Interchange Modification Study

February 2012

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CONTENTS

I. Executive Summary

Increasing congestion in the SR 18 corridor has prompted a couple of traffic studies to be conducted over the last several years. These studies were performed to evaluate potential safety and capacity improvements needed to accommodate future traffic demands in the corridor.

One of these studies, the Summit 18 Corridor Study, began in 2005 and identified the primary bottleneck in the corridor as the intersection of SR 18 and Crystal Lake Road/Montrose West Avenue. This intersection fails in the current conditions and without improvements will be overwhelmed by additional traffic in the future. Traffic spillbacks from this intersection are the major contributing factor to the existing operational deficiencies in the study corridor. Therefore, fixing this intersection in the near term is critical to improving the overall traffic operations of the study corridor.

This Interchange Modification Study (IMS) will evaluate and document the recommended improvements to the SR 18 and Crystal Lake Road/Montrose West Avenue intersection.

The recommended improvements address the identified safety and congestion issues by providing additional through and turn lanes to better serve the high peak hour traffic demands. Specifically, these improvements are:

- Relocation of Montrose West Avenue to tie into Heritage Woods Drive.
- New roundabout at the intersection of Heritage Woods Drive and Montrose West Avenue.
- Revised geometry for the intersection of SR 18 and Heritage Woods Drive to accommodate additional traffic due to Montrose West Avenue relocation.
- One additional eastbound lane on SR 18 from just east of Scenic View Drive to the I-77 southbound ramp, making it a two lane ramp. The two-lane ramp will be reduced to one-lane prior to joining southbound I-77 as per Figure 505-1a of the ODOT Location and Design Manual, Volume 1.

Freeway segment, weave and ramp junction operation are essentially unaffected by the recommended improvements in the SR 18 corridor.

This report will document that the recommended improvements will significantly enhance both the safety and operations of the SR 18 and Crystal Lake Road/Montrose West Avenue intersection while not degrading the interstate operations.

II. Background

The dual role of SR 18 in serving commuters and providing direct access has caused poor traffic operations along SR 18 for some time. Residents, commuters and business owners along the corridor are concerned about the degrading performance of the roadway. The Summit County Engineer conducted a planning study in 1998 that looked into congestion along SR 18. The study area for the 1998 SR 18 study was from the Medina County line to the Cleveland-Massillon Road. In addition to the study of SR 18, it included a review of the I-77 and SR 18 interchange. The study findings of the corridor included the following:

- Improved, effective access management is paramount for optimal, safe movement of vehicles through the corridor.
- Growth in corridor traffic levels, including both commuter and short trips worsens the congested condition.
- Modification of the I-77 interchange from a clover leaf design to an urban interchange type by 2010
- By 2025, the existing interchange will fail.
- The westbound SR 18 and I-77 loop ramp weaving section causes disruptions in traffic flow along SR 18.
- Lack of signal coordination causes unnecessary backups throughout the corridor.

Major recommendations from the 1998 study include the following:

- Construct a northbound right turn lane on Cleveland-Massillon Road at SR 18 (complete)
- Signalize the SR 18 and Heritage Woods Drive Intersection (complete)
- Numerous striping improvements (complete)
- Construct a center two-way left turn lane along SR 18 from Medina Line Road to Heritage Woods Drive
- Construct additional south-bound through lanes on Cleveland-Massillon Road from Springside Drive to SR 18
- Construct the Brookwall Road Connector from Brookmont Road to Rothrock Road (complete)
- Widen Cleveland-Massillon Road from Ridgewood Road to SR 18 and reconstruct the SR 18 intersection
- Initiate an access management plan
- Monitor the Crystal Lake Road and Embassy Parkway intersection for signalization (complete)
- Reconstruct the SR 18 and I-77 interchange

The Summit 18 Corridor Study began in 2005 to develop and evaluate alternatives for the SR 18 corridor and I-77 interchanges with SR 18 and SR 21. As acknowledged in the *Purpose and Need* document, the primary bottleneck in the study corridor is the intersection of SR 18 and Crystal Lake Road/Montrose West Avenue. This intersection fails in the current conditions and

without improvements will be overwhelmed by additional traffic in the future. Traffic spillbacks from this intersection are the major contributing factor to the existing operational deficiencies in the study corridor. Therefore, fixing this intersection in the near term is critical to improving the overall traffic operations of the study corridor. A decision was made to separate the corridor improvements into two projects. The first project will provide enhancements that are specifically targeted at improving the operations at this intersection. The second project will address the remaining problem areas in the corridor, including the interstate improvements.

This Interchange Modification Study will document the improvements to the SR 18 and Crystal Lake Road/Montrose West Avenue intersection. The remaining improvements will be part of a future, unfunded project.

Funding from the Highway Safety Program will be combined with Ohio Department of Transportation (ODOT) District Allocation and Akron Metropolitan Area Transportation Study (AMATS) funding, to finance the Crystal Lake Road improvements.

III. Purpose and Need

The intersection of SR 18 and Crystal Lake Road/Montrose West Avenue is deficient with respect to capacity, level of service and traffic safety under existing traffic conditions. The significant growth anticipated in this area will further degrade the traffic operations at this intersection. Improvements are needed to provide adequate capacity, level of service, and safety for current and future traffic volumes.

The purpose and need of this project is to:

- Construct a roadway system that provides adequate capacity and levels of service for existing and future traffic volumes.
- Provide safety improvements in the study area at high crash rate locations.

IV. Study Area

The SR 18 study area, Figure 1, is located in Summit County to the northwest of the Akron metropolitan area. The interchange of I-77 and SR 18 is located at Mile Post 137 on I-77. The primary focus of the study is the intersection of SR 18 and Crystal Lake Road/Montrose West Avenue. Adjacent intersections along SR 18 have been included in the study area to evaluate the effects of the recommended improvements.

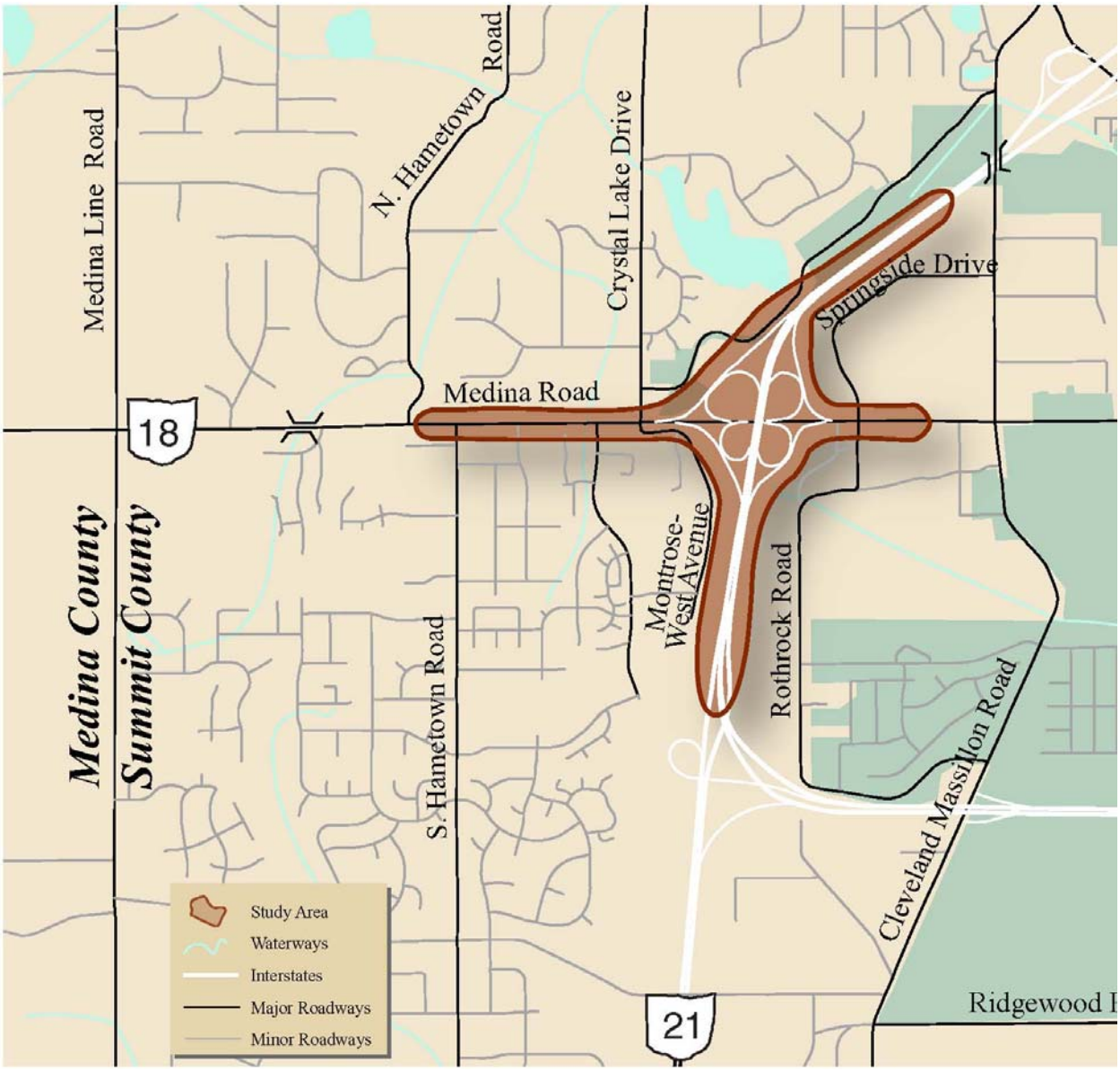
Intersections along SR 18 included in the study area are:

- SR 18 and Scenic View Drive (Unsignalized)

- SR 18 and Heritage Woods Drive (Signalized)
- SR 18 and Crystal Lake Road (Signalized)
- SR 18 and Springside Drive (Signalized)

Because of the close proximity of SR 18 and I-77 interchange to the Crystal Lake Road/Montrose West Avenue intersection, I-77 must be evaluated to determine if any negative impacts are caused by the recommended improvements. I-77 between the interchanges with Ghent Road and SR 21 is included in the study area.

Figure 1: Study Area



V. Analysis Years

Opening Year for the SR 18 intersection improvement project is 2015, with the Design Year established as 2035.

VI. Alternatives Considered

The Summit 18 Corridor Study evaluated several alternatives to reduce congestion and improve safety at the Crystal Lake Road/Montrose West Avenue intersection. Alternatives evaluated include:

No-Build

The No-Build alternative, shown in Figure 2, would maintain the existing 5-lane section of SR 18 between South Hametown and Montrose West. All side street approaches would also maintain their existing lane configurations.

