Traffic Impact Study

Loudoun County School Board: HS-7/ES

Loudoun County Public Schools

Loudoun County, Virginia

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EXECUTIVE SUMMARY

The following report presents the findings of a traffic impact analysis for the proposed Elementary School (ES) and High School (HS-7) to be located in Loudoun County, Virginia. The proposed schools will be located along Goshen Road, west of Gum Spring Road (Route 659), north of Braddock Road (Route 620) and south of Route 50 in Loudoun County, Virginia. The schools will be built on an assemblage of properties of approximately 97 acres. A special exception on the property is being proposed to allow for the construction of a High School and an Elementary School, comprising of approximately 1,800 students and 875 students, respectively. The proposed development will be phased, with the High School (HS) anticipated to open in 2012 and the Elementary School (ES) anticipated to open in 2015.

The analysis presented in this report supports the following major conclusions:

- The proposed development plan consists of approximately 97 acres and proposes a special exception on the property to allow for the construction of a High School and Elementary School comprising of approximately 1,800 and 875 students, respectively.
- The proposed High School is anticipated to be open by 2012.
- The proposed Elementary School is anticipated to be open by 2015.
- The following is a summary of the planned improvements/mitigations required to accommodate existing and future regional and local traffic:
  - **Existing Conditions (2009):**

    All study intersections operate at acceptable levels of service under existing conditions, except for the intersection of Braddock Road and Gum Spring Road. At the time the traffic counts were conducted in November 2009, construction for the following planned improvements was in progress. Hence, the following planned improvements were included as planned mitigation measures for this intersection *(These improvements are part of the transportation proffers for the approved Kirkpatrick Farms development – ZMAP 1995-0014/ZCPA 2004-0009. Please refer to Appendix T)*:

    Intersection of Braddock Road and Gum Spring Road:

    - Add a traffic signal (planned),
    - Modify eastbound approach to a separate right turn lane and a shared through-left turn lane (planned),
    - Modify westbound approach to a separate right turn lane and a shared through-left turn lane (planned),
    - Modify northbound approach to a separate left turn lane and a separate through lane and a shared through-right turn lane (planned), and,

- Modify southbound approach to a separate right turn lane, two separate through lanes and a separate left turn lane (planned)
- With the planned improvements listed above in place, the intersection of Braddock Road and Gum Spring Road will operate at acceptable levels of service.

o **Future Conditions without Development (2012):**

The following improvement in the vicinity of the proposed development was assumed to be in place by 2012:

- Planned construction of a two-lane section of Relocated Route 659 (Northstar Boulevard) from Tall Cedars Parkway to Braddock Road
- Planned paving of Braddock Road from Great Berkhamstead Drive to Goshen Road (approx. 0.3 mile section). Great Berkhamstead Drive provides access to the Stratshire Crossing (Braddock Crossing) residential development

All study intersections operate at acceptable levels of service under future conditions without development, except for the intersection of Braddock Road with Gum Spring Road and Goshen Road with Route 50. The following improvements are recommended under this scenario:

Intersection of Braddock Road and Gum Spring Road:

- Add a separate eastbound left turn lane (planned);
- Add a separate westbound left turn lane (planned);
- Adjust signal timings and phasing (recommended)

The minor approach (Goshen Road) at the intersection of Route 50 and Goshen Road continues to operate at unacceptable levels of service conditions, however a traffic signal is not warranted. The queuing results show that the maximum queue does not exceed the turn bay lengths.

o **Future Conditions with Development (High School Build Out – 2012)**

All study intersections operate at acceptable levels of service under future conditions with development (2012) conditions**.** The following improvements are recommended under this scenario:

Intersection of Braddock Road and Relocated Rt. 659 (Northstar Boulevard):

- Add a westbound right turn lane *(Based on turn lane warrant analysis)*
- Add a southbound left turn lane *(Based on turn lane warrant analysis)*

Intersection of Relocated Gum Spring Road and Road A:

- Add a separate northbound left turn lane;

- Add a separate southbound right turn lane.

Intersection of Relocated Gum Spring Road and Road B:

- Add a separate northbound left turn lane;
- Add a separate southbound right turn lane.

The minor approach (Goshen Road) at the intersection of Route 50 and Goshen Road continues to operate at unacceptable levels of service conditions, however a traffic signal is not warranted. The queuing results show that the maximum queue does not exceed the turn bay lengths.

With the proposed School development in place, the existing section of Goshen Road between Braddock Road and Road A just north of the High School building on the school property will be abandoned. The planned construction of Relocated Route 659 will replace this section of Goshen Road and provide a safer and paved north south access.

O Future Conditions without Development (2015)

The following planned improvements in the vicinity of the proposed development were assumed to be in place by 2015:

- West Spine Road: is a planned four-lane corridor to run between Route 50 just east of existing Route 659, and continuing south to join the present alignment of existing Route 659 at Tall Cedars Parkway. As part of this planned roadway, existing Route 659 connection to Route 50 will be eliminated.
- As part of the Westport By-Right Development, there are plans to eliminate the existing severe curve on Goshen Road just south of Route 50 with a four-leg 90-degree intersection. Goshen Road will terminate at the proposed Westport Boulevard, which will form the southern leg of the new 90-degree intersection. A signal is also planned at the new Westport Boulevard and Route 50 intersection.

All study intersections operate at acceptable levels of service under future conditions without development (2105). The following planned improvements were incorporated under this scenario:

Intersection of Rt. 50 and Goshen Road:

- Eliminate existing severe curve on Goshen Road just south of Route 50 with a four-leg 90-degree intersection (planned)
- Goshen Road will terminate at the proposed Westport Boulevard, which will form the southern leg of the new 90-degree intersection (planned)
- Add traffic signal (Signal is warranted - planned)

Intersection of Tall Cedars Parkway and West Spine Road:

- Realign northbound leg (planned)
- Add 2nd through lane in northbound and southbound direction (planned)

o **Future Conditions with Development (Elementary School Build Out - 2015)**

All study intersections operate at acceptable levels of service under future conditions with development (2015) conditions.

o **Future Conditions with Development plus five years (2020)**

All study intersections operate at acceptable levels of service under future conditions with development (2020) conditions with the following recommended improvements in place:

Intersection of Braddock Road and West Spine Road/Gum Spring Road:

- Add 2nd eastbound through lane (recommended)
- Add 2nd westbound through lane (recommended)
- Add 2nd eastbound left turn lane (recommended)

Intersection of Tall Cedars Parkway and West Spine Road:

- Add a traffic signal (recommended)

Intersection of Braddock Road and Relocated Route 659 (Northstar Boulevard):

- Add a traffic signal (recommended)

- The analysis presented in the traffic study shows that with the planned and recommended improvements in place, all study intersections will operate at acceptable levels of service conditions. The improvements identified under future conditions with development plus five years (2020) are due solely to background traffic, not traffic to and from the proposed school. Loudoun County Public Schools is not responsible for correcting the background traffic related impacts post build out of the proposed schools.
- The planned, recommended and proposed (site) roadway improvements for future conditions 2012, 2015 and 2020 are shown in **Figures A, B and C** respectively.

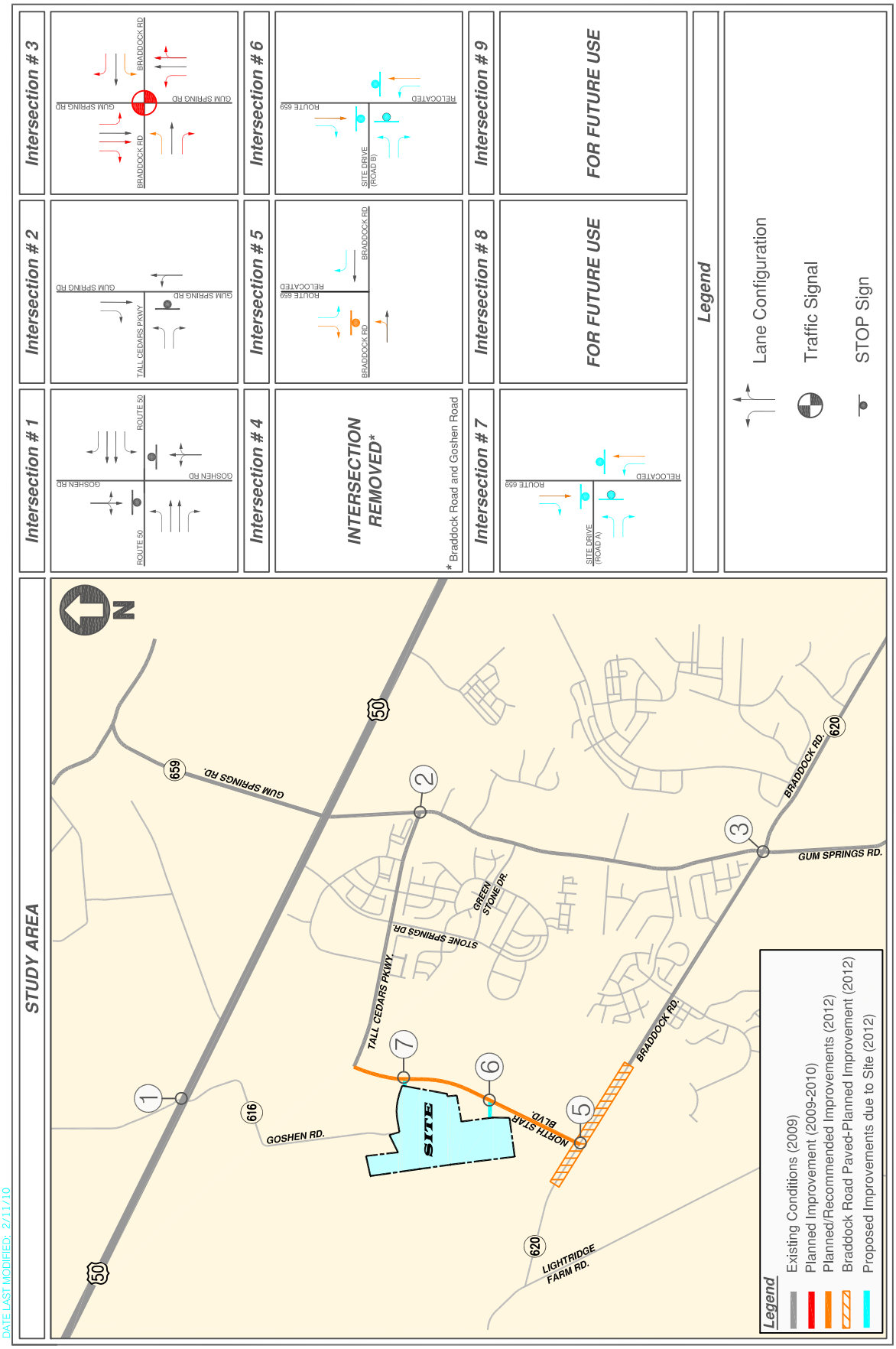

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Figure A
Roadway Improvements (2012)

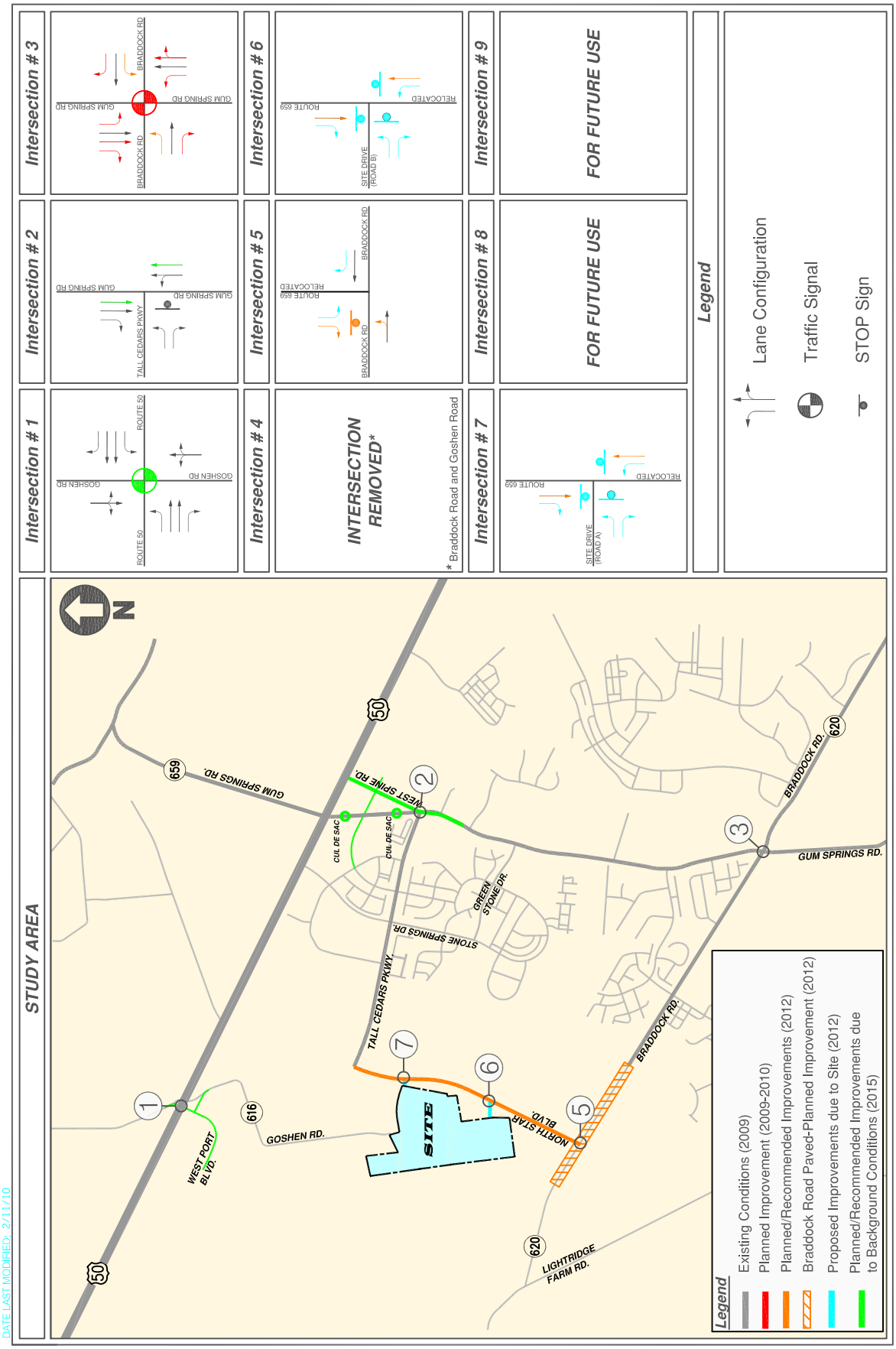

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Figure B
Roadway Improvements (2015)

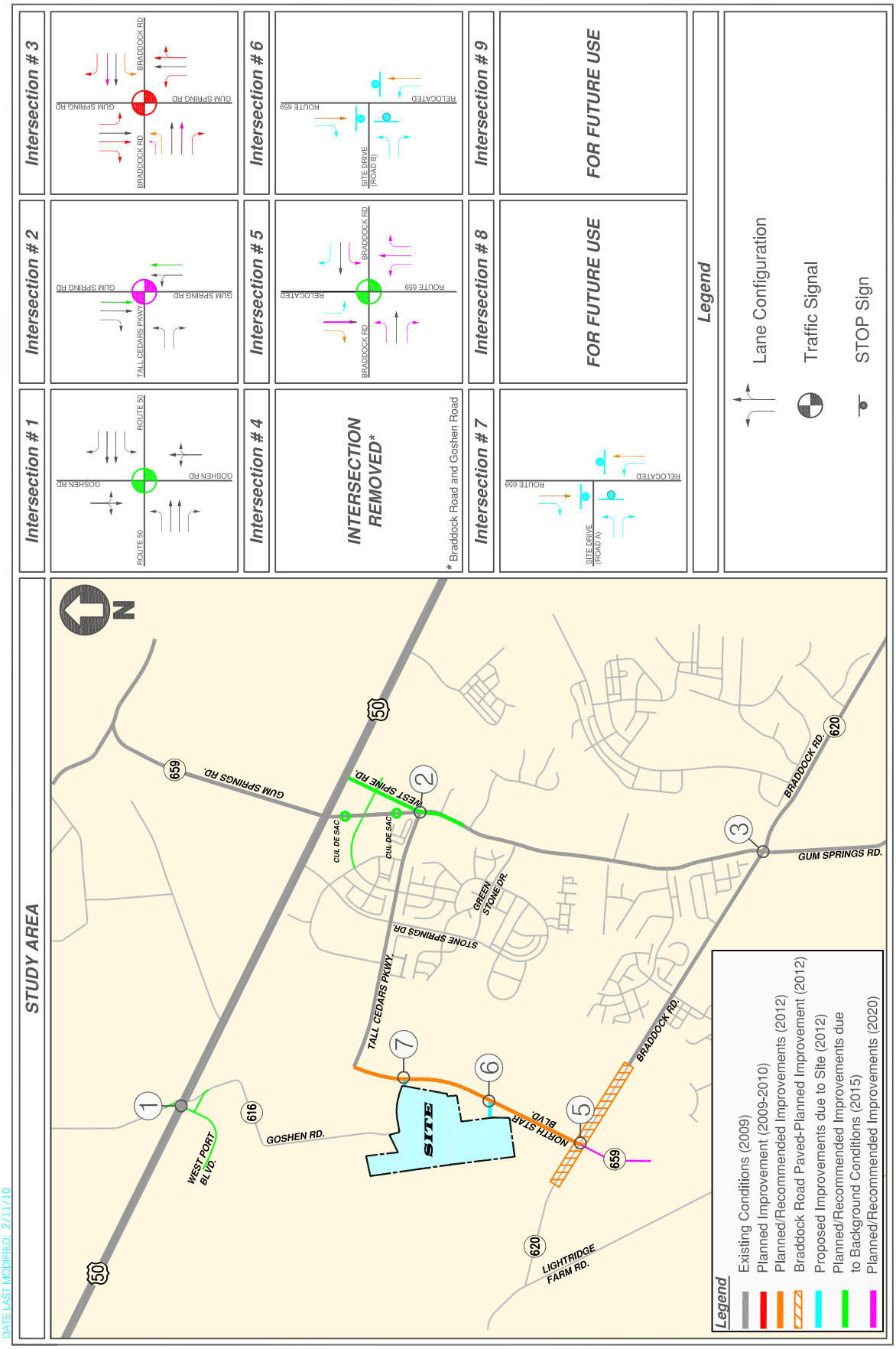

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Figure C
Roadway Improvements (2020)

INTRODUCTION

The following report presents the findings of a traffic impact analysis for the proposed High School (HS-7) and Elementary School (ES) to be located in Loudoun County, Virginia. The proposed schools will be located along Goshen Road, west of Gum Spring Road (Route 659), north of Braddock Road (Route 620) and south of Route 50 in Loudoun County, Virginia. The schools will be built on an assemblage of properties of approximately 97 acres. A special exception on the property is being proposed to allow for the construction of a High School and an Elementary School, comprising of approximately 1,800 students and 875 students, respectively. The proposed development will be phased, with the High School (HS) anticipated to open in 2012 and the Elementary School (ES) anticipated to open in 2015.

The following tasks were completed as part of this study:

- A scoping meeting was held on November 18, 2009 with representatives from Virginia Department of Transportation (VDOT) and Loudoun County, which included discussions about the parameters of the study and relevant background information. A copy of the signed scoping letter confirming the parameters and assumptions used in the traffic impact study is included in Appendix A.
- Field reconnaissance in the vicinity of the site was performed to collect information related to existing traffic controls, roadway geometry, and traffic flow characteristics.
- In order to determine the weekday peak hour turning movement traffic volumes, traffic counts were conducted on Thursday, November 19, 2009 during the AM and PM peak periods.
- Future traffic conditions were estimated based on regional growth, approved background developments located within the study area, and the proposed development plan.
- Traffic volumes for the background developments were generated using the methodology outlined in the Institute of Transportation Engineers' (ITE) Trip Generation, 7th Edition publication.
- Traffic volumes for the proposed Elementary and High Schools were generated using the methodology outlined in the Institute of Transportation Engineers' (ITE) Trip Generation, 8th Edition publication.
- Intersection capacity analyses were performed for existing conditions (2009), future conditions without development (2012), future conditions with development (High School only -2012), future conditions without development (2015), future conditions with development (High School and Elementary School -2015), and future conditions with development (2020) during weekday morning and afternoon HS and ES school peak hour traffic conditions at the intersections located within the study area.

Sources of data for this study include Institute of Transportation Engineers (ITE), Loudoun County Public Schools Planning Department, Loudoun County's Office of Transportation Services, the Virginia Department of Transportation (VDOT), and the office files and field reconnaissance efforts by Gorove/Slade Associates, Inc.

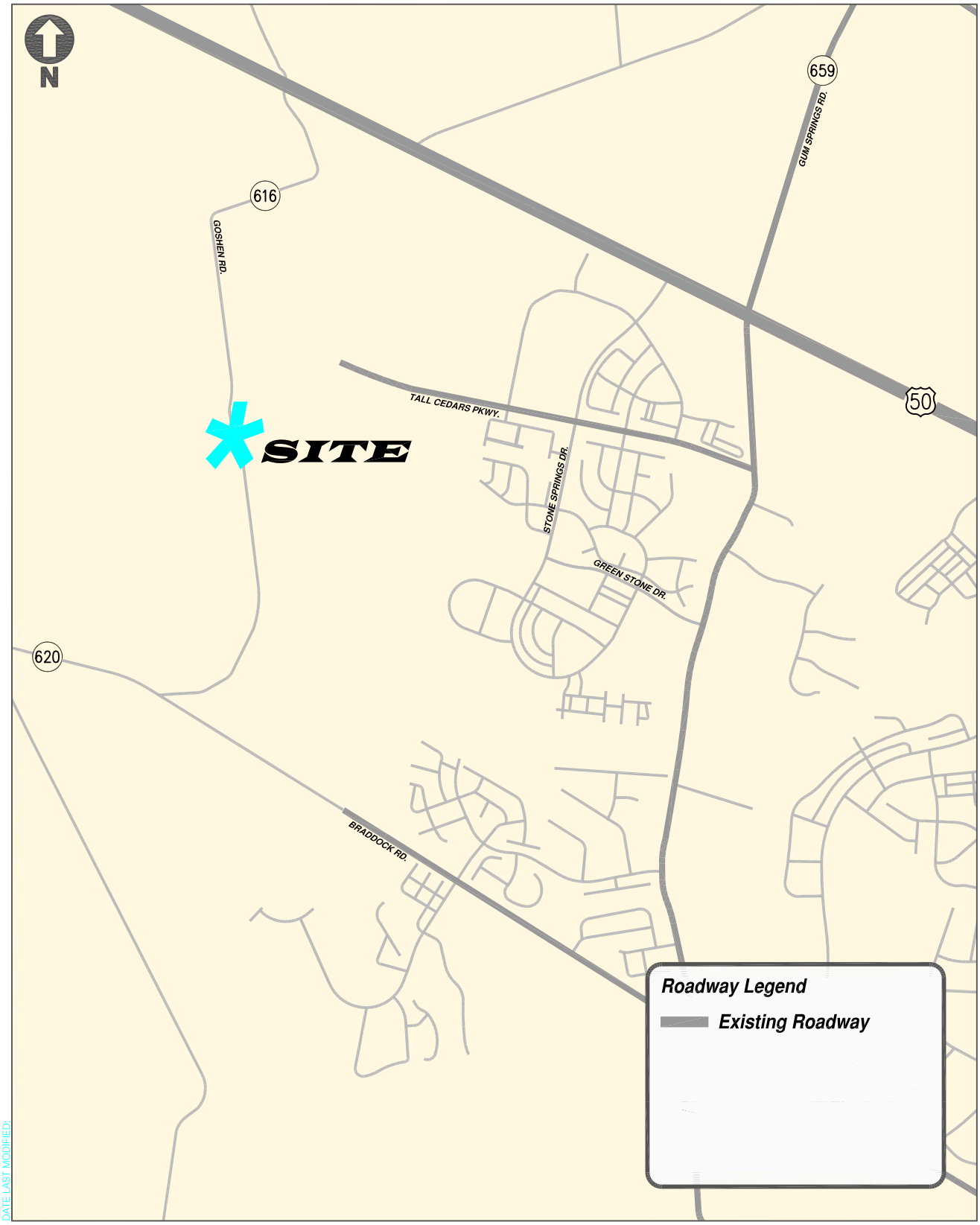

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Figure 1A
Area Map and Site Location

Figure 1B: Long Term Roadway Improvements -Per Loudoun county CTP

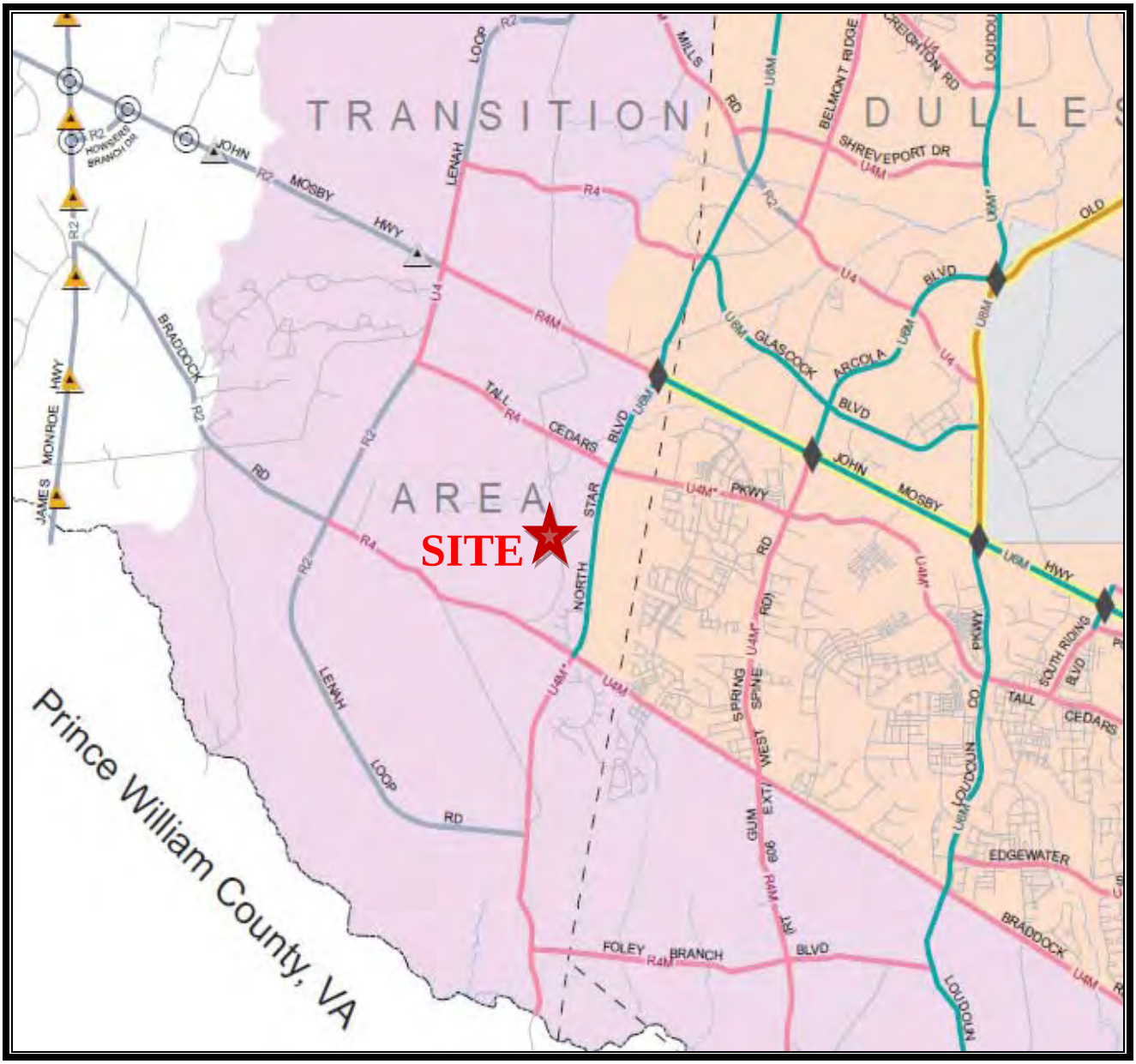
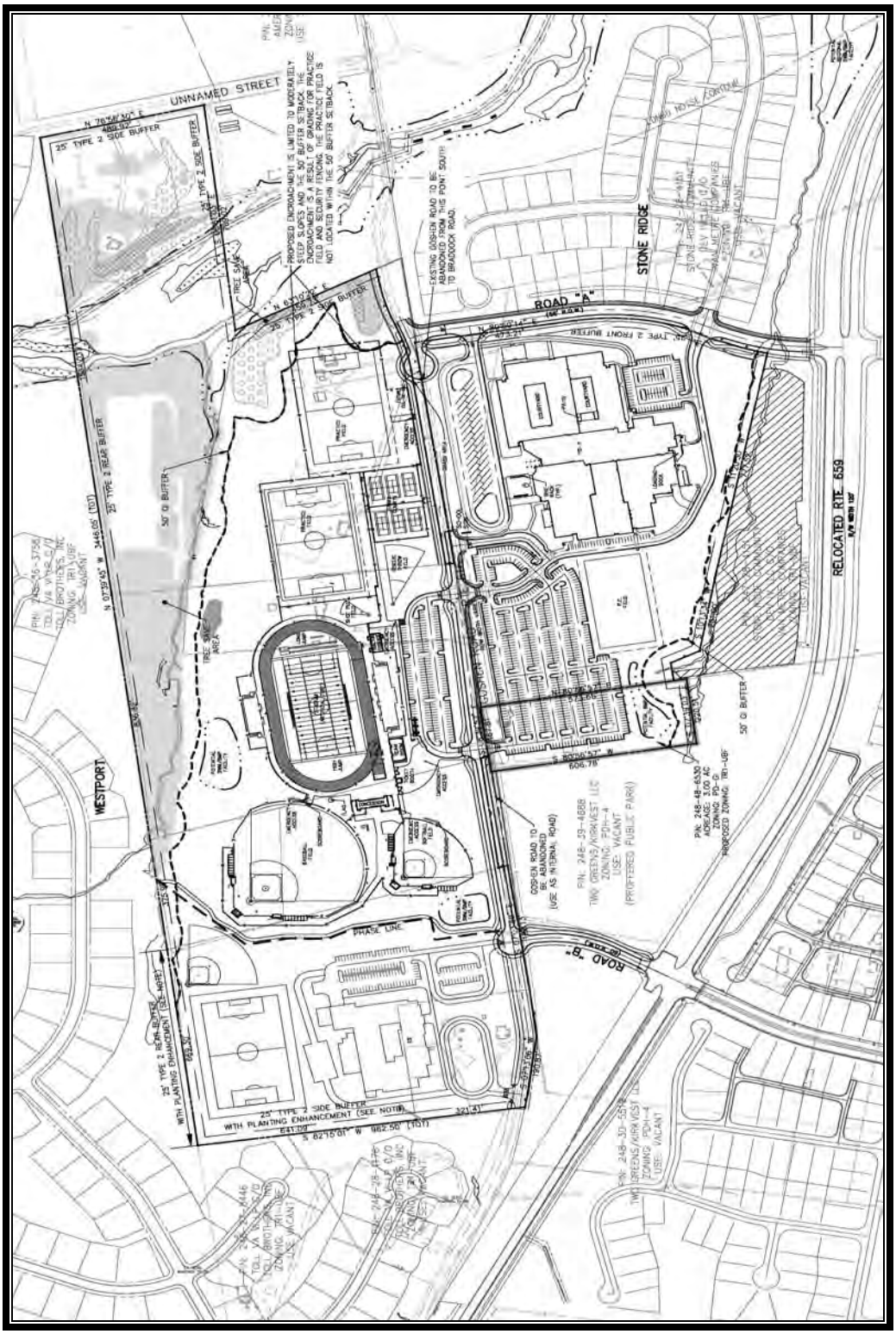


Figure 2: Concept Plan



Scope of Study

The following intersections were identified for inclusion in this study.

