0.0	0.0	0.0	0.0	0.7
	Crashes with fixed object:	31.3	0.2	0.4	2.7	5.9	22.1
	Crashes with other object:	5.0	0.0	0.0	0.2	0.4	4.3
	Crashes with parked vehicle:	0.7	0.0	0.0	0.1	0.1	0.5
	Other single-vehicle crashes	5.9	0.0	0.1	0.8	1.7	3.3
	Total single-vehicle crashes:	43.6	0.2	0.5	3.8	8.1	30.9
Total crashes:		136.1	0.7	1.7	11.6	25.0	97.2

Output Summary

General Information

Project description:	I-270 NB Local Lanes Betweeen MD 189 and MD 28 (NB 2A) - Future (2040) No-Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	24.6	0.2	0.7	3.9	11.2	8.6
Estimated average crash freq. during Study Period, crashes/yr:	24.6	0.2	0.7	3.9	11.2	8.6

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	24.6	0.2	0.7	3.9	11.2	8.6
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	24.6	0.2	0.7	3.9	11.2	8.6
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
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	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.1	0.2	0.1
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	15.2	0.2	0.5	2.6	7.7	4.2
	Sideswipe crashes:	4.6	0.0	0.1	0.5	1.4	2.6
	Other multiple-vehicle crashes:	2.9	0.0	0.1	0.5	1.5	0.8
	Total multiple-vehicle crashes:	23.1	0.2	0.7	3.7	10.8	7.6
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.2	0.0	0.0	0.1	0.3	0.8
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.5	0.0	0.0	0.1	0.4	0.9
Total crashes:		24.6	0.2	0.7	3.9	11.2	8.6

Output Summary

General Information									
Project description:	I-270 NB Local Lanes Between MD 189 and MD 28 - NB 2A Concept Future (2040) Build								
Analyst:	LW	Date:	1/4/2017		Area type:		Urban		
First year of analysis:	2040								
Last year of analysis:	2040								

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	21.0	0.2	0.5	2.9	8.5	8.8
Estimated average crash freq. during Study Period, crashes/yr:	21.0	0.2	0.5	2.9	8.5	8.8

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	3	21.0	0.2	0.5	2.9	8.5	8.8
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	21.0	0.2	0.5	2.9	8.5	8.8
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
	2051						
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	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.0
	Rear-end crashes:	12.3	0.1	0.4	1.9	5.6	4.3
	Sideswipe crashes:	4.1	0.0	0.1	0.4	1.0	2.6
	Other multiple-vehicle crashes:	2.4	0.0	0.1	0.4	1.1	0.8
	Total multiple-vehicle crashes:	19.1	0.2	0.5	2.7	8.0	7.8
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.5	0.0	0.0	0.1	0.4	0.9
	Crashes with other object:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.3	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.9	0.0	0.0	0.2	0.6	1.1
Total crashes:		21.0	0.2	0.5	2.9	8.5	8.8

Output Summary

General Information								
Project description:	I-270 NB Express Lanes at MD 28 Interchange (NB 2B) - Future (2040) No-Build							
Analyst:	LW	Date:	1/4/2017		Area type:	Urban		
First year of analysis:	2040							
Last year of analysis:	2040							

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		15.0	0.1	0.2	1.1	2.7	11.0
Estimated average crash freq. during Study Period, crashes/yr:		15.0	0.1	0.2	1.1	2.7	11.0
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	5	15.0	0.1	0.2	1.1	2.7	11.0
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	15.0	0.1	0.2	1.1	2.7	11.0
	2041						
	2042						
	2043						
	2044						
	2045						
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	2047						
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	7.6	0.0	0.1	0.6	1.4	5.4
	Sideswipe crashes:	2.6	0.0	0.0	0.1	0.3	2.1
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	10.7	0.0	0.1	0.8	1.9	7.8
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.1	0.0	0.0	0.2	0.6	2.3
	Crashes with other object:	0.5	0.0	0.0	0.0	0.0	0.4
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.6	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	4.4	0.0	0.0	0.3	0.8	3.1
Total crashes:		15.0	0.1	0.2	1.1	2.7	11.0

Output Summary

General Information									
Project description:	I-270 NB Express Lanes at MD 28 Interchange - NB 2B Concept Future (2040) Build								
Analyst:	LW	Date:	1/4/2017		Area type:		Urban		
First year of analysis:	2040								
Last year of analysis:	2040								
Crash Data Description									
Freeway segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp segments	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Ramp terminals	Segment crash data available?			No	First year of crash data:				
	Project-level crash data available?			No	Last year of crash data:				
Estimated Crash Statistics									
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**	
Estimated number of crashes during Study Period, crashes:			16.2	0.1	0.2	1.3	2.9	11.8	
Estimated average crash freq. during Study Period, crashes/yr:			16.2	0.1	0.2	1.3	2.9	11.8	
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**	
Freeway segments, crashes:		5	16.2	0.1	0.2	1.3	2.9	11.8	
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0	
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0	
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**	
Estimated number of crashes during the Study Period, crashes:		2040	16.2	0.1	0.2	1.3	2.9	11.8	
		2041							
		2042							
		2043							
		2044							
		2045							
		2046							
		2047							
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Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	8.0	0.0	0.1	0.6	1.5	5.7
	Sideswipe crashes:	2.8	0.0	0.0	0.2	0.4	2.2
	Other multiple-vehicle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:	11.3	0.0	0.1	0.9	2.0	8.3
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	3.5	0.0	0.0	0.3	0.7	2.5
	Crashes with other object:	0.6	0.0	0.0	0.0	0.0	0.5
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.7	0.0	0.0	0.1	0.2	0.4
	Total single-vehicle crashes:	4.8	0.0	0.1	0.4	0.9	3.4
Total crashes:		16.2	0.1	0.2	1.3	2.9	11.8

Output Summary

General Information

Project description:	I-270 NB Entrance Ramp from NB Shady Grove Rd - Loop Ramp (NB 3A) - Future (2040) No-Build				
Analyst:	KEB	Date:	1/5/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	31.9	0.2	0.7	4.0	12.1	15.0
Estimated average crash freq. during Study Period, crashes/yr:	31.9	0.2	0.7	4.0	12.1	15.0

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	4	18.9	0.2	0.5	2.9	7.3	8.1
Crossroad ramp terminals, crashes:	1	13.0	0.0	0.2	1.1	4.8	6.9

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	31.9	0.2	0.7	4.0	12.1	15.0
	2041						
	2042						
	2043						
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	2047						
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	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	3.2	0.0	0.1	0.3	1.3	1.6
	Rear-end crashes:	17.2	0.1	0.4	2.3	7.5	6.9
	Sideswipe crashes:	4.4	0.0	0.1	0.4	1.0	2.9
	Other multiple-vehicle crashes:	2.1	0.0	0.1	0.3	0.9	0.7
	Total multiple-vehicle crashes:	27.2	0.2	0.6	3.4	10.9	12.1
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	3.7	0.0	0.1	0.4	0.8	2.4
	Crashes with other object:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.9	0.0	0.0	0.1	0.3	0.4
	Total single-vehicle crashes:	4.7	0.0	0.1	0.6	1.2	2.9
Total crashes:		31.9	0.2	0.7	4.0	12.1	15.0

Output Summary

General Information

Project description:	I-270 NB Entrance Ramp from NB Shady Grove Rd - Loop Ramp - NB 3A Concept Future (2040) Build				
Analyst:	KEB	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	28.8	0.1	0.5	2.9	9.3	15.9
Estimated average crash freq. during Study Period, crashes/yr:	28.8	0.1	0.5	2.9	9.3	15.9

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Ramp segments, crashes:	6	14.9	0.1	0.4	2.2	5.7	6.4
Crossroad ramp terminals, crashes:	1	13.9	0.0	0.1	0.7	3.6	9.5

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	28.8	0.1	0.5	2.9	9.3	15.9
	2041						
	2042						
	2043						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.3	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	3.3	0.0	0.0	0.2	1.0	2.1
	Rear-end crashes:	16.2	0.1	0.3	1.8	5.9	8.1
	Sideswipe crashes:	4.4	0.0	0.1	0.3	0.8	3.2
	Other multiple-vehicle crashes:	1.8	0.0	0.1	0.3	0.8	0.7
	Total multiple-vehicle crashes:	26.0	0.1	0.5	2.6	8.6	14.2
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	2.1	0.0	0.0	0.2	0.5	1.4
	Crashes with other object:	0.1	0.0	0.0	0.0	0.0	0.0
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.5	0.0	0.0	0.1	0.2	0.2
	Total single-vehicle crashes:	2.7	0.0	0.0	0.3	0.7	1.7
Total crashes:		28.8	0.1	0.5	2.9	9.3	15.9

Output Summary

General Information

Project description:	I-270 NB Slip Ramp to Express Lanes South of I-370 (NB 3B) - Future (2040) No-Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	16.9	0.1	0.3	1.9	4.9	9.6
Estimated average crash freq. during Study Period, crashes/yr:	16.9	0.1	0.3	1.9	4.9	9.6

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	2	7.6	0.0	0.1	0.7	1.4	5.4
Ramp segments, crashes:	3	9.3	0.1	0.2	1.2	3.6	4.2
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	16.9	0.1	0.3	1.9	4.9	9.6
	2041						
	2042						
	2043						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.1	0.0
	Right-angle crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Rear-end crashes:	8.9	0.1	0.2	1.2	3.0	4.4
	Sideswipe crashes:	3.1	0.0	0.0	0.2	0.6	2.2
	Other multiple-vehicle crashes:	1.1	0.0	0.0	0.2	0.5	0.4
	Total multiple-vehicle crashes:	13.4	0.1	0.3	1.6	4.2	7.2
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	2.5	0.0	0.0	0.2	0.5	1.7
	Crashes with other object:	0.3	0.0	0.0	0.0	0.0	0.3
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.5	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	3.5	0.0	0.1	0.3	0.7	2.4
Total crashes:		16.9	0.1	0.3	1.9	4.9	9.6

Output Summary							
General Information							
Project description:	I-270 NB Slip Ramp to Express Lanes South of I-370 - NB 3B Concept Future (2040) Build						
Analyst:	LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2040						
Last year of analysis:	2040						
Crash Data Description							
Freeway segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp segments	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			
Ramp terminals	Segment crash data available?		No	First year of crash data:			
	Project-level crash data available?		No	Last year of crash data:			

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		14.8	0.1	0.3	1.6	4.0	8.9
Estimated average crash freq. during Study Period, crashes/yr:		14.8	0.1	0.3	1.6	4.0	8.9
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	2	7.1	0.0	0.1	0.6	1.2	5.1
Ramp segments, crashes:	2	7.7	0.1	0.2	1.0	2.8	3.8
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	14.8	0.1	0.3	1.6	4.0	8.9
	2041						
	2042						
	2043						
	2044						
	2045						
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	2047						
	2048						
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	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	7.2	0.1	0.2	0.9	2.4	3.8
	Sideswipe crashes:	2.5	0.0	0.0	0.2	0.5	1.9
	Other multiple-vehicle crashes:	0.9	0.0	0.0	0.1	0.4	0.4
	Total multiple-vehicle crashes:	11.0	0.1	0.2	1.2	3.3	6.2
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	2.8	0.0	0.0	0.2	0.5	2.0
	Crashes with other object:	0.4	0.0	0.0	0.0	0.0	0.3
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.5	0.0	0.0	0.1	0.2	0.3
	Total single-vehicle crashes:	3.9	0.0	0.1	0.3	0.7	2.8
Total crashes:		14.8	0.1	0.3	1.6	4.0	8.9

Output Summary							
General Information							
Project description:	I-270 NB Entrance Ramp from MD 124 / Local Lanes (NB 4) - Future (2040) No-Build						
Analyst:	LW	Date:	1/4/2017		Area type:	Urban	
First year of analysis:	2040						
Last year of analysis:	2040						

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics							
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		84.8	0.5	1.3	7.0	12.6	63.4
Estimated average crash freq. during Study Period, crashes/yr:		84.8	0.5	1.3	7.0	12.6	63.4
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	6	84.8	0.5	1.3	7.0	12.6	63.4
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	84.8	0.5	1.3	7.0	12.6	63.4
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
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	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility							
Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	1.4	0.0	0.0	0.2	0.3	0.9
	Rear-end crashes:	46.4	0.3	0.8	4.2	7.5	33.6
	Sideswipe crashes:	15.8	0.1	0.2	1.0	1.8	12.7
	Other multiple-vehicle crashes:	1.7	0.0	0.0	0.2	0.3	1.2
	Total multiple-vehicle crashes:	65.5	0.4	1.1	5.6	10.0	48.5
Single vehicle	Crashes with animal:	0.3	0.0	0.0	0.0	0.0	0.3
	Crashes with fixed object:	13.9	0.1	0.2	1.0	1.9	10.7
	Crashes with other object:	2.3	0.0	0.0	0.1	0.1	2.1
	Crashes with parked vehicle:	0.3	0.0	0.0	0.0	0.0	0.2
	Other single-vehicle crashes	2.5	0.0	0.1	0.3	0.5	1.6
	Total single-vehicle crashes:	19.3	0.1	0.3	1.4	2.6	14.9
Total crashes:		84.8	0.5	1.3	7.0	12.6	63.4