Basic Lane Addition

This alternative, shown in Figure 3, adds two through lanes on SR 18 in both the eastbound and westbound directions. In the eastbound direction, single lanes would be added from free-flow northbound right turns at the South Hametown Road and Heritage Woods Drive intersections. The additional eastbound lanes would be signed in advance for I-77/SR 21 southbound traffic as both lanes would drop at the interchange. The addition of these two lanes prevents the eastbound traffic queue at the Montrose West Avenue signal from spilling back into the intersection at Heritage Woods Drive.

In the westbound direction, the two additional lanes would provide enough capacity to eliminate the bottleneck at Crystal Lake Road/Montrose West Avenue during the PM peak hour. Both additional lanes would extend west, where they would drop before South Hametown Road. A single left turn lane into South Hametown would be striped, although SR 18 would be widened to accommodate the projected future need for a dual left turn to serve the heavy volume of commuter traffic destined for the adjacent Copley subdivisions. A future project will widen South Hametown Road to receive the second left turn lane.

The intersection of Heritage Woods Drive and SR 18 is enhanced by the addition of through lanes on SR 18, a second westbound left turn lane into Heritage Woods Drive and a northbound left turn lane out of Heritage Woods Drive.

The Basic Lane Addition alternative maintains the split phase signal and existing lane configuration on the northbound and southbound approaches of the SR 18 and Crystal Lake/Montrose West Avenue intersection. A second left turn lane would be added to SR 18 on both the eastbound and westbound approaches.

Figure 2: No-Build Condition (1 of 2)

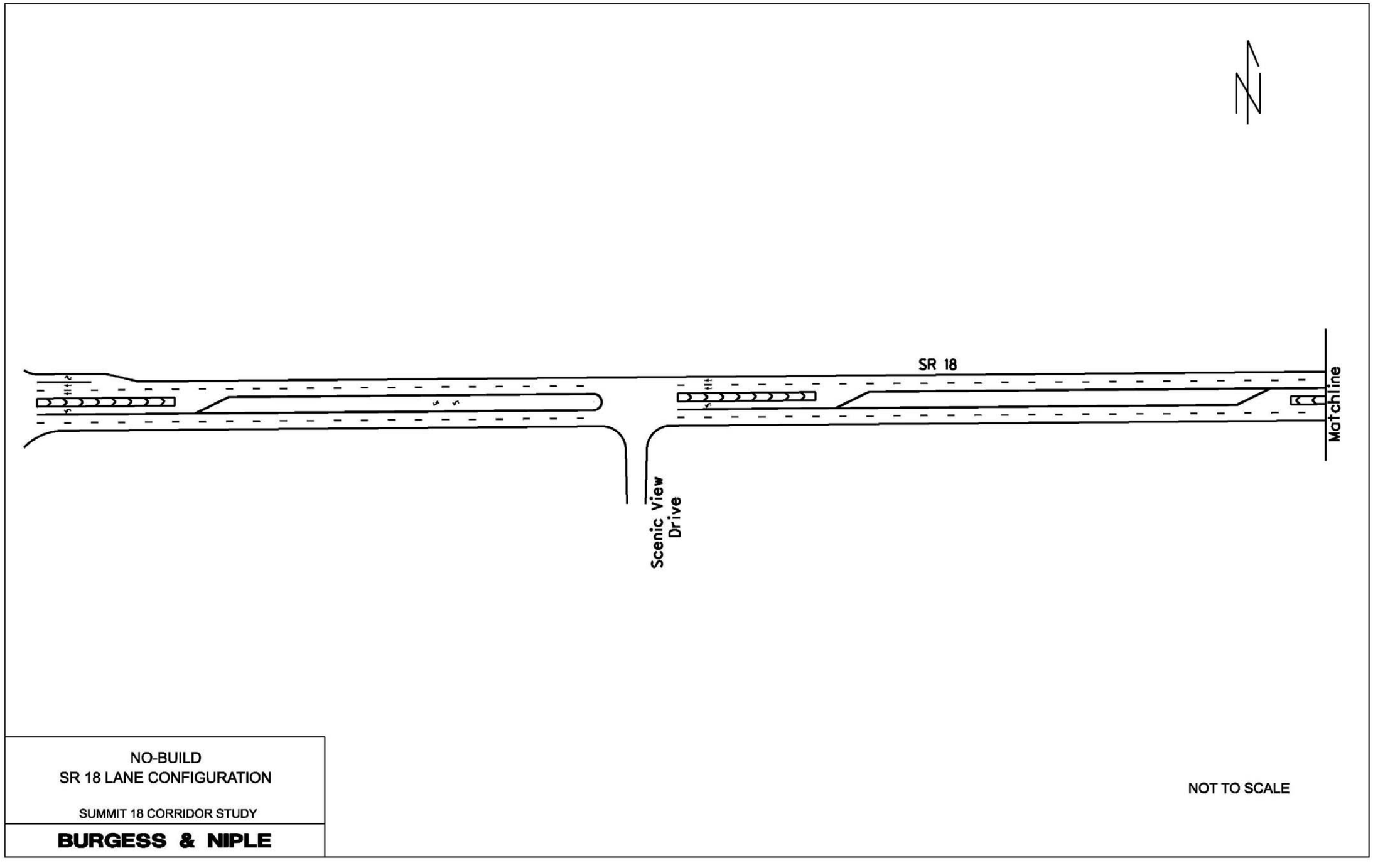


Figure 2: No-Build Condition (2 of 2)

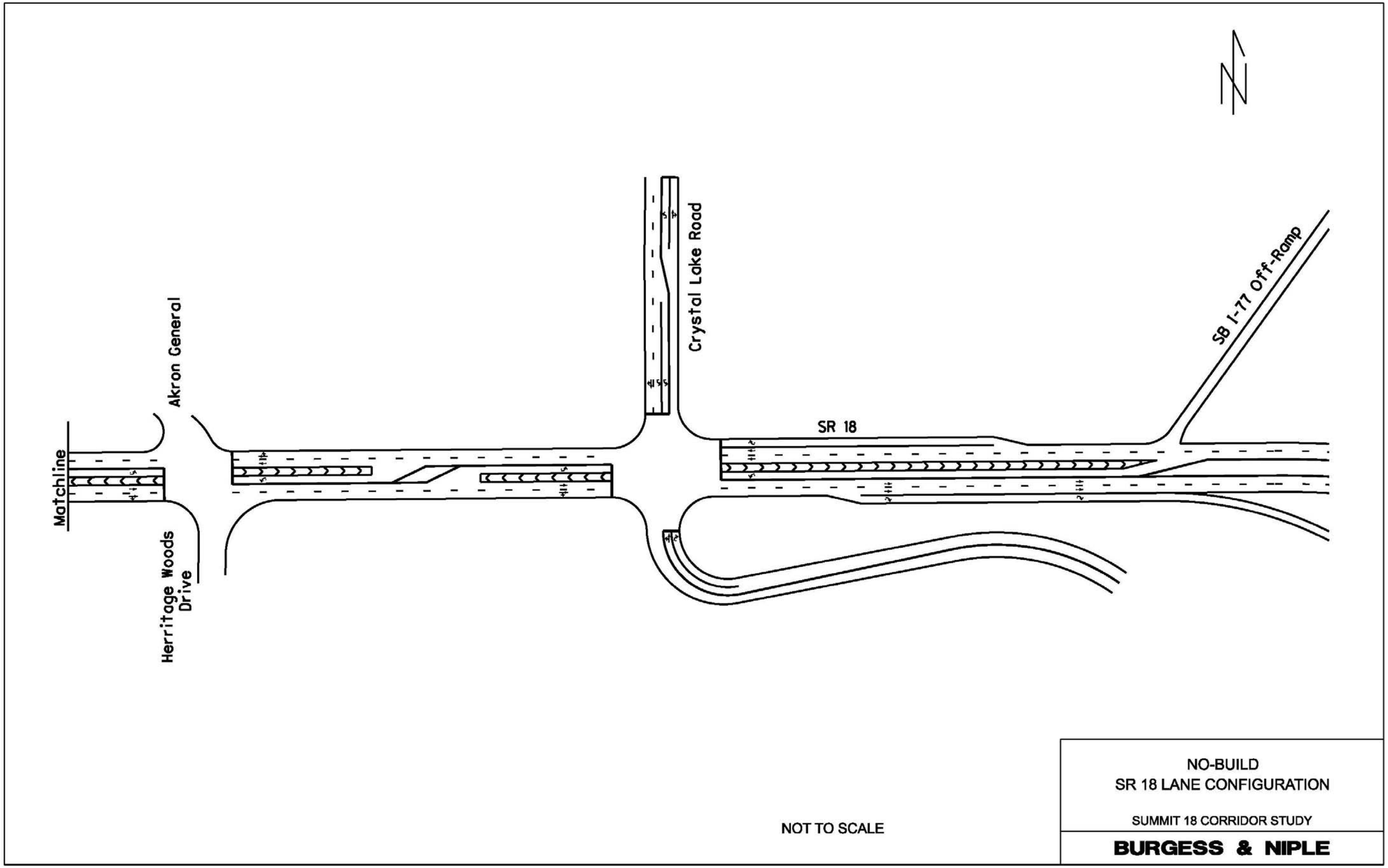


Figure 3: Basic Lane Addition Alternative (1 of 2)