1. Braddock Road (Rt. 620) and Gum Spring Road (Rt. 659);
2. Lee Jackson Memorial Highway (Rt. 50) and Goshen Road (Rte. 616);
3. Braddock Road and Goshen Road;
4. Gum Spring Road and Tall Cedars Parkway;
5. Tall Cedars Parkway and Relocated Route 659 (Northstar Boulevard)*;
6. Braddock Road and Relocated Route 659 (Northstar Boulevard);
7. Road A (School Entrance) and Relocated Rt. 659;and;
8. Road B (School Entrance) and Relocated Rt. 659.

** Relocated Route 659 was assumed to be in place from Braddock Road to Tall Cedars Parkway. Tall Cedars Parkway was assumed to be in place from Gum Spring Road to Relocated Route 659. No northern or western approaches were assumed to be in place at this intersection, resulting in no conflicting movements. Hence, no capacity analysis was conducted for this intersection.*

As discussed at the scoping meeting, an analysis of the traffic volume on the roadway links that fall outside of the study area was conducted, specifically to determine if there were additional impacts to intersections along Route 50. If the proposed development traffic volumes exceed 10% of the existing link volumes at any intersection, then that off-site intersection will need to be counted and analyzed. In order to analyze whether there will be any impact to Route 50, the north-south roads connecting Braddock Road to Route 50 were evaluated. Tables 1A and 1B show the results of the roadway link analysis for the Route 50 intersections.

Table 1A: Adjacent Roadway Link Analysis on Route 50 Intersections Based on HS Peak Hour (Alternative 1: Mixed Feed)

Roadway	Link Segment	% of DOA*	AM/PM Site Volume	AM/PM Existing Volume	% of AM/PM Site Volume	Triggers 10% Rule?
Goshen Road	South of Rt.50	18%	136	63	216%	**Yes**
Gum Spring Road	South of Route 50	4%	30	560	5%	No
Stone Springs Drive	South of Route 50	4%	30	330	9%	No
AM Trip Generation	**756**		**197**			
Goshen Road	South of Rt.50	18%	107	41	260%	**Yes**
Gum Spring Road	South of Route 50	4%	24	741	3%	No
Stone Springs Drive	South of Route 50	4%	24	376	6%	No
PM Trip Generation	**593**		**154**			

**DOA: Direction of Approach – Distribution of Site Traffic*

Table 1B: Adjacent Roadway Link Analysis on Route 50 Intersections Based on HS Peak Hour (Alternative 2: Pure Feed)

Roadway	Link Segment	% of DOA*	AM/PM Site Volume	AM/PM Existing Volume	% of AM/PM Site Volume	Triggers 10% Rule?
Goshen Road	South of Rt.50	12%	91	63	144%	**Yes**
Gum Spring Road	South of Route 50	2%	15	560	3%	No
Stone Springs Drive	South of Route 50	2%	15	330	5%	No
AM Trip Generation	**756**		**121**			
Goshen Road	South of Rt.50	12%	71	41	174%	**Yes**
Gum Spring Road	South of Route 50	2%	12	741	2%	No
Stone Springs Drive	South of Route 50	2%	12	376	3%	No
PM Trip Generation	**593**		**95**			

**DOA: Direction of Approach – Distribution of Site Traffic*

Note: Based on the catchment area projections provided for the Elementary School, no trips would be generated by the ES that will access the intersection of Route 50 with Gum Spring Road and Route 50 with Stone Springs Boulevard.

This report presents the findings of analyses performed for the following conditions:

- **Existing Conditions (2009):** Considers existing traffic volumes and existing roadway lane configurations.
- **Future Conditions without Development (2012):** Considers future traffic conditions with the background growth and approved developments within the vicinity but without the proposed High School.
- **Future Conditions with Development (Proposed High School - Phase I - 2012):** Considers future traffic conditions for the year 2012 with the background growth, approved developments within the vicinity and the proposed High School. Two Alternatives* were considered for this scenario:

  - Alternative 1: Catchment Area I (Based on Mixed Feed)
  - Alternative 2: Catchment Area II (Based on Pure Feed)

***Note: Loudoun County Public Schools periodically evaluates the school attendance boundaries for all public schools in Loudoun County (Elementary, Middle and High Schools). All existing schools have a demarcated student catchment area. However, the school attendance boundaries for existing and proposed public schools are currently undergoing a revision. The Loudoun County School Board is currently in the process of undertaking public hearings and work sessions to revise the attendance boundaries. Since there is a certain amount of uncertainty related to the catchment area for the proposed High School (HS-7), two catchment areas were compiled and analyzed. The two catchment areas looked at two extreme and opposite possibilities. Catchment Area I represents a well-distributed and mixed distribution of the proposed school traffic and Catchment Area II looked at the possibility of almost half of the students attending the proposed High School from the area east of Route 659. The reason behind analyzing two extreme scenarios was to analyze the worst-**

case scenarios, as the recommendations based on the worst case scenarios will also apply for the actual catchment area that may fall anywhere between the two extreme scenarios.

- **Future Conditions without Development (2015):** Considers future traffic conditions with the background growth and approved developments within the vicinity but without the proposed Elementary School.
- **Future Conditions with Development (High School and Elementary School - Phase II 2015):** Considers future traffic conditions for the year 2015 with the background growth, approved developments within the vicinity and with the proposed High School and Elementary School.
- **Future Conditions with Development (2020):** Considers future traffic conditions for the year 2020 with the background growth, approved developments within the vicinity and with the proposed High School and Elementary School.

The results of the analysis and the traffic impacts associated with the proposed Elementary and High Schools are presented in the conclusion section of this report.

EXISTING CONDITIONS (2009)

Existing Roadway Network

Braddock Road is a two-lane undivided east-west road. The posted speed limit in the vicinity of the site is 35 mph.

Gum Spring Road (Route 659) is a two-lane undivided highway. The usual posted speed limit is 45 mph in the vicinity of the site. Currently the speed limit is posted as 35mph due to construction work on Gum Spring Road in the vicinity of the site.

Tall Cedars Parkway is a four-lane divided roadway with turn lanes at most intersections. The speed limit on this roadway is 35 mph in the vicinity of the site.

Goshen Road is a two-lane gravel road connecting Braddock Road to US Route 50.

The existing lane configuration and traffic control for these study intersections are shown in **Figure 3**.

Existing Traffic Volumes

In order to determine the weekday peak hour turning movement traffic volumes, traffic counts were conducted on Thursday, November 19, 2009 during the AM and PM peak periods. The following peak hours were analyzed*:

- HS AM Peak Hour: 8:00 AM to 9:00 AM
- HS PM Peak Hour: 3:30 PM to 4:30 PM
- ES AM Peak Hour: 7:00 AM to 8:00 AM
- ES PM Peak Hour: 2:15 PM to 3:15 PM

The existing morning and afternoon HS and ES school peak hour traffic volumes for the intersections contained within the study area are shown in **Figures 4A and 4B** respectively. The estimated average daily traffic data for different roadways are also shown in the same graphic. The existing turning movement counts are included in Appendix B.

**Note: For the AM and PM HS and ES School peak hours, the peak hour of generator was utilized for trip generation and capacity analysis purposes. As agreed in the scoping meeting, the commuter peak hours for PM was not analyzed. The trip generation rates were agreed upon at the scoping meeting held with the County and VDOT officials and is reported in the scoping document. The proposed elementary school is anticipated to run on the following schedule: 7:50 AM to 2:35 PM and the proposed high school is anticipated to run on the following schedule: 9:00 AM to 3:48 PM.*

Hazardous Locations

Goshen Road is an unpaved/gravel road from Braddock Road to the entrance for the existing Boyd School located along Goshen Road (Approx. 0.3 miles south of Route 50). This 0.3-mile section from Route 50 to the school entrance is paved.

Braddock Road is an unpaved/gravel road from Great Berkhamstead Drive to Goshen Road (approx.

0.3 mile section). Great Berkhamstead Drive provides access to the Stratshire Crossing (Braddock Crossing) residential development.

In addition, currently, the unpaved section of Goshen Road terminates and intersects Braddock Road at an angle, which is unsafe for vehicles to maneuver, and poses sight distance issues. The aerial snapshot below shows the intersection and the geometry, which is not safe to maneuver, especially for the vehicles travelling southbound on Goshen Road turning left to travel eastbound on Braddock Road:

Planned Roadway Improvements

At the time the traffic counts were conducted (November 2009), the following improvements were under construction but not in place. Hence, these improvements were included as 'mitigation measures' under the existing conditions capacity analysis.

1. Traffic signal installation at the intersection of Gum Spring Road and Braddock Road, and
2. Planned lane improvements at the intersection of Gum Spring Road and Braddock Road*.

**Note: The traffic signal and roadway geometry plan for the intersection of Gum Spring Road and Braddock Road was obtained in order to confirm the proposed lane configuration. The transportation proffers and the final initial traffic signal plan dated June 2009 prepared and submitted by PHR+A is included in Appendix T.*

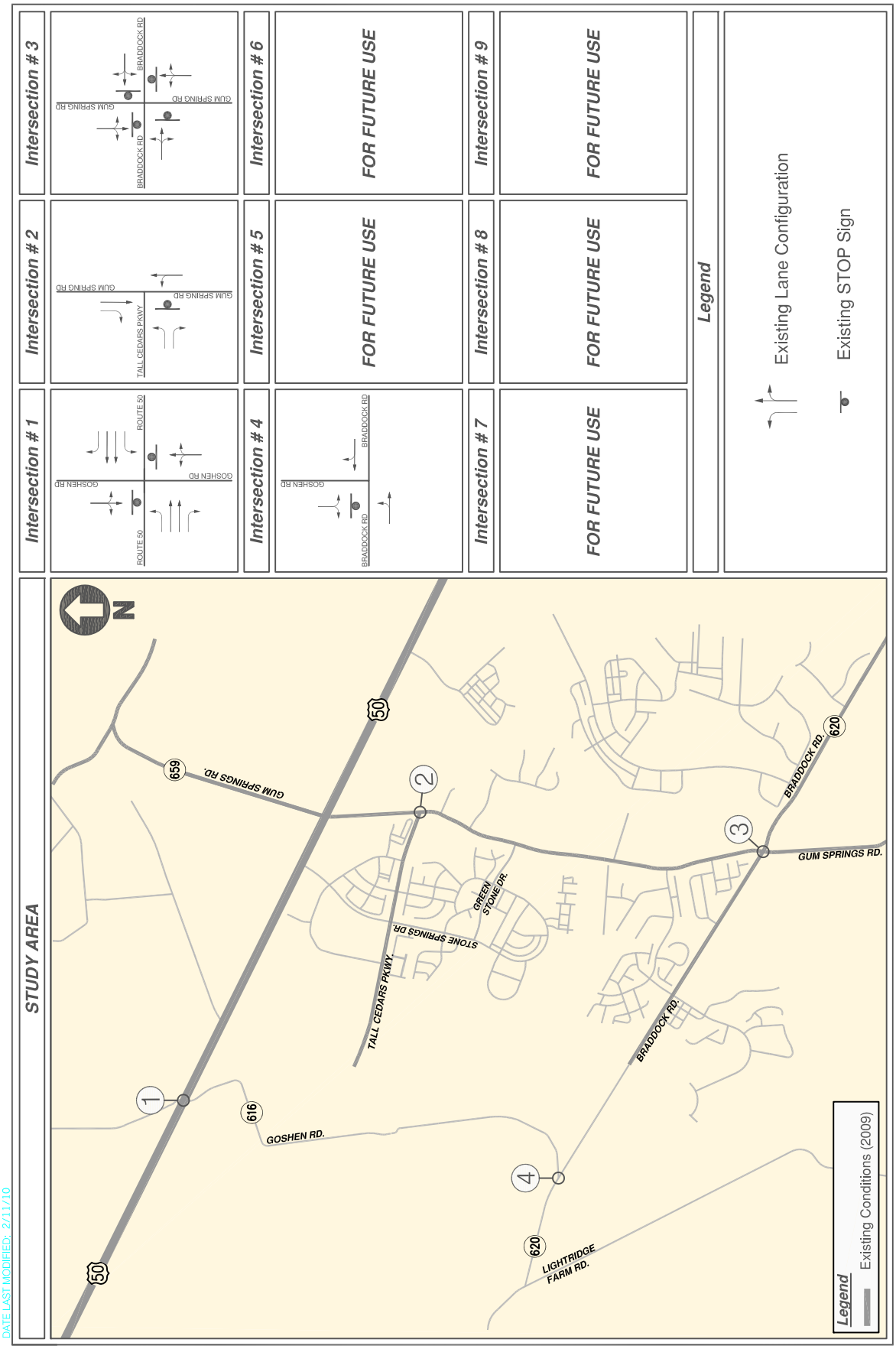


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Figure 3
Local Roadway Network (2009)

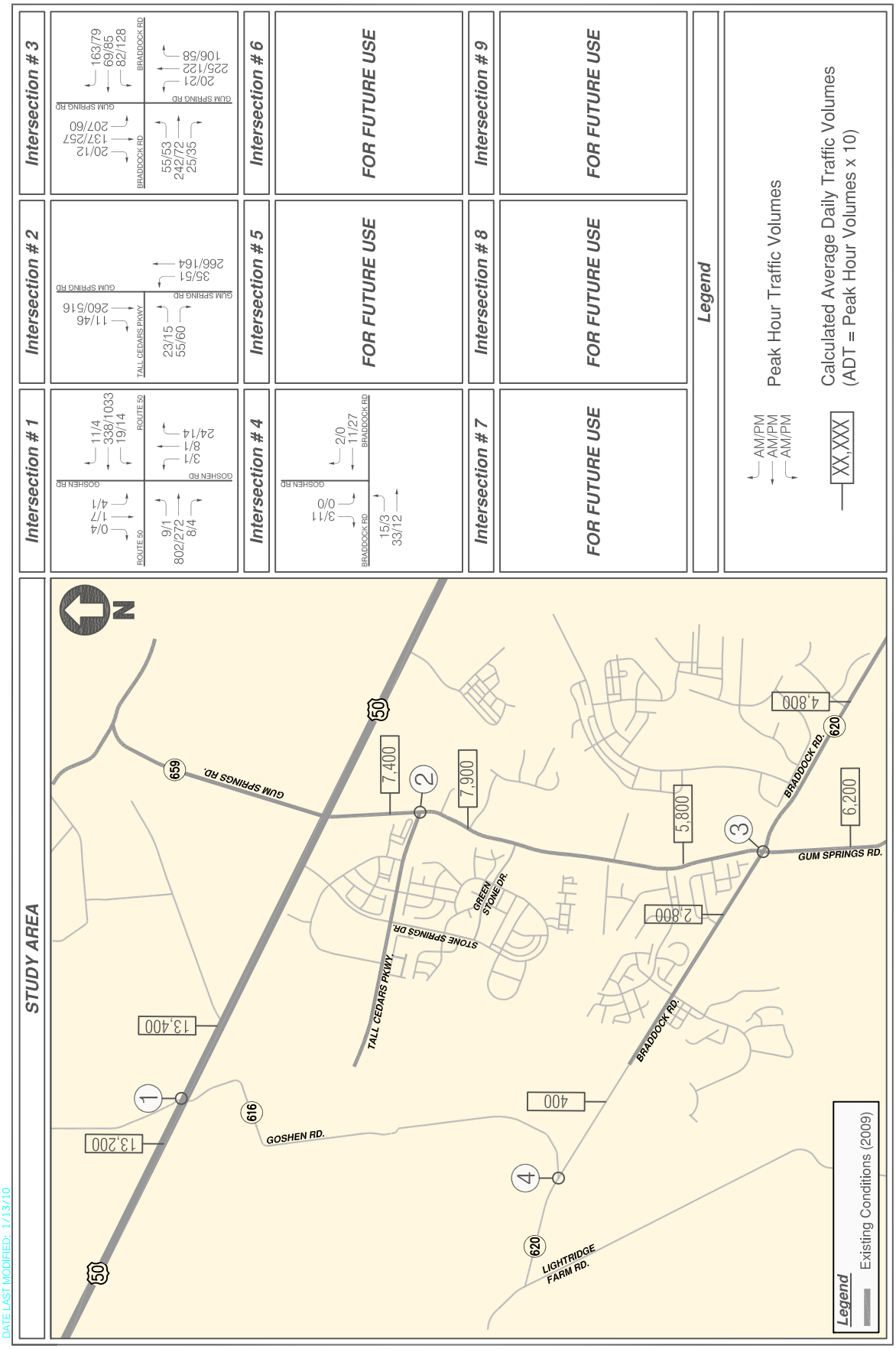

Figure 4A
Existing Traffic Volumes (2009)
High School Peak Hour
(8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)

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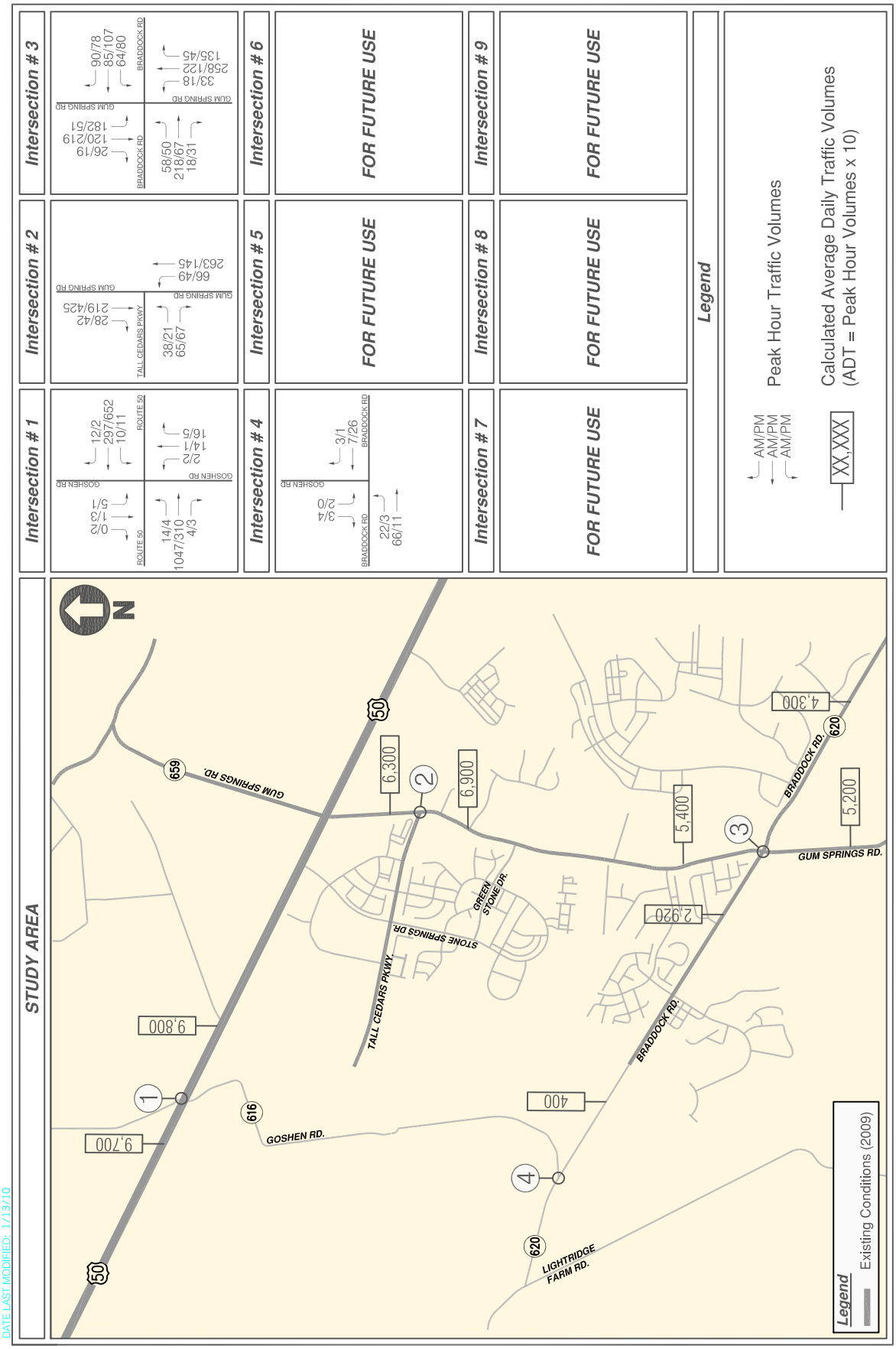

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Figure 4B
Existing Traffic Volumes (2009)
Elementary School Peak Hour
(7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)

Existing Conditions Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the morning and afternoon HS and ES school peak hours, under the existing conditions. Intersection capacity analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology.

The results of the intersection capacity analyses for the existing conditions are summarized in **Tables 2A and 2B**. The description of the different LOS and delay and the detailed analysis worksheets for the existing conditions are included in Appendix D.

Table 2A: Existing (2009) Intersection Capacity Analysis (HS Peak Hour)

	Existing Condition (2009) -HS Peak Hour			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.1	B	11.3
Westbound Left Turn	A	9.9	A	7.9
Northbound Approach	C	19.6	B	12.1
Southbound Approach	D	26.2	D	32.5
Tall Cedars Parkway and Gum Spring Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	B	11.7	C	15.2
Northbound Approach	A	1.2	A	2.7
Southbound Right Turn	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	F	60.5	**B**	**14.1**
Westbound Approach	F	57.1	**C**	**20.9**
Northbound Approach	F	88.3	B	14.4
Southbound Approach	F	70.4	C	20.8
Overall Mitigation - Add a Signal	**C**	**32.7**	**C**	**27.1**
Eastbound Approach-**Add a right turn lane**	D	41.5	C	29.1
Westbound Approach-**Add a right turn lane**	C	33.6	C	27.1
Northbound Approach-**Modify to a left turn lane, a through and a shared through right turn lane**	C	34.6	C	27.5
Southbound Approach-**Modify to a left turn lane, 2 through lanes and a right turn lane**	C	21.6	C	25.9
Braddock Road and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	2.3	A	1.5
Southbound Approach	A	8.4	A	8.5

Table 2B: Existing (2009) Intersection Capacity Analysis (ES Peak Hour)

	Existing Condition (2009)-ES Peak Hour			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.3	A	9.2
Westbound Left Turn	B	11.1	A	8.0
Northbound Approach	D	34.6	B	13.1
Southbound Approach	E	35.2	C	19.1
Tall Cedars Parkway and Gum Spring Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	B	12.3	B	13.1
Northbound Approach	A	2.0	A	2.5
Southbound Right Turn	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	E	38.8	B	14.3
Westbound Approach	D	25.6	C	16.3
Northbound Approach	F	88.4	B	13.0
Southbound Approach	E	39.4	C	20.7
Overall Mitigation-Add a Signal	**C**	**33.6**	**C**	**26.3**
Eastbound Approach-**Add a right turn lane**	D	42.4	C	28.0
Westbound Approach-**Add a right turn lane**	D	37.0	C	26.7
Northbound Approach-**Modify to a left turn lane, a through and a shared through right turn lane**	C	34.4	C	26.5
Southbound Approach-**Modify to a left turn lane, 2 through lanes and a right turn lane**	C	21.1	C	24.7
Braddock Road and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	1.9	A	1.6
Southbound Approach	A	8.8	A	8.5

According to the Loudoun County level of service (LOS) criteria, it is desirable to achieve a level of service (LOS) D or better for each approach at an intersection. As shown in Tables 2A and 2B, all of the study intersections operate at overall acceptable levels of service with the planned improvements in place, except for the southbound approach at the intersection of Route 50 and Goshen Road. The minor approach (Goshen Road) operates at unacceptable levels of service at the intersection of Route 50 and Goshen Road; however a traffic signal is not warranted under existing conditions. The following improvements are planned at the intersection of Braddock Road and Gum Spring Road and were incorporated in the analysis:

- *Intersection of Braddock Road and Gum Spring Road:*
  - Add a traffic signal,

- Modify eastbound approach to a separate right turn lane and a shared through-left turn lane;
- Modify westbound approach to a separate right turn lane and a shared through-left turn lane;
- Modify northbound approach to a separate left turn lane and a separate through lane and a shared through-right turn lane;
- Modify southbound approach to a separate right turn lane, two separate through lanes and a separate left turn lane.

The existing levels of service and recommended improvements are shown in **Figures 5A, 5B and 6, respectively**.