Output Summary								
General Information								
Project description:	I-270 NB Entrance Ramp from MD 124 / Local Lanes - NB 4 Concept Future (2040) Build							
Analyst:	LW	Date:	1/4/2017		Area type:		Urban	
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			82.4	0.6	1.4	7.5	13.1	59.8
Estimated average crash freq. during Study Period, crashes/yr:			82.4	0.6	1.4	7.5	13.1	59.8
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		6	82.4	0.6	1.4	7.5	13.1	59.8
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:		2040	82.4	0.6	1.4	7.5	13.1	59.8
		2041						
		2042						
		2043						
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		2046						
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		2062						
		2063						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.2	0.0	0.0	0.0	0.1	0.1
	Right-angle crashes:	1.3	0.0	0.0	0.2	0.3	0.8
	Rear-end crashes:	42.9	0.3	0.8	4.2	7.4	30.2
	Sideswipe crashes:	14.5	0.1	0.2	1.0	1.8	11.4
	Other multiple-vehicle crashes:	1.6	0.0	0.0	0.2	0.3	1.0
	Total multiple-vehicle crashes:	60.5	0.4	1.1	5.6	9.8	43.6
Single vehicle	Crashes with animal:	0.4	0.0	0.0	0.0	0.0	0.4
	Crashes with fixed object:	15.7	0.1	0.3	1.3	2.3	11.7
	Crashes with other object:	2.5	0.0	0.0	0.1	0.2	2.2
	Crashes with parked vehicle:	0.3	0.0	0.0	0.0	0.0	0.2
	Other single-vehicle crashes	2.9	0.0	0.1	0.4	0.7	1.7
	Total single-vehicle crashes:	21.8	0.1	0.3	1.8	3.2	16.3
Total crashes:		82.4	0.6	1.4	7.5	13.1	59.8

Output Summary

General Information						
Project description:	I-270 NB from MD 121 to MD 109 (NB 5) - Future (2040) No-Build					
Analyst:	LW	Date:	1/5/2017	Area type:	Urban	
First year of analysis:	2040					
Last year of analysis:	2040					

Crash Data Description				
Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:	21.2	0.1	0.3	1.8	3.3	15.7
Estimated average crash freq. during Study Period, crashes/yr:	21.2	0.1	0.3	1.8	3.3	15.7

Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	4	21.2	0.1	0.3	1.8	3.3	15.7
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during the Study Period, crashes:	2040	21.2	0.1	0.3	1.8	3.3	15.7
	2041						
	2042						
	2043						
	2044						
	2045						
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	2047						
	2048						
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	2063						

Distribution of Crashes for Entire Facility

Crash Type	**Crash Type Category**	**Estimated Number of Crashes During the Study Period**					
		Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:	0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:	10.1	0.1	0.2	0.9	1.8	7.2
	Sideswipe crashes:	3.5	0.0	0.0	0.2	0.4	2.8
	Other multiple-vehicle crashes:	0.4	0.0	0.0	0.0	0.1	0.3
	Total multiple-vehicle crashes:	14.4	0.1	0.2	1.3	2.3	10.4
Single vehicle	Crashes with animal:	0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:	4.9	0.0	0.1	0.4	0.7	3.8
	Crashes with other object:	0.8	0.0	0.0	0.0	0.0	0.7
	Crashes with parked vehicle:	0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes	0.9	0.0	0.0	0.1	0.2	0.6
	Total single-vehicle crashes:	6.9	0.0	0.1	0.5	0.9	5.3
	Total crashes:	21.2	0.1	0.3	1.8	3.3	15.7

Output Summary								
General Information								
Project description:	I-270 NB from MD 121 to MD 109 - NB 5 Concept Future (2040) Build							
Analyst:	LW	Date:	1/5/2017		Area type:		Urban	
First year of analysis:	2040							
Last year of analysis:	2040							
Crash Data Description								
Freeway segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp segments	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Ramp terminals	Segment crash data available?			No	First year of crash data:			
	Project-level crash data available?			No	Last year of crash data:			
Estimated Crash Statistics								
Crashes for Entire Facility			**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:			21.3	0.2	0.3	1.9	3.4	15.6
Estimated average crash freq. during Study Period, crashes/yr:			21.3	0.2	0.3	1.9	3.4	15.6
Crashes by Facility Component		**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:		4	21.3	0.2	0.3	1.9	3.4	15.6
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		**Year**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during		2040	21.3	0.2	0.3	1.9	3.4	15.6
the Study Period, crashes:		2041						
		2042						
		2043						
		2044						
		2045						
		2046						
		2047						
		2048						
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Distribution of Crashes for Entire Facility								
Crash Type	**Crash Type Category**		**Estimated Number of Crashes During the Study Period**					
			Total	**K**	**A**	**B**	**C**	**PDO**
Multiple vehicle	Head-on crashes:		0.1	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:		0.3	0.0	0.0	0.0	0.1	0.2
	Rear-end crashes:		10.0	0.1	0.2	1.0	1.8	7.0
	Sideswipe crashes:		3.4	0.0	0.0	0.2	0.4	2.7
	Other multiple-vehicle crashes:		0.4	0.0	0.0	0.0	0.1	0.2
	Total multiple-vehicle crashes:		14.2	0.1	0.2	1.3	2.4	10.1
Single vehicle	Crashes with animal:		0.1	0.0	0.0	0.0	0.0	0.1
	Crashes with fixed object:		5.2	0.0	0.1	0.4	0.7	4.0
	Crashes with other object:		0.9	0.0	0.0	0.0	0.1	0.8
	Crashes with parked vehicle:		0.1	0.0	0.0	0.0	0.0	0.1
	Other single-vehicle crashes		0.9	0.0	0.0	0.1	0.2	0.6
	Total single-vehicle crashes:		7.2	0.0	0.1	0.5	1.0	5.5
Total crashes:			21.3	0.2	0.3	1.9	3.4	15.6

Output Summary

General Information

Project description:	I-270 NB at MD 118 Interchange (NB 7) - Future (2040) No-Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	6.8	0.0	0.1	0.6	1.2	4.9
Estimated average crash freq. during Study Period, crashes/yr:	6.8	0.0	0.1	0.6	1.2	4.9

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	1	6.8	0.0	0.1	0.6	1.2	4.9
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	6.8	0.0	0.1	0.6	1.2	4.9
	2041						
	2042						
	2043						
	2044						
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	2047						
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Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	3.7	0.0	0.1	0.3	0.7	2.6
	Sideswipe crashes:	1.2	0.0	0.0	0.1	0.2	1.0
	Other multiple-vehicle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Total multiple-vehicle crashes:	5.1	0.0	0.1	0.5	0.9	3.7
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.2	0.0	0.0	0.1	0.2	0.9
	Crashes with other object:	0.2	0.0	0.0	0.0	0.0	0.2
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.7	0.0	0.0	0.2	0.3	1.2
	Total crashes:	6.8	0.0	0.1	0.6	1.2	4.9

Output Summary

General Information

Project description:	I-270 NB at MD 118 Interchange - NB 7 Concept Future (2040) Build				
Analyst:	LW	Date:	1/4/2017	Area type:	Urban
First year of analysis:	2040				
Last year of analysis:	2040				

Crash Data Description

Freeway segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp segments	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	
Ramp terminals	Segment crash data available?	No	First year of crash data:	
	Project-level crash data available?	No	Last year of crash data:	

Estimated Crash Statistics

Crashes for Entire Facility	Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:	6.4	0.0	0.1	0.6	1.1	4.5
Estimated average crash freq. during Study Period, crashes/yr:	6.4	0.0	0.1	0.6	1.1	4.5

Crashes by Facility Component	Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:	1	6.4	0.0	0.1	0.6	1.1	4.5
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Crashes for Entire Facility by Year	Year	Total	K	A	B	C	PDO
Estimated number of crashes during the Study Period, crashes:	2040	6.4	0.0	0.1	0.6	1.1	4.5
	2041						
	2042						
	2043						
	2044						
	2045						
	2046						
	2047						
	2048						
	2049						
	2050						
	2051						
	2052						
	2053						
	2054						
	2055						
	2056						
	2057						
	2058						
	2059						
	2060						
	2061						
	2062						
	2063						

Distribution of Crashes for Entire Facility

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.0	0.0	0.0	0.0	0.0	0.0
	Right-angle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Rear-end crashes:	3.5	0.0	0.1	0.3	0.6	2.4
	Sideswipe crashes:	1.1	0.0	0.0	0.1	0.2	0.9
	Other multiple-vehicle crashes:	0.1	0.0	0.0	0.0	0.0	0.1
	Total multiple-vehicle crashes:	4.8	0.0	0.1	0.4	0.8	3.4
Single vehicle	Crashes with animal:	0.0	0.0	0.0	0.0	0.0	0.0
	Crashes with fixed object:	1.2	0.0	0.0	0.1	0.2	0.8
	Crashes with other object:	0.2	0.0	0.0	0.0	0.0	0.2
	Crashes with parked vehicle:	0.0	0.0	0.0	0.0	0.0	0.0
	Other single-vehicle crashes	0.2	0.0	0.0	0.0	0.1	0.1
	Total single-vehicle crashes:	1.6	0.0	0.0	0.2	0.3	1.1
	Total crashes:	6.4	0.0	0.1	0.6	1.1	4.5

Submitted to:

State Highway Administration
Maryland Department of Transportation

Appendix I

ATM Supplemental Materials

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

World Class Solutions with Local Leadership

Submitted to:

SHA State Highway Administration
Maryland Department of Transportation

Appendix I

INTERSTATE 270

1 – ATM White Paper

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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I Appendix I: ATM Supplemental Materials

Appendix I is divided into two sections of supplemental materials regarding Active Traffic Management (ATM):

1. ATM White Paper, which summarizes the methodology, input data and cost benefit analysis for various ATM concepts along I-270; and
2. ATM Operational Scenarios, which consists of figures depicting the proposed display patterns for dynamic speed limit signs (regulatory and advisory) and dynamic message signs for queue warning.

1. ATM White Paper

Summary

This memorandum summarizes the methodology, input data and the results of the cost benefit analysis (CBA) for various Active Traffic Management (ATM) concepts along I-270. This analysis is separate from the benefit-cost analysis that was performed for the entire program of improvements which is described in Appendix J. SHA's Benefit-Cost Analysis Tool was utilized to conduct the CBA. Major benefits of the ATM concepts include improved safety (i.e., reduced number of traffic crashes) and the associated reduction in non-recurring delay resulting in improved mobility and reliability.

Based on the results of the CBA, the CGI Team has included the following ATM strategies described in Table I-1 in the proposed program of improvements.

Table I-1. Anticipated ATM Strategies

Segment (MP)	Direction	Strategies	Benefit-Cost Ratio
Spurs (0-3)	NB	Dynamic speed limits (single sign on mast arm over roadway), queue warning via DMS, and CCTV on this assembly. Nominal ½-mile spacing.	6.0
Spurs (0-3)	SB	Dynamic speed limits (single sign on mast arm over roadway), queue warning via DMS, and CCTV on this assembly. Nominal ½-mile spacing.	6.0
Local / Express (3-12)	NB	Dynamic speed limits (signs on mast arms, with on sign over the local and another over the express roadway), queue warning via DMS, and CCTV on this assembly. Nominal ½-mile spacing. Local and express roadway will be managed as separate roadways (e.g., different speed limits may be displayed for each).	5.7
Local / Express (3-12)	SB	Dynamic speed limits (signs on mast arms, with on sign over the local and another over the express roadway), queue warning via DMS, and CCTV on this assembly. Nominal ½-mile spacing. Local and express roadway will be managed as separate roadways (e.g., different speed limits may be displayed for each).	9.0
N/A	N/A	Software and Central Hardware	Note

Note: The cost of the ATM software and central hardware is included in the BCA for the individual segment

Scenarios

A total of 20 separate CBA were conducted to determine the effectiveness of the proposed ATM concepts at different road segments. The combination is made up of 4 Active Traffic Management scenarios, applied to three potential segments. For two of the segments, a separate analysis was done for southbound and northbound directions. For the northern segment, only a southbound ATM application is proposed. The study area was divided into 5 different road segments as shown in Table I-2.

These specific segments were identified for more in-depth analysis in accordance with the FHWA *Active Traffic Management Feasibility and Screening Guide* (FHWA-HOP-14-019). The specific step involves identifying major segments that will likely benefit from deploying ATM. Specifically, these segments were identified for further analysis based on a review of the crash histograms. In essence, the selected segments have the highest number of crashes and most ATM strategies (e.g., dynamic speed limits, dynamic lane assignment, queue warning) focus on improving safety. Moreover, a near majority of crashes along I-270 are rear-end, while the majority of "probable cause" for crashes are "followed too closely" and "too fast for conditions." These are conditions that practically beg for the implementation of dynamic speed limits and queue warning.