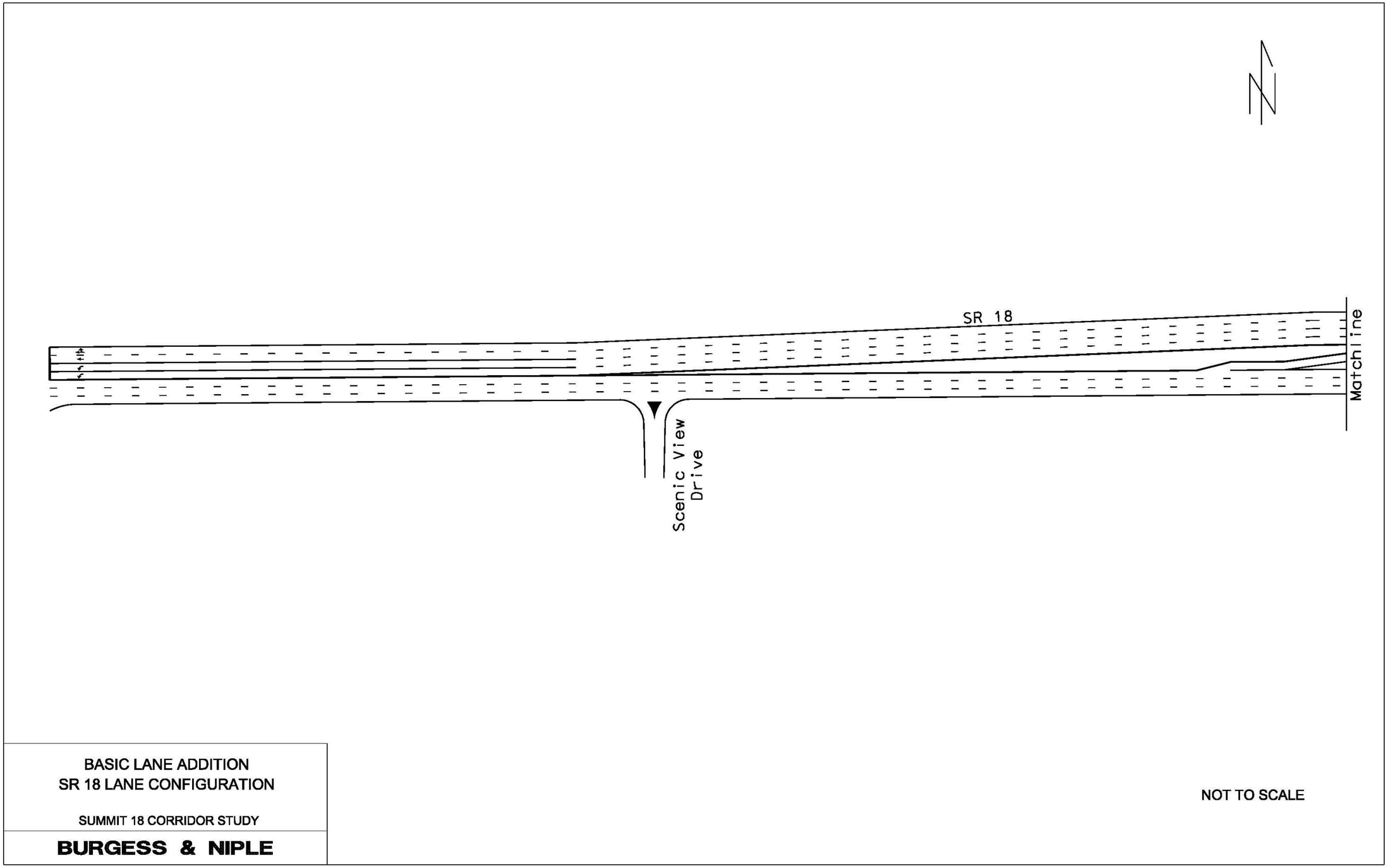
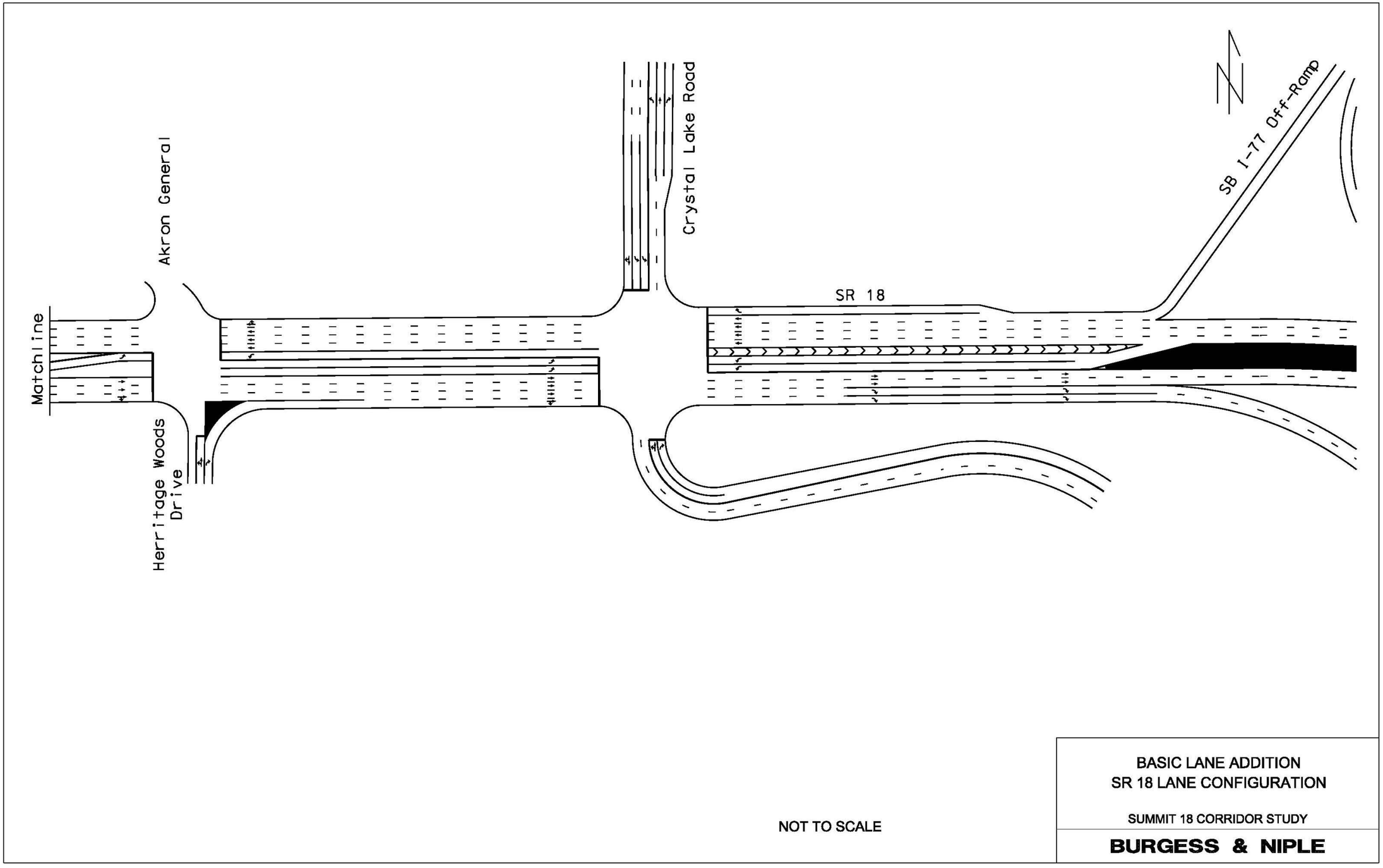


Figure 3: Basic Lane Addition Alternative (2 of 2)



Montrose West Relocation

- This alternative realigns Montrose West Avenue to a new northern terminus at an improved intersection with Heritage Woods Drive, thus eliminating the southern leg of the Crystal Lake Road and SR 18 intersection. This alternative also adds an additional through lane in both directions along SR 18. The additional eastbound through lane allows for a two-lane ramp to I-77 SB. This eliminates the excessive lane changing that occurs east of the Crystal Lake Road intersection and allows the ramp traffic to travel through the Heritage Woods Drive and Crystal Lake Road intersections in two-lanes, instead of stacking in the curb lane as it does today. The ramp tapers back to one lane prior to merging with I-77 southbound.

This alternative eliminates the split phase signal operation at the Crystal Lake Road/Montrose West Avenue and SR 18 intersection. The following three closely spaced signals will operate in a coordinated network: Crystal Lake Road & SR 18, Heritage Woods Drive & SR 18 and Embassy Parkway & Crystal Lake Road. Montrose West Avenue traffic, destined for eastbound SR 18 and I-77, would enter SR 18 upstream of the existing intersection at Heritage Woods Drive. A dual right turn is added to the northbound approach of the Heritage Woods Drive and SR 18 intersection.

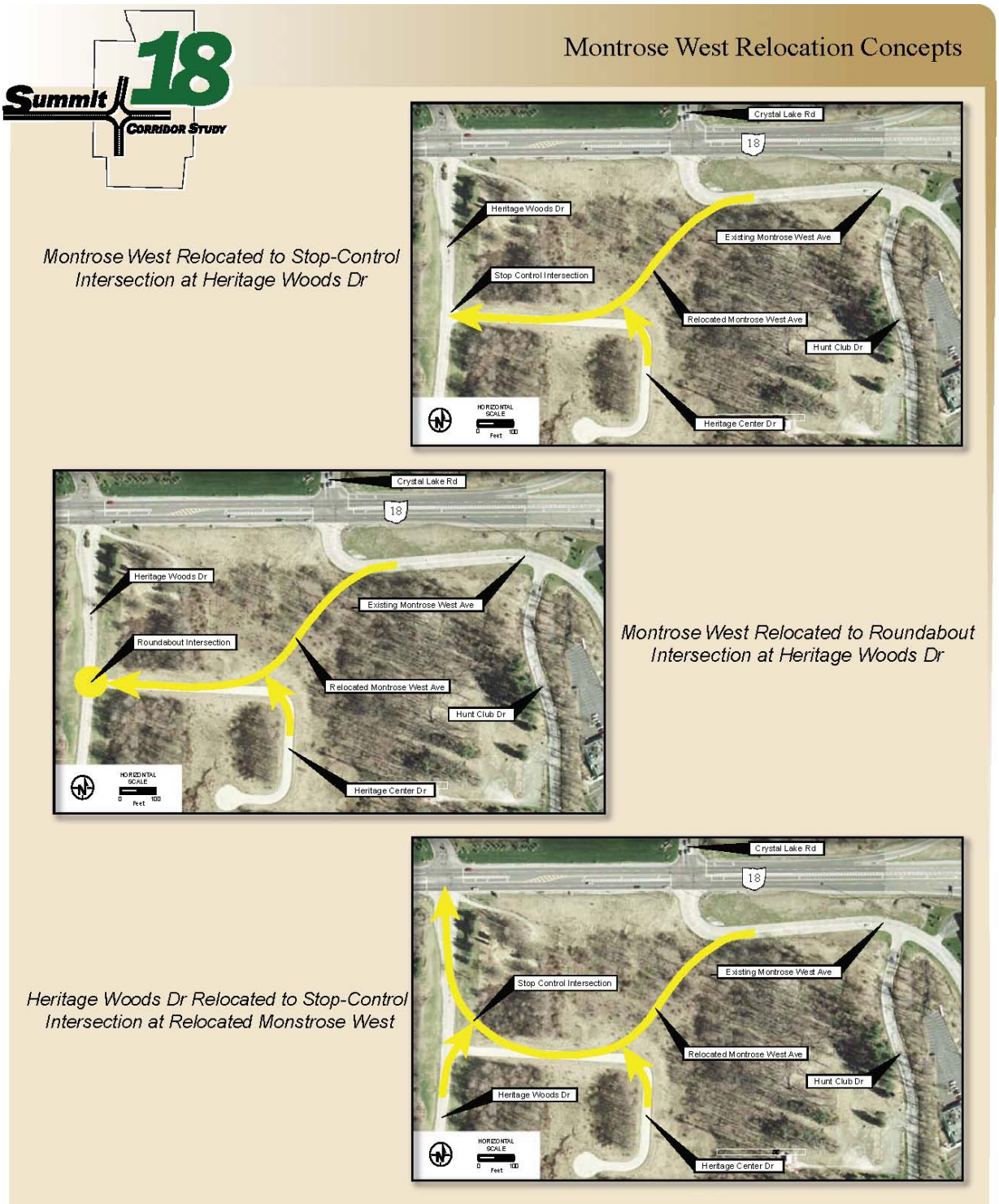
The intersection of the relocated Montrose West Avenue and Heritage Woods Drive could be constructed using several configurations. See Figure 4 for a graphical depiction of the configurations.