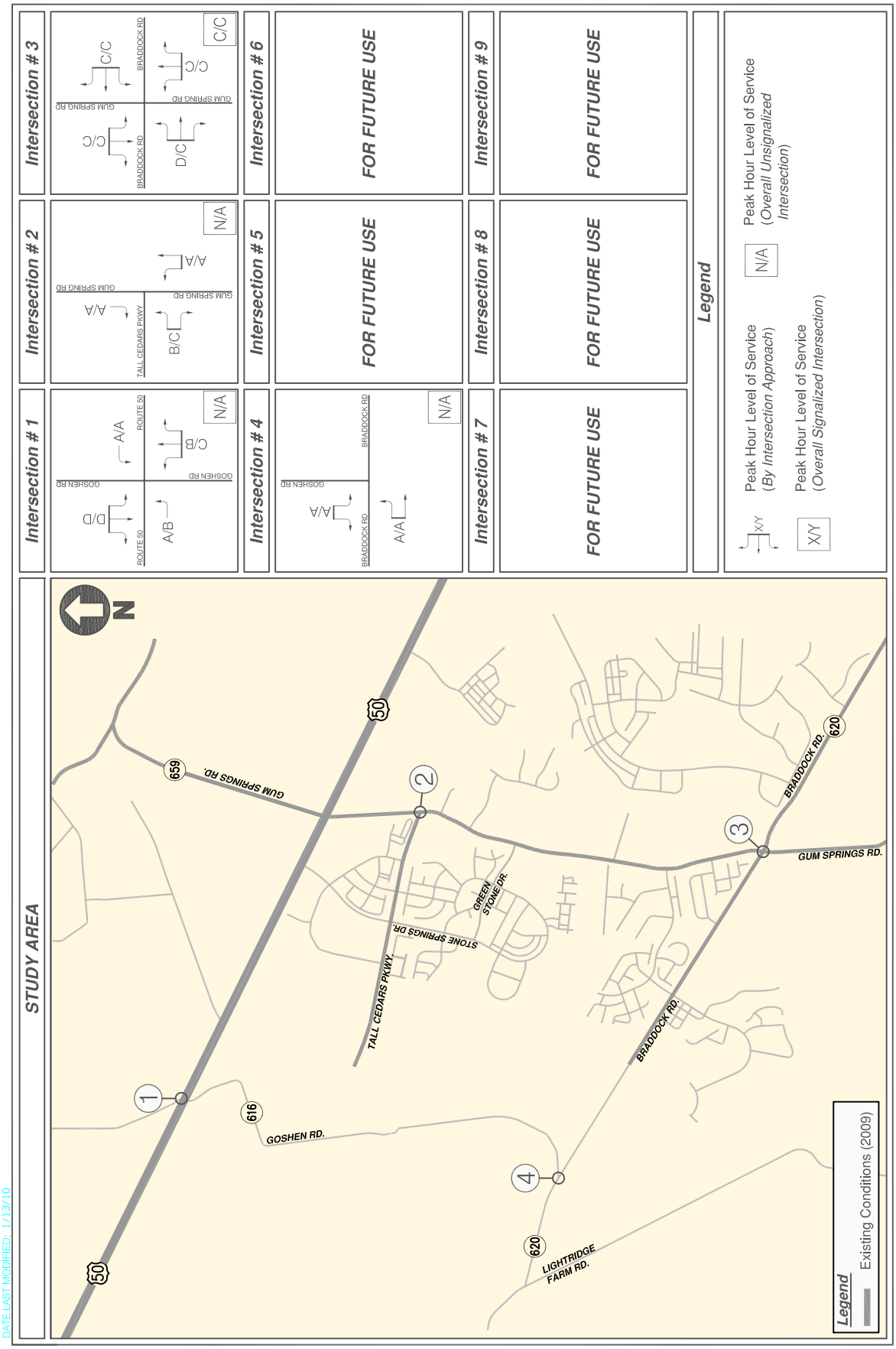

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Figure 5A
Existing Levels of Service (2009)
High School Peak Hours
(8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)

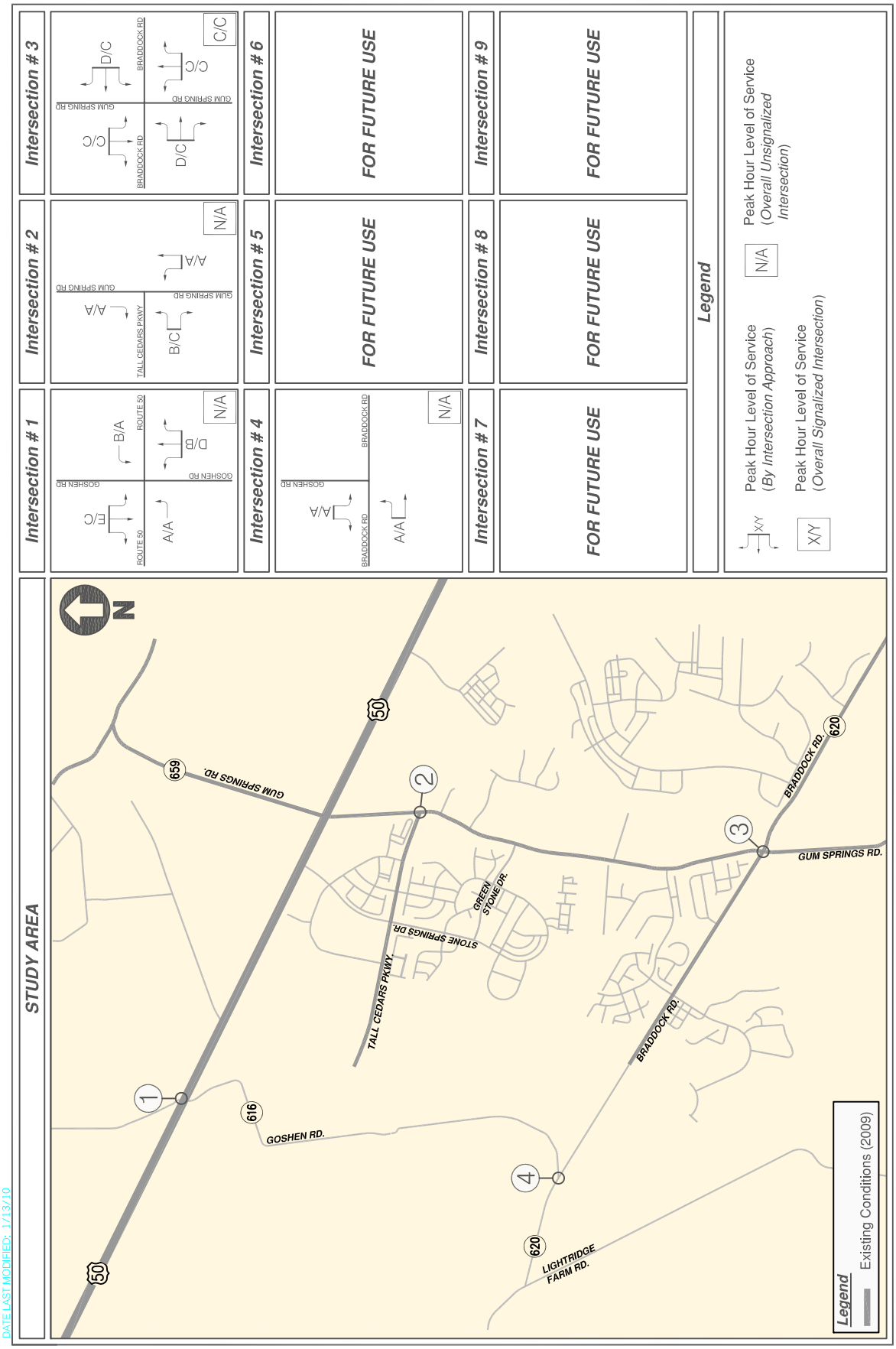

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Figure 5B
Existing Levels of Service (2009)
Elementary School Peak Hour
(7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)

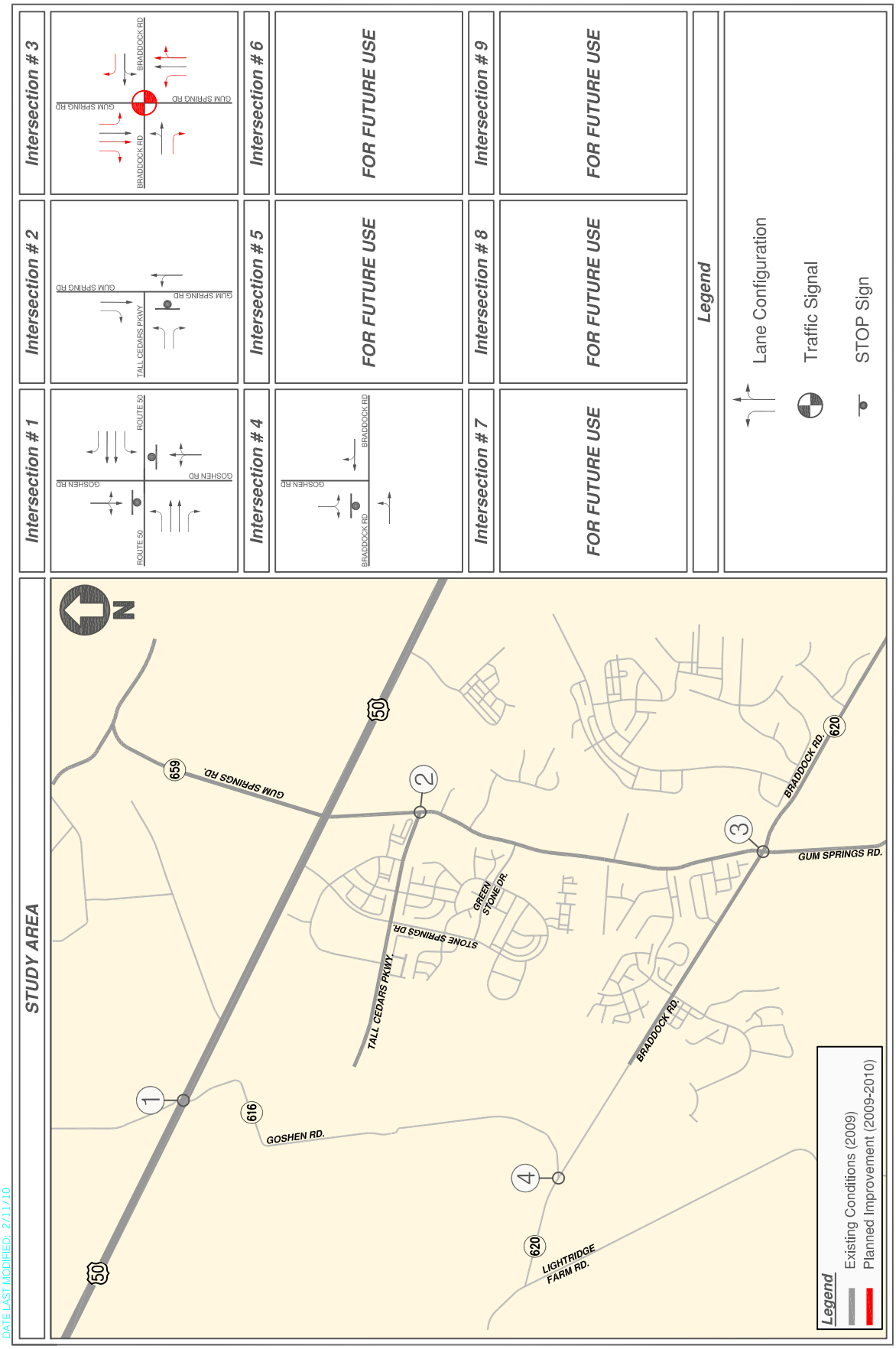

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Figure 6
Existing Conditions Recommended Improvements (2009)

FUTURE CONDITIONS WITHOUT DEVELOPMENT (2012)

Planned Roadway Improvements

The following improvement in the vicinity of the proposed development were assumed to be in place by 2012:

- Planned construction of a two-lane section of Relocated Route 659 (Northstar Boulevard) from Tall Cedars Parkway to Braddock Road

- Planned paving of Braddock Road from Great Berkhamstead Drive to Goshen Road (approx. 0.3 mile section). Great Berkhamstead Drive provides access to the Stratshire Crossing (Braddock Crossing) residential development.

Future Conditions without Development Traffic Volumes

Future traffic conditions were projected for the interim year of 2012. VDOT's historical traffic data along with the approved studies (Greenfields TIA and Stoneridge Commercial TIA, prepared by Wells + Associates and Loudoun County School Board: MS-5 TIA, prepared by Gorove/Slade Associates) in the vicinity of the proposed site were utilized to calculate the inherent growth rate for the roads. In addition, the Loudoun County Growth Summary (2009) was used to verify the traffic projections. The data was presented to VDOT and Loudoun County OTS representatives for verification and approval. Based on the interaction with VDOT and OTS staff, it was decided that a growth rate of two percent (2%) per year would be applied to the major roads in the area in addition to the trips generated by approved background developments to match the Loudoun County's Growth Summary projections. The VDOT's historical traffic data calculations are shown in Appendix E.

The traffic generated by the following background developments in the area, as discussed and documented in the scoping letter, was considered as part of the background traffic for the future without development (2012) conditions:

1. Westport By-Right Property
2. Stone Ridge
3. Marrwood Property
4. CD Smith
5. Kirkpatrick Farms West
6. Kirkpatrick Farms
7. Braddock Corner
8. LCPS MS-5
9. Lenah Property

10. Greenfield Property
11. Gum Spring Village Center
12. Providence Glen
13. Braddock Crossing

The location map of the approved developments is shown in **Figure 7**. The trips generated by these future background approved developments were taken from the following approved traffic studies in accordance with Loudoun County:

1. Stone Ridge Commercial, prepared by Wells + Associates, dated January 26, 2009
2. Greenfields TIA, prepared by Wells + Associates, dated October 19, 2009
3. Loudoun County Public School MS-5, prepared by Gorove Slade Associates, dated March 27, 2009

These trips were added to the existing volumes and inherent growth to estimate the future without development volumes as illustrated in **Figure 8**. The trips generated by these approved background developments are included in the Technical Appendix. Please refer to Appendix F.

As mentioned earlier, a list of background development assumptions and a comparison of the trips generated by the background developments with Loudoun County's Growth Summary projections were provided in advance to VDOT's Planning department and OTS for review, before finalizing this study. The memorandum listing out the assumptions and the email conversations are also included in Appendix F.

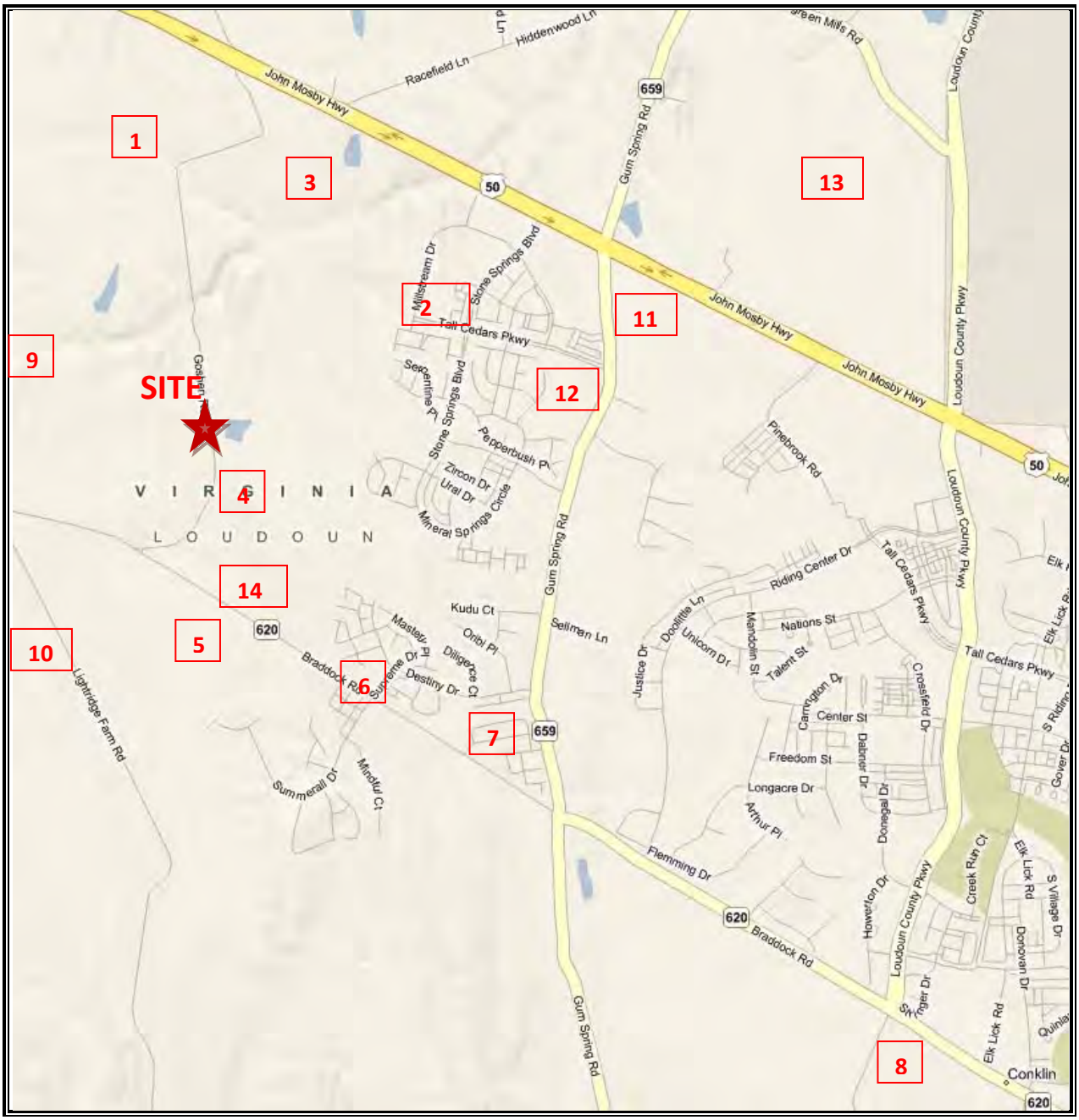

Figure 7: Location Map of Approved Background Development

1 Westport By-Right Property
2 Stone Ridge
3 Marrwood Property
4 CD Smith
5 Kirkpatrick Farms West
6 Kirkpatrick Farms
7 Braddock Corner
8 LCPS MS-5
9 Lenah Property
10 Greenfield Property
11 Gum Spring Village Center
12 Providence Glen
13 Arcola Center
14 Braddock Crossing

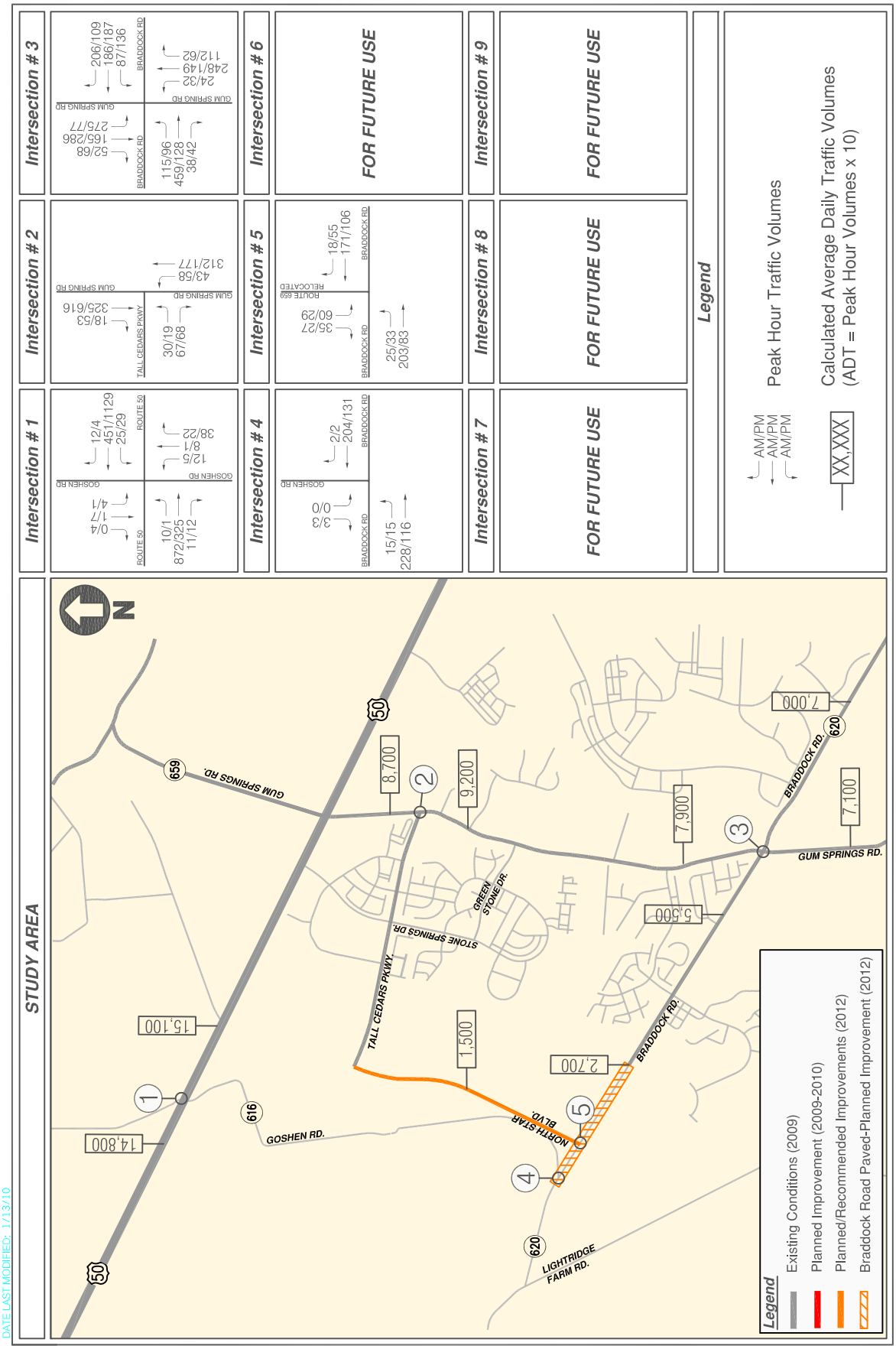

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Figure 8
Future Conditions without Development Traffic Volumes (2012)
High School Peak Hour
(8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)

Future Conditions without Development Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday HS school peak hours, under the future without development conditions. Intersection capacity analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology.

The results of the intersection capacity analyses for the future without development conditions are summarized in **Table 3**. The description of the different LOS and delay and the detailed analysis worksheets for the future conditions without development are included in Appendix G.

Table 3: Future Conditions without Development (2012) Intersection Capacity Analysis

	Future Background Conditions (2012) - HS Peak Hour			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.2	B	11.4
Westbound Left Turn	B	10.3	A	8.1
Northbound Approach	C	24.0	B	14.2
Southbound Approach	D	29.4	E	37.2
Tall Cedars Parkway and Gum Spring Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	B	12.6	C	15.7
Northbound Approach	A	1.3	A	2.8
Southbound Right Turn	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**E**	**78.0**	**C**	**32.4**
Eastbound Approach	F	145.3	D	37.3
Westbound Approach	E	61.8	C	33.1
Northbound Approach	D	44.7	C	32.3
Southbound Approach	D	36.3	C	28.6
Overall (Signalized)	**C**	**28.3**	**C**	**21.3**
Eastbound Approach - **Add a left turn lane**	C	32.8	C	21.6
Westbound Approach - **Add a left turn lane**	C	21.0	B	19.1
Northbound Approach	D	36.2	C	25.5
Southbound Approach	C	23.8	C	20.9
Braddock Road and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	0.6	A	0.9
Southbound Approach	A	9.4	A	9.0

	Future Background Conditions (2012) - HS Peak Hour			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	1.0	A	2.3
Westbound Approach	A	0.0	A	0.0
Southbound Approach	B	11.9	B	10.1

As mentioned earlier, according to the Loudoun County level of service (LOS) criteria, it is desirable to achieve a level of service (LOS) D or better for each approach at an intersection. As shown in Table 3, the following intersections operate at unacceptable levels of service:

1. Route 50 and Goshen Road, and
2. Gum Spring Road and Braddock Road

The minor approach (Goshen Road) at the intersection of Route 50 and Goshen Road continues to operate at unacceptable levels of service conditions, however a traffic signal is not warranted. The following improvements are recommended along Braddock Road in order to achieve acceptable level of service conditions:

- *Intersection of Braddock Road and Gum Spring Road:*
  - Add a separate eastbound left turn lane;
  - Add a separate westbound left turn lane;
  - Adjust signal timings and phasing.

Based on the improvements listed above, all study intersections will operate at acceptable levels of service conditions under future without development conditions (2012). The results of the intersection capacity analyses and recommended improvements are shown graphically in **Figures 9 and 10.**

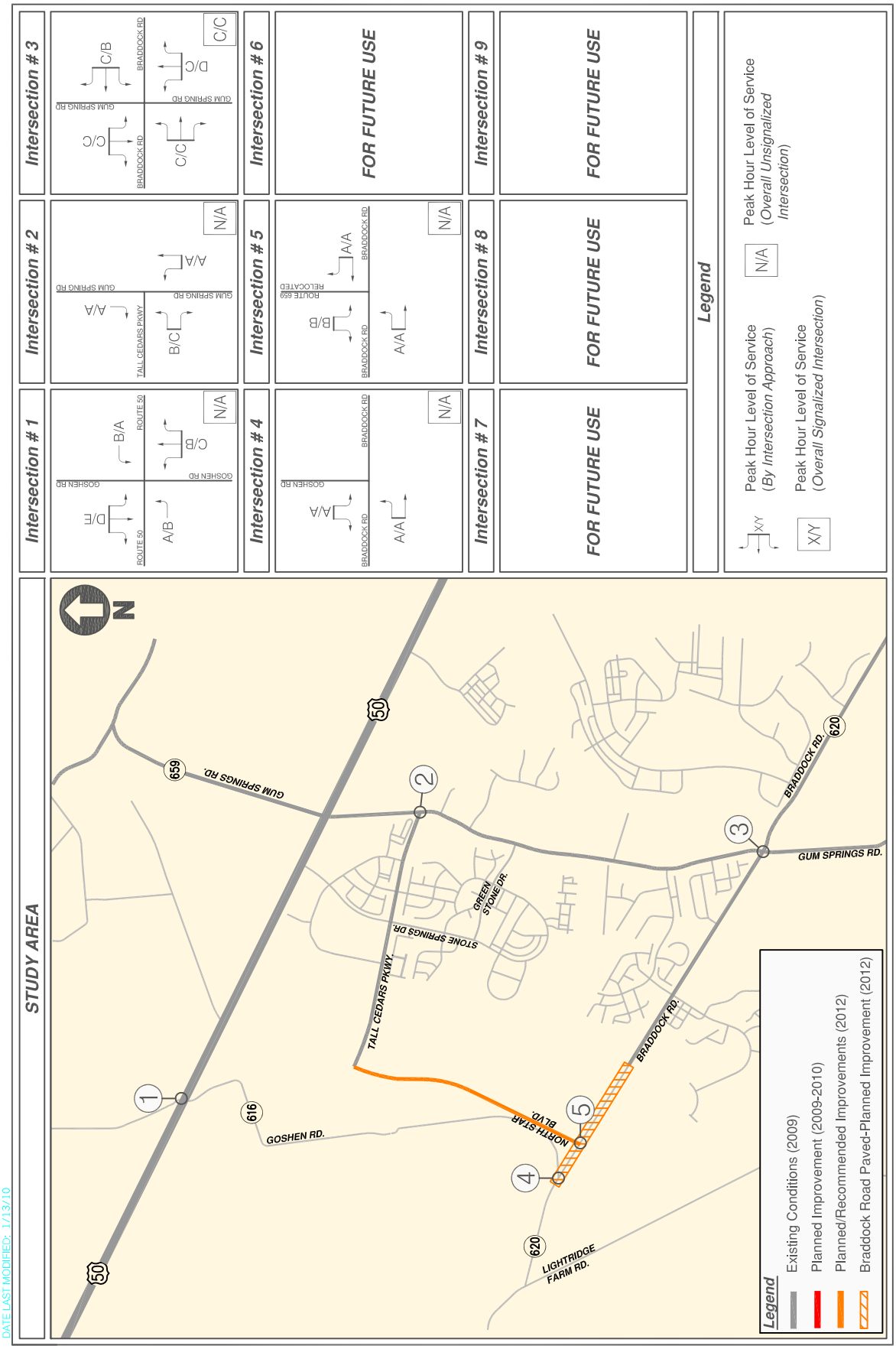

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Figure 9
Future Conditions without Development Levels of Service (2012)
High School Peak Hour
(8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)