Table I-2. ATM Road Segments

Road Segment	Mile Post
Beltway Spurs Northbound	0 to 3.0
Beltway Spurs Southbound	0 to 3.0
Local/Express Lanes Northbound	3.0 to 12.0
Local/Express Lanes Southbound	3.0 to 12.0
Northern Segment Southbound	22.0 to 31.0

Four ATM concepts were developed for analysis as summarized in Table I-3 below.

Table I-3. ATM Concepts

ATM Concept	Description
1a	Dynamic speed limits and queue warning via mast arm. ½ mile spacing, with DMS for queue warning. Mast arms with dynamic speed limit signs – one sign over the local and one over the express lanes – co-located on same pole.
1b	Same as 1a, with CCTV on each pole / mast arm assembly.
2a	Dynamic speed limits only via post mount signs at ½-mile spacing. No DMS (i.e., queue warning.) Note – Using only pole mounts for dynamic speed limits for the local / express configuration may not be appropriate and could cause confusion when different speed limits are displayed between the local and express)
2b	Same as 2A, with CCTV on each pole / mast arm.

It is noted that the decision was made early on not to analyze dynamic lane assignment. It would undoubtedly further enhance safety. The key concern with dynamic lane assignment was the need – and associated cost – for installing full matrix DMS (nominally 5' x 5') over each lane, thereby requiring full gantries over the roadways. Another concern was the need for additional software (such as a Decision Support System) and the greater need for operator interaction in controlling dynamic lane assignment, all coupled with the goal of minimizing the need for integration with the CHART system. On the other hand, the operation of dynamic speed limits and queue warning can be automated to a great extent.

Basic Assumptions

The period of CBA analysis is set at 15 years. Base cost of the estimates is 2016 dollars. All cost and benefits are escalated by an annual escalation factor of 2.30% as suggested by the SHA Benefit-Cost Analysis Tool. The discount rate used to determine the present value is 2.94% (source: FHWA TIFIA Interest rate, updated 9/11/2015).

Capital and O&M Cost

Project Cost: An American Society of Professional Estimators (ASPE) Level One Estimate (referred to as an "Order of Magnitude" Estimate) was developed for each scenario, applied to each segment in each direction. Therefore, a total of 20 estimates were developed.

Data sources for these estimates were:

- SHA Bid Tab database
- VDOT 2 Year Bid Tab Averages
- R.S. Means Construction Cost Database
- FHWA RITA ITS Cost Database
- Estimator Experience

Project costs were developed with the following assumptions:

- No Right of Way is required
- Mast arms use butterfly structure with single cast in drilled hole foundation
- Utility relocation conducted by utility owner but compensated through project
- VSL assumed to be Daktronics 5220 or similar
- DMS assumed to by Skyline Large LiftFace or similar
- Controller assumed to be NEMA 2070 with NEMA size 7 cabinet
- Power/telecommunications backbone available at all locations and pull from backbone to node approximately 15 feet
- CCTV assumed to be Cohu Helois 3930HD or similar with pole mount

The following typical markups/overheads were applied to the neat construction cost as shown in Table I-4.

Table I-4. Typical Markups/Overheads

Cost Item	% to Neat Construction Cost
Preliminary engineering	2%
Final Design	8%
Utility Relocation	0.5%
Mobilization	5%
Maintenance of Traffic	2.5%
Construction management	8%
Contingency	25%
Public Education of Outreach	A lump sum of $350,000

Operation and Maintenance Cost: During the 15-year O&M period, the operation cost for the ATM system is assumed to be 3% of the construction cost. Some ATM equipment will require replacement during the 15-year O&M period. The renewal frequency of the major equipment is provided in Table I-5.

Based upon these inputs, assumptions and methodology, the project costs and total life cycle cost estimates were calculated as shown in Table I-6. These cost estimates are preliminary and do not reflect final pricing for construction.

Table I-5. Equipment Renewal Frequency

Equipment	Renewal Frequency
VSL Sign	15 years
Overhead Detector on Mast Arm	8 years
Controller	10 years
CCTV	10 years
Central Software	8 years

Reduction in Traffic Crashes

As previously noted, a major benefit from deploying ATM is crash reduction. The CGI Team evaluated benefits from ATM installations involving dynamic speed limits and queue warning (as well as lane assignment in many instances). This evaluation included US applications and European applications. In general, the benefits from European applications of ATM are greater than those in the US. This is likely due to the existence of automated speed enforcement and better driver discipline.

For the CBA, a decision was made to be conservative in estimating the projected reduction in crashes, and also to assume that ramp metering would also be implemented as part of the I-270 effort (as also exists in the recent US applications of ATM). With a range of crash reductions from ATM in the US between 8.5% (in Washington State) and 21% (in Portland, which does not include dynamic lane assignment), we determined that an estimated 10% reduction in crashes was more than feasible for I-270 as well as very conservative.

For the scenarios that do not include DMS for queue warning – an approach that is not recommended by the CGI Team – we reduced the crash reduction factor by half. Table I-7 summarizes the crash reduction factors used in the analysis.

3 years of actual crash data were provided by SHA. Crash data by type by road segment are provided in Table I-8. The CBA convert the historic no-build crash data into monetary value with the following conversion. Cost of accident is obtained from the Association for the Advancement of Automotive Medicine – Pedestrian and Pedalcyclist Injury Costs in the US by Age and Injury Severity in 2000. The year 2000 dollar is adjusted with CPI inflation from the Bureau of Labor Statistics. The costs per accident type are provided in Table I-9.

Table I-6. Project Costs and Total Life Cycle Cost Estimates

Scenario	Segment	Direction	Project Cost (2016$)	Total Life-cycle Cost[1] (2016$)
1A	Spurs	NB	$2,744,860	$3,652,210
1A	Spurs	SB	$2,744,860	$3,652,210
1B	Spurs	NB	$2,767,510	$3,690,492
1B	Spurs	SB	$2,767,510	$3,690,492
2A	Spurs	NB	$2,391,520	$3,289,007
2A	Spurs	SB	$2,391,520	$3,289,007
2A	Spurs	NB	$2,459,470	$3,403,854
2B	Spurs	SB	$2,414,170	$3,327,289
1A	Express/Local	NB	$8,140,090	$9,882,042
1A	Express/Local	SB	$8,140,090	$9,882,042
1B	Express/Local	NB	$8,343,940	$10,226,582
1B	Express/Local	SB	$8,343,940	$10,226,582
2A	Express/Local	NB	$5,000,800	$6,655,122
2A	Express/Local	SB	$5,000,800	$6,655,122
2B	Express/Local	NB	$5,204,650	$6,999,662
2B	Express/Local	SB	$5,204,650	$6,999,662
1A	Northern	SB	$5,571,580	$6,917,835
1B	Northern	SB	$5,775,430	$7,262,375
2A	Northern	SB	$4,511,560	$5,828,225
2B	Northern	SB	$4,715,410	$6,172,766

Table I-7. Crash Reduction Factors

ATM Concept	Crash Reduction
1a – dynamic speed limits with queue warning	10%
1b – same as 1a with CCTV	10%
2a – speed limits with no queue warning	5%
2b – same as 2a with CCTV	5%

Table I-8. Crash Data by Road Segment

Year	Type	Spur SB	Spur NB	Express/Local SB	Express/Local NB	Northern SB
2011	Property	0	56	0	195	57
	Injury	0	30	0	109	30
	Fatal	0	0	0	3	1

[1] Total life-cycle cost includes project cost, routine maintenance cost and equipment renewal cost for the 15-year analysis period.

Year	Type	Spur SB	Spur NB	Express/Local SB	Express/Local NB	Northern SB
2012	Property	18	36	80	125	85
	Injury	10	14	42	99	30
	Fatal	0	0	0	0	3
2013	Property	67	0	183	40	79
	Injury	32	0	102	30	27
	Fatal	0	0	3	0	0

Table I-9. Cost per Accident Type

Accident Type	Cost per Accident Type
Property Damage Only	$9,177
Injury	$81,355
Fatal	$1,453,861

Reduction in Non-Recurring Traffic Delay

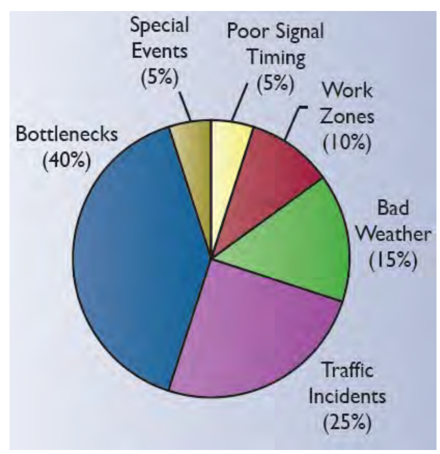
Total traffic delay – both recurring and non-recurring – was determined using 2015 real traffic data from INRIX (as available in the RITIS system). Percent of vehicle distribution is based on actual data of each individual road segment. For segments that do not have percent information, the defaults of 90% passenger car and 10% commercial (truck) are used. Total traffic delay for the segments is provided in Table I-10.

Table I-10. Total Delay by Road Segment

Road Segment	2015 No-Build Annual Delay (hrs)
Beltway Spurs Northbound	482, 322
Beltway Spurs Southbound	489,147
Local/Express Lanes Northbound	1,096,053
Local/Express Lanes Southbound	201,820
Northern Segment Southbound	373,011

The basic assumption was that if crashes are reduced by X%, then the non-recurring congestion will also be reduced by X%. As noted above, available delay data from RITIS only provides total delays. The general rule of thumb in the US is that only 40% of congestion is recurring, and that the rest is non-recurrent, with about 50% due to crashes and weather (see pie chart from FHWA below). We were unable to find any MD-specific numbers in this regard.

If we assume that 50% + of delays on I-270 are due to non-recurrent congestion, then the reduction in the associated delay costs due to ATM should be approximately half the percentage value for crash reduction.



Another concept developed was to include full CCTV coverage of the ATM segments, thereby improving incident detection, verification and response times. Based on information from a recent CHART evaluation, it was determined that full coverage of CCTV can reduce overall incident response times by 2 minutes per incident so that the times are closer to those found for I-495. This equates to 20% reduction in incident response time, and given the “4:1 rule” that is so frequently used for incident management (1 minute of reduced incident management time = reduction of 4 minutes of congestion), we increased the reduction factors for total delay costs for the scenarios incorporating CCTV. The resulting factors for reductions in delay from ATM are summarized in Table I-11.

The annual traffic growth rate of 1% (default value of the SHA CBA model) was applied to the no-build annual delay scenario. Cost per vehicle hour delay is assumed to be $31.54 and $45.40 for passenger car and truck respectively (Source: 2014 CHART Benefit Analysis).

Table I-11. Delay Reduction Factors

ATM Concept	Delay Reduction
1a – dynamic speed limits with queue warning	5%
1b – same as 1a with CCTV	8%
2a – speed limits with no queue warning	2.5%
2b – same as 2a with CCTV	5%

Results

The monetary value of the project cost, life-cycle cost and benefits were input to the SHA Cost-Benefit Analysis Tool with an analysis period of 15 years. The benefit-cost ratio of the 20 scenarios range from 1.3 to 9.0. The results are summarized in **Table I-12** below.