1. **Montrose West Avenue Relocated to a Stop-Control Intersection at Heritage Woods Drive –** This configuration would relocate Montrose West Avenue access from the south leg of the split-phase signal at Crystal Lake Road and SR 18 and realign Montrose West Avenue southwest to the existing Heritage Center Drive intersection with Heritage Woods Drive. The Montrose West approach to the intersection would be stop-controlled.

2. **Montrose West Avenue Relocated to a Roundabout Intersection at Heritage Woods Drive –** This configuration would relocate Montrose West Avenue access from the south leg of the split-phase signal at Crystal Lake Road and SR 18 and realign Montrose West Avenue southwest to a new roundabout intersection in the vicinity of the existing Heritage Center Drive intersection with Heritage Woods Drive.

3. **Heritage Woods Drive Relocated to a Stop-Control Intersection at Relocated Montrose West Avenue –** This configuration would relocate Montrose West Avenue access from the south leg of the split-phase signal at Crystal Lake Road and SR 18 and realign Montrose West Avenue to the south leg of the existing signalized intersection at Heritage Woods Drive/Akron General entrance and SR 18. Heritage Woods Drive would be realigned to a new stop-control intersection along relocated Montrose West Avenue, approximately 600 feet south of SR 18.

Figure 4: Montrose West Relocation Concepts



I-77 Mainline and Interchange Improvements

The Summit 18 Corridor Study also evaluated several alternatives to improve traffic operations at the SR 18 interchange and along the mainline between SR 18 and SR 21. Interchange options included a No-Build, Tight Diamond, Single Point Urban Interchange (SPUI), Modified Cloverleaf and an Offset SPUI. Mainline alternatives included Early Split and Southbound Collector-Distributor System. These alternatives will be further evaluated and refined as part of a potential future project.

Preferred Alternative

The relocation of Montrose West Avenue to the Heritage Woods intersection is the preferred alternative for the SR 18 corridor for several reasons. First, the Montrose West relocation is much more economically feasible than the Basic Lane Addition. Second, the Montrose West relocation only requires one additional through lane on SR 18, as opposed to the basic lane addition which requires two additional through lanes. Finally, the Montrose West relocation eliminates the need for a split-phase signal at the Crystal Lake Road and SR 18 intersection, significantly increasing the capacity. The No-Build alternative along the SR 18 corridor between South Hametown and Montrose West is unacceptable because capacity enhancements to SR 18 are required to improve traffic operations and safety at the Crystal Lake Road and SR 18 intersection, a primary goal of this project.

The preferred alternative is shown in Figure 5, and represents the Build condition evaluated in this Interchange Modification Study. It will not preclude any of the identified potential I-77 mainline and interchange improvements. Specific components of the preferred alternative include:

- Relocation of Montrose West Avenue to tie into Heritage Woods Drive.
- New Roundabout at the intersection of Heritage Woods Drive and Montrose West Avenue.
- Revised geometry for the intersection of SR 18 and Heritage Woods Drive to accommodate additional traffic due to Montrose West Avenue relocation.
- One additional eastbound lane on SR 18 from just east of Scenic View Drive to the I-77 southbound ramp, making it a two lane ramp. The two-lane ramp will be reduced to one-lane prior to joining southbound I-77 as per Figure 505-1a of the ODOT Location and Design Manual, Volume 1.

Figure 5: Preferred Build Alternative (1 of 2)

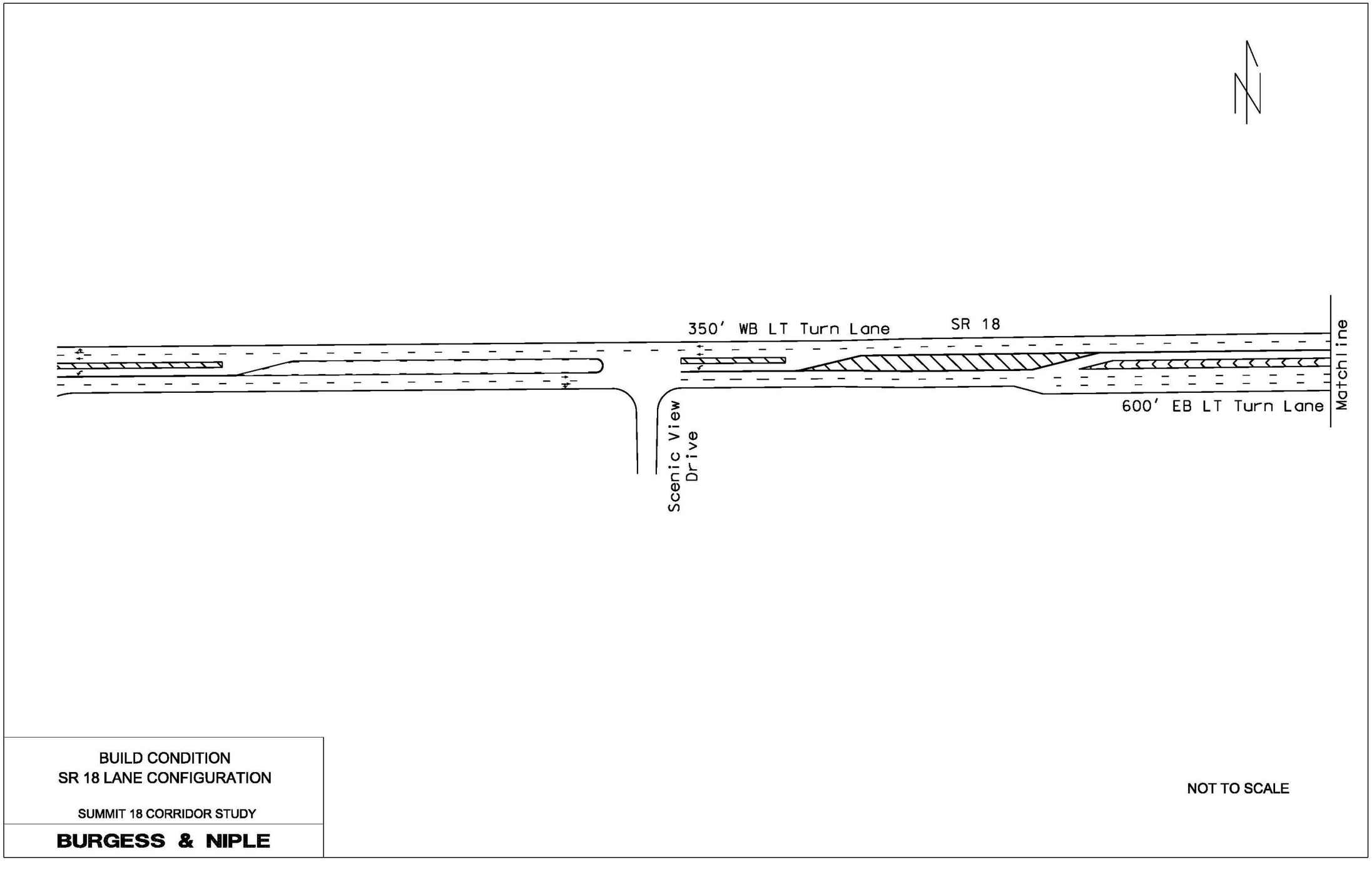
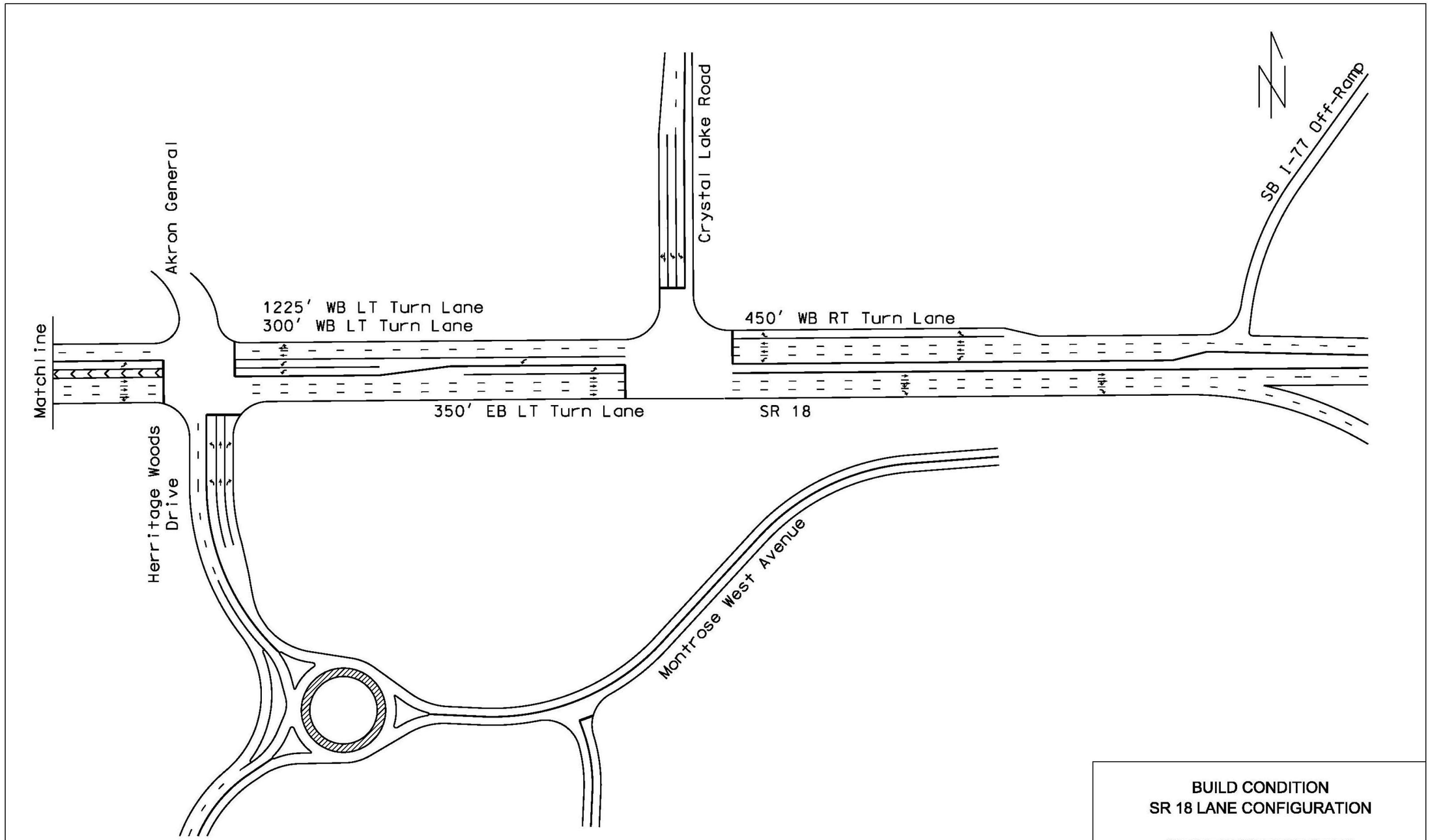