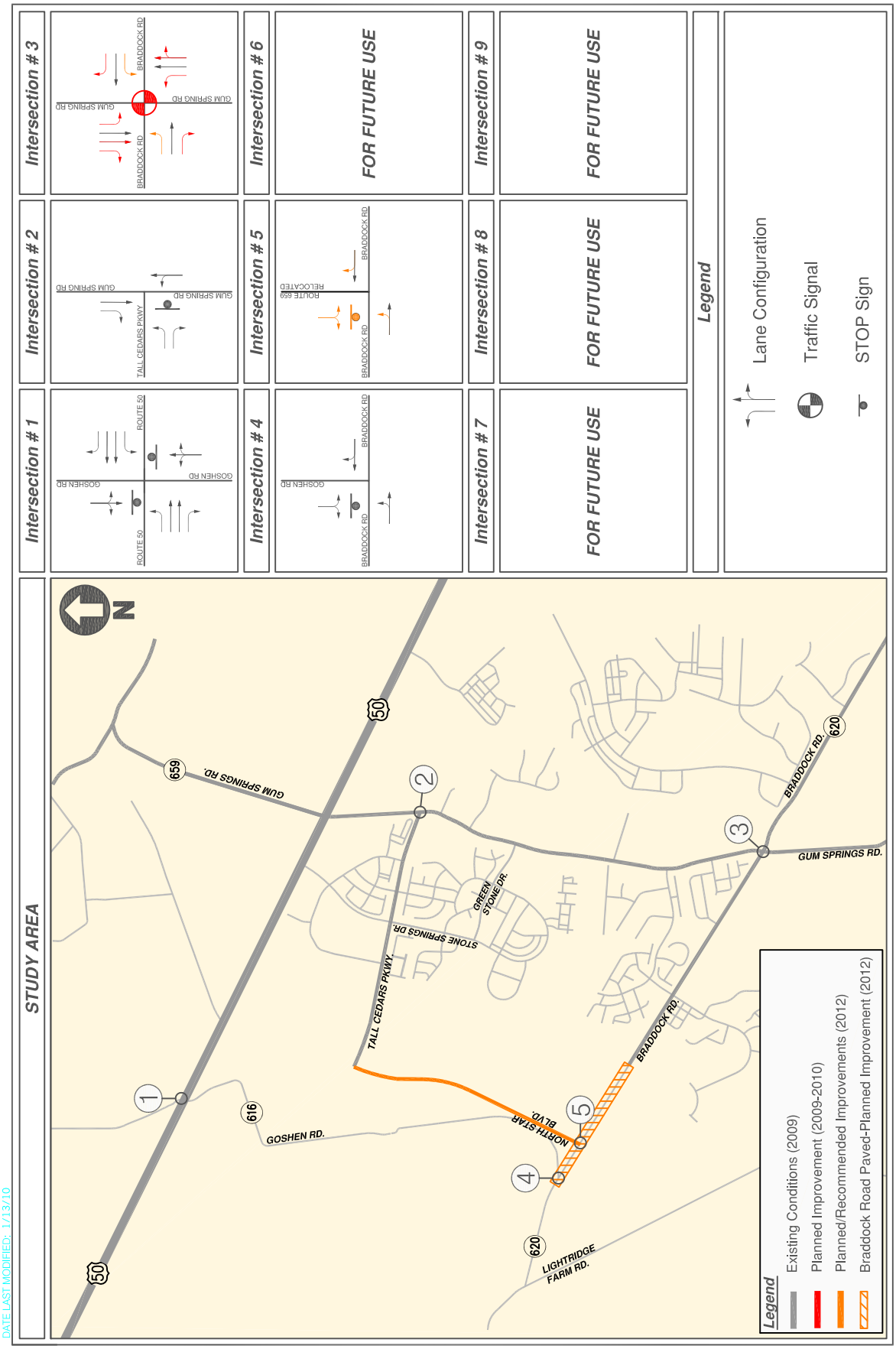

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Figure 10
Future without Development Recommended Improvements (2012)
High School Peak Hour
(8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)

FUTURE CONDITIONS WITH DEVELOPMENT (HIGH SCHOOL BUILD-OUT-2012)

Site Description

The proposed schools will be located in the Dulles South area in Loudoun County, Virginia. The proposed schools will be located along Goshen Road, west of Gum Spring Road (Route 659), north of Braddock Road (Route 620) and south of Route 50 in Loudoun County, Virginia. The schools will be built on an assemblage of properties of approximately 97 acres. A special exception on the property is being proposed to allow for the construction of a High School and an Elementary School, comprising of approximately 1,800 students and 875 students, respectively. The proposed development will be phased, with the High School (HS) anticipated to open in 2012 and the Elementary School (ES) anticipated to open in 2015. The projection estimates provided by Loudoun County Public Schools Planning Department are attached in the appendix section (Appendix H) of the report.

Based on the student projection estimates provided, two catchment areas* were analyzed for the purposes of this report:

- Alternative 1: Catchment Area I (Based on Mixed Feed)
- Alternative 2: Catchment Area II (Based on Pure Feed)

***Note: Loudoun County Public Schools periodically evaluates the school attendance boundaries for all public schools in Loudoun County (Elementary, Middle and High Schools). All existing schools have a demarcated student catchment area. However, the school attendance boundaries for existing and proposed public schools are currently undergoing a revision. Since there is a certain amount of uncertainty related to the catchment area for the proposed High School (HS-7), two catchment areas were compiled and analyzed. The two catchment areas looked at two extreme and opposite possibilities. Catchment Area I represents a well-distributed and mixed distribution of the proposed school traffic and Catchment Area II looked at the possibility of almost half of the students attending the proposed High School from the area east of Route 659. The reason behind analyzing two extreme scenarios was to analyze the worst-case scenarios, as the recommendations based on the worst case scenarios will also apply for the actual catchment area that may fall anywhere between the two extreme scenarios.**

Site Access

The following two access points will serve the proposed High School:

1. A full access driveway (from Road A)* along Relocated Rt.659, and
2. A full access driveway (from Road B) along Relocated Rt.659

With the proposed School development in place, the existing section of Goshen Road between Braddock Road to Road A just north of the High School building on the school property will be abandoned. The planned construction of Relocated Route 659 will replace this section of Goshen Road and provide a safer north south access.

**Note: Site Driveway (Road A) would primarily provide access to the school bus and staff traffic only.*

Site Generated Volumes

In order to calculate the trips generated by the proposed development, ITE's Trip Generation, 8th Edition was used to determine the trips into and out of the study site for the weekday morning and afternoon peak hours. **Table 4A** shows the trip generation calculations for the build out year of the high school, 2012.

Table 4A: Trip Generation (Peak Hour of Generator – HS School Peak)

Land Use	ITE Code	Size		------ Weekday ------						
				AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	Total
High School	530	1800	Students	515	241	756	173	349	522	2,784
TOTAL				**515**	**241**	**756**	**173**	**349**	**522**	**2,784**

**Note: For the AM and PM School peak hours, the peak hour of generator was utilized for trip generation and capacity analysis purposes. The trip generation rates were agreed upon at the scoping meeting held with the County and VDOT officials and is reported in the scoping document. The proposed high school is anticipated to run on the following schedule: 9:00 AM to 3:48 PM.*

A trip generation comparison of the approved and proposed use is shown in **Table 4B** below:

Table 4B: Trip Generation Comparison (Approved Vs Proposed)

Land Use	ITE Code	Size		------ Weekday ------						
				AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	Total
Approved Use										
SF Detached Housing	210	31	Units	8	24	32	24	13	37	354
Proposed Use										
High School	530	1800	Students	515	241	756	173	349	522	2,784
Difference (Proposed – Approved)				**507**	**217**	**724**	**149**	**336**	**485**	**2,430**

Table 4B shows that the proposed High School will generate approximately 724 new trips in the weekday morning school peak hour and approximately 485 new trips in the weekday afternoon school peak hour, and approximately 2,430 average weekday daily trips.

Direction of Approach and Future Conditions with Development (2012) Volumes

The direction of approach for the proposed trips was evaluated based on the catchment area data provided by the Loudoun County Public Schools Planning Department. The catchment area data was divided into land bay zones in the vicinity of the proposed schools, and number of students assigned to each land bay zone was provided. Based on this information, the direction of approach for the proposed High School traffic was evaluated. The detailed calculations involved in compiling the direction of approach are provided in Appendix H.

As mentioned earlier, two catchment areas were analyzed for the purposes of this report:

- Alternative 1: Catchment Area I (Based on Mixed Feed)
- Alternative 2: Catchment Area II (Based on Pure Feed)

The direction of approach for traffic generated by the proposed High School for Catchment Area I (Alternative 1-Based on Mixed Feed) are given below:

- To and from west along US Route 50 7%
- To and from east along US Route 50 19%
- To and from west along Braddock Road 12%
- To and from east along Braddock Road 17%
- To and from south along Gum Springs Road 3%
- To and from west along Destiny Drive 4%
- To and from north along Supreme Drive 4%
- To and from south along Supreme Drive 12%
- To and from north along Stone Springs Drive 7%
- To and from south along Stone Springs Drive 15%

The direction of approach for traffic generated by the proposed High School for Catchment Area II (Alternative 2-Based on Pure Feed) are given below:

- To and from west along US Route 50 6%
- To and from east along US Route 50 10%
- To and from west along Braddock Road 9%
- To and from east along Braddock Road 49%
- To and from south along Gum Springs Road 2%
- To and from west along Destiny Drive 3%
- To and from north along Supreme Drive 4%
- To and from south along Supreme Drive 10%
- To and from north along Stone Springs Drive 5%
- To and from south along Stone Springs Drive 2%

The inbound and outbound trips calculated for the weekday morning and afternoon school peak hours and weekday afternoon commuter peak hours were routed in the roadway network to the site. The

site traffic assignment for both alternatives is illustrated in **Figures 11 and 12**. The proposed site trips were added to the future background volumes in order to establish the total future traffic volumes, as shown in **Figures 13 and 14** respectively, under both the alternatives.

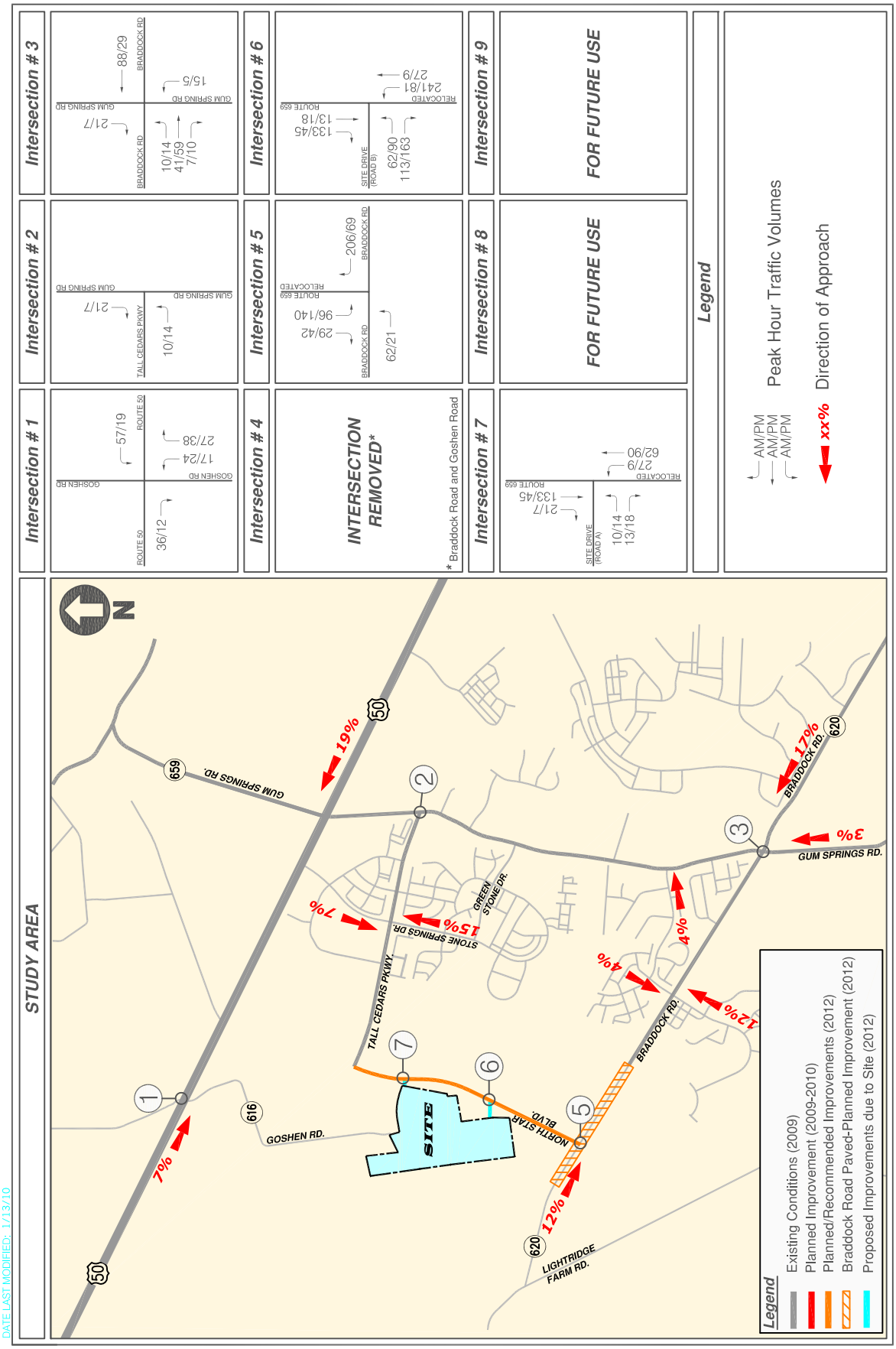

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Figure 11
Site Generated Traffic Volumes and Direction of Approach (2012)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1: Mixed Feed

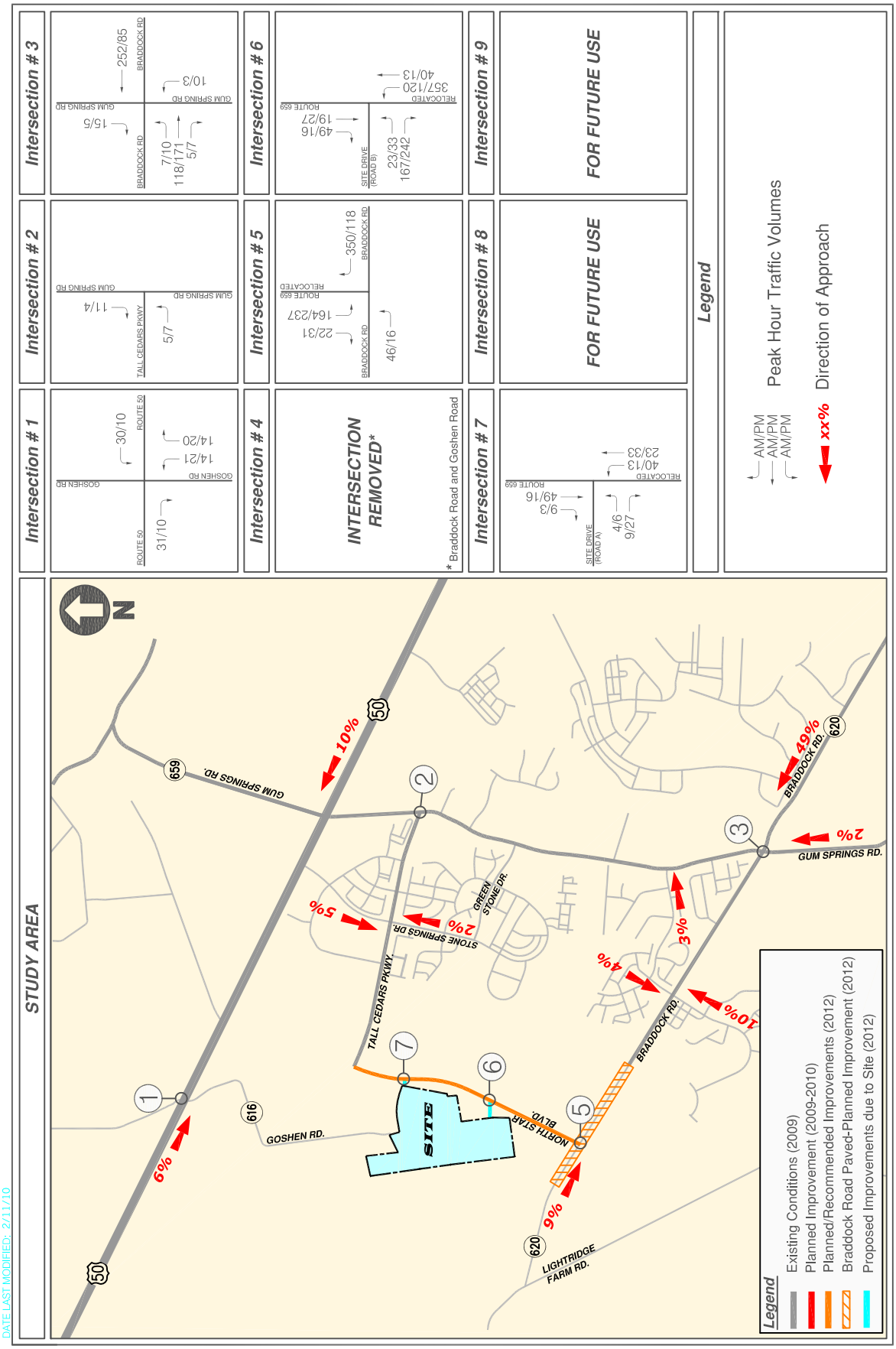

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Figure 12
Site Generated Traffic Volumes and Direction of Approach (2012)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2: Pure Feed

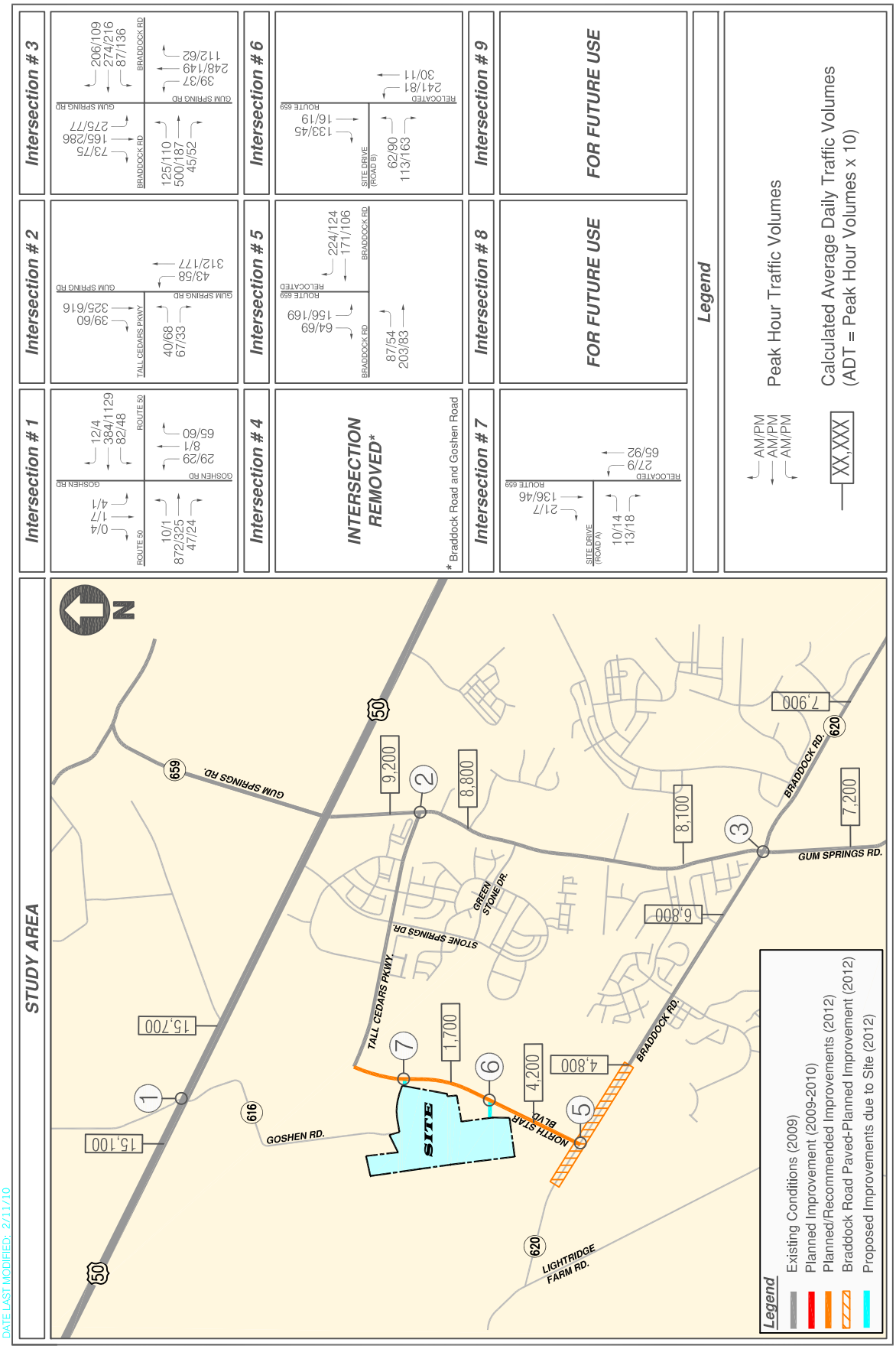

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Figure 13
Future Conditions with Development Traffic Volumes (2012)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1: Mixed Feed

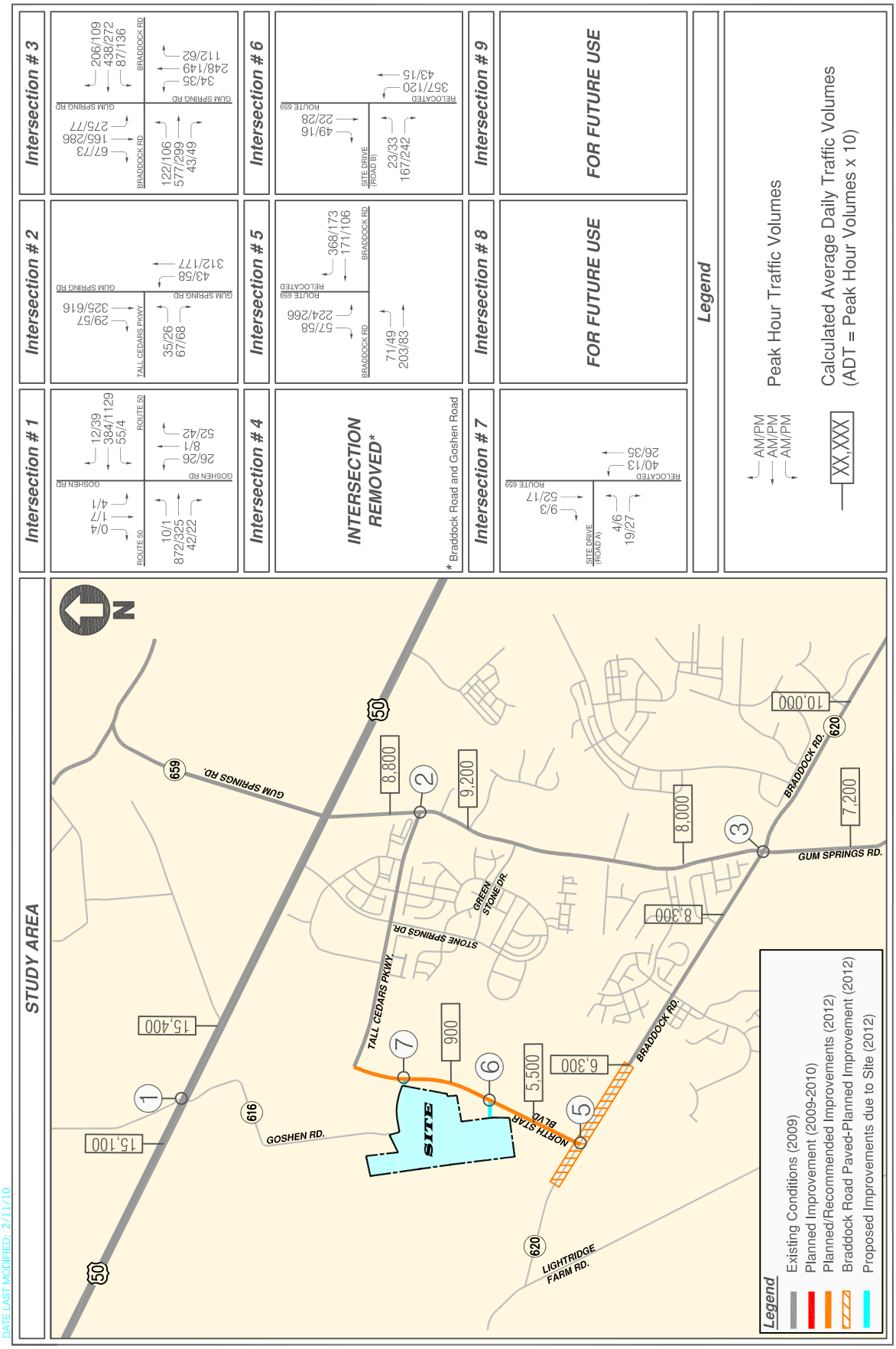

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Figure 14
Future with Development Traffic Volumes (2012)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2: Pure Feed

Future Conditions with Development Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday morning and afternoon school peak hours and weekday afternoon commuter peak hours, under the future with development conditions. Intersection capacity analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology.

The results of the intersection capacity analyses for the future with development conditions for Alternative 1 and 2 are summarized in **Tables 5A and 5B**. The description of the different LOS and delay and the detailed analysis worksheets for the future conditions with development (2012) are included in the Technical Appendix I-1 and I-2.

Table 5A: Future Conditions with Development (2012) Intersection Capacity Analysis-(Alternative 1)

	Total Future Condition (2012) - HS Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.2	B	11.4
Westbound Left Turn	B	11.1	A	8.2
Northbound Approach	E	44.1	C	21.1
Southbound Approach	E	41.9	E	41.2
Tall Cedars Parkway and Gum Spring Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	B	13.1	C	16.9
Northbound Approach	A	1.3	A	2.8
Southbound Right	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**C**	**29.7**	**C**	**22.4**
Eastbound Approach	C	34.2	C	22.6
Westbound Approach	C	22.6	C	22.2
Northbound Approach	D	37.7	C	25.6
Southbound Approach	C	25.3	C	20.7
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	3.1	A	3.3
Westbound Approach	A	0.0	A	0.0
Southbound Approach	C	23.8	B	14.5
Overall (Unsignalized) Mitigations				
Eastbound Approach	A	3.1	A	3.3
Westbound Approach **-Add a right turn lane**	A	0.0	A	0.0

	Total Future Condition (2012) - HS Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Southbound Approach**-Add a left turn lane**	C	16.2	B	11.9
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.5**	**A**	**7.3**
Eastbound Approach	A	7.5	A	8.3
Northbound Approach **– Add a left turn lane**	A	7.4	A	7.2
Southbound Approach **-Add a right turn lane**	A	7.5	A	6.9
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.4**	**A**	**7.7**
Eastbound Approach	A	8.1	A	7.6
Northbound Approach **– Add a left turn lane**	B	11.2	A	8.4
Southbound Approach **-Add a right turn lane**	A	7.6	A	7.3

Table 5B: Future Conditions with Development (2012) Intersection Capacity Analysis-(Alternative 2)

	Total Future Condition (2012) - HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.2	B	11.4
Westbound Left Turn	B	10.8	A	8.2
Northbound Approach	E	35.8	C	21.1
Southbound Approach	E	35.4	E	39.4
Tall Cedars Parkway and Gum Spring Road				
Overall (Signalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	B	12.8	C	16.2
Northbound Approach	A	1.3	A	2.8
Southbound Right	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**C**	**34.0**	**C**	**29.4**
Eastbound Approach	D	39.8	C	26.5
Westbound Approach	C	27.8	C	21.9
Northbound Approach	D	40.9	C	28.0
Southbound Approach	C	29.0	C	23.0
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	2.9	A	3.2
Westbound Approach	A	0.0	A	0.0
Southbound Approach	E	43.3	C	19.3

	Total Future Condition (2012) - HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Overall (Unsignalized) Mitigations				
Eastbound Approach	A	2.4	A	3.2
Westbound Approach **- Add a right turn lane**	A	0.0	A	0.0
Southbound Approach **- Add a left turn lane**	C	19.5	B	14.1
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.2**	**A**	**7.2**
Eastbound Approach	A	6.9	A	7.7
Northbound Approach **– Add a left turn lane**	A	7.7	A	7.0
Southbound Approach **-Add a right turn lane**	A	6.9	A	6.6
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**B**	**12.6**	**A**	**8.4**
Eastbound Approach	A	8.8	A	8.2
Northbound Approach **– Add a left turn lane**	C	15.3	A	9.0
Southbound Approach **-Add a right turn lane**	A	7.4	A	8.1

As previously mentioned, it is desirable to achieve a level of service (LOS) D or better per approach at each intersection. All of the study intersections will operate at acceptable levels of service of D or better with the exception of the intersection of Route 50 and Goshen Road. The minor approaches continue to operate at unacceptable levels of service conditions, however a traffic signal is not warranted under this condition as well. The following mitigations are recommended under this alternative to achieve acceptable levels of service.