Table I-12. Benefit-Cost Results

Concept	ATM Scenario	Road Segment	Present Value of Delay Savings ('000)	Present Value of Safety Savings ('000)	Present Value of Total Savings ('000)	Present Value of Costs ('000)	Overall Benefit-Cost Ratio
1	1A	Spurs NB	$12,624	$2,000	$14,624	$3,670	4.0
2	1A	Spurs SB	$12,804	$1,897	$14,702	$3,670	4.0
3	1B	Spurs NB	$20,198	$2,000	$22,198	$3,708	6.0
4	1B	Spurs SB	$20,487	$1,897	$22,384	$3,708	6.0
5	2A	Spurs NB	$6,312	$1,000	$7,312	$3,465	2.1
6	2A	Spurs SB	$6,402	$949	$7,351	$3,465	2.1
7	2B	Spurs NB	$12,624	$1,000	$13,624	$3,585	3.8
8	2B	Spurs SB	$12,804	$949	$13,753	$3,505	3.9
9	1A	Express/Local NB	$28,691	$12,218	$40,909	$9,928	4.1
10	1A	Express/Local SB	$52,713	$8,359	$61,072	$9,928	6.2
11	1B	Express/Local NB	$45,905	$12,218	$58,124	$10,273	5.7
12	1B	Express/Local SB	$84,341	$8,359	$92,700	$10,273	9.0
13	2A	Express/Local NB	$14,345	$6,109	$20,455	$6,695	3.1
14	2A	Express/Local SB	$26,357	$4,179	$30,536	$6,695	4.6
15	2B	Express/Local NB	$28,691	$6,109	$34,800	$7,040	4.9
16	2B	Express/Local SB	$52,713	$4,179	$56,893	$7,040	8.1
17	1A	Northern SB	$9,765	$6,745	$16,511	$6,953	2.4
18	1B	Northern SB	$15,624	$6,745	$22,370	$7,298	3.1
19	2A	Northern SB	$4,883	$3,373	$8,255	$6,182	1.3
20	2B	Northern SB	$9,765	$3,373	$13,138	$6,543	2.0

Submitted to:

State Highway Administration

Maryland Department of Transportation

Appendix I

INTERSTATE 270

2 - ATM Operational Scenarios

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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2. ATM Operational Scenarios

ATM OPERATIONAL SCENARIOS DYNAMIC SPEED LIMITS (DSL) - REGULATORY OPTION

Scenario	Plan	Pattern
Free Flow	Under normal conditions DSL signs will display the normal posted speed limit (55 mph)	SPEED LIMIT 55 · SPEED LIMIT 55 · SPEED LIMIT 55 · SPEED LIMIT 55 — Direction of Travel →
Recurrent Congestion	To manage congestion DSL signs will display reduced speeds upstream of congestion in a step pattern	SPEED LIMIT 50 · SPEED LIMIT 45 · SPEED LIMIT 40 · SPEED LIMIT 55 — Direction of Travel →
Lane Restriction	Reduce speed upstream of lane blockage in a step pattern	SPEED LIMIT 50 · SPEED LIMIT 45 · SPEED LIMIT 45 · SPEED LIMIT 55 — Direction of Travel →
Weather Conditions (Icy/Slippery)	Icy and slippery conditions may necessitate reduction of speeds, even if expressway flow is less than capacity	SPEED LIMIT 45 · SPEED LIMIT 40 · SPEED LIMIT 35 · SPEED LIMIT 45 — Direction of Travel →
Complete Closure	In the event of complete closure of all traffic lanes, DSL signs will display the normal posted speed limit	See Free Flow
Non-Recurrent Congestion	Non-recurrent congestion will follow the same traffic pattern as recurrent congestion	See Recurrent Congestion

ATM OPERATIONAL SCENARIOS DYNAMIC SPEED LIMITS (DSL) - ADVISORY OPTION

Scenario	Plan	Pattern
Free Flow	Under normal conditions DSL signs will display the normal posted speed limit (55 mph)	55 MPH, 55 MPH, 55 MPH, 55 MPH Direction of Travel
Recurrent Congestion	To manage congestion DSL signs will display reduced speeds upstream of congestion in a step pattern	55 MPH, 55 MPH, 40 MPH, 55 MPH Direction of Travel
Lane Restriction	Reduce speed upstream of lane blockage in a step pattern	55 MPH, 55 MPH, 45 MPH, 55 MPH Direction of Travel
Weather Conditions (Icy/Slippery)	Icy and slippery conditions may necessitate reduction of speeds, even if expressway flow is less than capacity	45 MPH, 40 MPH, 35 MPH, 45 MPH Direction of Travel
Complete Closure	In the event of complete closure of all traffic lanes, DSL signs will display the normal posted speed limit	See Free Flow
Non-Recurrent Congestion	Non-recurrent congestion will follow the same traffic pattern as recurrent congestion	See Recurrent Congestion

ATM OPERATIONAL SCENARIOS QUEUE WARNING

Scenario	Plan	Pattern
Free Flow	Under normal conditions the DMS will be left blank or display a text message indicating the travel time to a specific exit or interchange	[blank sign] OR TRAVEL TIME MESSAGE
Recurrent Congestion - Peak Hour	Far upstream from the congestion area the DMS will display a queue warning. Closer to the congestion area a reduce speed warning will be displayed.	LOCAL LANES CONGESTION 1 MILE / LOCAL LANES CONGESTION AREA REDUCE SPEED
Lane Restriction	In general the DMS signs will display lane closure warnings upstream of the closure. The DMS may display a more specific message depending on the type of lane restriction (work zone, accident, debris).	LOCAL LANES RIGHT LANE CLOSED 1 MILE / LOCAL LANES RIGHT LANE CLOSED MOVE LEFT
Weather Conditions (Icy/Slippery)	Icy and slippery conditions may necessitate reduction of speeds, even if expressway flow is less than capacity	WINTER CONDITIONS REDUCE SPEED
Complete Closure	In the event of complete closure of all traffic lanes, DMS will be left blank beyond the closure	[blank sign]
Non-Recurrent Congestion	During non-recurrent congestion DMS signs can display the recurrent congestion display seen above or an alternative display seen here	LOCAL LANES STOPPED TRAFFIC AHEAD OR EXPRESS LANES CRASH AT EXIT 10 USE CAUTION

Submitted to:

State Highway Administration
Maryland Department of Transportation

Appendix J

INTERSTATE 270

Benefit-Cost Analysis

Submitted by:

Concrete General, Inc. *in association with* RK&K ch2m Bruce & Merrilees

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J Appendix J: Benefit-Cost Analysis

SHA's "Benefit-Cost Analysis Template (v 1.3)" was used to perform a lifecycle analysis of the CGI Team's program of improvements for I-270. The spreadsheet is designed for computing and comparing benefits and costs of a project. It is used as part of the Congestion Management Studies effort to evaluate projects.

This memorandum describes each data entry tab of the spreadsheet and discusses the methods and assumptions used in performing the analysis for the CGI Team's program of improvements. Output from every tab of the spreadsheet may be found at the end of this memorandum and the Excel file is included with the electronic appendices.

Introduction

The tool has multiple tabs that receive input from the user to perform calculations. Each tab is described below:

- Initial Input - This section allows the user to input basic project information and other related parameters.
- Delay – This section allows the user to enter network level delay information for the existing and proposed improvements.
- Safety Data – This tab allows the user to enter existing crashes by crash type and the anticipated reduction in crashes as a result of the improvements.
- Cost – This tab allows the user to enter cost information for the project over its life span.
- Reliability – The part of the tool computes the dollar amount saved as a result of the improvements leading to increased reliability.
- Summary – This tab provides a summary of all the costs and benefits computed based on inputs in the Delay, Safety Data, Cost, and Reliability sections for the no-build and build scenarios. It also shows the Benefit-Cost ratio for no-build conditions, and the operational improvements, safety improvements, and overall improvement Benefit-Cost ratio for the project.

Other tabs such as CMFs, Crash Data, and Example – Crash Data are provided for the user to document source data, but were not used in this analysis. All documentation is contained in this memorandum.

Initial Input Tab

The Initial Input tab allows the user to input project-related information and cost parameters. These values are used in calculating the overall benefit-cost of the project. The following table shows each value and the default value in the template. Some values were changed to better reflect conditions on I-270 or to update economic statistics, so the table also shows the value used in this analysis and any explanation as to why default value was changed.

Table 1 Initial Input Values

TITLE	DEFAULT VALUE	VALUE USED FOR I-270 ANALYSIS	EXPLANATION
Project	-	I-270 Innovative Congestion Management	-
Project Opening Year	-	2020	For the purposes of the analysis, 2020 was assumed to be the first full year all improvements would be complete and open to traffic.
Project Life Span (Years)	20	20	This is the total life span of the project.

TITLE	DEFAULT VALUE	VALUE USED FOR I-270 ANALYSIS	EXPLANATION
Hours of AM and PM Peak	3	3	The number of hours during AM and PM period where congested traffic conditions are expected.
Heavy Vehicle Percentage (%)	10%	7%	Percentage of heavy vehicles (FHWA Class 4 and above) within the project area. The default value was changed, because according to Page 2 of the December 2015 "Modeling Calibration Methodologies" memorandum, heavy vehicle percentages ranged from 6% to 8% for the majority of roadways within the study area of the VISSIM model provided by SHA.
Annual Traffic Growth Factor (%)	1%	1.75%	Anticipated traffic growth factor (expressed as a percentage) per year within the project area. According to the Governor's press release on July 18, 2016, I-270 near the future Watkins Mill interchange carries 166,000 vehicles a day and is estimated to grow to 235,000 vehicles a day by 2035. Assuming the existing traffic volume is from 2015, the compounded growth rate is 1.75%. It is reasonable to assume the entire corridor will experience this level of growth in the future. See http://governor.maryland.gov/2016/07/18/governor-larry-hogan-announces-229-6-million-plan-to-reduce-congestion-along-i-270-corridor/ for the press release.
Annual Growth in Heavy Vehicle Percentage (%)	2%	2%	Anticipated heavy vehicle growth factor (expressed as a percentage) per year within the project area.
Working Days per Year	250	250	Total number of working days per year.
Average Vehicle Occupancy	1.2	1.2	Average number of people per vehicle at a given time.
Auto Congestion Cost Per Hour ($)	$31.54	$31.54	The average cost incurred by an automobile for an hour of delay due to congestion. The value was taken from the 2014 CHART Benefit Analysis.
Truck Congestion Cost Per Hour ($)	$65.60	$65.60	The average cost incurred by a truck for an hour of delay due to congestion. It is the sum of the driver rate ($20.20) and the cargo rate ($45.40), for a total of $65.60. The value was taken from the 2014 CHART Benefit Analysis.
Reliability Measurement	-	Mean-variance Approach	The methodology used to determine reliability savings. The Mean-variance Approach uses the mean-variance approach to evaluate reliability as a function of the mean and standard deviation of travel time from multiple simulation runs and the reliability ratios for autos and trucks. It was selected since the travel time results from five simulation runs were available for each scenario.
Reliability Ratio - Auto	0.75	0.75	The value of reliability as a fraction of auto congestion cost. The SHRP2 Reliability Project L35 results recommend a value of 0.75 for automobiles.

TITLE	DEFAULT VALUE	VALUE USED FOR I-270 ANALYSIS	EXPLANATION
Reliability Ratio – Heavy Vehicles	2.0	2.0	The value of reliability as a fraction of HV congestion cost. The SHRP2 Reliability Project L35 results recommend a value of 2.0 for heavy vehicles.
Annual Depreciation in Travel Time Reliability (%)	3	3	The percentage reduction in travel time reliability due to annual growth in traffic volumes.
Fuel Savings per Hour of Delay Savings	$0.72 per hour	$0.72 per hour	Average savings in fuel cost per hour of delay savings. The value was taken from the 2014 CHART Benefit Analysis.
Salvage Value	10%	10%	Estimated value of an asset at the end of its "useful life."
Annual Inflation Rate	2.30%	2.08%	Annual increase in the general level of prices for goods and services. The default value is the Bureau of Labor Statistics inflation rate average from 2004 to 2014. The revised value uses the average from 2005 to 2015.
Annual Discount Rate	2.94%	3.13%	The amount of interest paid as a percentage of the balance at the end of the annual period. The value is the FHWA's TIFIA interest rate, which is updated daily. The revised value was updated to reflect current conditions.

Delay Tab

On the Delay tab, the average network delay for five simulation runs were entered for each scenario – Existing AM, Existing PM, Existing Build AM, Existing Build PM, 2040 No Build AM, 2040 No Build PM, 2040 Build AM, and 2040 Build PM. Table 2 shows the values that were entered.

It is important to note that the VISSIM models did not capture all of the reduction in delay that will be realized when the CGI Team's program of improvements is implemented. The values shown in the table below only represent the reduction in recurring congestion due to the roadway improvements and adaptive ramp meters. The ATM improvements were not modeled in VISSIM, so the reduction in nonrecurring congestion due to improved incident management and reduction in crashes was not captured. In addition, any reductions ATM has on recurring congestion was not modeled. Finally, while the virtual weigh station improvement was modeled in the VISSIM build scenarios, the files provided by SHA did not model the existing weigh stations. The increased delay due to heavy vehicles entering and exiting the weigh stations was not captured in the no build models.

The actual reduction in delay that will be realized when the program of improvements is implemented will be greater than what is shown.

Table 2 Delay Data Input

EXISTING NETWORK DELAY (HOURS)		EXISTING BUILD NETWORK DELAY (HOURS)		2040 NO BUILD NETWORK DELAY (HOURS)		2040 BUILD NETWORK DELAY (HOURS)	
AM	PM	AM	PM	AM	PM	AM	PM
6085.2	6053.4	3548.9	5201.4	10236.3	9604.9	6830.1	7898.6

Safety Data Tab

The Safety Data tab allows users to enter historic crash data and the anticipated reduction in crashes after the improvements are implemented. The crash data can be entered by crash type – fatal, injury, property damage only, and pedestrian crashes (not applicable to this analysis). The reduction in crashes is applied to each crash type and the benefits are monetized by associating a cost to each crash type.

The methodology for determining the reduction in crashes due to the improvements differed for each type of improvement – roadway improvements, adaptive ramp metering, and ATM. To determine the safety benefit for the entire project, the individual safety benefit for each type of improvement was determined using the Safety Data tab. The individual safety benefits were then added together to determine the overall safety benefit. This section discusses the Safety Data inputs for roadway improvements, adaptive ramp metering, and ATM. Refer to Section 3 and Appendix H for discussion on the methodologies used to determine the crash reductions for each type of improvement.