Figure 5: Preferred Build Alternative (2 of 2)



VII. Existing Conditions

SR 18 is oriented east-west and is classified as an urban principal arterial. The facility is 4-lanes plus dedicated turn lanes and has a posted speed limit of 40 mph. SR 18 carries approximately 37,000 vehicles on an average day west of Crystal Lake Road and 51,000 vehicles east of Crystal Lake Road, approximately 4% representing trucks. By 2035, it is anticipated that there will be 49,000 vehicles west and almost 63,000 vehicles east of Crystal Lake Road.

I-77 is oriented north-south and is classified as a 6-lane urban interstate with a posted speed of 65 mph. Auxiliary lanes are present between the SR 18 and SR 21 interchanges. I-77 carries approximately 84,000 vehicles on an average day between SR 18 and SR 21 with approximately 11% representing trucks. By 2035, it is anticipated that nearly 102,000 vehicles will travel through this area daily. I-77 lane designations between SR 18 and SR 21 are shown in Figure 6.

Crash Data

The Summit 18 Corridor Study *Existing Condition and Future Needs Report* evaluated traffic crashes to assess safety issues and determine high crash locations. This report identified two locations that are within the IMS study area as having safety issues. These two locations are the SR 18 intersection with Heritage Woods Drive and the SR 18 intersection with Crystal Lake Road/Montrose West Avenue. The crash data for these two locations has been updated as part of this IMS report. Crash data for SR 18 was obtained from the Ohio Department of Transportation for three years (2006-2008). During this three year period, 155 crashes occurred in the study area. Of that total, 96 crashes occurred at the two intersections. It is important to note that while the two intersections are analyzed as two separate locations, they are closely spaced (~700). This spacing, coupled with the noted congestion, results in some crashes being assigned to the wrong intersection. Collision diagrams and collision statistics can be found in Appendix A.

<u>SR 18 and Heritage Woods Drive</u>

From 2006 to 2008, there were 24 crashes at the intersection – 17 property damage and seven injury crashes. None of the crashes involved a fatality. The 2006-2008 crash rate at this intersection is 0.62 crashes per million entering vehicles. The predominant crash type is rear-end, which accounts for more than 75 percent of the crashes. Based on the collision diagrams and crash summaries, the following patterns and possible causes of these crashes are apparent:

Rear-end crashes: While rear-end crashes are typical of signalized intersections, the percentage of rear-end crashes at this intersection is high. Between 2006 and 2008, seven rear-end crashes resulted in injury. The problem is especially distinct on the east and west approaches. Potential causes for rear-end crashes are congestion and queued traffic. Based upon capacity analysis and field observations, congestion is significant at this intersection and contributes to the number of rear-end crashes.

<u>SR 18 and Crystal Lake Road/Montrose West Avenue</u>

From 2006 to 2008, there were 72 crashes at this intersection – 55 property damage, 16 involving an injury and one involving a fatality. The 2006-2008 crash rate at this intersection is 1.32

crashes per million entering vehicles. The data shows that over half of all crashes occur between 4 p.m. and 8 p.m. The predominant crash types at this location are rear-end and left turn crashes, which together account for more than 84 percent of all crashes. Based on the collision diagrams and crash summaries, the following patterns and possible causes of these crashes are apparent:

Rear-end crashes: While rear-end crashes are typical of signalized intersections, the percentage of rear-end crashes at this intersection is high compared with the statewide average for urban intersections. This is the most significant pattern of crashes at this intersection (43 of 72). Between 2006 and 2008, six of these crashes resulted in an injury. The problem is especially distinct on the east and west approaches. Potential causes for rear-end crashes are congestion and queued traffic. Based upon capacity analysis and field observations, congestion is significant at this intersection and contributes to the number of rear-end crashes.

Left turn crashes: This is the second most significant (18 of 72) type of crash at this intersection. Between 2006 and 2008, more than one-half (10 of 18) of these crashes resulted in an injury. The problem is especially distinct on the eastbound and westbound approaches. Potential causes for left turn crashes include restricted sight distance, permitted left turn phase, and excessive speeding on approaches.

There is a moderate volume of left turns at this intersection. During the PM Peak Hour, the westbound left turn volume is 360 vehicles. The left turn volume for the southbound approach is 590 vehicles. Delay and vehicle queues experienced by these movements are also significant.

Currently, all four approaches at the intersection have protected left-turn phasing. Phasing on the east and west legs allows for a protected / permitted eastbound and westbound left turn. Based on field observations, one to two vehicles frequently continue through the intersection after the onset of the red light, often accelerating in the process. This situation creates a crash hazard with opposing left turning vehicles waiting in the intersection for a gap in traffic. Also, with the volume of opposing through vehicles on each approach, there are very few acceptable gaps during the permissive phase during peak hours of traffic.

Safety Improvements

To address the identified crash patterns at these intersections, the Build Alternative was developed to relieve the bottleneck at the intersection of SR 18 and Crystal Lake Drive/Montrose West Avenue.

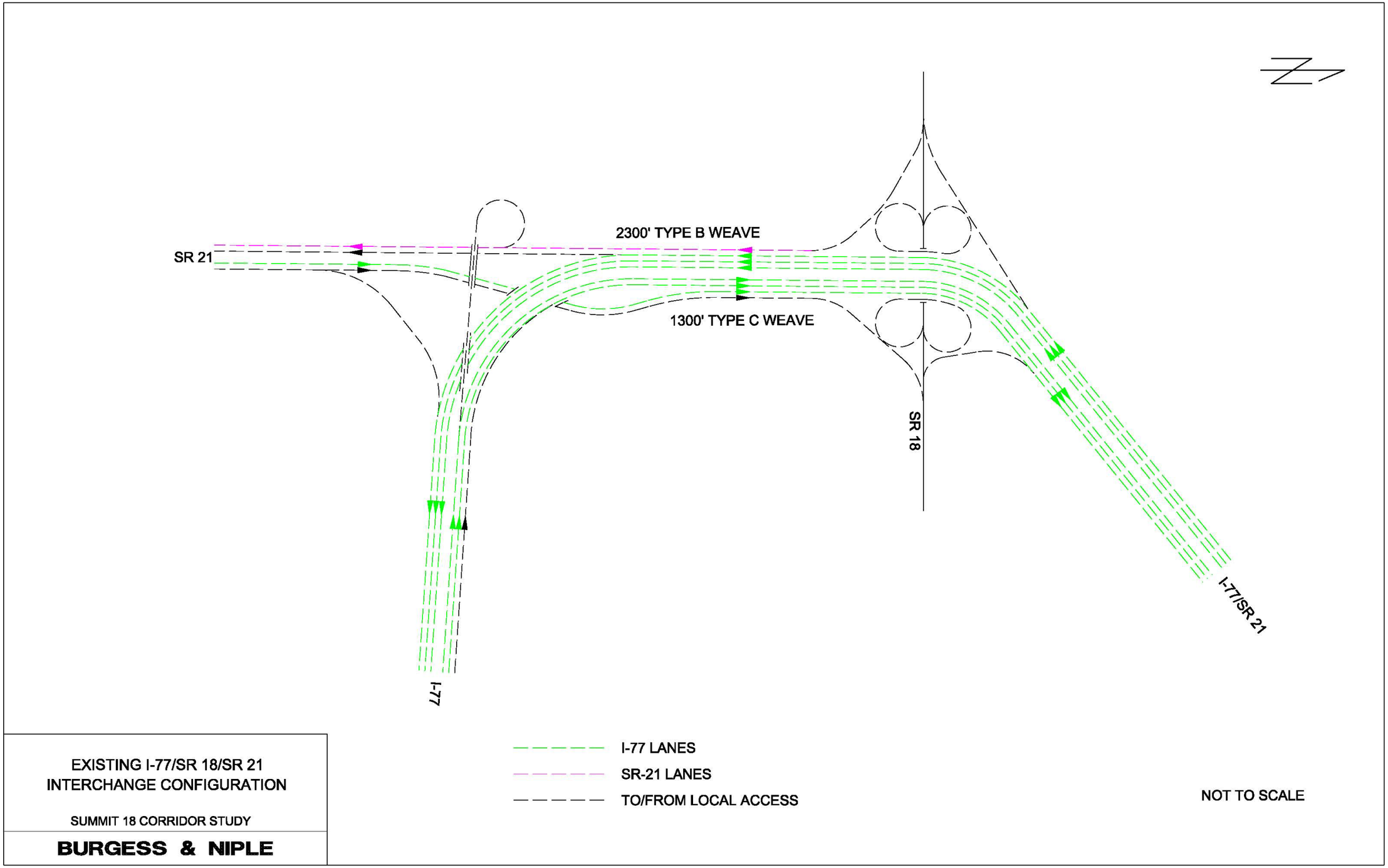
The Build alternative addresses the identified crash patterns in the following ways:

- Adding dual left turn lanes on the westbound approach to the intersection of SR 18 and Montrose West Avenue/Heritage Woods Drive increases the capacity of the intersection and reduces the amount of left turn collisions at the intersection. This will most likely also reduce the rate of rear-end, sideswipe, and angle crashes.
- Due to the high number of southbound left turns from Crystal Lake Road and westbound left turns onto Montrose West Avenue, combined with a high volume of East-West

through traffic, it becomes beneficial to eliminate Montrose West Avenue and relocate it to Heritage Woods Drive. This relocation makes it possible to eliminate conflict points at the intersection and reduce the number of phases. This improvement makes it possible to reduce congestion and conflict points, reducing the number of left turn crashes and congestion related crashes.