- *Intersection of Braddock Road and Relocated Rt. 659 (Northstar Boulevard):*
  - Add a westbound right turn lane *(Based on turn lane warrant analysis)*
  - Add a southbound left turn lane *(Based on turn lane warrant analysis)*
- *Intersection of Relocated Rt. 659 (Northstar Boulevard) and Site Drive A/Site Drive B:*
  - Add northbound left turn lane
  - Add southbound right turn lane

With the proposed mitigations listed above in place, all study intersections including site access intersections operate at acceptable levels of service conditions. The results of the intersection capacity analyses and recommended improvements for 2012 (Alternative-1 and 2) are shown graphically in **Figures 15 through 17.**

Note: The heavy vehicle (bus traffic percentage) was applied to the school entrances. Approximately 30 buses will serve the proposed High School. Hence, the turning movements in the capacity analysis were adjusted using the appropriate heavy vehicle percentages. Appendix S shows the heavy vehicle percentages for the site entrances.

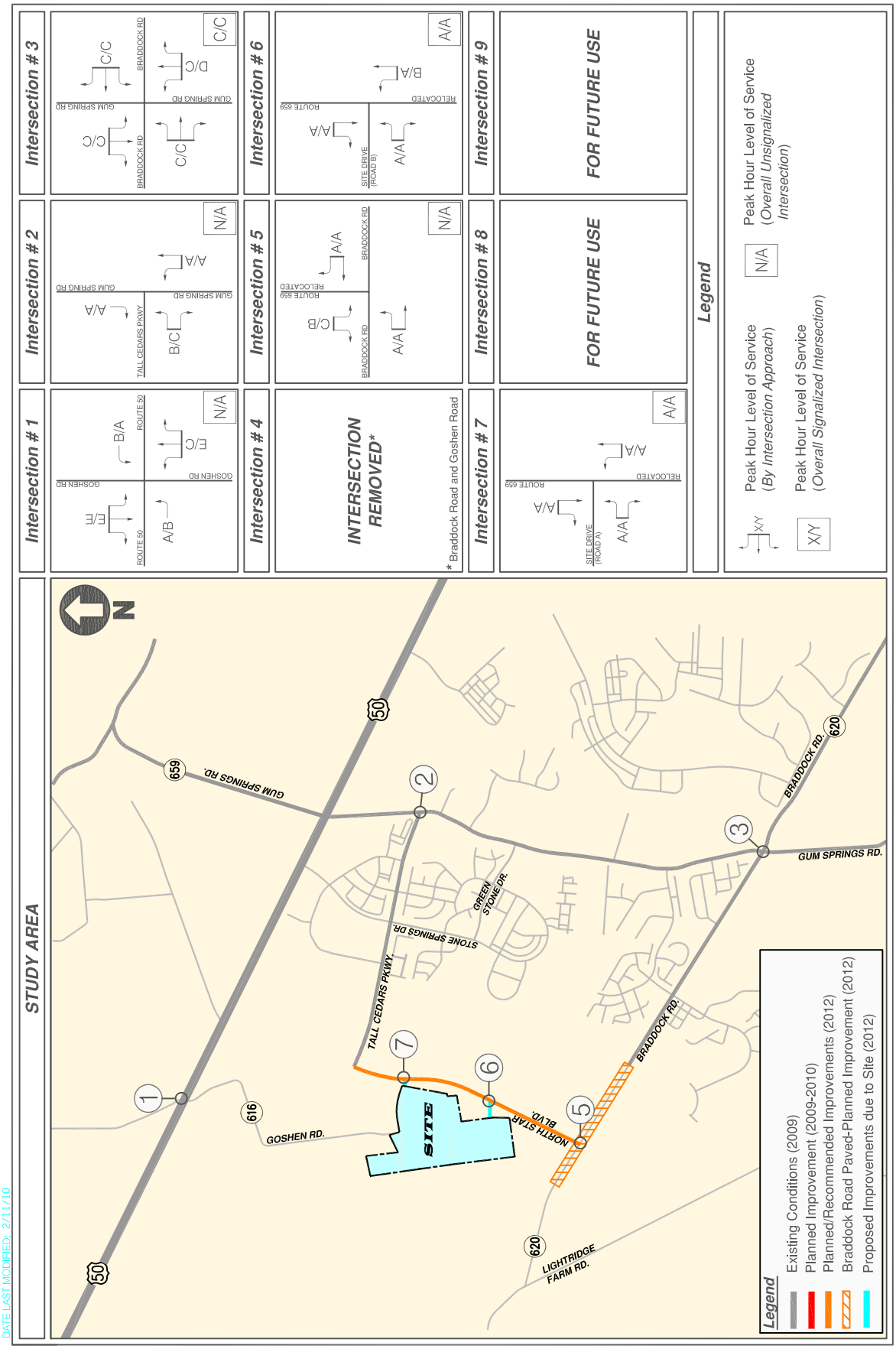

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Figure 15
Future Conditions with Development Levels of Service (2012)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1: Mixed Feed

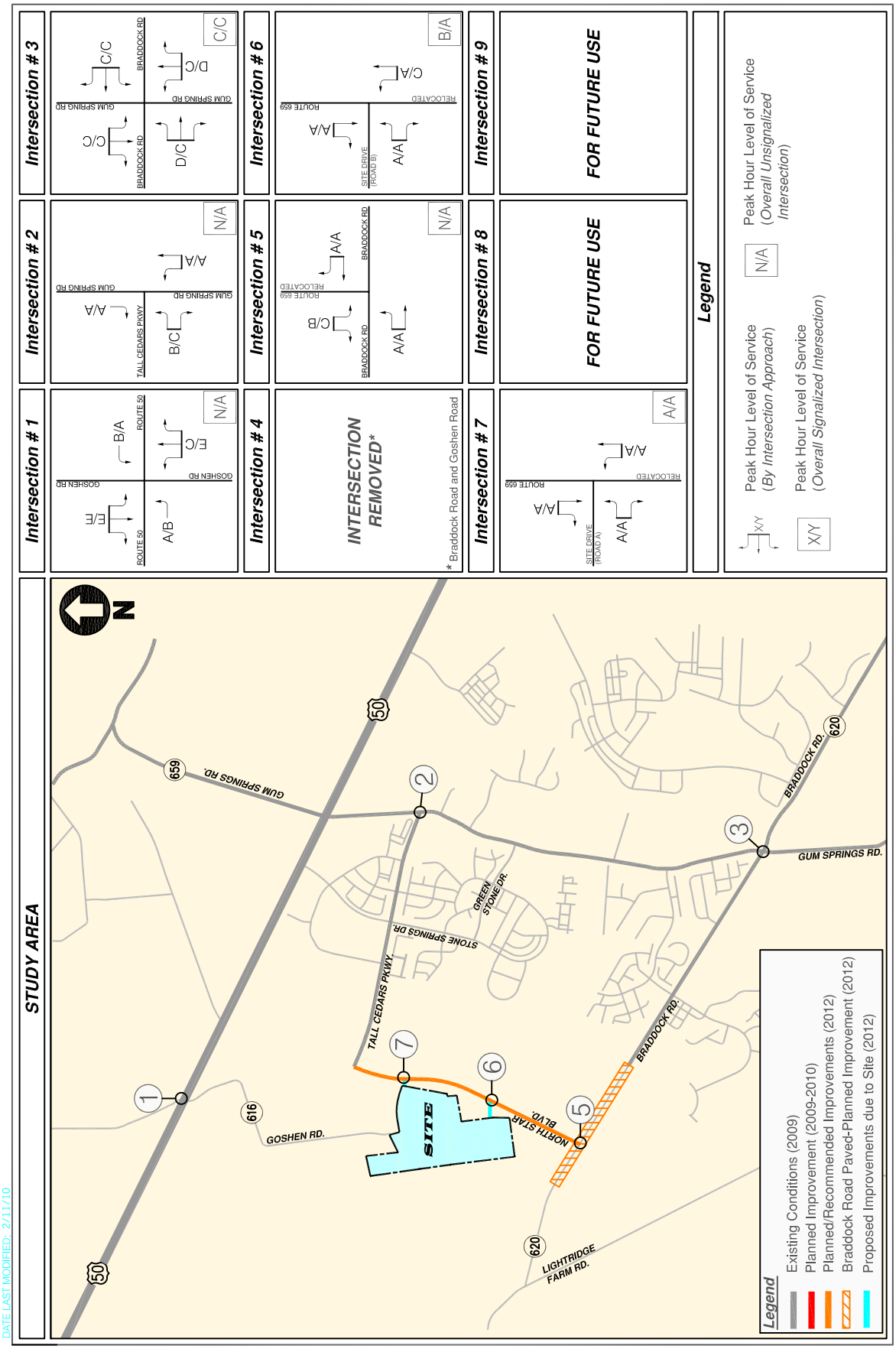

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Figure 16
Future with Development Levels of Service (2012)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2: Pure Feed

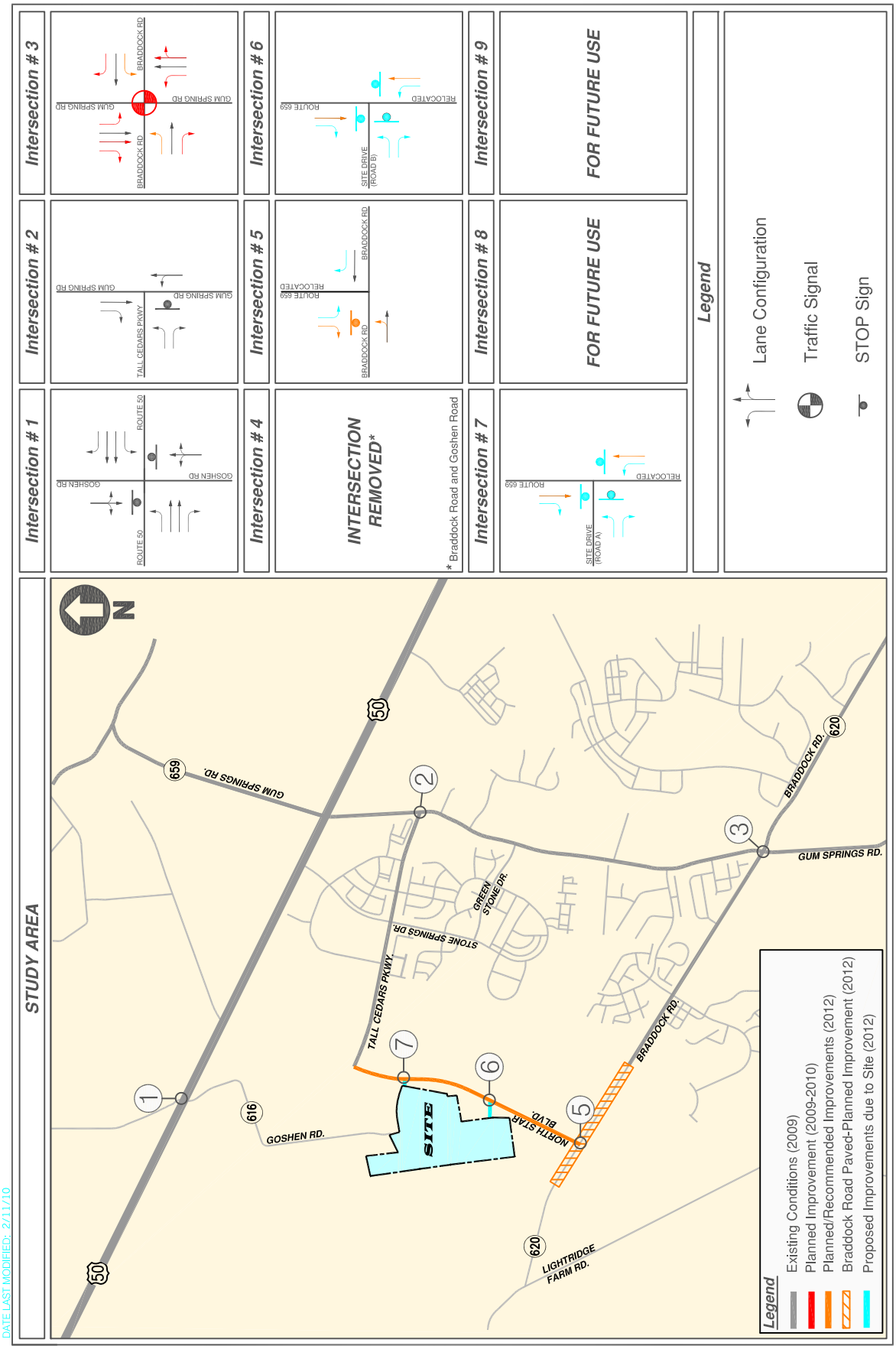

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Figure 17
Future with Development Recommended Improvements (2012)
High School Peak Hour
(8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)

FUTURE CONDITIONS WITHOUT DEVELOPMENT (2015)

Planned Roadway Improvements

The following improvements in the vicinity of the proposed development were assumed to be in place by 2015:

1. West Spine Road: is a planned four-lane corridor to run between Route 50 just east of existing Route 659, and continuing south to join the present alignment of existing Route 659 at Tall Cedars Parkway. As part of this planned roadway, existing Route 659 connection to Route 50 will be eliminated.
2. As part of the Westport By-Right Development, there are plans to eliminate the existing severe curve on Goshen Road just south of Route 50 with a four-leg 90-degree intersection. Goshen Road will terminate at the proposed Westport Boulevard, which will form the southern leg of the new 90-degree intersection. A signal is also planned at the new Westport Boulevard and Route 50 intersection.

Future Conditions without Development Traffic Volumes

Future traffic conditions were projected for the build-out year of 2015. VDOT's historical traffic data along with the approved studies (Greenfields TIA and Stoneridge Commercial TIA, prepared by Wells + Associates and Loudoun County School Board: MS-5 TIA, prepared by Gorove/Slade Associates) in the vicinity of the proposed site were utilized to calculate the inherent growth rate for the roads. In addition, the Loudoun County Growth Summary (2009) was used to verify the traffic projections. The data was presented to VDOT and Loudoun County OTS representatives for verification and approval. Based on the interaction with VDOT and OTS staff, it was decided that a growth rate of two percent (2%) per year would be applied to the major roads in the area in addition to the trips generated by approved background developments to match the Loudoun County's Growth Summary projections. The VDOT's historical traffic data and inherent growth rate calculations are shown in Appendix E.

In addition, the traffic generated by the following background developments in the area, as discussed and documented in the scoping letter, was considered as part of the background traffic for the future without development (2015) conditions:

1. Westport By-Right Property
2. Stone Ridge
3. Marrwood Property
4. CD Smith
5. Kirkpatrick Farms West
6. Kirkpatrick Farms

7. Braddock Corner
8. LCPS MS-5
9. Lenah Property
10. Greenfield Property
11. Gum Spring Village Center
12. Providence Glen
13. Braddock Crossing
14. Arcola Center; and
15. **HS-7 (Traffic generated by the proposed High School was considered under the future without development (2015) conditions)**

The location map of the approved developments is shown in **Figure 6**. The trips generated by these future background approved developments were taken from the following approved traffic studies in accordance with Loudoun County:

1. Stone Ridge Commercial, prepared by Wells + Associates, dated January 26, 2009
2. Greenfields TIA, prepared by Wells + Associates, dated October 19, 2009
3. Loudoun County Public School MS-5, prepared by Gorove Slade Associates, dated March 27, 2009
4. Arcola Center TIA, prepared by Gorove Slade Associates, dated August 31, 2005.

These trips were added to the existing volumes, inherent growth and the trips generated by the proposed High School development to estimate the future without development volumes as illustrated in **Figures 18 through 21**. The trip generation and the trips generated by these approved background developments are included in the Technical Appendix. Please refer to Appendix J.

As mentioned earlier, a list of background development assumptions and a comparison of the trips generated by the background developments with Loudoun County's Growth Summary projections were provided in advance to VDOT's Planning department and OTS for review, before finalizing this study. The memorandum listing out the assumptions and the email conversations are also included in Appendix F.

There will be an overlap in the traffic generated by the High School and the Elementary School. The percentage of overlap in the school traffic is discussed in detail under the future conditions with development (2015) scenario.

Since the Elementary School Peak hours are different from the High School Peak hours and there is an overlap of High School Traffic with Elementary School traffic, the following four scenarios were analyzed under future conditions without development (2015) scenario:

- Future Conditions without Development (2015) – HS Peak – Alternative 1
- Future Conditions without Development (2015) – HS Peak – Alternative 2
- Future Conditions without Development (2015) – ES Peak – Alternative 1 (HS Traffic Overlap: 25% in AMPH and 30% in PMPH)
- Future Conditions without Development (2015) – ES Peak – Alternative 2 (HS Traffic Overlap: 25% in AMPH and 30% in PMPH)

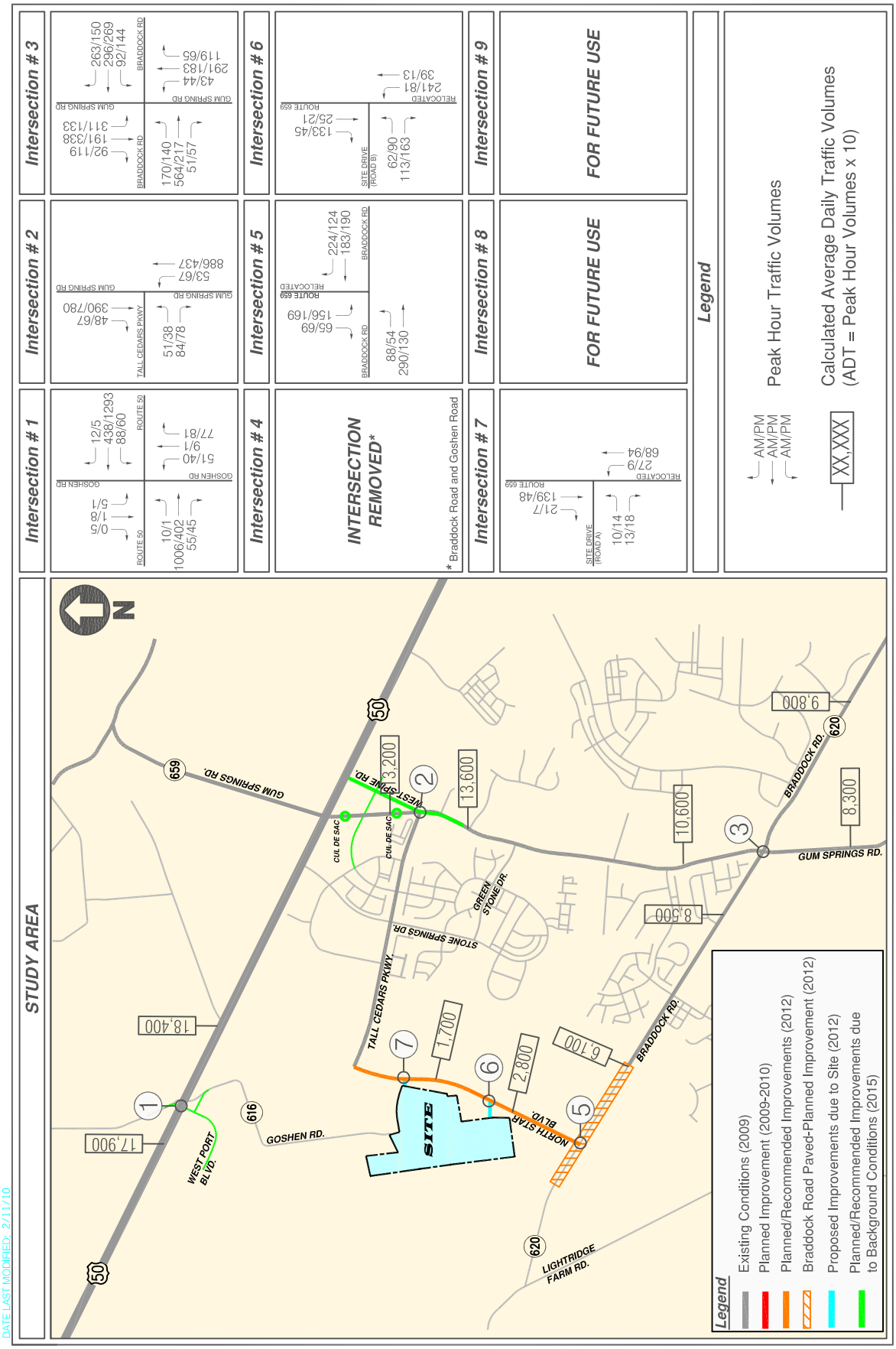

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Figure 18
Future without Development Traffic Volumes (2015)
High School Peak Hours (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1: Mixed Feed

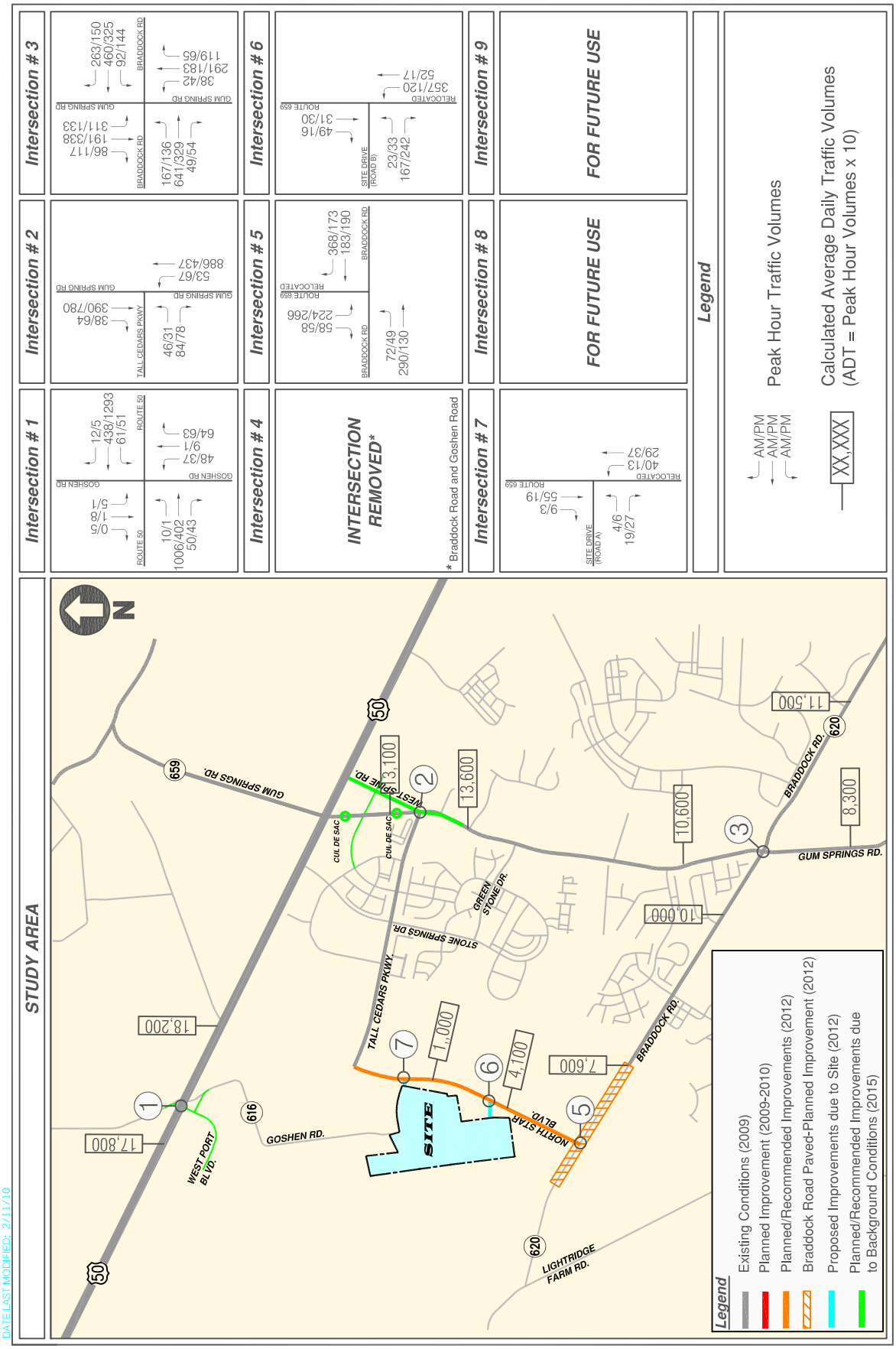

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Figure 19
Future without Development Traffic Volumes (2015)
High School Peak Hours (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2 : Pure Feed

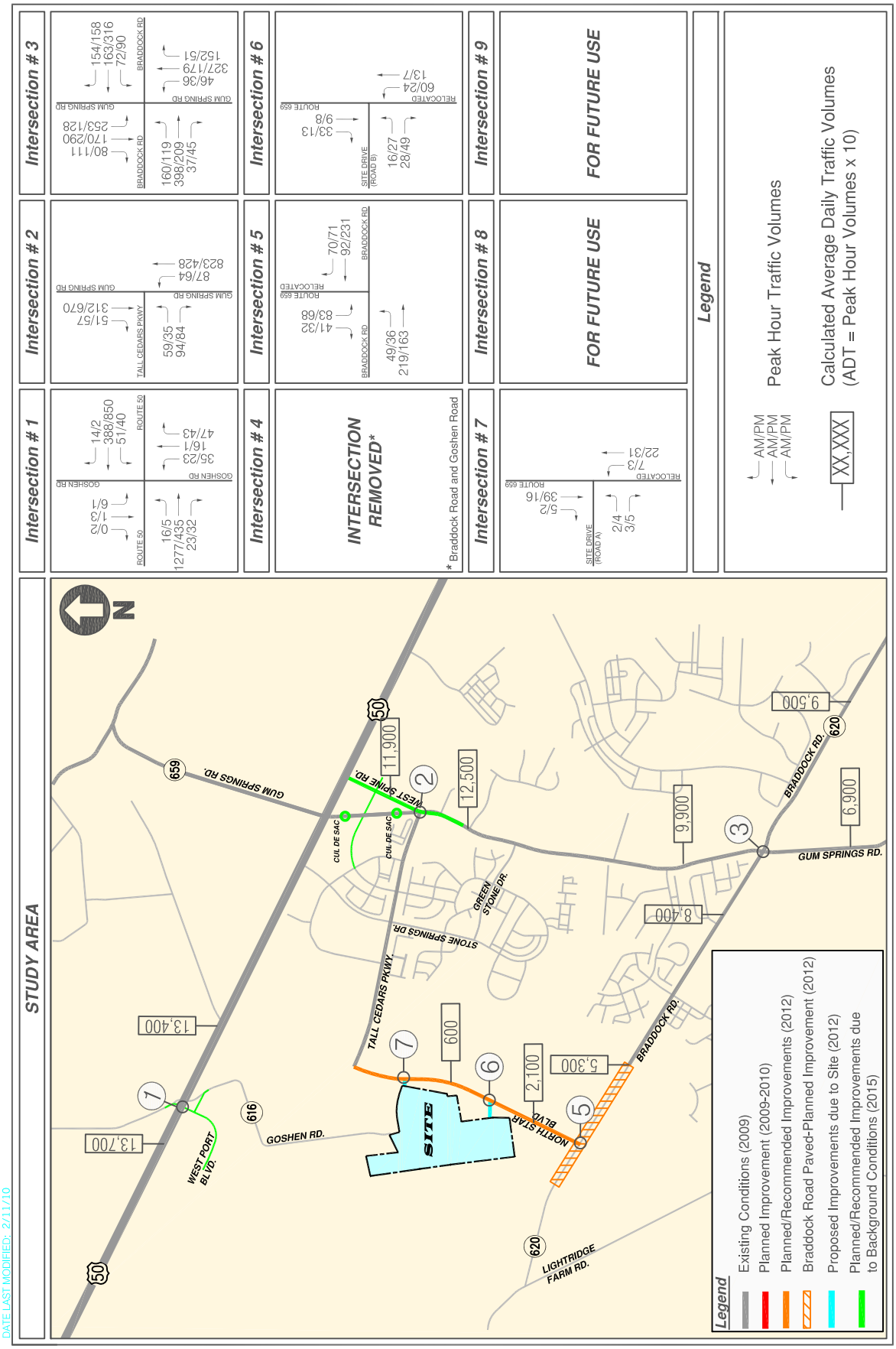

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Figure 20
Future without Development Traffic Volumes (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 1: Mixed Feed