Accident Cost Data: The data used to associate a cost to an accident type is originally from a 2012 report from the National Safety Council entitled "Estimating the Costs of Unintentional Injuries." The costs for each accident type were adjusted to 2016 dollars using the Bureau of Labor Statistics' CPI Inflation Calculator. The calculator uses the average Consumer Price Index for a given calendar year to adjust prices and costs from one year to another. As a result, the 2012 costs were multiplied by 1.051 to obtain 2016 costs. The 2016 costs are shown in the following table.

Table 3 Accident Cost Data

CRASH TYPE	COST PER CRASH TYPE (2016 DOLLARS)
Fatal	$1,482,215
Injury	$82,941
Property Damage Only	$9,356

Safety Benefits of Roadway Improvements: As discussed in Section 3, the Highway Safety Manual (HSM) and Enhanced Interchange Safety Analysis Tool (ISATe) were used to estimate the safety benefits of each targeted roadway improvement. For each roadway improvement, a crash frequency was predicted based on the conditions without the improvement (existing conditions) and with the improvement implemented. In order to properly compare existing conditions and improvement conditions, the predicted crash frequencies for both cases were calculated within the limits of the improvement concept. So each roadway improvement is associated with a predicted number of crashes per year without the improvement and with the improvement. The table below shows the total number of predicted crashes for each targeted roadway concept, without and with the improvement implemented.

Table 4 Total Number of Predicted Crashes for Each Concept, Without and With Improvements

ROADWAY CONCEPT	TOTAL NUMBER OF CRASHES PER YEAR WITHOUT IMPROVEMENT	TOTAL NUMBER OF CRASHES PER YEAR WITH IMPROVEMENT
SB 1A	24.01	23.93
SB 1B	24.01	23.64
SB 2	16.62	16.66
SB 5A	14.49	13.88
SB 6	9.66	7.27
SB 7	25.87	14.30
SB 8	22.02	16.57
SB 10	19.32	16.52
SB 12	137.33	130.26
NB 1	127.50	118.94

NB 2A	20.07	17.66
NB 2B	12.92	13.84
NB 3A	18.92	19.87
NB 3B	13.94	12.40
NB 4	67.51	66.00
NB 5	16.71	16.85
NB 7	5.53	5.25
Total	576.42	533.85

The analysis shows there would be 42.57 fewer crashes along the I-270 segments where the improvements are implemented.

The analysis also predicted the number crashes by severity for each roadway concept (again, with and without the improvement implemented). The severity categories are:

- K – at least one fatality
- A – at least one incapacitating injury
- B – at least one evident but non-capacitating injury
- C – at least one possible injury
- O – no injury; property damage only

The table below shows the number of crashes per category without and with the improvements implemented.

Table 5 Crashes by Category, Without and With Improvements

	TOTAL NUMBER OF CRASHES PER YEAR	K CRASHES PER YEAR	A CRASHES PER YEAR	B CRASHES PER YEAR	C CRASHES PER YEAR	O CRASHES PER YEAR
Without Improvements	576.42	3.23	9.11	54.13	122.85	387.10
With Improvements	533.85	3.15	8.09	49.26	108.89	364.46

In order to calculate the safety benefit of implementing the roadway improvements, the crashes were categorized according to the crash type categories in the B-C Tool. The crash types were categorized in the following manner:

- K categorized as "Fatal"
- A, B, and C categorized as "Injury"
- categorized as "Property Damage Only"

The newly categorized crashes without improvements were used as "Historic Crash Data (Existing Conditions)" in the B-C Tool.

In order to use the Tool to analyze the reduction in crashes, the categorized crashes with improvements were converted into crash modification factors (CMF) for each category. A crash modification factor is a multiplicative factor used to calculate the expected number of crashes after implementing an improvement.

The table below shows how the CMFs for the improvements were calculated for each category. It is the percentage difference in crashes without and with improvements, subtracted from 1. Note that this is not the actual method used to calculate CMFs in accordance with the Highway Safety Manual. These calculations were performed in order to adapt the predictive results that were obtained through detailed analysis (as discussed in Section 3 and Appendix H) to the standard B-C Tool spreadsheet. By adapting the results to the B-C Tool, the safety benefits of the roadway improvements could be incorporated into the analysis.

Table 6 CMF Calculations

	CRASHES WITHOUT IMPROVEMENTS / HISTORIC CRASH DATA (EXISTING CONDITIONS)	CRASHES WITH IMPROVEMENTS	CMF Calculation	CMF
Fatal	3.23	3.15	$1 - \frac{3.23 - 3.15}{3.23}$	0.98
Injury	186.09	166.24	$1 - \frac{186.09 - 166.24}{186.09}$	0.89
Property Damage Only	387.10	364.46	$1 - \frac{387.10 - 364.46}{387.10}$	0.94

The CMFs were entered in the "Safety Analysis Results" section in the B-C Tool.

Safety Benefits of Adaptive Ramp Metering: As discussed in Section 3 the HSM does not address ramp metering, so the CGI Team assumed a 10% reduction in crashes of all severities along southbound I-270 for the segments where adaptive ramp metering will be deployed. This is a conservative estimate considering many locations have experienced a larger reduction in crashes after implementing ramp metering.

The following crashes for each category were entered as "Historic Crash Data (Existing Conditions)" and will be reduced by 10% due to deployment of adaptive ramp metering.

- Fatal – 2 crashes
- Injury – 81 crashes
- Property Damage Only – 155 crashes
- Total – 238 crashes

Safety Benefits of ATM: As with adaptive ramp metering and discussed in Section 3, the HSM does not address ATM. The CGI Team assumed a 10% reduction in crashes of all severities along the segments where ATM will be deployed.

The following crashes for each category were entered as "Historic Crash Data (Existing Conditions)" and will be reduced by 10% due to deployment of adaptive ramp metering.

- Fatal – 2 crashes
- Injury – 150 crashes
- Property Damage Only – 260 crashes
- Total – 412 crashes

Cost Tab

The following table shows the values that were used in performing cost calculations. The B-C Tool has default values for costs, and if values were changed an explanation is provided.

Table 7 Project Cost Values

TITLE	DEFAULT VALUE	VALUE USED FOR I-270 ANALYSIS	EXPLANATION
Concept Cost	-	$100,000,000	
No-Build Operations and Maintenance Cost	15%	15%	
Percent of Planning, Engineering and ROW costs as a percent of Construction Cost	30%	0%	The improvements will not require any additional right-of-way and all planning and engineering costs are included in the $100,000,000 concept cost.
Operation Cost (Project Life Span)	10%	10%	

Rehabilitation

The following paragraphs describe the anticipated lifespan of project elements that will not last the full 20-year life of the project. Cost estimates for rehabilitating or replacing the elements are also provided and were incorporated into "Rehabilitation" costs of the Cost tab.

Roadway Pavement: Most of the proposed roadway concepts utilize existing shoulders as travel lanes. However, while these shoulders are sufficient to support full-time traffic loading over the short term, they are not sufficient to support traffic over the assumed life of the adjacent mainline pavement. In order to maintain the shoulders in good condition, an intermediate resurfacing will be required during Year 7 of the project lifespan. The resurfacing will cost about $3,803,000 total (2016 dollars), which includes percentages for maintaining traffic during work and a contingency. This will be in addition to SHA's programmed roadway (mainline and shoulders) resurfacing/maintenance. The escalated cost used in the analysis is $4,769,500 (2027 dollars).

Adaptive Ramp Metering: The ramp meter controllers and software will need to be replaced at Year 10. The estimated cost to replace all controllers is $36,000 (assuming $2,000 per controller and 18 total controllers). Each ramp metering location will have four overhead detectors. The detectors will need to be replaced every eight years at $8,000 per detector for a total cost of $576,000. All other elements of adaptive ramp metering system are anticipated to last the full 20-year life of the project.

ATM: Some ATM equipment will require replacement during the project lifespan. The replacement frequency, replacement cost per unit, estimated total number of units to replace, and total cost of replacement per replacement cycle is shown in the table below. It is expected that the DMS will last 20 years, the full life of the project.

Table 8 ATM Component Replacement Costs

COMPONENT	REPLACEMENT FREQUENCY (YEARS)	COST PER UNIT	TOTAL NUMBER OF UNITS TO REPLACE	TOTAL COST OF REPLACEMENT PER REPLACEMENT CYCLE
Variable Speed Limit Sign	15	$10,000	63	$630,000
Overhead Detector	8	$8,000	63	$504,000
Controller and Central Software	10	$12,000	63	$756,000
CCTV	10	$15,000	34	$510,000

The estimation of total units to replace does not account for possible duplication of detectors or controllers that are used with the adaptive ramp metering, leading to a conservative analysis.

Virtual Weigh Stations: The weigh-in-motion sensors and software will need to be replaced after 10 years at a cost of $20,000 (assuming $5,000 per lane and four lanes).

The costs to replace the technology equipment were not escalated to future year values. It is reasonable to assume the price of components will remain fairly constant, if not decrease, as technology evolves in the future. The roadway rehabilitation prices were escalated because the price of materials used to resurface the pavement depend on the price of commodities which fluctuate and generally increase from year to year.

Reliability Tab

The Reliability tab calculates the dollar amount saved as a result of the improvements leading to increased reliability. The calculations are the based on the Strategic Highway Research Program 2 (SHRP 2) Project L35, "Guidebook on Placing a Value on Time Reliability." The computations are shown below:

User Cost= A*mean travel time + B* standard deviation of travel time

where, User Cost= Time Cost + Reliability Cost

A= Value of travel time= auto and truck congestion costs per hour

B= Value of Reliability= 0.75* Auto congestion cost per hour + 2.0* Truck congestion cost per hour

The reliability ratios of 0.75 and 2.0 are based on the SHRP 2 Reliability Project L35 results.

The travel time results from five simulation runs were entered for the Existing AM, Existing PM, Existing Build AM, and Existing Build PM scenarios. Note that the tab does not perform reliability calculations using future year data.

Table 9 Network Travel Time Data Entered in the Reliability Tab

RUN	EXISTING NETWORK TRAVEL TIME (HOURS)		EXISTING BUILD NETWORK TRAVEL TIME (HOURS)	
	AM	PM	AM	PM
1	14,604.3	14,933.6	12,740.9	14,228.7
2	13,967.2	14,766.2	11,519.5	14,036.6
3	14,017.8	14,976.1	11,896.7	14,309.1
4	14,522.8	14,813.4	12,191.8	14,147.1
5	14,072.4	14,994.5	12,176.3	14,164.8

In addition to calculating the User Cost for each scenario, the Reliability tab calculates Reliability Savings, which is given by:

Reliability Savings= User cost savings - Time Cost savings

Time cost= Value of Reliability*standard deviation of travel time

Since Reliability Savings is a positive number as shown in Table 10, the proposed improvement is substantial enough to improve reliability within the project area.

Table 10 Reliability Tab Input (Blue) and Calculations (Red)

Computation of Reliability Savings

Computation of reliability is based on Mean- Variance approach, given by,

User Cost= A*mean travel time + B* standard deviation of travel time

where, User Cost= Time Cost + Reliability Cost
A= Value of travel time ($/min) = Auto/ Truck congestion cost per hour
B= Value of reliability ($/min) = 0.75 * Auto congestion cost per hour or 2 * Truck congestion per hour

Default reliability ratio of 0.75 and 2.0 for auto and trucks, respectively, are based on SHRP 2 Reliability Project L 35 Results

Reliability Savings= User cost savings - Time Cost savings

Concept-1											
Run	Existing Network TT (Hour)				Concept Network TT (Hours)				User Cost Savings ($/Hour)	Time Cost Savings ($/Hour)	Reliability Savings ($/Year in 1000's)
	AM (Hour)	PM (Hour)	User Cost ($/Hour) AM	User Cost ($/Hour) PM	AM (Hour)	PM (Hour)	User Cost ($/Hour) AM	User Cost ($/Hour) PM			
1	14604.3	14933.56	492389.1	508524.9	12740.93	14228.69	424627.8	484104.2	$92,182.0	$89,931.3	$2,025.6
2	13967.22	14766.2			11519.47	14036.59					
3	14017.77	14976.09			11896.72	14309.07					
4	14522.81	14813.37			12191.85	14147.14					
5	14072.4	14994.5			12176.26	14164.8					
6											
7											
8											
9											
10											
Mean	14236.9	14896.7			12105.0	14177.3					
Std Dev	301.9	101.5			448.1	101.1					

Summary Tab

The Summary tab shows a summary of all the costs and benefits computed based on user inputs for the no-build and build scenarios. Table 11 shows the no-build B-C analysis results. Table 12 shows that the CGI Team's program of improvements has an Operations Benefit-Cost Ratio of 18.8 and a Safety Benefit-Cost Ratio of 0.8. Taken together, the Overall Benefit-Cost Ratio is 19.6. Over the life of the project, the program of improvements will save over $2.5 billion in delay costs and almost $46 million in fuel costs.