- SR 18 carries a high volume of East-West through traffic through the intersection of Crystal Lake Road/West Montrose Avenue. Additional through lane capacity at the intersection reduces the congestion and will reduce the number of rear-end and congestion related crashes. In addition, a two-lane entrance ramp for I-77 southbound reduces the congestion for the eastbound to southbound movement.

Figure 6: I-77 Mainline Lane Configuration



VIII. Traffic Volumes

Certified traffic was provided by the ODOT Office of Technical Services for the mainline, ramp locations and intersections along SR 18. Weaving volumes for northbound and southbound I-77 between the SR 18 and SR 21 interchanges were developed by Burgess & Niple, Inc. As previously stated, the Opening Year is 2015 and the Design Year is 2035. The certified traffic volumes can be found in Appendix B.

IX. Traffic Analysis

Capacity analysis using the *Highway Capacity Software, Version 5.5 (HCS+)* was performed for the SR 18 corridor for the No-Build and Build Alternative. Specific elements analyzed included the SR 18 intersections, I-77 mainline, the merge and diverge of the SR 18 interchange ramps, and weaving sections on I-77 between SR 18 and SR 21.

Capacity analyses for the existing system and proposed improvements were made for the year 2035. All design year traffic analyses are based on the procedures outlined in the *Highway Capacity Manual 2000 (HCM)*. This manual uses Level of Service (LOS) as the main criteria for determining how well a particular location is performing. The LOS is a letter grade that gives a qualitative description of the traffic operation. A grade of "E" or "F" indicates the average delay for traffic movement is beyond what most users would consider acceptable. For example, at a traffic signal, LOS F usually indicates that during peak hour travel, it requires vehicles to wait more than one traffic signal cycle to clear the intersection (delay > 80 seconds per vehicle).

Freeway Operations

The freeway operational analysis on I-77 was performed for the section between its interchanges with Ghent Road and SR 21. Operational analysis for the freeway facility consists of basic freeway segments, freeway weaving, and ramp junctions. The majority of freeway analyses were identical for the No-Build and Build conditions and therefore no separate analyses for the Build alternatives were necessary. However, the southbound weaving analyses for I-77 between SR 18 and SR 21 were affected by the proposed Build condition and therefore a No-Build and Build weave analyses were presented upon the consideration of constrained traffic. Refer to page 29, Constrained Analysis, for more information.

Basic Freeway Segments

LOS for basic freeway segments for the Design Year (2035) is presented in Table 1 and shown on Figure 7 through Figure 10. Copies of the *HCS+* analysis reports are included in Appendix C.

Freeway Weaving

LOS for the weaving segments for the Design Year (2035) is presented in Table 1 and shown on Figure 7 through Figure 10. Copies of the *HCS+* analysis reports are included in Appendix C.

Ramp Junctions

LOS for the ramp junctions for the Design Year (2035) is presented in Table 1 and shown on Figure 7 through Figure 10. Copies of the *HCS+* analysis reports are included in Appendix C.

Interpretation of Freeway Operational Results

Operations for the freeway segments shown in Table 1 and Figure 7 through Figure 10 indicate that except for four weaving areas and one ramp, all the freeway segments perform at an acceptable level of service. A future project to evaluate the freeway alternatives identified in the Summit 18 Corridor Study will address these issues.

Table 1: Level of Service

Summit 18 Corridor HCS Analyses Summary									
		2035 AM				2035 PM			
Intersection	Type	No-Build		Build		No-Build		Build	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Heritage Woods Road	Signalized	52.6	D	49.1	D	40.4	D	41.8	D
Crystal Lake Road	Signalized	115.2	F	29.9	C	180.9	F	39.8	D
Springside Drive	Signalized	25.0	C	N/A	N/A	92.3	F	N/A	N/A
Scenic View Drive	Unsignalized	2238.0	F	2238.0	F	17.9	C	17.9	C
		2035 AM				2035 PM			
Freeway	Type	No-Build		Build		No-Build		Build	
		Density (pc/mi/lane)	LOS	Density (pc/mi/lane)	LOS	Density (pc/mi/lane)	LOS	Density (pc/mi/lane)	LOS
I-77 SB North of Ramp to SR 18 WB	Mainline	15.9	B	15.9	B	30.0	D	30.0	D
Ramp from I-77 SB to SR 18 WB	Diverge	19.5	B	19.5	B	31.4	D	31.4	D
I-77 SB South of Ramp to SR 18 WB	Mainline	14.8	B	14.8	B	26.4	D	26.4	D
Ramp from SR 18 WB to I-77 SB	Ramp	3.7	A	3.7	A	13.4	B	13.4	B
I-77 SB and SR 18 Loops	Weaving	13.26	B	13.26	B	30.25	D	30.25	D
Ramp from I-77 SB to SR 18 EB	Ramp	3.8	A	3.8	A	6.2	A	6.2	A
I-77 SB South of Ramp to SR 18 EB	Mainline	14.8	B	14.8	B	29.1	D	29.1	D
Ramp from SR 18 EB to I-77 SB	Ramp	37.2	E	37.2	E	29.9	D	29.9	D
I-77 SB, SR 18 to SR 21	Weaving	27.56	C	27.56	C	40.64	E	40.64	E
I-77 NB, SR 21 to SR 18	Weaving	41.24	E	41.24	E	21.26	C	21.26	C
Ramp from I-77 NB to SR 18 EB	Ramp	12.1	B	12.1	B	12.0	B	12.0	B
I-77 NB North of Ramp to SR 18 EB	Mainline	32.7	D	32.7	D	19.5	C	19.5	C
Ramp from SR 18 EB to I-77 NB	Ramp	9.3	A	9.3	A	4.5	A	4.5	A
I-77 NB and SR 18 Loops	Weaving	36.76	E	36.76	E	25.20	C	25.20	C
Ramp from I-77 NB to SR 18 WB	Ramp	23.6	C	23.6	C	28.0	D	28.0	D
I-77 NB North of Ramp to SR 18 WB	Mainline	27.0	D	27.0	D	13.4	B	13.4	B
Ramp from SR 18 WB to I-77 NB	Merge	27.4	C	27.4	C	15.9	B	15.9	B
I-77 NB North of Ramp from SR 18 WB	Mainline	28.5	D	28.5	D	15.1	B	15.1	B
SR 18 WB and I-77 Loops	Weaving	24.16	C	24.16	C	48.27	F	48.27	F
SR 18 EB and I-77 Loops	Weaving	16.35	B	16.35	B	16.84	B	16.84	B