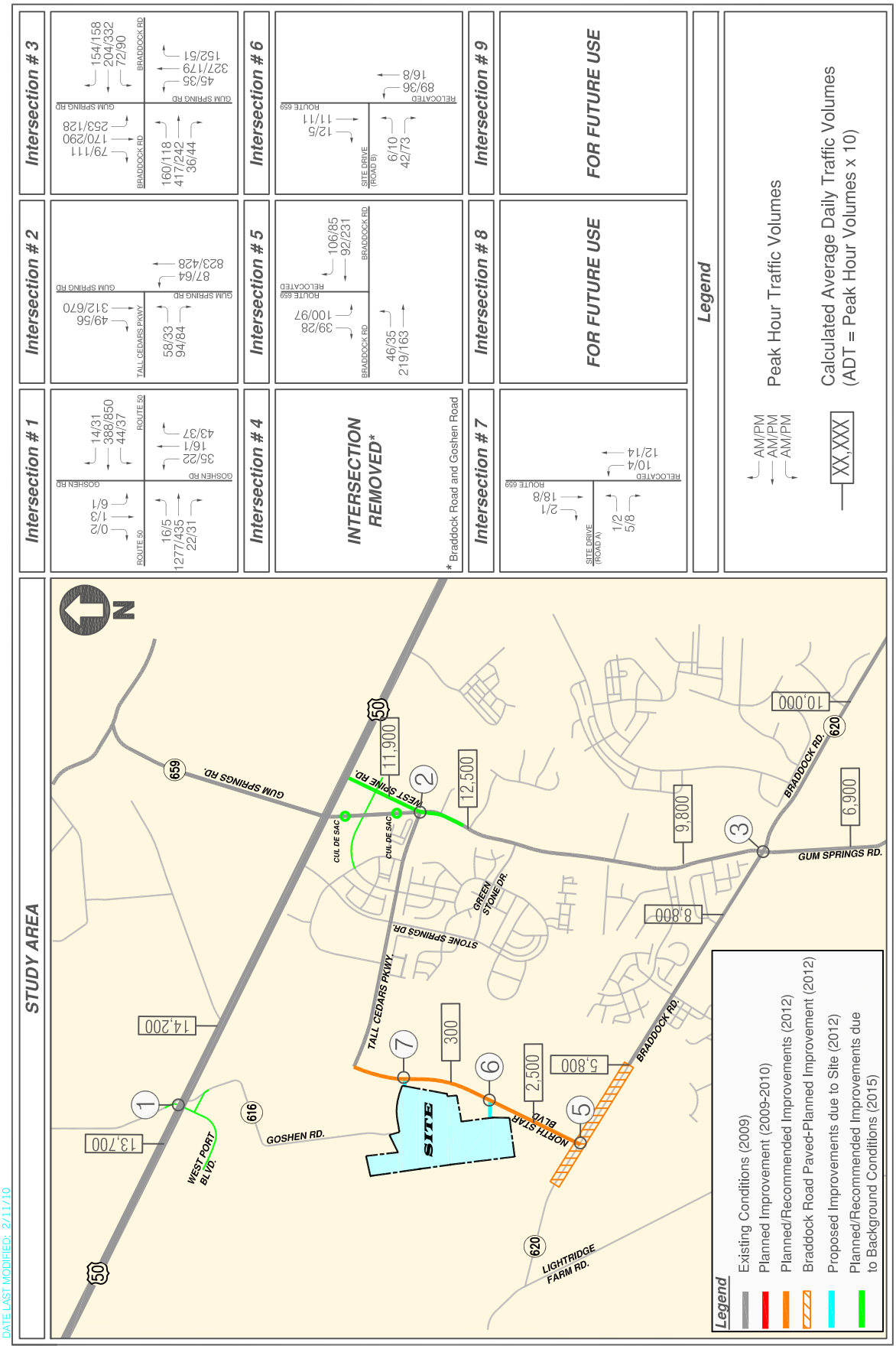

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Figure 21
Future without Development Traffic Volumes (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 2 : Pure Feed

Future Conditions without Development Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday HS school peak hours, under the future without development conditions. Intersection capacity analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology.

The results of the intersection capacity analyses for the future without development conditions are summarized in **Tables 6A through 6D**. The description of the different LOS and delay and the detailed analysis worksheets for the future conditions without development are included in Appendix K-1 through K-4.

Table 6A: Future Conditions without Development (2015) Intersection Capacity Analysis, HS Peak Alternative 1

	Future Background Condition (2015)-HS Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized) - Add a Signal (Warranted)	**B**	**17.5**	**B**	**15.9**
Eastbound Approach	B	17.3	B	12.3
Westbound Approach	B	12.8	B	15.9
Northbound Approach**-Realign NB approach**	D	37.1	C	27.9
Southbound Approach	C	31.2	C	25.3
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	16.4	C	20.4
Northbound Approach**-Add 2nd through lane**	A	1.7	A	3.9
Southbound Approach-**Add 2nd through lane**	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**D**	**35.5**	**C**	**23.8**
Eastbound Approach	D	42.5	C	22.6
Westbound Approach	C	23.7	C	24.3
Northbound Approach	D	42.7	C	28.1
Southbound Approach	C	33.7	C	22.0
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	2.7	A	8.1
Westbound Approach	A	0.0	A	0.0
Southbound Approach	C	19.0	B	13.8

	Future Background Condition (2015)-HS Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.3**	**A**	**7.1**
Eastbound Approach	A	7.1	A	7.1
Northbound Approach	A	7.2	A	7.2
Southbound Approach	A	7.4	A	6.8
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.3**	**A**	**7.7**
Eastbound Approach	A	8.2	A	7.6
Northbound Approach	B	11.0	A	8.4
Southbound Approach	A	7.6	A	7.0

Table 6B: Future Conditions without Development (2015) Intersection Capacity Analysis, HS Peak Alternative 2

	Future Background Condition (2015)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)-Add a Signal	**B**	**15.6**	**B**	**15.1**
Eastbound Approach	B	15.5	B	10.7
Westbound Approach	B	11.7	B	15.6
Northbound Approach**-Realign NB approach**	C	31.8	C	27.3
Southbound Approach	C	28.1	C	25.1
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	15.8	C	18.7
Northbound Approach**-Add 2nd through lane**	A	1.7	A	3.9
Southbound Approach-**Add 2nd through lane**	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**D**	**41.8**	**C**	**26.0**
Eastbound Approach	D	53.7	C	27.5
Westbound Approach	C	28.4	C	25.7
Northbound Approach	D	46.1	C	29.3
Southbound Approach	D	39.6	C	23.3
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	9.0	A	2.6
Westbound Approach	A	0.0	A	0.0

	Future Background Condition (2015)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Southbound Approach	C	24.7	C	17.5
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**6.9**	**A**	**6.9**
Eastbound Approach	A	6.4	A	6.8
Northbound Approach	A	7.2	A	7.0
Southbound Approach	A	6.7	A	6.6
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**B**	**12.4**	**A**	**8.3**
Eastbound Approach	A	8.8	A	8.2
Northbound Approach	C	15.1	A	8.9
Southbound Approach	A	7.4	A	7.5

Table 6C: Future Conditions without Development (2015) Intersection Capacity Analysis, ES Peak Alternative 1

	Future Background Condition (2015)-ES Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)-Add a Signal	**B**	**16.3**	**B**	**13.0**
Eastbound Approach	B	16.5	B	11.2
Westbound Approach	B	11.6	B	13.5
Northbound Approach**-Realign NB approach**	D	35.5	B	19.0
Southbound Approach	C	32.3	B	18.2
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	16.3	C	16.7
Northbound Approach**-Add 2nd through lane**	A	2.6	A	3.5
Southbound Approach-**Add 2nd through lane**	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**C**	**28.4**	**C**	**23.8**
Eastbound Approach	C	31.2	B	19.2
Westbound Approach	C	22.0	C	24.5
Northbound Approach	D	35.9	C	30.0
Southbound Approach	C	22.2	C	23.4
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	1.7	A	1.7
Westbound Approach	A	0.0	A	0.0

	Future Background Condition (2015)-ES Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Southbound Approach	B	11.6	B	12.2
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**6.8**	**A**	**6.8**
Eastbound Approach	A	7.1	A	8.0
Northbound Approach	A	6.9	A	6.7
Southbound Approach	A	6.7	A	6.5
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**6.8**	**A**	**6.6**
Eastbound Approach	A	6.5	A	6.4
Northbound Approach	A	7.5	A	7.1
Southbound Approach	A	6.1	A	6.2

Table 6D: Future Conditions without Development (2015) Intersection Capacity Analysis, ES Peak Alternative 2

	Future Background Condition (2015)-ES Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized) - Add a Signal	**B**	**16.1**	**B**	**12.9**
Eastbound Approach	B	16.3	B	11.1
Westbound Approach	B	11.1	B	13.4
Northbound Approach-**Realign NB approach**	D	35.1	B	18.9
Southbound Approach	C	32.0	B	18.2
Tall Cedars Parkway and West Spine Road				
Overall (Signalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	16.2	C	16.3
Northbound Approach-**Add 2nd through lane**	A	2.6	A	3.5
Southbound Approach-**Add 2nd through lane**	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**C**	**29.0**	**C**	**24.2**
Eastbound Approach	C	31.5	B	19.7
Westbound Approach	C	22.7	C	24.8
Northbound Approach	D	37.0	C	30.4
Southbound Approach	C	23.1	C	23.8
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	1.6	A	1.7

	Future Background Condition (2015)-ES Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Westbound Approach	A	0.0	A	0.0
Southbound Approach	B	11.9	B	13.1
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**6.9**	**A**	**7.0**
Eastbound Approach	A	6.8	A	7.5
Northbound Approach	A	7.2	A	6.9
Southbound Approach	A	6.6	A	6.5
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**7.2**	**A**	**6.7**
Eastbound Approach	A	6.3	A	6.3
Northbound Approach	A	7.7	A	7.3
Southbound Approach	A	6.4	A	7.2

As mentioned earlier, according to the Loudoun County level of service (LOS) criteria, it is desirable to achieve a level of service (LOS) D or better for each approach at an intersection. As shown in Tables 6A through 6D, all of the study intersections will operate at acceptable levels of service of D with the planned improvements in place.

The following roadway improvements are planned and were incorporated in the analysis:

- *Intersection of Rt. 50 and Goshen Road:*
  - Eliminate existing severe curve on Goshen Road just south of Route 50 with a four-leg 90-degree intersection
  - Goshen Road will terminate at the proposed Westport Boulevard, which will form the southern leg of the new 90-degree intersection
  - Add traffic signal
- *Intersection of Tall Cedars Parkway and West Spine Road:*
  - Realign northbound leg
  - Add 2nd through lane in northbound and southbound direction

Based on the improvements listed above, all study intersections will operate at acceptable levels of service conditions under future without development conditions (2015). The results of the intersection capacity analyses and recommended improvements are shown graphically in **Figures 22 through 26.**

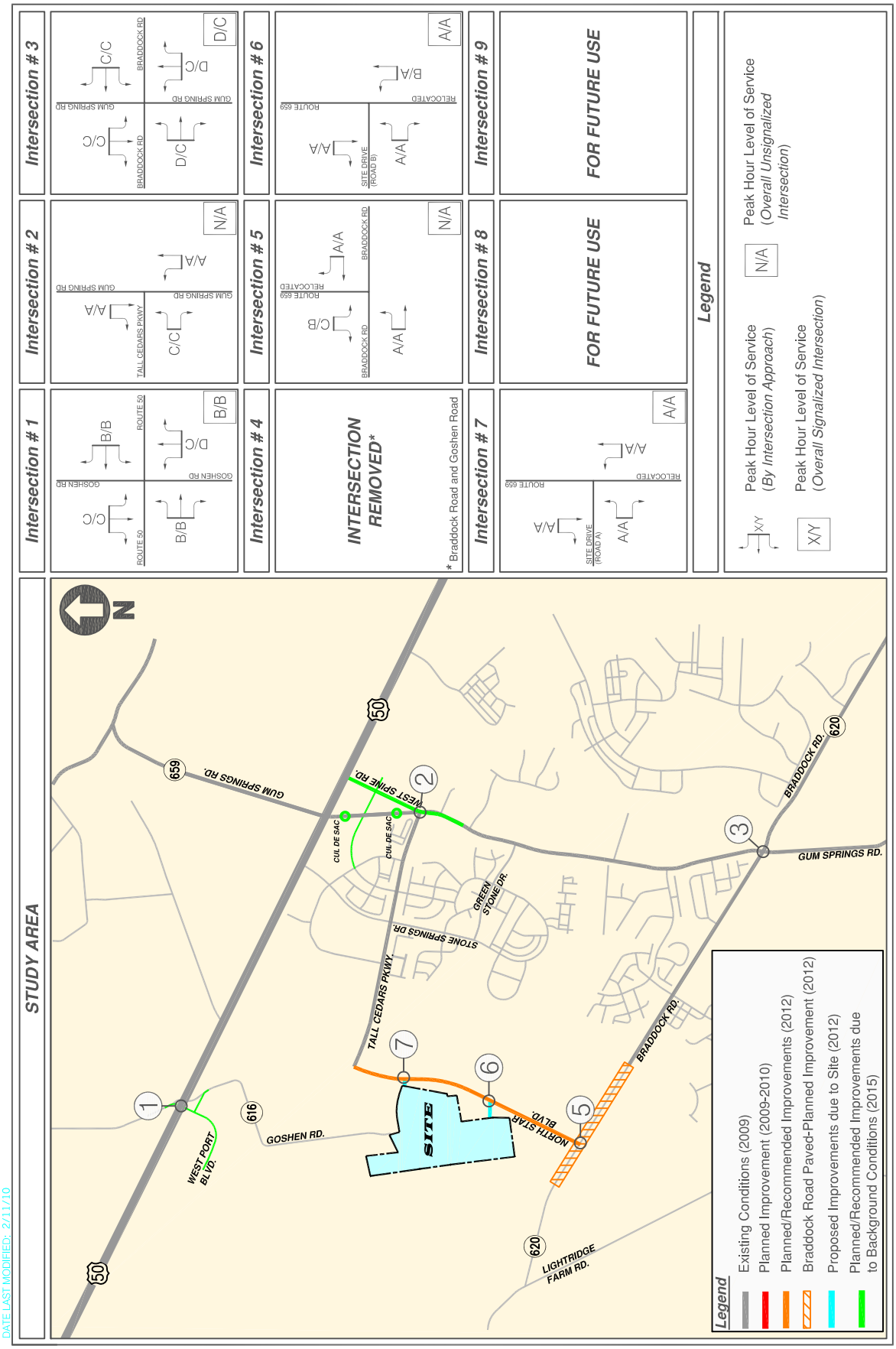

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Figure 22
Future without Development Levels of Service (2015)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1: Mixed Feed

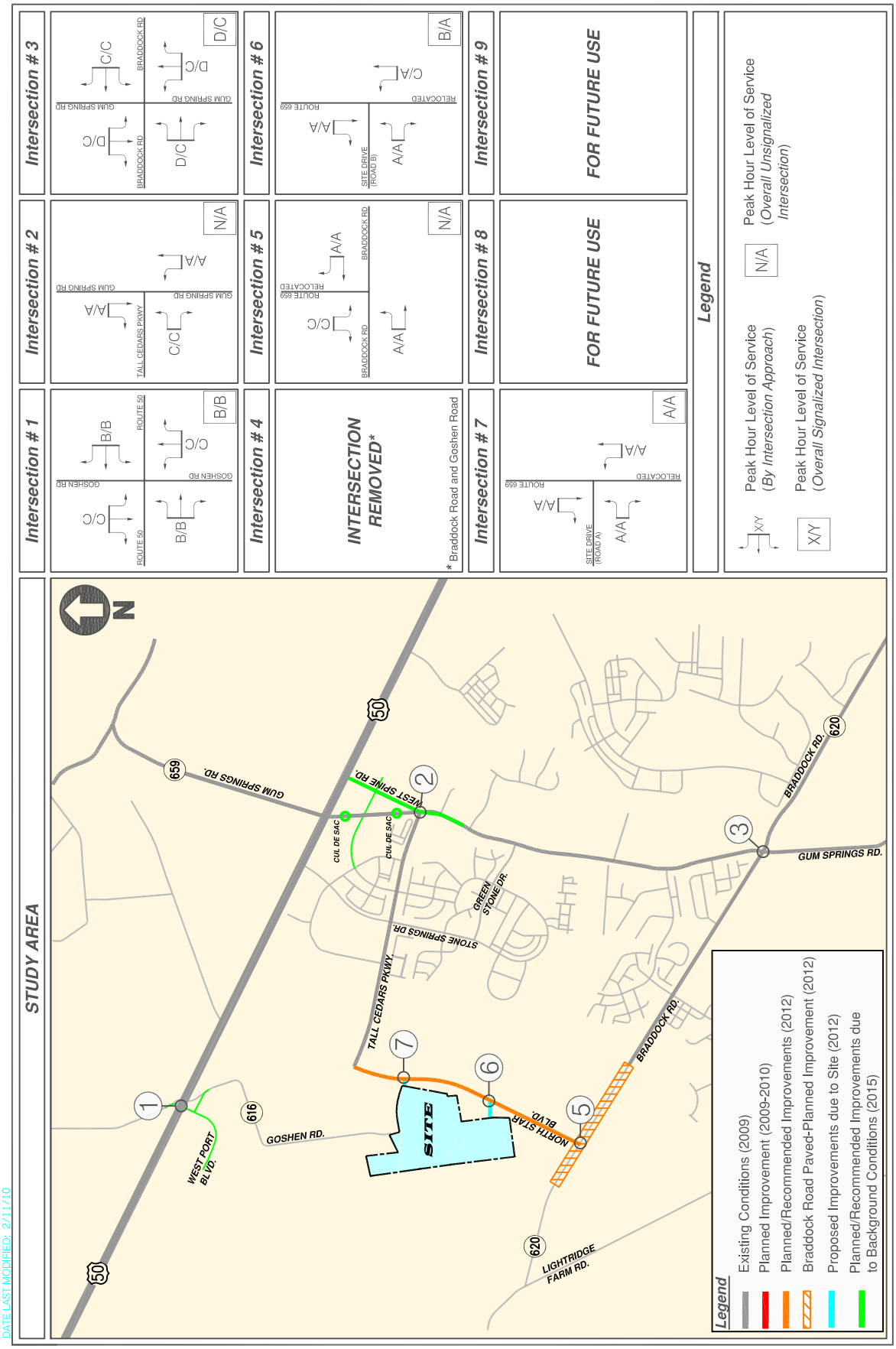

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Figure 23
Future without Development Levels of Service (2015)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2 : Pure Feed

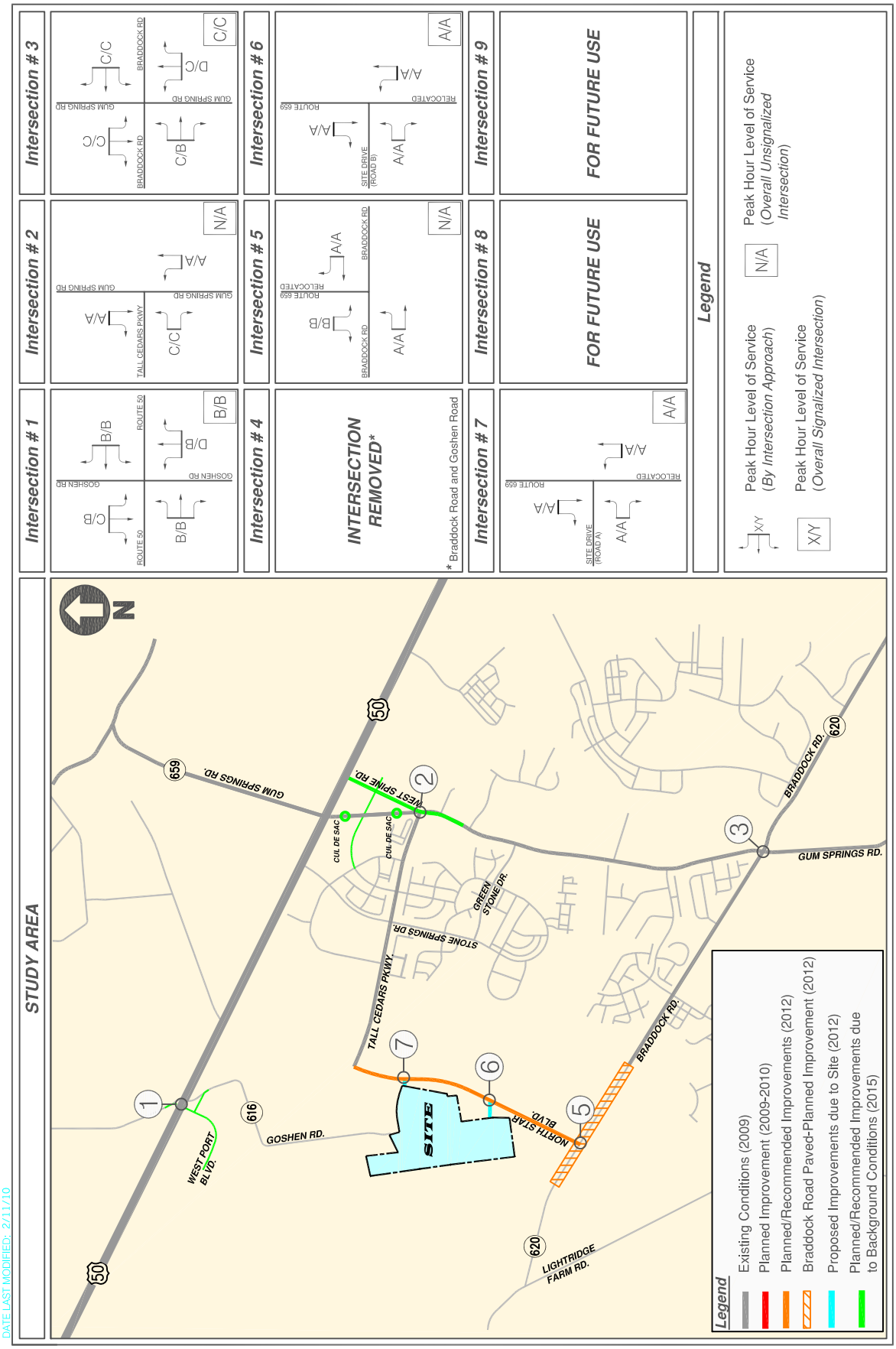

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Figure 24
Future without Development Levels of Service (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 1: Mixed Feed

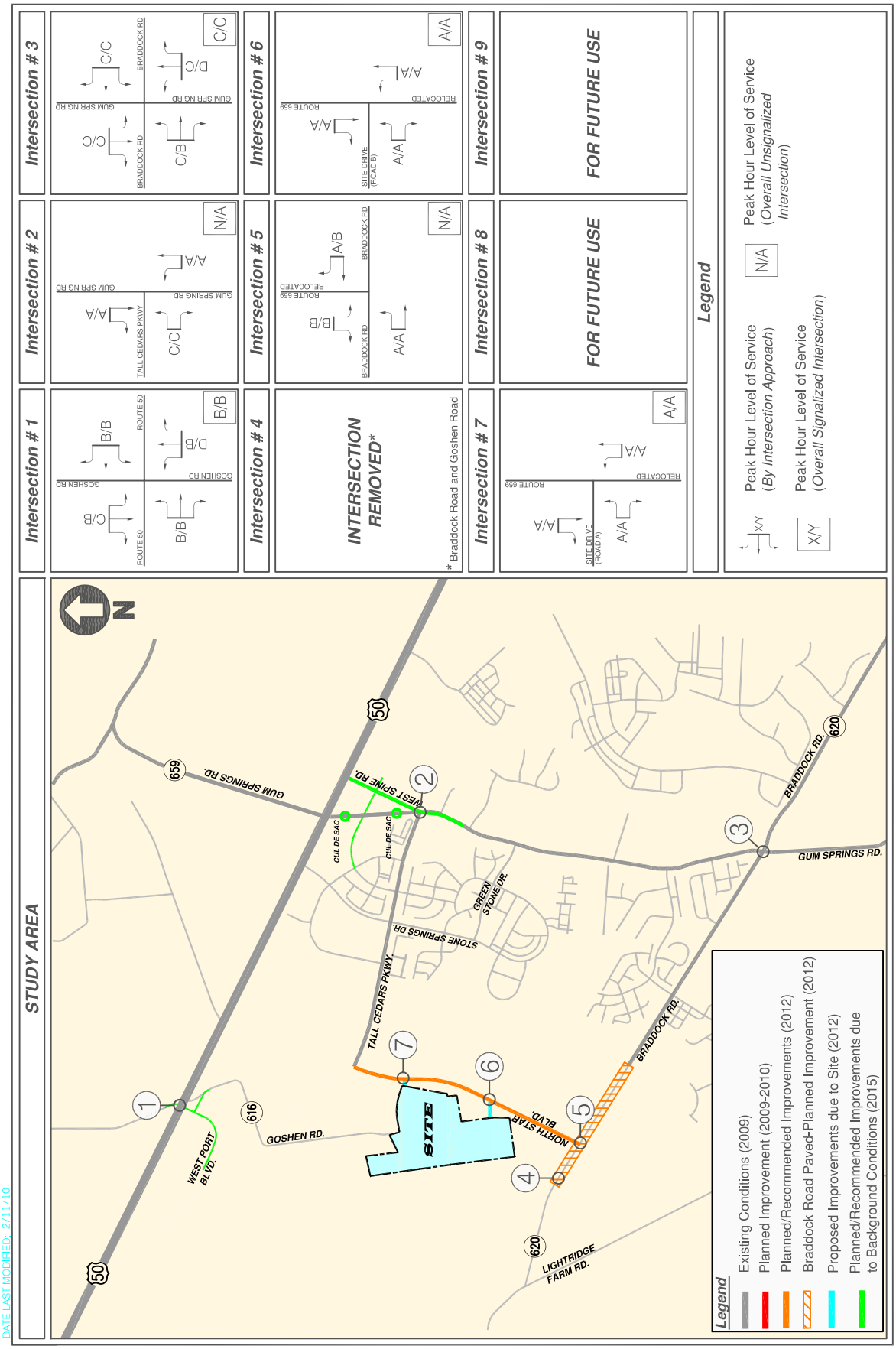

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Figure 25
Future without Development Levels of Service (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 2 : Pure Feed

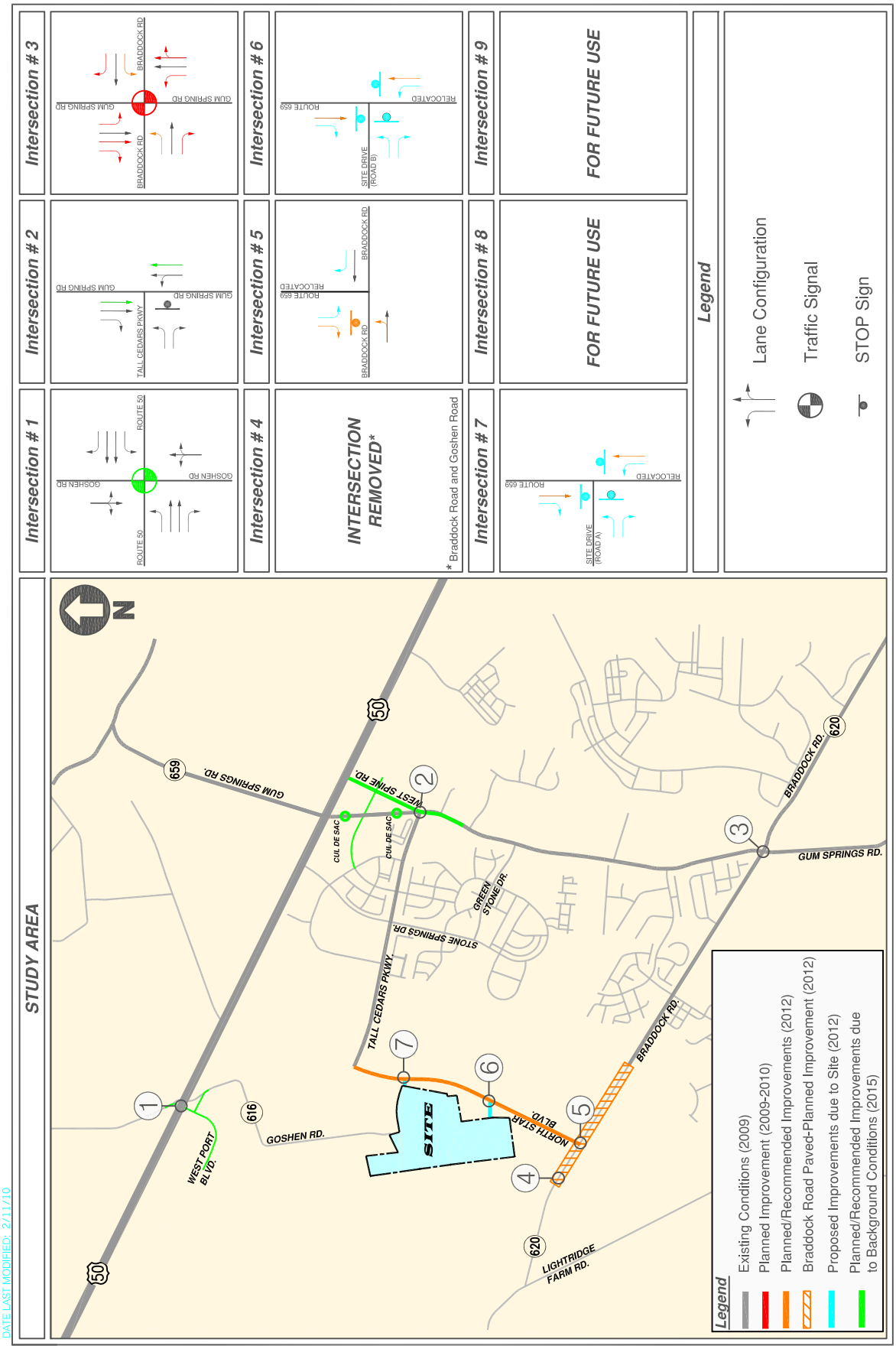

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Figure 26
Future without Development Recommended Improvements (2015)

FUTURE CONDITIONS WITH DEVELOPMENT (ELEMENTARY SCHOOL BUILD-OUT-2015)

Site Description

The proposed schools will be located in the Dulles South area in Loudoun County, Virginia. The proposed schools will be located along Goshen Road, west of Gum Spring Road (Route 659), north of Braddock Road (Route 620) and south of Route 50 in Loudoun County, Virginia. The schools will be built on an assemblage of properties of approximately 97 acres. A special exception on the property is being proposed to allow for the construction of a High School and an Elementary School, comprising of approximately 1,800 students and 875 students, respectively. The proposed development will be phased, with the High School (HS) anticipated to open in 2012 and the Elementary School (ES) anticipated to open in 2015. The projection estimates provided by Loudoun County Public Schools Planning Department are attached in the appendix section (Appendix H) of the report.