As stated previously, this analysis is conservative. The VISSIM models only captured the reduction in recurring congestion due to the roadway improvements and adaptive ramp metering. No non-recurring congestion was modeled, so no benefits associated with reducing non-recurring congestion were captured in the analysis. In addition, none of the ATM improvements were modeled in VISSIM, so any reduction ATM has on recurring congestion was not captured. Finally, the benefits of the virtual weigh station improvement were not included in the analysis.

The actual benefits that will be realized when the program of improvements is implemented will be greater than what is shown in the results.

Table 11 No-Build B-C Analysis Results

No-Build Analysis		
No-Build Disbenefits ('000)	No-Build Costs ('000)	No-Build Benefit Cost Ratio
-$2,030,958.1	$15.0	-135,354.8

Table 12 Program of Improvements B-C Analysis Results

Build Analysis											
Cumilative Delay Cost Savings ('000)	Cumilative Fuel Cost Savings ('000)	Cumilative Reliability Savings ('000)	Cumilative Safety Savings ('000)	Total Savings ('000)	Present Value of Operation Savings ('000)	Present Value of Safety Savings ('000)	Present Value of Total Savings ('000)	Present Value of Net Costs ('000)	Operations Benefit-Cost Ratio	Safety Benefit-Cost Ratio	Overall Benefit-Cost Ratio
$2,532,213.9	$45,926.2	$30,803.5	$117,540.2	$2,726,483.8	$2,088,744.1	$94,235.5	$2,182,979.5	$111,224.3	18.8	0.8	**19.6**

Output

The following pages show input and output from the B-C Tool. The tool is also included electronically.

Default Values		Notes
Project	I-270 Innovative Congestion Management	-
Project Opening Year	2020	-
Project Life Span (Years)	20	-
Hours of AM and PM Peak	3	-
Heavy Vehicle Percentage	7	Per the Dec. 2015 "Modeling Calibration Methodologies" memo.
Annual Traffic Growth Factor (%)	1.75	Per the July 18, 2016 Governor's press release.
Annual Growth in Heavy Vehicle Percentage (%)	2.0	-
Working Days Per Year	250	-
Average Vehicle Occupancy	1.2	-
Auto Congestion Cost Per Hour ($)	31.54	*(a)*
Truck Congestion Cost Per Hour ($)	65.60	*(a)*
Reliability Measurement	Mean-variance Approach	Note: An option must be selected from drop down menu to left
Reliability Ratio- AUTO	0.75	*(b), only required if using Mean-variance Approach*
Reliability Ratio- Heavy Vehicles	2.0	*(b), only required if using Mean-variance Approach*
Reliability Ratio- All Vehicles	N/A	*(b), only required if using Reliability Ratio Multiplier*
Annual Deprciation in Travel Time Reliability (%)	3	*Assumption*
Fuel savings per hour of delay savings ($)	0.72	*(a)*
Salvage Value (%)	10.00%	*Assumption*
Annual Inflation Rate (%)	2.08%	*(c)*
Annual Discount rate (%)	3.13%	*(d)*

(a) 2014 CHART Benefit Analysis
(b) SHRP 2 Reliability Project L 35
(c) Source- Bureau of Labor Statistics, 2005-2015 Inflation Rate Average
(d) FHWA TIFIA Interest Rate, updated 1/3/2017

Note: The general rule applicable throughout the spreadsheet is to fill out all the light blue cells, while all the light red cells are automated.

Delay										
Concept #	Location	Concept Description	Base Year Results				Future Year Results			
			Existing Network Delay (Hours)		Build Network Delay (Hours)		Existing Network Delay (Hours)		Build Network Delay (Hours)	
			AM	PM	AM	PM	AM	PM	AM	PM
1	I-270	Program of Improvements - SB 1, SB2, SB 5A, SB 6, SB 7, SB 8, SB 10, SB 12, NB 1, NB 2, NB 3, NB 4, NB 5, NB 7, adaptive ramp metering, ATM, Virtual Weigh Stations	6085.2	6053.4	3548.9	5201.4	10236.3	9604.9	6830.1	7898.6

Accident Cost Data		
Accident Type	Cost per Accident Type (2012 Dollars) *(a)*	Cost per Accident Type (2016 Dollars) *(b)*
Fatal	$1,410,000	$1,482,215
Injury	$78,900	$82,941
Property Damage Only	$8,900	$9,356
Pedestrian Crashes *(c)*	$46,654	$49,043

(a) National Safety Council, "Estimating the Costs of Unintentional Injuries, 2012"

(b) Bureau of Labor Statistics- CPI Inflation Calculator

(C) Association for the Advancement of Automotive Medicine- Pedestrian and Pedalcyclist Injury Costs in the US by Age and Injury Severity (In 2000 Dollars)

CMF/Percent Reduction in Crashes
Provide resources and alternative values researched in a separate sheet. Multiple CMFs may need to be combined for a single concept, see Crash Data worksheet for combining multiple CMFs.

Roadway Improvements								
Accident Type	Historic Crash Data (Existing Conditions)						Safety Analysis Results	
	Year-1	Year-2	Year-3	Year-4	Year-5	Total	CMF (as a two digit decimal)	Percentage Reduction in Crashes (all crash types)
Fatal	3					3	0.98	
Injury	186					186	0.89	
Property Damage Only	387					387	0.94	
Pedestrian Crashes	0					0		
Total	576	0	0	0	0	576	Note: Enter CMF by either crash type (Column M) or as an overall percentage (Column N). DO NOT fill both columns.	

Adaptive Ramp Metering								
Accident Type	Historic Crash Data (Existing Conditions)						Safety Analysis Results	
	Year-1	Year-2	Year-3	Year-4	Year-5	Total	CMF (as a two digit decimal)	Percentage Reduction in Crashes (all crash types)
Fatal	2					2		10%
Injury	81					81		
Property Damage Only	155					155		
Pedestrian Crashes	0					0		
Total	238	0	0	0	0	238	Note: Enter CMF by either crash type (Column M) or as an overall percentage (Column N). DO NOT fill both columns.	

Active Traffic Management								
Accident Type	Historic Crash Data (Existing Conditions)						Safety Analysis Results	
	Year-1	Year-2	Year-3	Year-4	Year-5	Total	CMF (as a two digit decimal)	Percentage Reduction in Crashes (all crash types)
Fatal	2					2		10%
Injury	150					150		
Property Damage Only	260					260		
Pedestrian Crashes	0					0		
Total	412	0	0	0	0	412	Note: Enter CMF by either crash type (Column M) or as an overall percentage (Column N). DO NOT fill both columns.	

Concept Description	Concept Cost (1,000's)
Program of Improvements - SB 1, SB2, SB 5A, SB 6, SB 7, SB 8, SB 10, SB 12, NB 1, NB 2, NB 3, NB 4, NB 5, NB 7, adaptive ramp metering, ATM, Virtual Weigh Stations	$100,000.0

No-Build Operations and Maintenance Cost	Percent of Planning, Engineering and ROW costs as a percent of Construction Cost	Operation Cost (Project Life Span)
15%	0%	10%

Note: If additional details on cost, or costs by year, are available, then provide data below (switch to Normal View for guidance). Otherwise above tables will automatically populate cost fields below

CONCEPT-1 DIRECT PROJECT COSTS (in thousands of dollars)						
Year	INITIAL COSTS (1'000's)		SUBSEQUENT COSTS (1000's)		TOTAL COSTS (in 1000's of dollars)	
	Project		Maintenance		Constant Dollars	Present Value
	Planning+Engineering+ROW *(a)*	Construction				
Construction Period						
1	$0.0	$100,000.0			$100,000.0	$100,031.3
2	$0.0				$0.0	$0.0
3	$0.0				$0.0	$0.0
4	$0.0				$0.0	$0.0
5	$0.0		Note: If only one cost value is provided, enter in Year 1 to the left		$0.0	$0.0
6	$0.0				$0.0	$0.0
7	$0.0				$0.0	$0.0
8	$0.0				$0.0	$0.0
9	$0.0				$0.0	$0.0
10	$0.0				$0.0	$0.0
Project Open						
			Operation	Rehabiltation	Constant Dollars	Present Value
2021			$500.0		$500.0	$500.2
2022			$510.4		$510.4	$510.7
2023			$521.0		$521.0	$521.5
2024			$531.9		$531.9	$532.5
2025			$542.9		$542.9	$543.8
2026			$554.2		$554.2	$555.3
2027			$565.7	$4,769.5	$5,335.2	$5,346.9
2028			$577.5	$1,080.0	$1,657.5	$1,661.7
2029			$589.5		$589.5	$591.2
2030			$601.8	$1,322.0	$1,923.8	$1,929.8
2031			$614.3		$614.3	$616.4
2032			$627.1		$627.1	$629.4
2033			$640.1		$640.1	$642.7
2034			$653.4		$653.4	$656.3
2035			$667.0	$630.0	$1,297.0	$1,303.1
2036			$680.9	$1,080.0	$1,760.9	$1,769.7
2037			$695.1		$695.1	$698.8
2038			$709.5		$709.5	$713.5
2039			$724.3		$724.3	$728.6
2040			$739.3		$739.3	$744.0
Total	$0 $0	$100,000	$12,246	$8,882	$121,127	$121,227

Note: This sheet only needs to be filled out when the mean-variance approach is used to calculate reliability savings.

Computation of Reliability Savings

Computation of reliability is based on Mean- Variance approach, given by,

User Cost= A*mean travel time + B* standard deviation of travel time

where,

User Cost= Time Cost + Reliability Cost

A= Value of travel time ($/min) = Auto/ Truck congestion cost per hour

B= Value of reliability ($/min) = 0.75 * Auto congestion cost per hour or 2 * Truck congestion per hour

Default reliability ratio of 0.75 and 2.0 for auto and trucks, respectively, are based on SHRP 2 Reliability Project L 35 Results

Reliability Savings= User cost savings - Time Cost savings

Concept-1

Run	Existing Network TT (Hour)				Concept Network TT (Hours)				User Cost Savings ($/Hour)	Time Cost Savings ($/Hour)	Reliability Savings ($/Year in 1000's)
	AM (Hour)	PM (Hour)	User Cost ($/Hour)		AM (Hour)	PM (Hour)	User Cost ($/Hour)				
			AM	PM			AM	PM			
1	14604.3	14933.56	492389.1	508524.9	12740.93	14228.69	424627.8	484104.2	$92,182.0	$89,931.3	$2,025.6
2	13967.22	14766.2			11519.47	14036.59					
3	14017.77	14976.09			11896.72	14309.07					
4	14522.81	14813.37			12191.85	14147.14					
5	14072.4	14994.5			12176.26	14164.8					
6											
7											
8											
9											
10											
Mean	14236.9	14896.7			12105.0	14177.3					
Std Dev	301.9	101.5			448.1	101.1					

Summary																	
			No-Build Analysis			Build Analysis											
Concept #	Location	Concept Description	No-Build Disbenefits ('000)	No-Build Costs ('000)	No-Build Benefit Cost Ratio	Cumilative Delay Cost Savings ('000)	Cumilative Fuel Cost Savings ('000)	Cumilative Reliability Savings ('000)	Cumilative Safety Savings ('000)	Total Savings ('000)	Present Value of Operation Savings ('000)	Present Value of Safety Savings ('000)	Present Value of Total Savings ('000)	Present Value of Net Costs ('000)	Operations Benefit-Cost Ratio	Safety Benefit-Cost Ratio	Overall Benefit-Cost Ratio
1	I-270	Program of Improvements - SB 1, SB2, SB 5A, SB 6, SB 7, SB 8, SB 10, SB 12, NB 1, NB 2, NB 3, NB 4, NB 5, NB 7, adaptive ramp metering, ATM, Virtual Weigh Stations	-$1,871,534.5	$15.0	-124,729.9	$2,532,213.9	$45,926.2	$30,803.5	$117,540.2	$2,726,483.8	$2,088,744.1	$94,235.5	$2,182,979.5	$111,224.3	18.8	0.8	**19.6**