Figure 7: No-Build LOS Results for AM Peak Hour

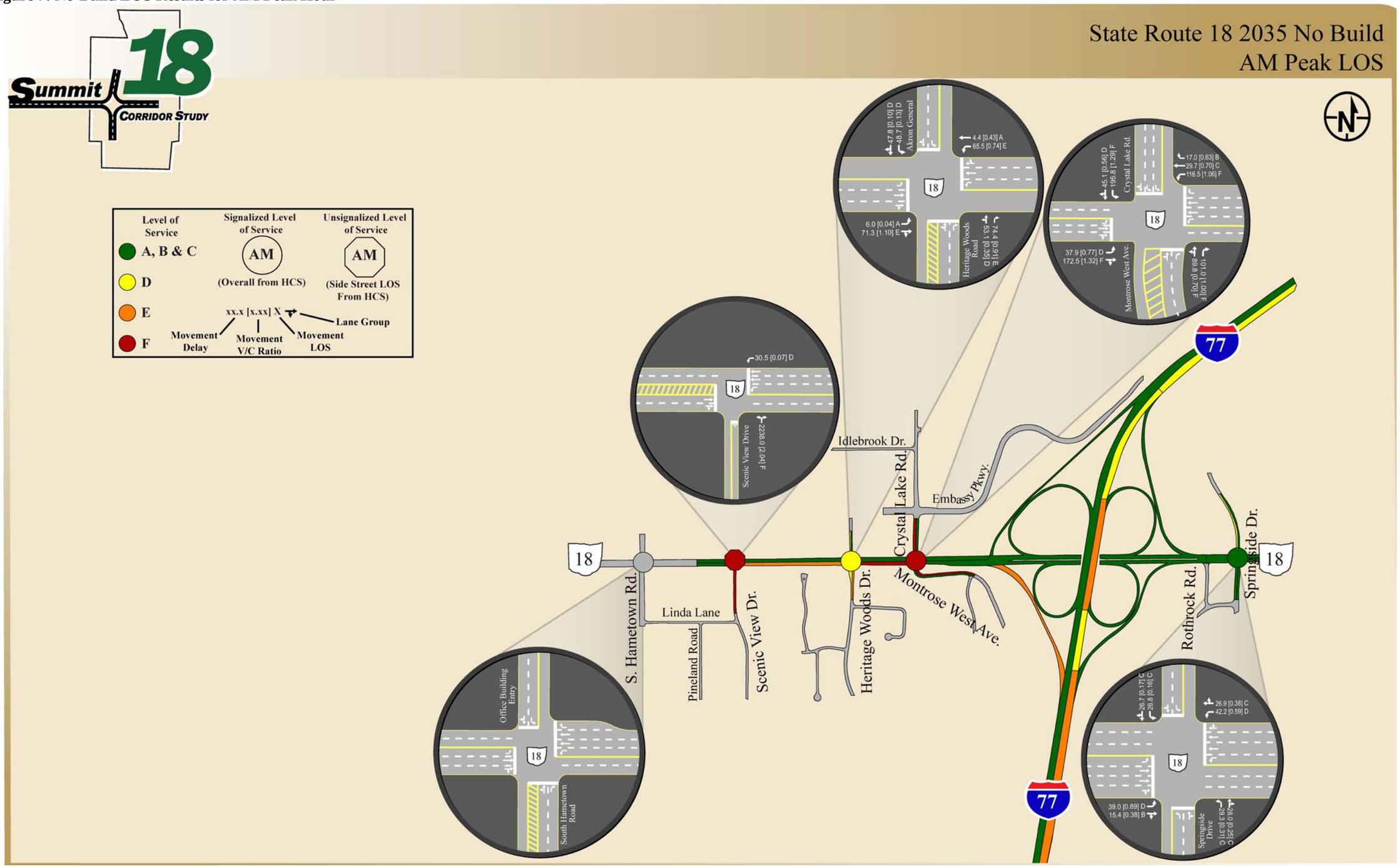


Figure 8: No-Build LOS Results for PM Peak Hour

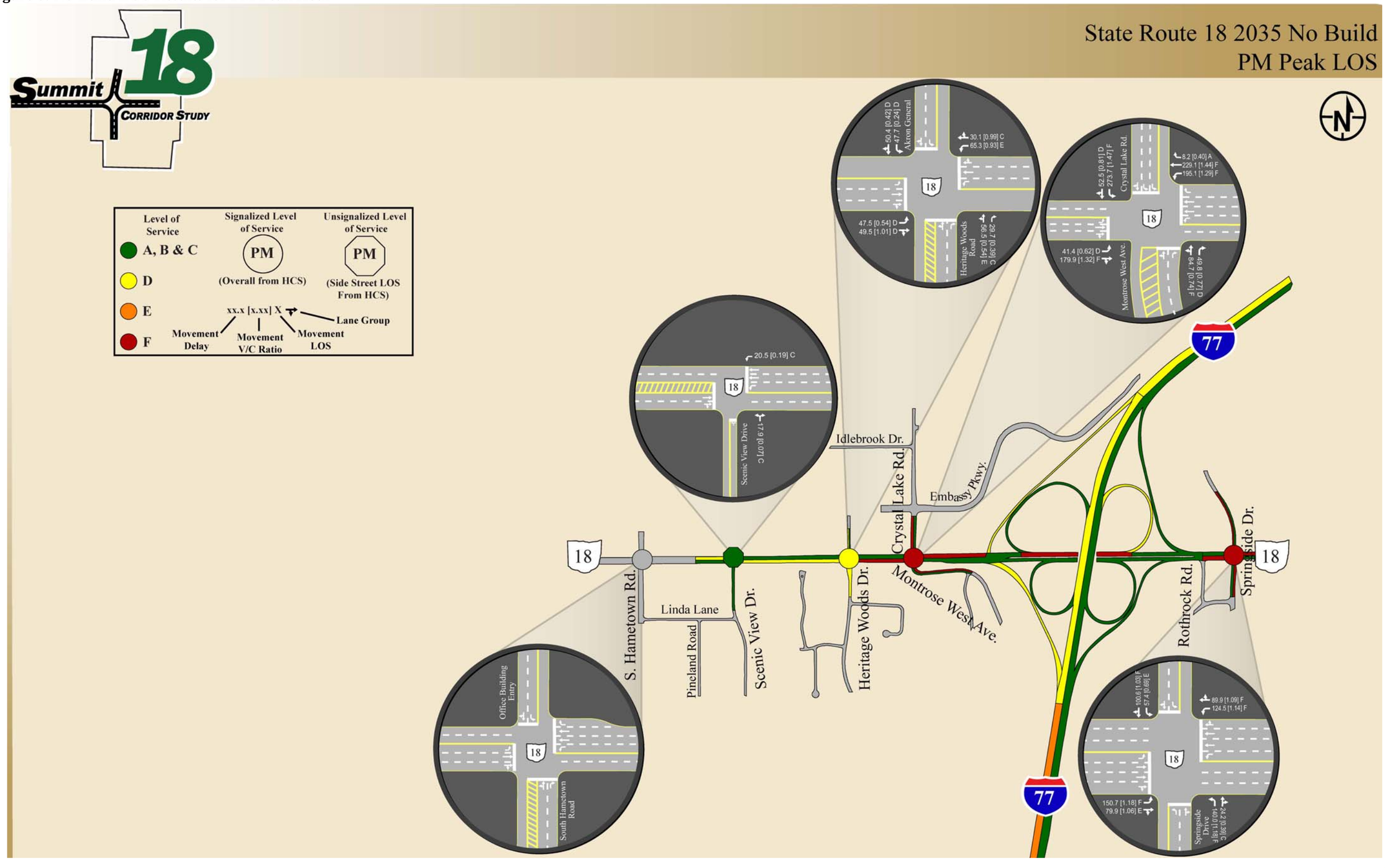


Figure 9: Build LOS Results for AM Peak Hour

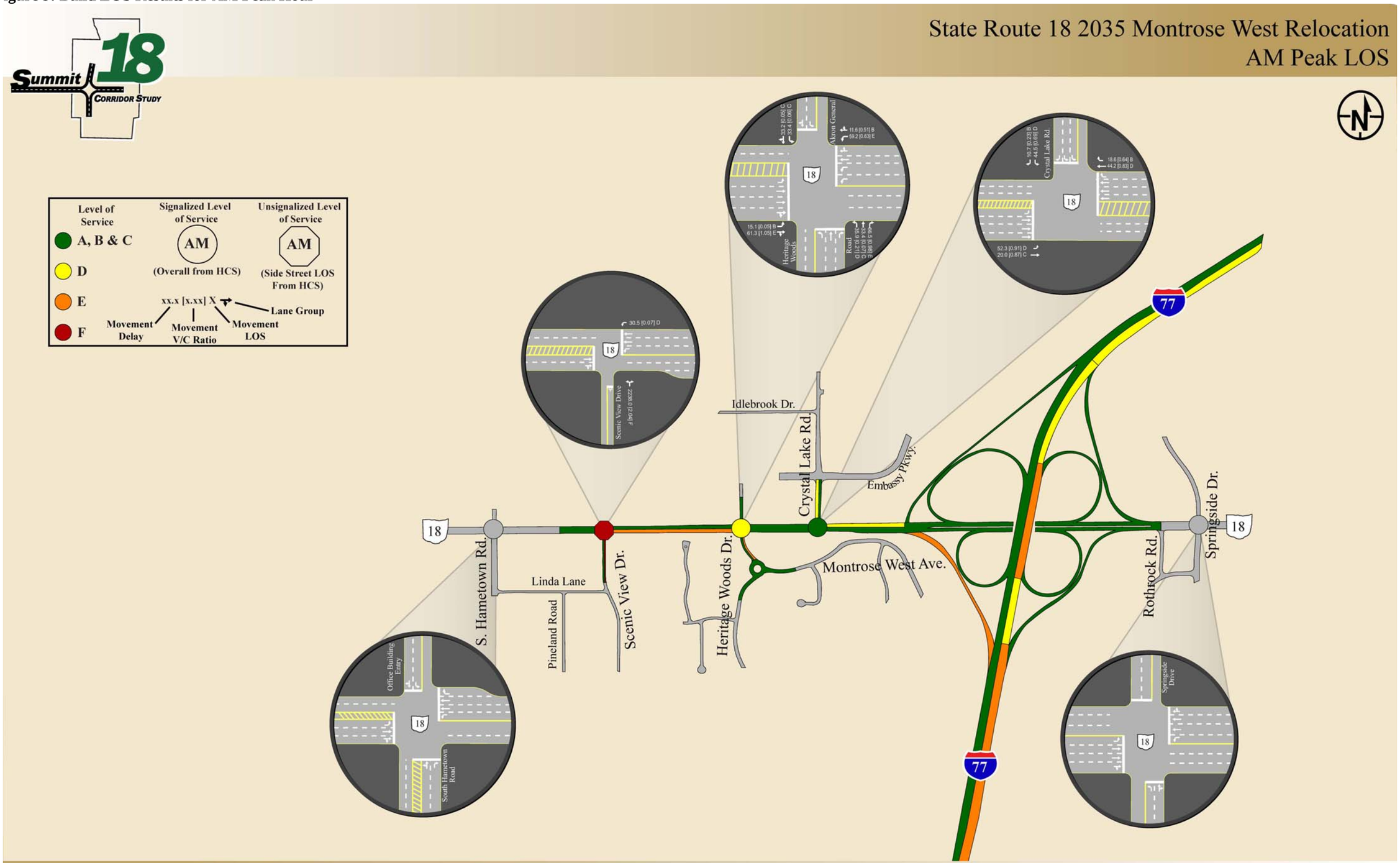
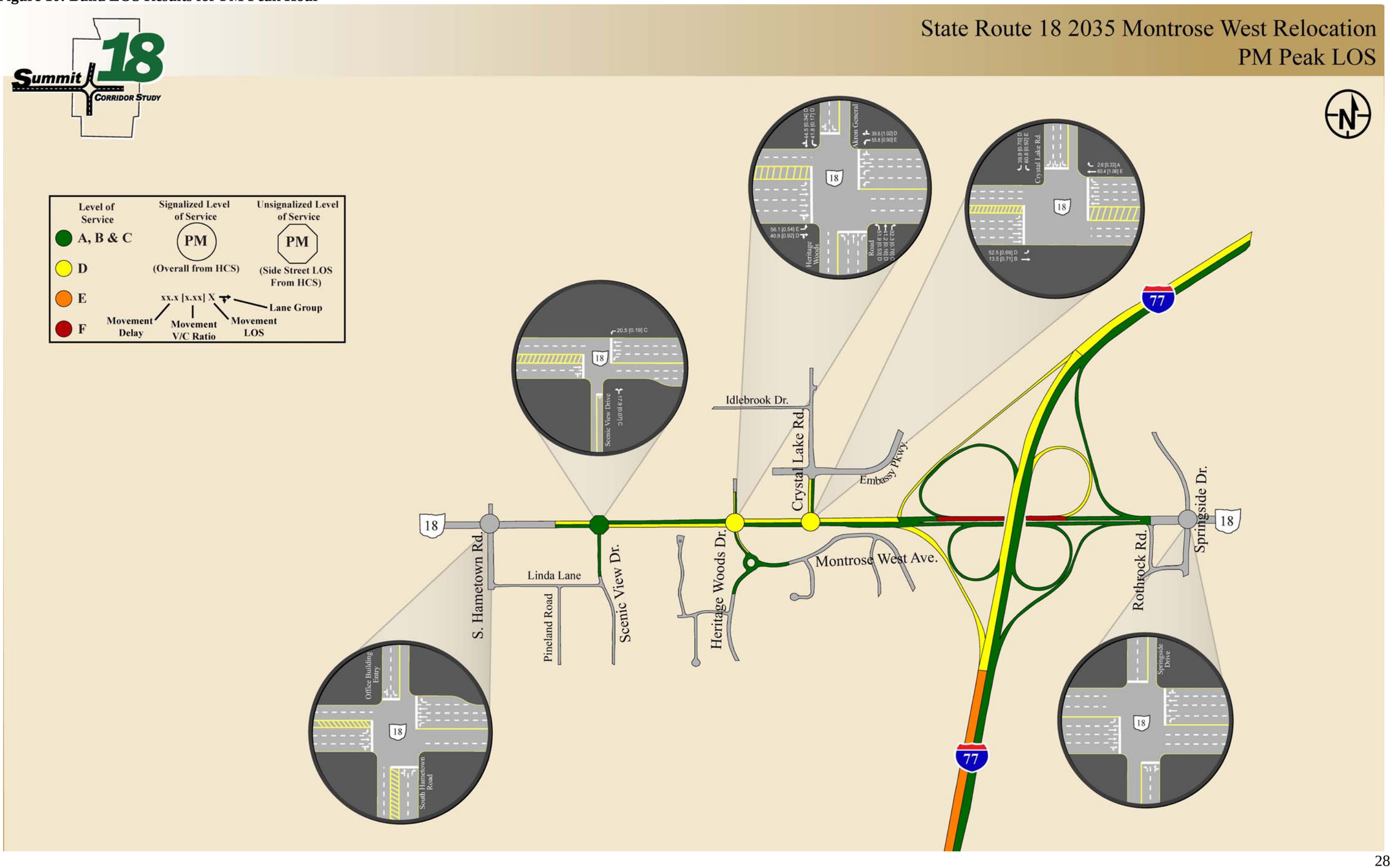


Figure 10: Build LOS Results for PM Peak Hour



Intersection Analysis

The intersections along SR 18 were analyzed using *HCS+*. ODOT's methodology for intersection design requires that signalized intersection delays are balanced. To achieve this, the timing of each phase of a signalized intersection was adjusted so the worst of the east-west approach delay was within one second of the worst of the north-south approach delay.