As mentioned earlier, based on the student projection estimates provided for the High School, two catchment areas* were analyzed for the purposes of this report:

- Alternative 1: Catchment Area I (Based on Mixed Feed)
- Alternative 2: Catchment Area II (Based on Pure Feed)

***Note: Loudoun County Public Schools periodically evaluates the school attendance boundaries for all public schools in Loudoun County (Elementary, Middle and High Schools). All existing schools have a demarcated student catchment area. However, the school attendance boundaries for existing and proposed public schools are currently undergoing a revision. The Loudoun County School Board is currently in the process of undertaking public hearings and work sessions to revise the attendance boundaries. Since there is a certain amount of uncertainty related to the catchment area for the proposed High School (HS-7), two catchment areas were compiled and analyzed. The two catchment areas looked at two extreme and opposite possibilities. Catchment Area I represents a well-distributed and mixed distribution of the proposed school traffic and Catchment Area II looked at the possibility of almost half of the students attending the proposed High School from the area east of Route 659. The reason behind analyzing two extreme scenarios was to analyze the worst-case scenarios, as the recommendations based on the worst case scenarios will also apply for the actual catchment area that may fall anywhere between the two extreme scenarios.**

Site Access

The following two access points will serve the proposed High School:

3. A full access driveway (from Road A)* along Relocated Rt.659, and
4. A full access driveway (from Road B) along Relocated Rt.659

**Note: Site Driveway (Road A) would primarily provide access to the school bus and staff traffic only.*

Study Time Periods

Since the operating hours of both the Elementary School and High School are not the same, two sets of peak hours were analyzed-High School Peak Hour and Elementary School Peak Hour, as shown in **Table 7** below:

Table 7: Study Time Periods

School	Operating Hours	AM School Peak	PM School Peak
Elementary School	7:50 AM - 2:35 PM	7:00 - 8:00 AM	2:15 - 3:15 PM
High School	9:00 AM - 3:48 PM	8:00 - 9:00 AM	3:30 - 4:30 PM

Site Generated Volumes

In order to calculate the trips generated by the proposed development, ITE's Trip Generation, 8th Edition was used to determine the trips into and out of the study site for the weekday morning and afternoon peak hours. **Table 8A** shows the trip generation calculations.

Table 8A: Trip Generation (Peak Hour of Generator)

Land Use	ITE Code	Size		------ Weekday ------						
				AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	Total
Elementary School	520	875	Students	194	158	352	107	130	237	1,129
High School	530	1800	Students	515	241	756	173	349	522	2,784
OVERALL TOTAL				**709**	**399**	**1,108**	**280**	**479**	**759**	**3,913**

As mentioned earlier and shown in Table 7, the High School and Elementary School will have separate schedules. However, based on the opening and closing times, some traffic for the two schools will overlap. Gorove Slade Associates has collected actual field data for a significant number of schools for Loudoun County Public Schools. Based on the actual field data, the High School Peak Hour trip generation was evaluated using the following field observations:

- There will be NO overlap of Elementary School traffic with the High School traffic during the High School AM peak hour of 8:00 AM to 9:00 AM, as the Elementary School start time is 7:50 AM
- There will be an overlap of Elementary School traffic with the High School traffic during the High School PM peak hour of 3:30 PM to 4:30 PM
- The PM peak hour overlap of Elementary School traffic with High School traffic, based on the actual field data is approximately **30%**
- **Table 8B** on the next page shows the trips that would be generated during the High School Peak Hour.

Table 8B: Trip Generation (High School Peak Hours)

Land Use	ITE Code	Size		------ Weekday ------						
				AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	Total
High School	530	1800	Students	515	241	756	173	349	522	2,784
Elementary School	Overlap	30%	Students	0	0	0	32	39	71	1,129
OVERALL TOTAL				**515**	**241**	**756**	**205**	**388**	**593**	**3,913**

Based on the actual field data, the Elementary School Peak Hour trip generation was evaluated using the following field observations:

- There will be an overlap of High School traffic with the Elementary School traffic during the Elementary School AM peak hour of 7:00 AM to 8:00 AM. The High School start time is 9:00 AM, however there is some High School traffic which arrives prior to the High School peak hour of 8:00 AM to 9:00 AM
- The AM peak hour overlap of High School traffic with Elementary School traffic, based on the actual field data is approximately **25%**
- There will be an overlap of High School traffic with the Elementary School traffic during the Elementary School PM peak hour of 2:15 PM to 3:15 PM
- The PM peak hour overlap of High School traffic with Elementary School traffic, based on the actual field data is approximately **30%**
- **Table 8C** below shows the trips that would be generated during the Elementary School Peak Hour.

Table 8C: Trip Generation (Elementary School Peak Hour)

Land Use	ITE Code	Size		------ Weekday ------						
				AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	Total
Elementary School	520	875	Students	194	158	352	107	130	237	1,129
High School	Overlap	25%/30%	Students	129	60	189	52	105	157	2,784
OVERALL TOTAL				**323**	**218**	**541**	**159**	**235**	**394**	**3,913**

Table 8B shows that the proposed schools will generate approximately 756 new trips in the weekday morning high school peak hour and approximately 593 new trips in the weekday afternoon high school peak hour.

Table 8C shows that the proposed schools will generate approximately 541 new trips in the weekday morning elementary school peak hour and approximately 394 new trips in the weekday afternoon elementary school peak hour. A trip generation comparison of the approved and proposed use is shown in **Table 8D** on the next page.

Table 8D: Trip Generation Comparison (Approved Vs Proposed)

Land Use	ITE Code	Size		------ Weekday ------						
				AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	Total
Approved Use										
SF Detached Housing	210	31	Units	8	24	32	24	13	37	354
Proposed Use										
Elementary School	520	875	Students	194	158	352	107	130	237	1,129
High School	530	1800	Students	515	241	756	173	349	522	2,784
Total Proposed				**709**	**399**	**1,108**	**280**	**479**	**759**	**3,913**
Difference (Proposed – Approved)				***701***	***375***	***1,076***	***256***	***466***	***722***	***3,559***

Direction of Approach and Future Conditions with Development (2015) Volumes

The direction of approach for the proposed trips was evaluated based on the catchment area data provided by the Loudoun County Public Schools Planning Department. The catchment area data was divided into land bay zones in the vicinity of the proposed schools, and number of students assigned to each land bay zone was provided. Based on this information, the direction of approach for the proposed Elementary School traffic was evaluated. The detailed calculations involved in compiling the direction of approach are provided in Appendix H.

The direction of approach for traffic generated by the proposed Elementary School is given below:

- To and from west along Braddock Road 81%
- To and from west along Route 50 11%
- To and from north along Goshen Road 8%

The inbound and outbound trips calculated for the weekday morning and afternoon school peak hours were routed in the roadway network to the site. The site traffic assignment for the elementary school is illustrated in **Figure 27**. The proposed site trips were added to the future background volumes in order to establish the total future traffic volumes, as shown in **Figures 28 and 31** respectively, under all alternatives.

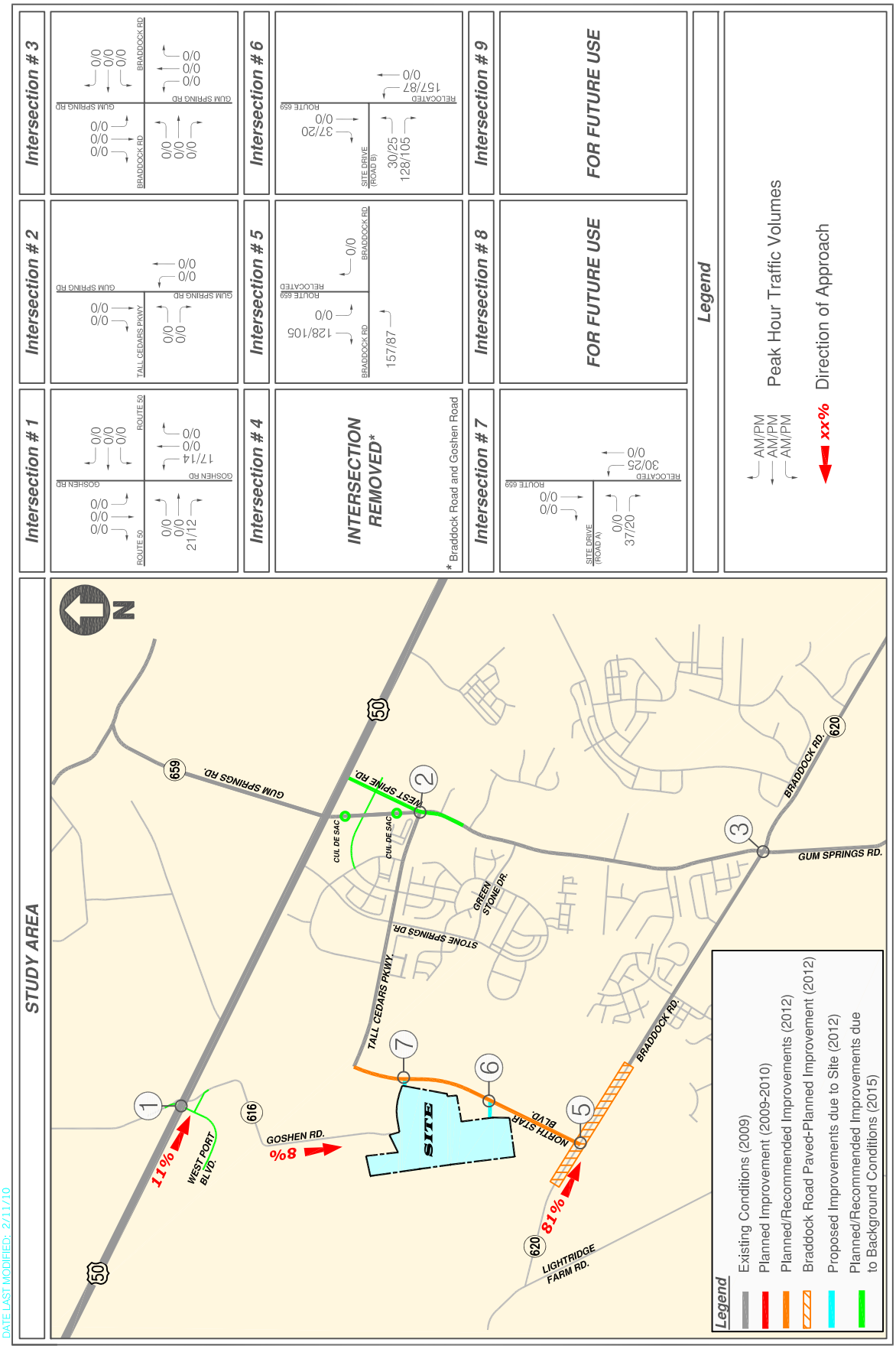

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Figure 27
Site Generated Traffic Volumes and Direction of Approach (2015)
Elementary School Peak Hours
(7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)

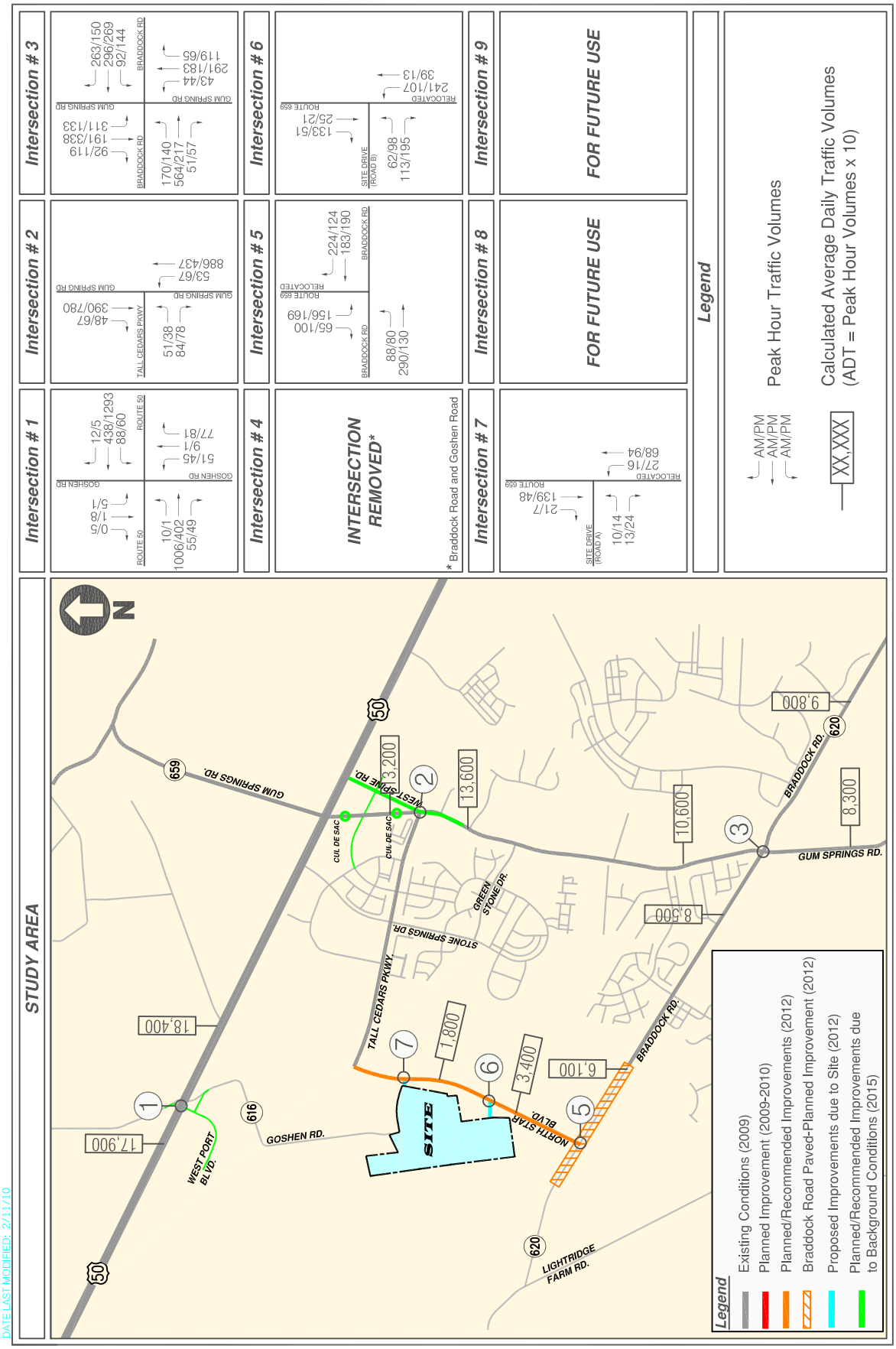

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Figure 28
Future with Development Traffic Volumes (2015)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1 : Mixed Feed

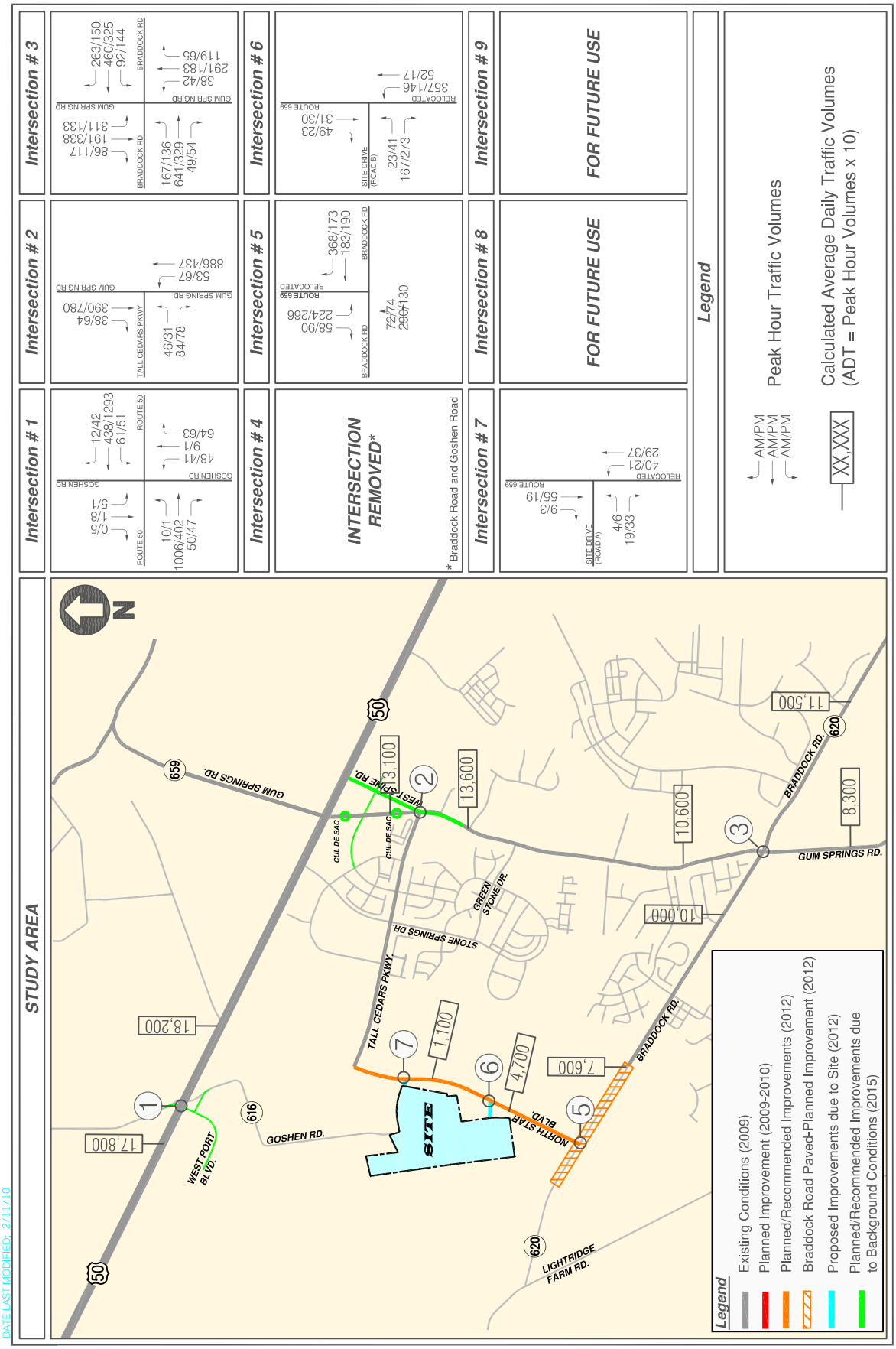

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Figure 29
Future with Development Traffic Volumes (2015)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2 : Pure Feed

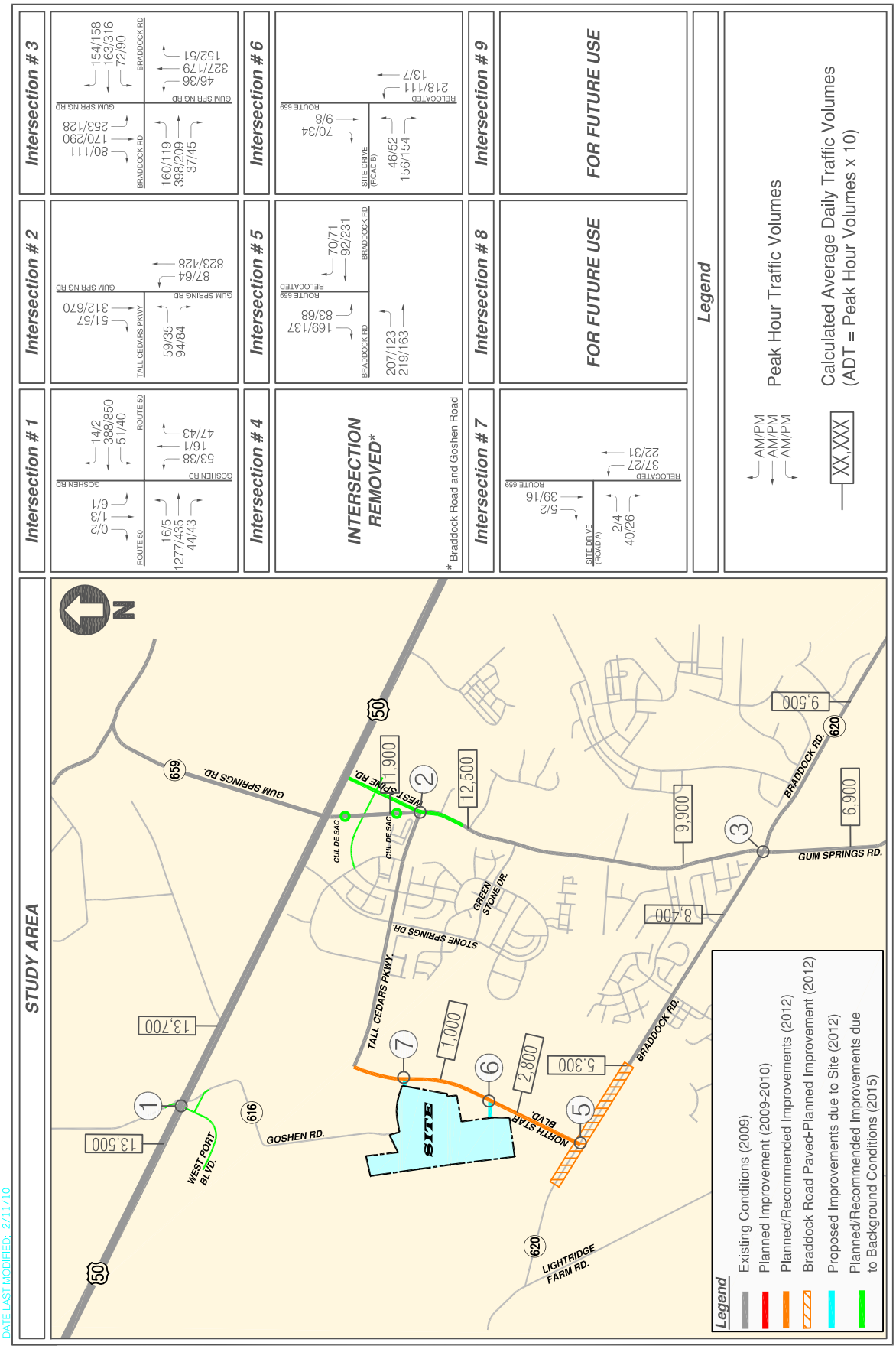

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Figure 30
Future with Development Traffic Volumes (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 1 : Mixed Feed

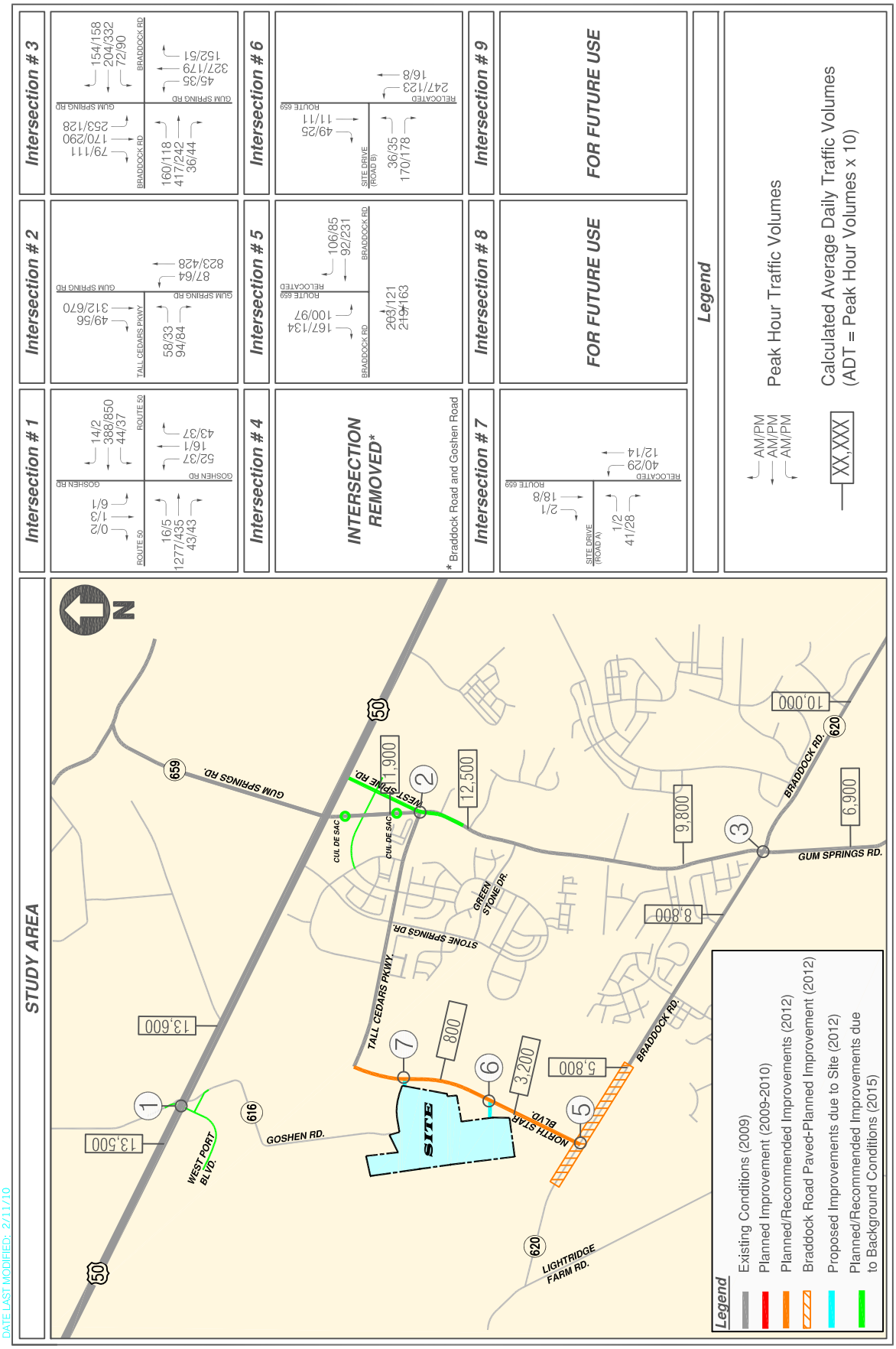

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Figure 31
Future with Development Traffic Volumes (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 2 : Pure Feed

Future Conditions with Development Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday morning and afternoon school peak hours, under the future with development conditions. Intersection capacity analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology.