NO-BUILD															
Year	n	Future Year Network Delay (Existing Condition, Hours)				Annual Delay Savings ('000)	Auto Cost Savings ('000)	Freight Cost Savings ('000)	Fuel savings per hour of delay savings ($)	Fuel Cost Savings ('000)	Reliability Savings ('000)	Present Value of Operation Savings ('000)	Safety Savings ('000)	Present Value of Safety Savings ('000)	Total Savings ('000)	Present Value of Total Savings ('000)
		AM		PM												
		Auto	Truck	Auto	Truck											
2021	1	5758.3	433.4	5728.2	431.2	-159.3	-$5,607.8	-$731.6	$0.7	-$114.7	$0.0	-$6,322.6	$0.0	$0.0	-$6,454.1	-$6,322.6
2022	2	5946.4	447.6	5888.4	443.2	-440.2	-$15,494.6	-$2,021.4	$0.7	-$317.1	$0.0	-$17,113.7	$0.0	$0.0	-$17,833.1	-$17,113.7
2023	3	6134.4	461.7	6048.6	455.3	-721.1	-$25,381.4	-$3,311.2	$0.7	-$519.5	$0.0	-$27,462.6	$0.0	$0.0	-$29,212.1	-$27,462.6
2024	4	6322.5	475.9	6208.8	467.3	-1,002.0	-$35,268.1	-$4,601.1	$0.7	-$722.0	$0.0	-$37,382.6	$0.0	$0.0	-$40,591.2	-$37,382.6
2025	5	6510.6	490.0	6369.0	479.4	-1,282.9	-$45,154.9	-$5,890.9	$0.7	-$924.6	$0.0	-$46,887.0	$0.0	$0.0	-$51,970.4	-$46,887.0
2026	6	6698.7	504.2	6529.3	491.5	-1,563.7	-$55,041.7	-$7,180.7	$0.7	-$1,127.3	$0.0	-$55,988.7	$0.0	$0.0	-$63,349.7	-$55,988.7
2027	7	6886.7	518.4	6689.5	503.5	-1,844.6	-$64,928.5	-$8,470.5	$0.7	-$1,330.1	$0.0	-$64,700.1	$0.0	$0.0	-$74,729.1	-$64,700.1
2028	8	7074.8	532.5	6849.7	515.6	-2,125.5	-$74,815.2	-$9,760.4	$0.7	-$1,532.9	$0.0	-$73,033.3	$0.0	$0.0	-$86,108.5	-$73,033.3
2029	9	7262.9	546.7	7009.9	527.6	-2,406.4	-$84,702.0	-$11,050.2	$0.7	-$1,735.9	$0.0	-$81,000.1	$0.0	$0.0	-$97,488.0	-$81,000.1
2030	10	7451.0	560.8	7170.2	539.7	-2,687.3	-$94,588.8	-$12,340.0	$0.7	-$1,938.9	$0.0	-$88,611.9	$0.0	$0.0	-$108,867.7	-$88,611.9
2031	11	7639.0	575.0	7330.4	551.7	-2,968.2	-$104,475.5	-$13,629.8	$0.7	-$2,142.0	$0.0	-$95,880.1	$0.0	$0.0	-$120,247.4	-$95,880.1
2032	12	7827.1	589.1	7490.6	563.8	-3,249.1	-$114,362.3	-$14,919.7	$0.7	-$2,345.2	$0.0	-$102,815.2	$0.0	$0.0	-$131,627.1	-$102,815.2
2033	13	8015.2	603.3	7650.8	575.9	-3,529.9	-$124,249.1	-$16,209.5	$0.7	-$2,548.4	$0.0	-$109,428.1	$0.0	$0.0	-$143,007.0	-$109,428.1
2034	14	8203.3	617.5	7811.0	587.9	-3,810.8	-$134,135.9	-$17,499.3	$0.7	-$2,751.8	$0.0	-$115,728.8	$0.0	$0.0	-$154,387.0	-$115,728.8
2035	15	8391.3	631.6	7971.3	600.0	-4,091.7	-$144,022.6	-$18,789.1	$0.7	-$2,955.2	$0.0	-$121,727.4	$0.0	$0.0	-$165,767.0	-$121,727.4
2036	16	8579.4	645.8	8131.5	612.0	-4,372.6	-$153,909.4	-$20,079.0	$0.7	-$3,158.8	$0.0	-$127,433.5	$0.0	$0.0	-$177,147.1	-$127,433.5
2037	17	8767.5	659.9	8291.7	624.1	-4,653.5	-$163,796.2	-$21,368.8	$0.7	-$3,362.4	$0.0	-$132,856.6	$0.0	$0.0	-$188,527.3	-$132,856.6
2038	18	8955.6	674.1	8451.9	636.2	-4,934.4	-$173,683.0	-$22,658.6	$0.7	-$3,566.1	$0.0	-$138,005.8	$0.0	$0.0	-$199,907.6	-$138,005.8
2039	19	9143.6	688.2	8612.2	648.2	-5,215.3	-$183,569.7	-$23,948.4	$0.7	-$3,769.8	$0.0	-$142,890.2	$0.0	$0.0	-$211,288.0	-$142,890.2
2040	20	9519.8	716.5	8932.6	672.3	-5,777.0	-$203,343.3	-$26,528.1	$0.7	-$4,176.8	$0.0	-$155,057.2	$0.0	$0.0	-$234,048.2	-$155,057.2
Sum	**-**	**151088.1**	**11372.2**	**145165.5**	**10926.4**	**-$56,835.4**	**-$2,000,530.0**	**-$260,988.3**	**-**	**-$41,039.4**	**$0.0**	**-$1,740,325.5**	**$0.0**	**$0.0**	**-$2,302,557.7**	**-$1,740,325.5**

NO-BUILD Safety Savings									
Year	Concept-1	Savings	Present Value	Concept-2	Savings	Present Value	Concept-3	Savings	Present Value
Existing	$23,843,753	-	-	$11,132,831	-		$17,838,140	-	
2021	$24,261,018	-$417,266	-$425,945	$11,327,656	-$194,825	-$198,877	$18,150,307	-$312,167	-$318,661
2022	$24,685,586	-$841,833	-$877,218	$11,525,890	-$393,059	-$409,580	$18,467,938	-$629,798	-$656,270
2023	$25,117,584	-$1,273,831	-$1,354,983	$11,727,593	-$594,762	-$632,652	$18,791,127	-$952,987	-$1,013,699
2024	$25,557,142	-$1,713,389	-$1,860,453	$11,932,825	-$799,994	-$868,660	$19,119,971	-$1,281,831	-$1,391,854
2025	$26,004,392	-$2,160,639	-$2,394,890	$12,141,650	-$1,008,819	-$1,118,192	$19,454,571	-$1,616,431	-$1,791,680
2026	$26,459,469	-$2,615,716	-$2,959,610	$12,354,129	-$1,221,298	-$1,381,865	$19,795,026	-$1,956,886	-$2,214,162
2027	$26,922,509	-$3,078,757	-$3,555,985	$12,570,326	-$1,437,495	-$1,660,317	$20,141,439	-$2,303,299	-$2,660,326
2028	$27,393,653	-$3,549,900	-$4,185,443	$12,790,307	-$1,657,476	-$1,954,216	$20,493,914	-$2,655,774	-$3,131,240
2029	$27,873,042	-$4,029,289	-$4,849,471	$13,014,137	-$1,881,306	-$2,264,255	$20,852,558	-$3,014,418	-$3,628,017
2030	$28,360,820	-$4,517,068	-$5,549,619	$13,241,884	-$2,109,053	-$2,591,160	$21,217,477	-$3,379,337	-$4,151,817
2031	$28,857,135	-$5,013,382	-$6,287,501	$13,473,617	-$2,340,786	-$2,935,682	$21,588,783	-$3,750,643	-$4,703,845
2032	$29,362,135	-$5,518,382	-$7,064,797	$13,709,406	-$2,576,575	-$3,298,608	$21,966,587	-$4,128,447	-$5,285,361
2033	$29,875,972	-$6,032,219	-$7,883,257	$13,949,320	-$2,816,489	-$3,680,753	$22,351,002	-$4,512,862	-$5,897,673
2034	$30,398,801	-$6,555,049	-$8,744,705	$14,193,433	-$3,060,602	-$4,082,970	$22,742,145	-$4,904,005	-$6,542,145
2035	$30,930,780	-$7,087,028	-$9,651,039	$14,441,819	-$3,308,988	-$4,506,144	$23,140,132	-$5,301,992	-$7,220,196
2036	$31,472,069	-$7,628,316	-$10,604,233	$14,694,550	-$3,561,719	-$4,951,198	$23,545,085	-$5,706,945	-$7,933,307
2037	$32,022,830	-$8,179,078	-$11,606,348	$14,951,705	-$3,818,874	-$5,419,093	$23,957,124	-$6,118,984	-$8,683,015
2038	$32,583,230	-$8,739,477	-$12,659,523	$15,213,360	-$4,080,529	-$5,910,829	$24,376,373	-$6,538,233	-$9,470,923
2039	$33,153,436	-$9,309,684	-$13,765,991	$15,479,594	-$4,346,763	-$6,427,447	$24,802,960	-$6,964,820	-$10,298,701
2040	$33,733,621	-$9,889,869	-$14,928,073	$15,750,487	-$4,617,656	-$6,970,032	$25,237,012	-$7,398,872	-$11,168,085
Total in ('000)	-	**-$98,150.17**	**-$131,209.09**	**$268,483.69**	**-$45,827.07**	**-$61,262.53**	**$430,191.53**	**-$73,428.73**	**-$98,160.98**

Concept-1																				
Year	n	Future Year Network Delay (Existing Condition, Hours)				Future Year Network Delay (Build Condition, Hours)				Annual Delay Savings ('000)	Auto Cost Savings ('000)	Freight Cost Savings ('000)	Fuel savings per hour of delay savings ($)	Fuel Cost Savings ('000)	Reliability Savings ('000)	Present Value of Operation Savings ('000)	Safety Savings ('000)	Present Value of Safety Savings ('000)	Total Savings ('000)	Present Value of Total Savings ('000)
		AM		PM		AM		PM												
		Auto	Truck	Auto	Truck	Auto	Truck	Auto	Truck											
2021	1	5758.3	433.4	5728.2	431.2	3358.3	252.8	4922.0	370.5	2,585.6	$91,010.9	$11,873.2	$0.7	$1,862.0	$2,025.6	$104,596.2	$4,959.2	$4,858.1	$111,731.0	$109,454.4
2022	2	5946.4	447.6	5888.4	443.2	3508.0	264.0	5043.2	379.6	2,648.1	$93,208.7	$12,160.0	$0.7	$1,907.4	$1,964.9	$104,834.4	$5,046.0	$4,842.4	$114,286.8	$109,676.8
2023	3	6134.4	461.7	6048.6	455.3	3657.6	275.3	5164.4	388.7	2,710.5	$95,406.4	$12,446.7	$0.7	$1,952.8	$1,905.9	$105,021.2	$5,134.3	$4,826.8	$116,846.0	$109,848.0
2024	4	6322.5	475.9	6208.8	467.3	3807.3	286.6	5285.5	397.8	2,773.0	$97,604.1	$12,733.4	$0.7	$1,998.2	$1,848.7	$105,158.5	$5,224.1	$4,811.2	$119,408.6	$109,969.6
2025	5	6510.6	490.0	6369.0	479.4	3957.0	297.8	5406.7	407.0	2,835.4	$99,801.9	$13,020.1	$0.7	$2,043.6	$1,793.3	$105,248.1	$5,315.5	$4,795.6	$121,974.4	$110,043.7
2026	6	6698.7	504.2	6529.3	491.5	4106.7	309.1	5527.9	416.1	2,897.8	$101,999.6	$13,306.8	$0.7	$2,089.0	$1,739.5	$105,292.0	$5,408.5	$4,780.1	$124,543.5	$110,072.1
2027	7	6886.7	518.4	6689.5	503.5	4256.4	320.4	5649.1	425.2	2,960.3	$104,197.3	$13,593.5	$0.7	$2,134.5	$1,687.3	$105,291.7	$5,503.2	$4,764.6	$127,115.9	$110,056.4
2028	8	7074.8	532.5	6849.7	515.6	4406.1	331.6	5770.3	434.3	3,022.7	$106,395.1	$13,880.3	$0.7	$2,180.0	$1,636.7	$105,249.1	$5,599.5	$4,749.2	$129,691.5	$109,998.4
2029	9	7262.9	546.7	7009.9	527.6	4555.8	342.9	5891.5	443.4	3,085.1	$108,592.8	$14,167.0	$0.7	$2,225.5	$1,587.6	$105,165.8	$5,697.5	$4,733.9	$132,270.3	$109,899.7
2030	10	7451.0	560.8	7170.2	539.7	4705.5	354.2	6012.7	452.6	3,147.6	$110,790.6	$14,453.7	$0.7	$2,271.0	$1,539.9	$105,043.4	$5,797.2	$4,718.6	$134,852.4	$109,762.0
2031	11	7639.0	575.0	7330.4	551.7	4855.1	365.4	6133.8	461.7	3,210.0	$112,988.3	$14,740.4	$0.7	$2,316.5	$1,493.8	$104,883.5	$5,898.7	$4,703.3	$137,437.6	$109,586.8
2032	12	7827.1	589.1	7490.6	563.8	5004.8	376.7	6255.0	470.8	3,272.5	$115,186.0	$15,027.1	$0.7	$2,362.1	$1,448.9	$104,687.6	$6,001.9	$4,688.1	$140,026.0	$109,375.7
2033	13	8015.2	603.3	7650.8	575.9	5154.5	388.0	6376.2	479.9	3,334.9	$117,383.8	$15,313.8	$0.7	$2,407.6	$1,405.5	$104,457.1	$6,106.9	$4,673.0	$142,617.6	$109,130.1
2034	14	8203.3	617.5	7811.0	587.9	5304.2	399.2	6497.4	489.1	3,397.3	$119,581.5	$15,600.6	$0.7	$2,453.2	$1,363.3	$104,193.6	$6,213.8	$4,657.9	$145,212.4	$108,851.5
2035	15	8391.3	631.6	7971.3	600.0	5453.9	410.5	6618.6	498.2	3,459.8	$121,779.2	$15,887.3	$0.7	$2,498.8	$1,322.4	$103,898.4	$6,322.5	$4,642.8	$147,810.3	$108,541.2
2036	16	8579.4	645.8	8131.5	612.0	5603.6	421.8	6739.8	507.3	3,522.2	$123,977.0	$16,174.0	$0.7	$2,544.4	$1,282.7	$103,572.9	$6,433.2	$4,627.8	$150,411.3	$108,200.7
2037	17	8767.5	659.9	8291.7	624.1	5753.3	433.0	6861.0	516.4	3,584.6	$126,174.7	$16,460.7	$0.7	$2,590.1	$1,244.3	$103,218.3	$6,545.7	$4,612.8	$153,015.5	$107,831.1
2038	18	8955.6	674.1	8451.9	636.2	5903.0	444.3	6982.2	525.5	3,647.1	$128,372.5	$16,747.4	$0.7	$2,635.8	$1,206.9	$102,836.0	$6,660.3	$4,597.9	$155,622.8	$107,433.9
2039	19	9143.6	688.2	8612.2	648.2	6052.6	455.6	7103.3	534.7	3,709.5	$130,570.2	$17,034.1	$0.7	$2,681.4	$1,170.7	$102,427.2	$6,776.9	$4,583.1	$158,233.3	$107,010.3
2040	20	9519.8	716.5	8932.6	672.3	6352.0	478.1	7345.7	552.9	3,834.4	$134,965.7	$17,607.6	$0.7	$2,772.3	$1,135.6	$103,668.9	$6,895.4	$4,568.2	$163,376.6	$108,237.2
Sum	**-**	**151,088.1**	**11,372.2**	**145,165.5**	**10,926.4**	**95,755.7**	**7,207.4**	**121,586.3**	**9,151.7**	**63,638.4**	**$ 2,239,986.2**	**$ 292,227.7**	**-**	**$ 45,926.2**	**$ 30,803.5**	**$ 2,088,744.1**	**$ 117,540.2**	**$ 94,235.5**	**$ 2,726,483.8**	**$ 2,182,979.5**