LOS for the intersections for the Design Year (2035) is presented in Table 1 and shown on Figure 7 through Figure 10. Copies of the *HCS+* analysis reports are included in Appendix D.

Interpretation of Intersection Operational Results

In Table 1 it is shown that the goal of improving traffic operations at the primary bottleneck in the corridor, the intersection of SR 18 and Crystal Lake Road/Montrose West Avenue, has been accomplished. The LOS improves to C from F, in the 2035 AM Peak Hour, and to a D from F in the 2035 PM Peak Hour. While the improvement in LOS is very good, it is not quite accurate. The Build alternative added a third westbound through lane at the intersection. This third lane feeds the left turn lanes at the Heritage Woods Drive intersection. While it is technically a through lane, it will not receive the equal proportion of the through traffic that *HCS+* assumes. To account for this, *HCS+* analysis was conducted with only two through lanes and the left turning volume removed from the through volume. Under this condition, the AM and PM LOS in the Build condition are still C and D, respectively, but the WB operation in the PM Peak Hour has declined from the previous analysis. It is now LOS E, and the volume to capacity (v/c) ratio for the through movement has increased from 1.06 to 1.09, which is still a significant improvement over the 1.44 in the No-Build condition.

At the intersection of SR 18 and Springside Drive, there are no proposed improvements in the preferred alternative. Therefore, the Build operation will be equal to the No-Build operation.

Constrained Traffic Analysis

The intersection of SR 18 and Crystal Lake Road/Montrose West Avenue operates at LOS F, in both the AM and PM peak for the No-Build condition. Since this intersection is immediately adjacent to the southbound I-77 ramps, it must be investigated for constrained analysis to determine if the Build improvements are allowing more traffic to enter southbound I-77, which may cause degradation to the operation on I-77. During the AM and PM peaks, the eastbound through and southbound left movements have v/c ratios greater than 1.0 in the No-Build condition. In the Build condition, the eastbound through and southbound left movement operation has improved and the v/c ratios are less than 1.0. This means that traffic in the No-Build condition is constrained and that the Build improvements will allow more traffic to reach southbound I-77. The eastbound SR 18 to southbound I-77 entrance ramp is an add lane to southbound I-77, that creates a weaving section between SR 18 and SR 21. Examining the LOS results for the AM condition, the weaving section operates at LOS C, under full demand traffic volumes. Because the section operates at an acceptable LOS D or better under full demand traffic, there is no degradation to the freeway due to constrained traffic. In the PM condition, the weaving section operates at LOS E, under full demand traffic, which means that analysis for the constrained condition must be conducted. The constrained analysis shows that the weaving

segment will operate at LOS E, under both the constrained and full demand condition. Because there is no change in LOS results, there is not a degradation to the freeway. Constrained traffic calculations can be found in Appendix E.

Queuing Analysis

Turn lane storage lengths were calculated for all project intersections based on the procedure described in the ODOT Location and Design (L&D) Manual, Section 401-7 to 401-12. The storage lengths are based on the highest of the AM and PM peak hour storage requirements. These calculations are included in Appendix F. They are also summarized in Table 2 and illustrated in Figure 5. Most turn lanes in the project area satisfy the minimum required storage length. Due to the high through lane volumes along SR 18, it was not possible for through vehicle backups to avoid blocking access to certain turn lanes. The turn lane storage provided at each signalized intersection is described below.

Table 2: Required Storage Length

	Required Storage Length (Feet)		
	EB Left	**WB Left**	**WB Right**
SR 18 and Heritage Woods Road/Akron General	225’	968’	
SR 18 and Crystal Lake Road	543’		793’

L&D storage calculations exceed available storage

SR 18 and Heritage Woods – The required storage length for the eastbound left turning traffic is 225 feet. To avoid being blocked by the eastbound through vehicle queue, the required left turn lane length is 825 feet. While it is possible to provide this length, Section 401.6 of the L&D Manual, Vol. 1, states that a maximum storage length of 600’ is recommended. Therefore, 600’ has been provided for this movement.

The westbound left turn movement provides dual left turn lanes. The initial lane is developed east of Crystal Lake Road. The second turn lane is developed east of Heritage Woods and is 300 feet in length. The combined storage length is in excess of 1500 feet, which is more than adequate. The rightmost of the two turn lanes will service traffic destined for Heritage Woods Drive. The leftmost lane will primarily service traffic destined for Montrose West Avenue, although Heritage Woods Drive traffic could use it as well. Overhead signing will be installed on SR 18, in advance of the intersection, to direct traffic into the correct lanes.

SR 18 and Crystal Lake Road – The eastbound left turn lane has a calculated storage length of 543 feet. However, this lane is back-to-back with the westbound left turn lane at SR 18 and Heritage Woods. Because of this, only 350 feet can be provided for the eastbound left turn at Crystal Lake. As a double check to the calculated storage length, *SimTraffic* was used to check the 95th percentile queue length under the proposed signal operation. Output files for the analysis are in Appendix G. *SimTraffic* shows that in 2035, the 95th percentile queue for the eastbound left turn will be 287 feet. Based on this, the 350 feet of **storage length provided will be sufficient.**

The storage length available for the westbound right turn at the intersection of SR 18 and Crystal Lake is 450 feet. The calculated storage length is 793 feet. At this location, the proximity of the southbound I-77 to westbound SR 18 ramp intersection prevents the storage length from being any longer. *SimTraffic* was used to check the required storage under the proposed signal operation. Output files for the analysis are in Appendix G. *SimTraffic* shows that in 2035, the 95th percentile queue for the westbound right turn will be 272 feet. Based on this, the 450 feet of **storage length provided will be sufficient.**

X. Cost Estimate

The cost for the project has been estimated to be $8.86 M. Funding from the Highway Safety Program will be combined with ODOT District Allocation and AMATS funding,

Items	Unit	Unit Cost $ (2006)	Total $	Quantity
General Construction Costs				
Major Cost Drivers				
Roadway				
Pavement Removed	sq yd	$8	$36,216	4527
Excavation/Embankment	mile	$168,000	$127,273	0.757576
Rock Excavation	cu yd	$30	$328,500	10950
Clearing/Trees	acre	$9,900	$22,968	2.32
Concrete Barrier	lf	$100	$0	0
Drainage				
Drainage for uncurbed pavement	ft	$80	$80,000	1000
Drainage for curbed pavement	ft	$200	$825,600	4128
Pavement				
Asphalt Widening	sq yd	$45	$483,480	10744
Asphalt Surfacing w/planing	sq yd	$12	$0	0
Curb and Gutter	ft	$36	$232,416	6456
Shoulder	sq yd	$38	$25,346	667
Traffic Signals	each	$125,000	$250,000	2
Misc. Additional Costs (80/20 Rule)			$602,950	
Right of Way Acquisition	acre	$750,000	$2,153,223	2.870964
Project Traffic Control			$225,000	
Project Erosion Control			$30,000	
Project MOT			$90,442	
Summary of Probable Total Construction Costs 2010			$5,513,414	
Preliminary Development Phase/Final Development Phase (12%)			$661,610	
Contraction Administration and Inspection (10%)			$551,341	
Contingencies (30%)			$2,017,909	
Summary of Probable Total Project Costs 2010			**$8,864,717**	

XI. Environmental Impacts

Preliminary environmental studies for the SR 18 corridor were conducted and presented in the *Existing and Future Conditions Report* for the Summit 18 Corridor Study. Based on this report, the following potential environmental issues have been identified:

- **Historic Properties** – Three historic sites were identified along SR 18, near the intersection with South Hametown Road. The preferred alternative will not impact these sites.
- **Parklands** –No public parks or recreational facilities are located within SR 18 corridor.
- **Wetland Impacts** – A few palustrine wetlands have been identified within the SR 18 corridor. It is not anticipated that the preferred alternative will impact these wetlands.
- **Hazardous Materials** – A few locations in the corridor were identified as potential solid and hazardous waste sites. Additional detailed studies could be required at these locations, or any others that may require strip takes, to identify potential contaminated soil or groundwater that may require additional remediation.
- **Right-of-way Impacts** – Additional right-of-way will be required for the preferred alternative. Most of the impacts will be south of SR 18 between Heritage Woods Drive and Montrose West Avenue, where four parcels slated for commercial development will be acquired. The impacted parcels are currently undeveloped. A total of 2.87 acres will be acquired for the preferred alternative. No building takes are anticipated.

More refined environmental impacts will be determined during the project's NEPA process.

XII. Recommendations

The recommendations for the SR 18 corridor, specifically the intersection of SR 18 and Crystal Lake Road/Montrose West Avenue, include:

- Relocation of Montrose West Avenue to tie into Heritage Woods Drive.
- New roundabout at the intersection of Heritage Woods Drive and Montrose West Avenue.
- Revised geometry for the intersection of SR 18 and Heritage Woods Drive to accommodate additional traffic due to Montrose West Avenue relocation.
- One additional eastbound lane on SR 18 from just east of Scenic View Drive to the I-77 southbound ramp, making it a two lane ramp.

As shown in the analysis presented in this report, the recommended improvements do not degrade freeway operation within the study area. In addition, they provide an operational improvement for the SR 18 and Crystal Lake Road intersection over the No-Build condition. Finally, the recommended improvements will meet the defined purpose and need of the project which is to reduce congestion and improve safety at the SR 18 and Crystal Lake Road/Montrose West Avenue intersection.