Active Traffic Management												
Year	n	Existing Condition Crashes					With Proposed Improvement					Crash Savings (1000's)
		Fatal	Injury	PDO	Ped	Costs	Fatal	Injury	PDO	Ped	Costs	
2021	1	2.0	152.6	264.6	0.0	$18,150,307.5	1.8	137.4	238.1	0.0	$16,335,276.7	$1,815.0
2022	2	2.1	155.3	269.2	0.0	$18,467,937.8	1.9	139.8	242.3	0.0	$16,621,144.0	$1,846.8
2023	3	2.1	158.0	273.9	0.0	$18,791,126.7	1.9	142.2	246.5	0.0	$16,912,014.1	$1,879.1
2024	4	2.1	160.8	278.7	0.0	$19,119,971.5	1.9	144.7	250.8	0.0	$17,207,974.3	$1,912.0
2025	5	2.2	163.6	283.6	0.0	$19,454,571.0	2.0	147.2	255.2	0.0	$17,509,113.9	$1,945.5
2026	6	2.2	166.5	288.5	0.0	$19,795,026.0	2.0	149.8	259.7	0.0	$17,815,523.4	$1,979.5
2027	7	2.3	169.4	293.6	0.0	$20,141,438.9	2.0	152.4	264.2	0.0	$18,127,295.0	$2,014.1
2028	8	2.3	172.3	298.7	0.0	$20,493,914.1	2.1	155.1	268.8	0.0	$18,444,522.7	$2,049.4
2029	9	2.3	175.3	303.9	0.0	$20,852,557.6	2.1	157.8	273.5	0.0	$18,767,301.8	$2,085.3
2030	10	2.4	178.4	309.3	0.0	$21,217,477.3	2.1	160.6	278.3	0.0	$19,095,729.6	$2,121.7
2031	11	2.4	181.5	314.7	0.0	$21,588,783.2	2.2	163.4	283.2	0.0	$19,429,904.9	$2,158.9
2032	12	2.5	184.7	320.2	0.0	$21,966,586.9	2.2	166.2	288.2	0.0	$19,769,928.2	$2,196.7
2033	13	2.5	187.9	325.8	0.0	$22,351,002.2	2.3	169.2	293.2	0.0	$20,115,902.0	$2,235.1
2034	14	2.5	191.2	331.5	0.0	$22,742,144.7	2.3	172.1	298.3	0.0	$20,467,930.2	$2,274.2
2035	15	2.6	194.6	337.3	0.0	$23,140,132.2	2.3	175.1	303.6	0.0	$20,826,119.0	$2,314.0
2036	16	2.6	198.0	343.2	0.0	$23,545,084.6	2.4	178.2	308.9	0.0	$21,190,576.1	$2,354.5
2037	17	2.7	201.5	349.2	0.0	$23,957,123.5	2.4	181.3	314.3	0.0	$21,561,411.2	$2,395.7
2038	18	2.7	205.0	355.3	0.0	$24,376,373.2	2.5	184.5	319.8	0.0	$21,938,735.9	$2,437.6
2039	19	2.8	208.6	361.5	0.0	$24,802,959.7	2.5	187.7	325.4	0.0	$22,322,663.8	$2,480.3
2040	20	2.8	212.2	367.8	0.0	$25,237,011.5	2.5	191.0	331.1	0.0	$22,713,310.4	$2,523.7
Total	-	48.2	3617.5	6270.3	0.0	$430,191,530.1	43.4	3255.7	5643.2	0.0	$387,172,377.1	$43,019.2

Adaptive Ramp Metering												
Year	n	Existing Condition Crashes					With Proposed Improvement					Crash Savings
		Fatal	Injury	PDO	Ped	Costs	Fatal	Injury	PDO	Ped	Costs	(1000's)
2021	1	2.0	82.4	157.7	0.0	$11,327,655.5	1.8	74.2	141.9	0.0	$10,194,890.0	$1,132.8
2022	2	2.1	83.9	160.5	0.0	$11,525,889.5	1.9	75.5	144.4	0.0	$10,373,300.6	$1,152.6
2023	3	2.1	85.3	163.3	0.0	$11,727,592.6	1.9	76.8	147.0	0.0	$10,554,833.3	$1,172.8
2024	4	2.1	86.8	166.1	0.0	$11,932,825.5	1.9	78.1	149.5	0.0	$10,739,542.9	$1,193.3
2025	5	2.2	88.3	169.0	0.0	$12,141,649.9	2.0	79.5	152.1	0.0	$10,927,484.9	$1,214.2
2026	6	2.2	89.9	172.0	0.0	$12,354,128.8	2.0	80.9	154.8	0.0	$11,118,715.9	$1,235.4
2027	7	2.3	91.5	175.0	0.0	$12,570,326.0	2.0	82.3	157.5	0.0	$11,313,293.4	$1,257.0
2028	8	2.3	93.1	178.1	0.0	$12,790,306.7	2.1	83.8	160.3	0.0	$11,511,276.1	$1,279.0
2029	9	2.3	94.7	181.2	0.0	$13,014,137.1	2.1	85.2	163.1	0.0	$11,712,723.4	$1,301.4
2030	10	2.4	96.3	184.4	0.0	$13,241,884.5	2.1	86.7	165.9	0.0	$11,917,696.0	$1,324.2
2031	11	2.4	98.0	187.6	0.0	$13,473,617.5	2.2	88.2	168.8	0.0	$12,126,255.7	$1,347.4
2032	12	2.5	99.7	190.9	0.0	$13,709,405.8	2.2	89.8	171.8	0.0	$12,338,465.2	$1,370.9
2033	13	2.5	101.5	194.2	0.0	$13,949,320.4	2.3	91.3	174.8	0.0	$12,554,388.3	$1,394.9
2034	14	2.5	103.3	197.6	0.0	$14,193,433.5	2.3	92.9	177.9	0.0	$12,774,090.1	$1,419.3
2035	15	2.6	105.1	201.1	0.0	$14,441,818.6	2.3	94.6	181.0	0.0	$12,997,636.7	$1,444.2
2036	16	2.6	106.9	204.6	0.0	$14,694,550.4	2.4	96.2	184.1	0.0	$13,225,095.4	$1,469.5
2037	17	2.7	108.8	208.2	0.0	$14,951,705.0	2.4	97.9	187.4	0.0	$13,456,534.5	$1,495.2
2038	18	2.7	110.7	211.8	0.0	$15,213,359.9	2.5	99.6	190.6	0.0	$13,692,023.9	$1,521.3
2039	19	2.8	112.6	215.5	0.0	$15,479,593.7	2.5	101.4	194.0	0.0	$13,931,634.3	$1,548.0
2040	20	2.8	114.6	219.3	0.0	$15,750,486.6	2.5	103.1	197.4	0.0	$14,175,437.9	$1,575.0
Total	-	48.2	1953.4	3738.0		$268,483,687.3	43.4	1758.1	3364.2	0.0	$241,635,318.6	$26,848.4

Roadway Improvements												
Year	n	Existing Condition Crashes					With Proposed Improvement					Crash Savings (1000's)
		Fatal	Injury	PDO	Ped	Costs	Fatal	Injury	PDO	Ped	Costs	
2021	1	3.3	189.3	393.9	0.0	$24,261,018.4	3.2	169.1	370.8	0.0	$22,249,648.9	$2,011.4
2022	2	3.3	192.7	400.8	0.0	$24,685,586.2	3.3	172.1	377.3	0.0	$22,639,017.8	$2,046.6
2023	3	3.4	196.0	407.8	0.0	$25,117,584.0	3.3	175.1	383.9	0.0	$23,035,200.6	$2,082.4
2024	4	3.5	199.5	414.9	0.0	$25,557,141.7	3.4	178.2	390.6	0.0	$23,438,316.6	$2,118.8
2025	5	3.5	203.0	422.2	0.0	$26,004,391.7	3.4	181.3	397.5	0.0	$23,848,487.2	$2,155.9
2026	6	3.6	206.5	429.6	0.0	$26,459,468.5	3.5	184.5	404.4	0.0	$24,265,835.7	$2,193.6
2027	7	3.6	210.1	437.1	0.0	$26,922,509.2	3.6	187.7	411.5	0.0	$24,690,487.8	$2,232.0
2028	8	3.7	213.8	444.7	0.0	$27,393,653.2	3.6	191.0	418.7	0.0	$25,122,571.4	$2,271.1
2029	9	3.8	217.5	452.5	0.0	$27,873,042.1	3.7	194.3	426.0	0.0	$25,562,216.3	$2,310.8
2030	10	3.8	221.3	460.4	0.0	$28,360,820.3	3.7	197.7	433.5	0.0	$26,009,555.1	$2,351.3
2031	11	3.9	225.2	468.5	0.0	$28,857,134.7	3.8	201.2	441.1	0.0	$26,464,722.4	$2,392.4
2032	12	4.0	229.2	476.7	0.0	$29,362,134.5	3.9	204.7	448.8	0.0	$26,927,855.0	$2,434.3
2033	13	4.0	233.2	485.0	0.0	$29,875,971.9	3.9	208.3	456.7	0.0	$27,399,092.5	$2,476.9
2034	14	4.1	237.2	493.5	0.0	$30,398,801.4	4.0	211.9	464.7	0.0	$27,878,576.6	$2,520.2
2035	15	4.2	241.4	502.2	0.0	$30,930,780.4	4.1	215.7	472.8	0.0	$28,366,451.7	$2,564.3
2036	16	4.3	245.6	510.9	0.0	$31,472,069.1	4.2	219.4	481.1	0.0	$28,862,864.6	$2,609.2
2037	17	4.3	249.9	519.9	0.0	$32,022,830.3	4.2	223.3	489.5	0.0	$29,367,964.7	$2,654.9
2038	18	4.4	254.3	529.0	0.0	$32,583,229.8	4.3	227.2	498.0	0.0	$29,881,904.1	$2,701.3
2039	19	4.5	258.7	538.2	0.0	$33,153,436.3	4.4	231.1	506.8	0.0	$30,404,837.4	$2,748.6
2040	20	4.6	263.3	547.7	0.0	$33,733,621.5	4.5	235.2	515.6	0.0	$30,936,922.1	$2,796.7
Total	-	77.9	4487.8	9335.5	0.0	$575,025,225.4	76.0	4009.1	8789.5	0.0	$527,352,528.3	$47,672.7