The results of the intersection capacity analyses for the future with development conditions are summarized in **Tables 9A through 9D**. The description of the different LOS and delay and the detailed analysis worksheets for the future conditions with development (2015) are included in the Technical Appendix. Please refer to Appendix L-1 through L-4

Table 9A: Future Conditions with Development (2015) Intersection Capacity Analysis- HS Peak, Alternative 1

	Total Future Condition (2015)-HS Peak Hour - Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**B**	**17.5**	**B**	**16.3**
Eastbound Approach	B	17.3	B	12.5
Westbound Approach	B	12.8	B	16.4
Northbound Approach	D	37.2	C	28.5
Southbound Approach	C	31.2	C	25.4
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	16.4	C	20.3
Northbound Approach	A	1.7	A	3.9
Southbound Approach	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**D**	**35.5**	**C**	**23.8**
Eastbound Approach	D	42.5	C	22.6
Westbound Approach	C	23.7	C	24.3
Northbound Approach	D	42.7	C	28.1
Southbound Approach	C	33.7	C	22.0
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	2.7	A	3.5
Westbound Approach	A	0.0	A	0.0
Southbound Approach	C	19.0	B	14.7

	Total Future Condition (2015)-HS Peak Hour - Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.6**	**A**	**7.4**
Eastbound Approach	A	8.2	A	8.4
Northbound Approach	A	7.4	A	7.3
Southbound Approach	A	7.6	A	7.0
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.4**	**A**	**8.2**
Eastbound Approach	A	8.2	A	8.0
Northbound Approach	B	11.1	A	9.0
Southbound Approach	A	7.6	A	7.6

Table 9B: Future Conditions with Development (2015) Intersection Capacity Analysis- HS Peak, Alternative 2

	Total Future Condition (2015)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**B**	**15.6**	**B**	**15.6**
Eastbound Approach	B	15.5	B	12.0
Westbound Approach	B	11.8	B	15.7
Northbound Approach	C	31.9	C	27.8
Southbound Approach	C	28.2	C	25.2
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	15.8	C	18.7
Northbound Approach	A	1.7	A	3.9
Southbound Right Turn	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**D**	**41.8**	**C**	**26.0**
Eastbound Approach	D	53.7	C	27.5
Westbound Approach	C	28.4	C	25.7
Northbound Approach	D	46.1	C	29.3
Southbound Approach	D	39.6	C	23.3
Braddock Road and Goshen Road	**Intersection Closed**			

	Total Future Condition (2015)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	2.5	A	3.4
Westbound Approach	A	0.0	A	0.0
Southbound Approach	C	24.8	C	20.0
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.2**	**A**	**7.3**
Eastbound Approach	A	6.9	A	8.0
Northbound Approach	A	7.7	A	7.1
Southbound Approach	A	6.9	A	6.8
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**B**	**12.5**	**A**	**9.0**
Eastbound Approach	A	8.8	A	8.8
Northbound Approach	C	15.2	A	9.7
Southbound Approach	A	7.5	A	8.4

Table 9C: Future Conditions with Development (2015) Intersection Capacity Analysis- ES Peak, Alternative 1

	Total Future Condition (2015)-ES Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**B**	**17.2**	**B**	**13.4**
Eastbound Approach	B	17.1	B	11.4
Westbound Approach	B	12.2	B	13.8
Northbound Approach	D	37.2	B	20.0
Southbound Approach	C	32.8	B	18.4
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	16.3	C	16.7
Northbound Approach	A	2.6	A	3.5
Southbound Approach	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**C**	**28.4**	**C**	**23.8**
Eastbound Approach	C	31.2	B	19.2
Westbound Approach	C	22.0	C	24.5

	Total Future Condition (2015)-ES Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Northbound Approach	D	35.9	C	30.0
Southbound Approach	C	22.2	C	23.4
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	4.8	A	4.2
Westbound Approach	A	0.0	A	0.0
Southbound Approach	B	13.8	B	13.2
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.3**	**A**	**7.6**
Eastbound Approach	A	6.6	A	7.9
Northbound Approach	A	8.0	A	7.8
Southbound Approach	A	6.9	A	6.7
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.1**	**A**	**7.7**
Eastbound Approach	A	8.0	A	7.3
Northbound Approach	B	10.7	A	8.7
Southbound Approach	A	7.2	A	6.9

Table 9D: Future Conditions with Development (2015) Intersection Capacity Analysis- ES Peak, Alternative 2

	Total Future Condition (2015)-ES Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**B**	**16.8**	**B**	**13.3**
Eastbound Approach	B	16.8	B	11.4
Westbound Approach	B	11.7	B	13.7
Northbound Approach	D	36.5	B	19.9
Southbound Approach	C	32.5	B	18.4
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	C	16.2	C	16.3
Northbound Approach	A	2.6	A	3.5
Southbound Approach	A	0.0	A	0.0
Braddock Road and Gum Spring Road				
Overall (Signalized)	**C**	**29.0**	**C**	**24.2**

	Total Future Condition (2015)-ES Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Eastbound Approach	C	31.5	B	19.7
Westbound Approach	C	22.7	C	24.8
Northbound Approach	D	37.0	C	30.4
Southbound Approach	C	23.1	C	23.8
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	A	4.7	A	4.1
Westbound Approach	A	0.0	A	0.0
Southbound Approach	B	14.7	B	14.0
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.3**	**A**	**7.4**
Eastbound Approach	A	6.4	A	7.8
Northbound Approach	A	8.3	A	7.3
Southbound Approach	A	6.7	A	6.6
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.7**	**A**	**7.9**
Eastbound Approach	A	8.1	A	7.5
Northbound Approach	B	11.4	A	8.9
Southbound Approach	A	7.2	A	7.2

As previously mentioned, it is desirable to achieve a level of service (LOS) D or better per approach at each intersection. Tables 9A through 9D show that all of the study intersections will operate at acceptable level of service D or better. Hence, no mitigations are recommended under the full build out (2015) conditions.

The results of the intersection capacity analyses and lane configurations for 2015 are shown graphically in **Figures 32 through and 36** respectively**.**

Note: The heavy vehicle (bus traffic percentage) was applied to the school entrances. Approximately 30 buses will serve the proposed High School and approximately 15 buses will serve the proposed Elementary School. Hence, the turning movements in the capacity analysis were adjusted using the appropriate heavy vehicle percentages. Appendix S shows the heavy vehicle percentages for the site entrances.

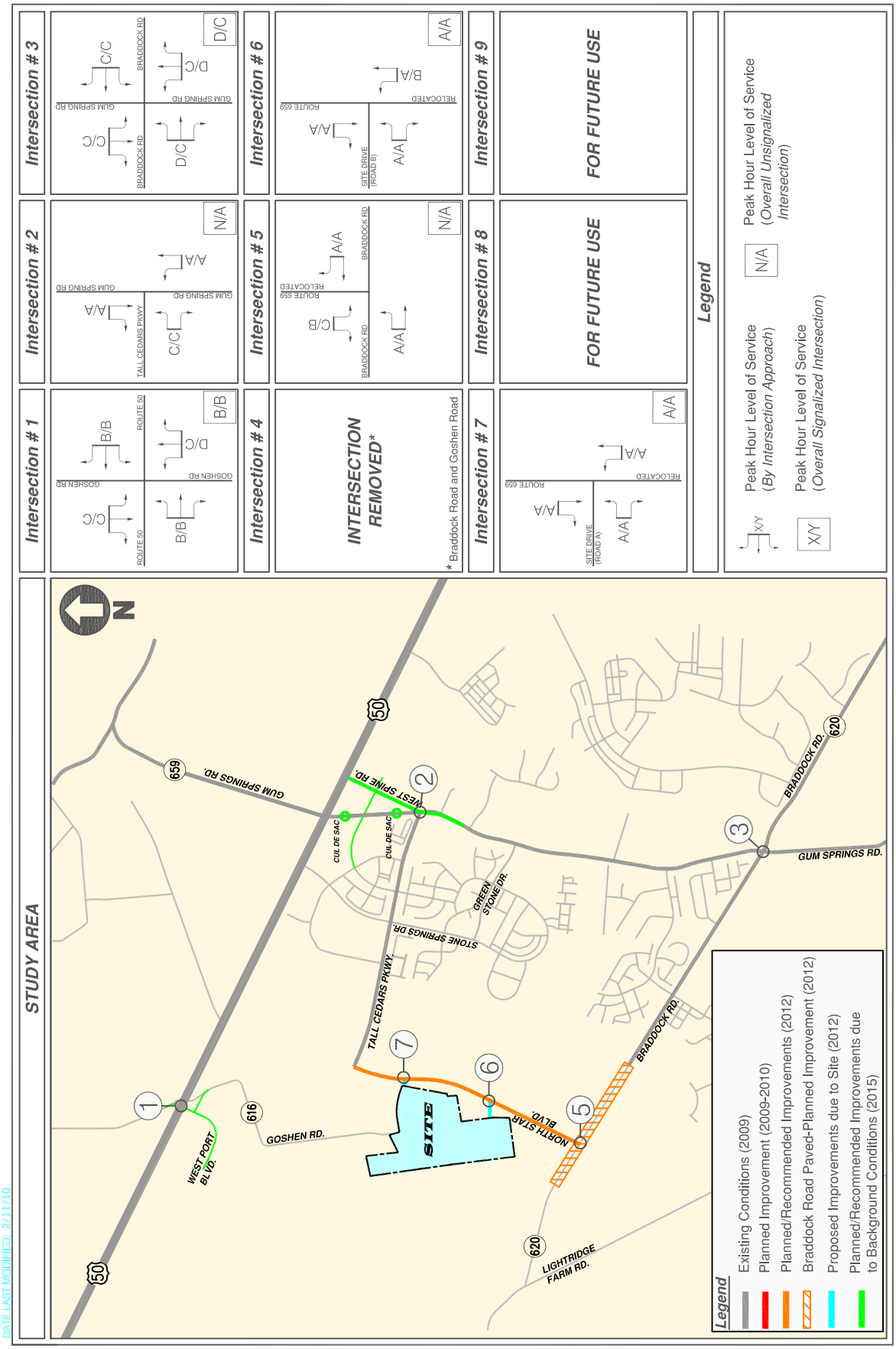

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Figure 32
Future with Development Levels of Service (2015)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1 : Mixed Feed

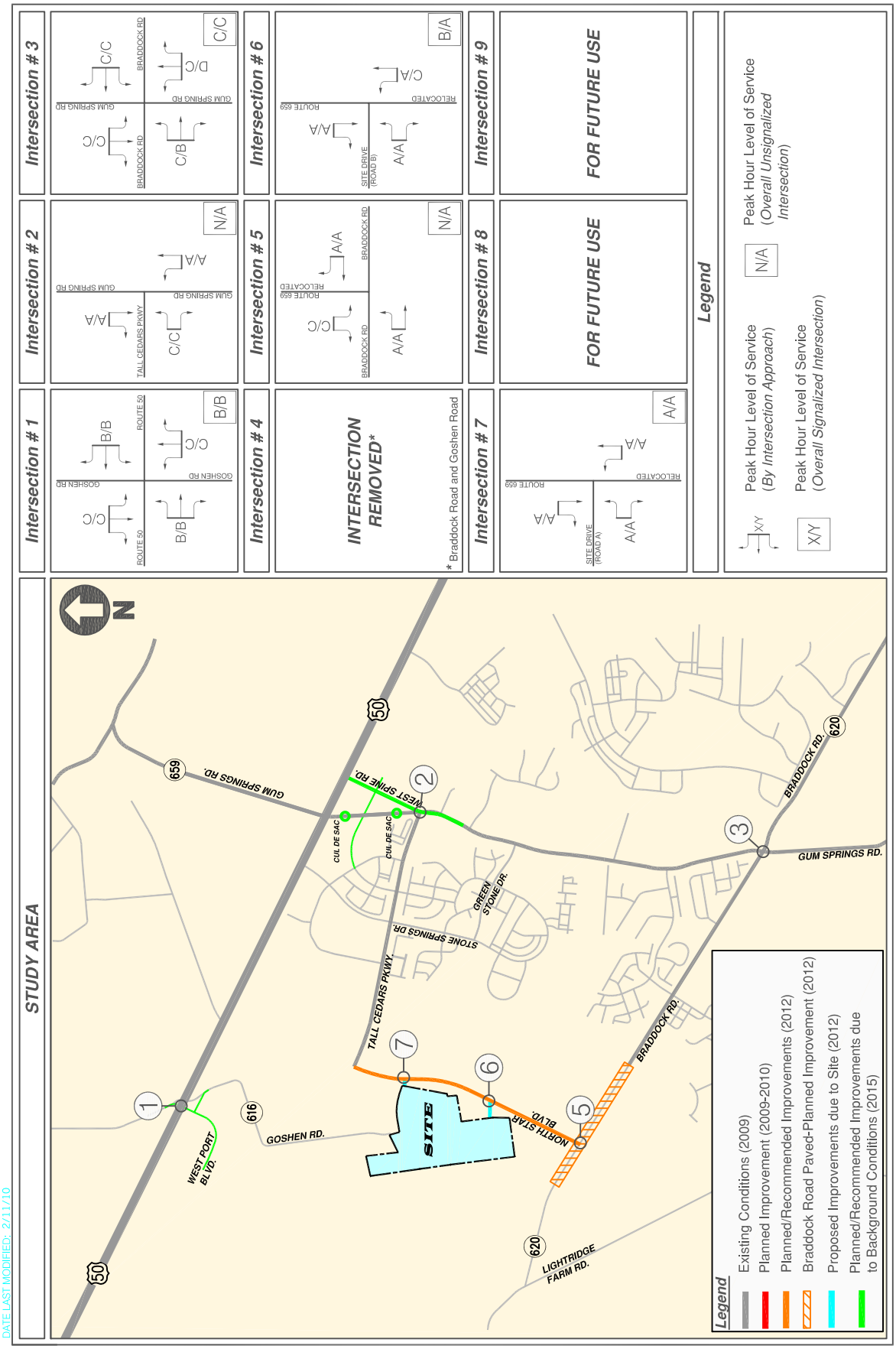

Figure 33
Future with Development Levels of Service (2015)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2 : Pure Feed

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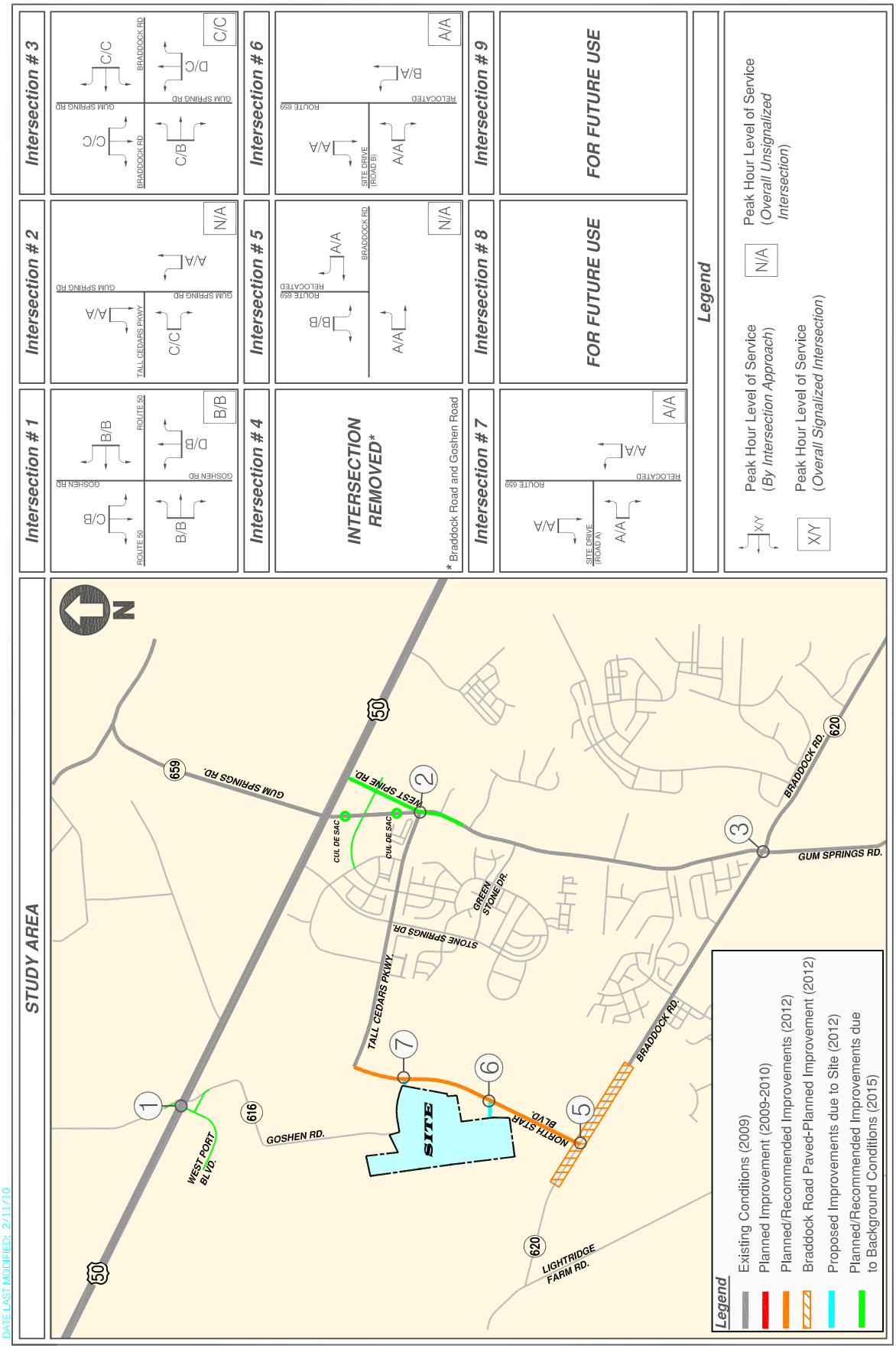

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Figure 34
Future with Development Levels of Service (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 1 : Mixed Feed

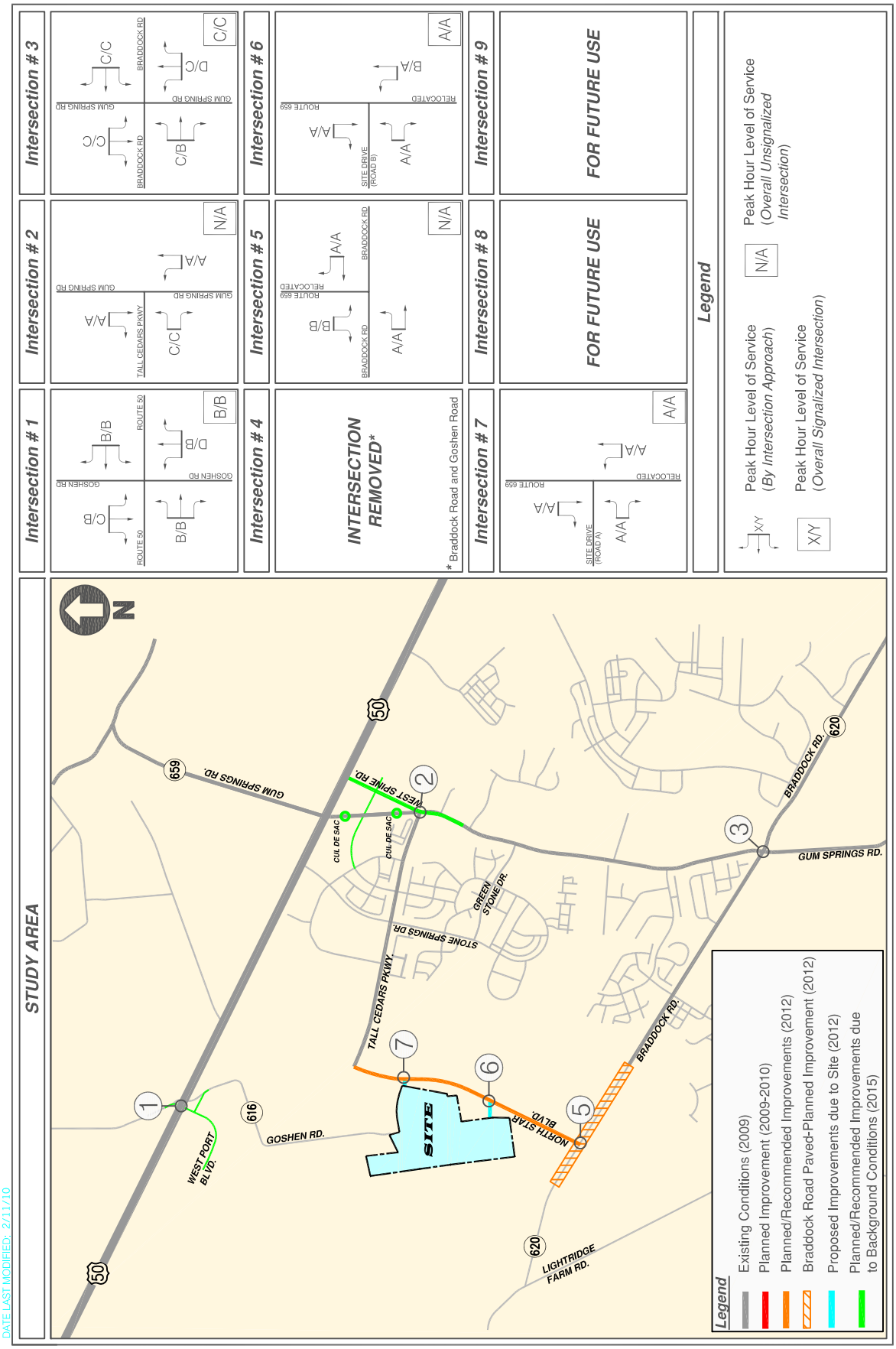

Figure 35
Future with Development Levels of Service (2015)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 2 : Pure Feed

FILE PATH: P:/2110/013.LCPS Goshen HS7/CAD
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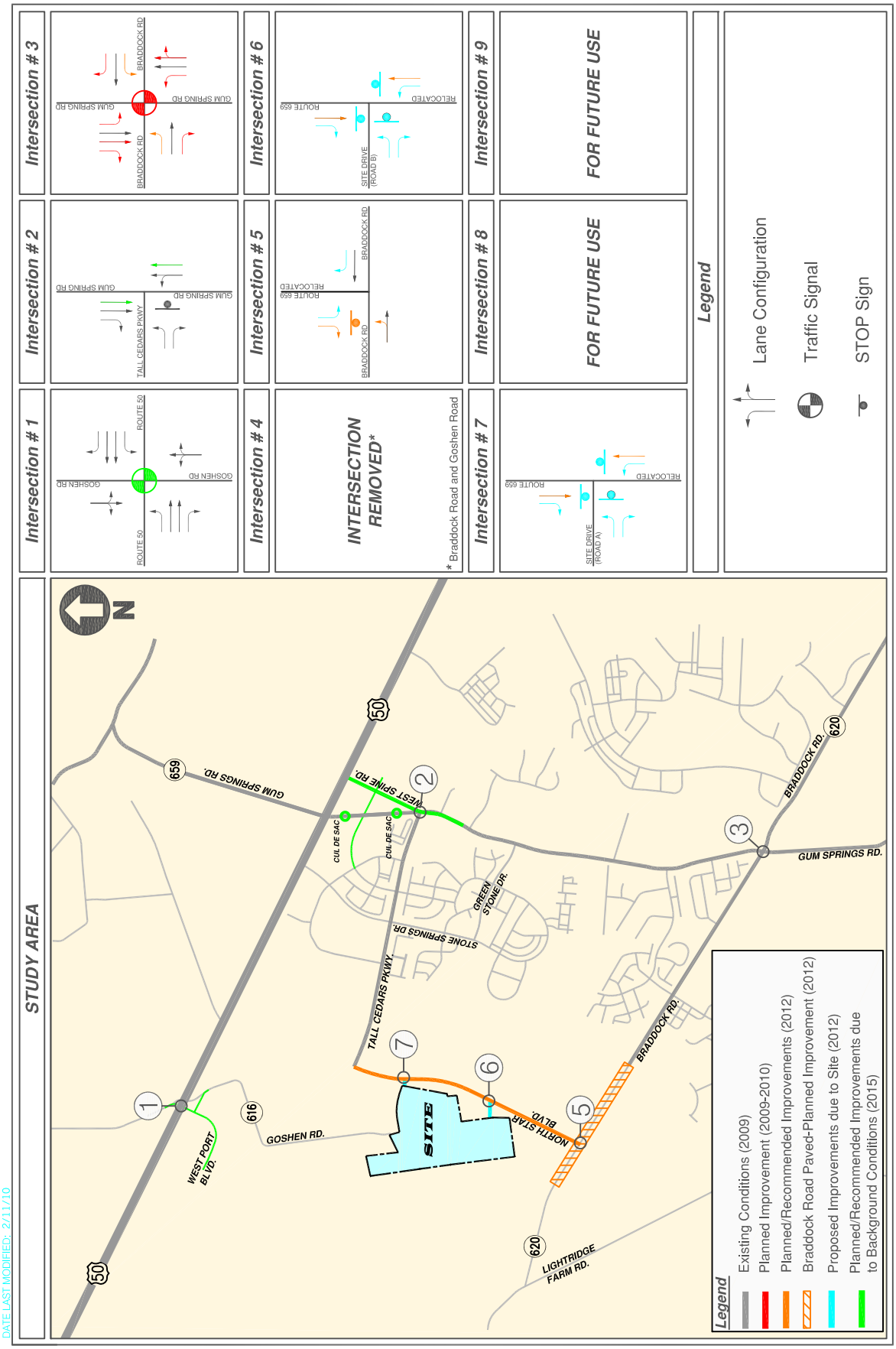

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Figure 36
Future with Development Recommended Improvements (2015)

FUTURE CONDITIONS WITH DEVELOPMENT PLUS FIVE YEARS (2020)

Planned Roadway Improvements

Planned improvements assumed under future conditions (2015) were maintained for this scenario.

Regional Background Traffic Volumes

Future traffic volumes were projected by increasing existing traffic volumes using a growth rate based on historical traffic growth and anticipated traffic patterns. VDOT's historical traffic data along with the approved studies (Greenfields TIA and Stoneridge Commercial TIA, prepared by Wells + Associates and Loudoun County School Board: MS-5 TIA, prepared by Gorove/Slade Associates) in the vicinity of the proposed site were utilized to calculate the inherent growth rate for the roads. In addition, the Loudoun County Growth Summary (2009) was used to verify the traffic projections. The data was presented to VDOT and Loudoun County OTS representatives for verification and approval. Based on the interaction with VDOT and OTS staff, it was decided that a growth rate of two percent (2%) per year would be applied to the major roads in the area in addition to the trips generated by approved background developments to match the Loudoun County's Growth Summary projections. The VDOT's historical traffic data and inherent growth rate calculations are shown in Appendix E.

In addition, the traffic generated by the following background developments in the area, as discussed and documented in the scoping letter, were added to the study network:

1. Westport By-Right Property
2. Stone Ridge
3. Marrwood Property
4. CD Smith
5. Kirkpatrick Farms West
6. Kirkpatrick Farms
7. Braddock Corner
8. LCPS MS-5
9. Lenah Property
10. Greenfield Property
11. Gum Spring Village Center
12. Providence Glen
13. Braddock Crossing
14. Arcola Center; and
15. **HS-7 (Traffic generated by the proposed High School was considered under the future without development (2015) conditions)**

16. **ES (Traffic generated by the proposed Elementary School was considered under the future with development (2020) conditions)**

The inherent regional growth and the traffic generated by the approved and proposed sites were added to the existing volumes in order to estimate the future volumes with development plus five years (2020) as shown in **Figures 37 through 40.** The trips generated by the approved developments are included in the Technical Appendix M.

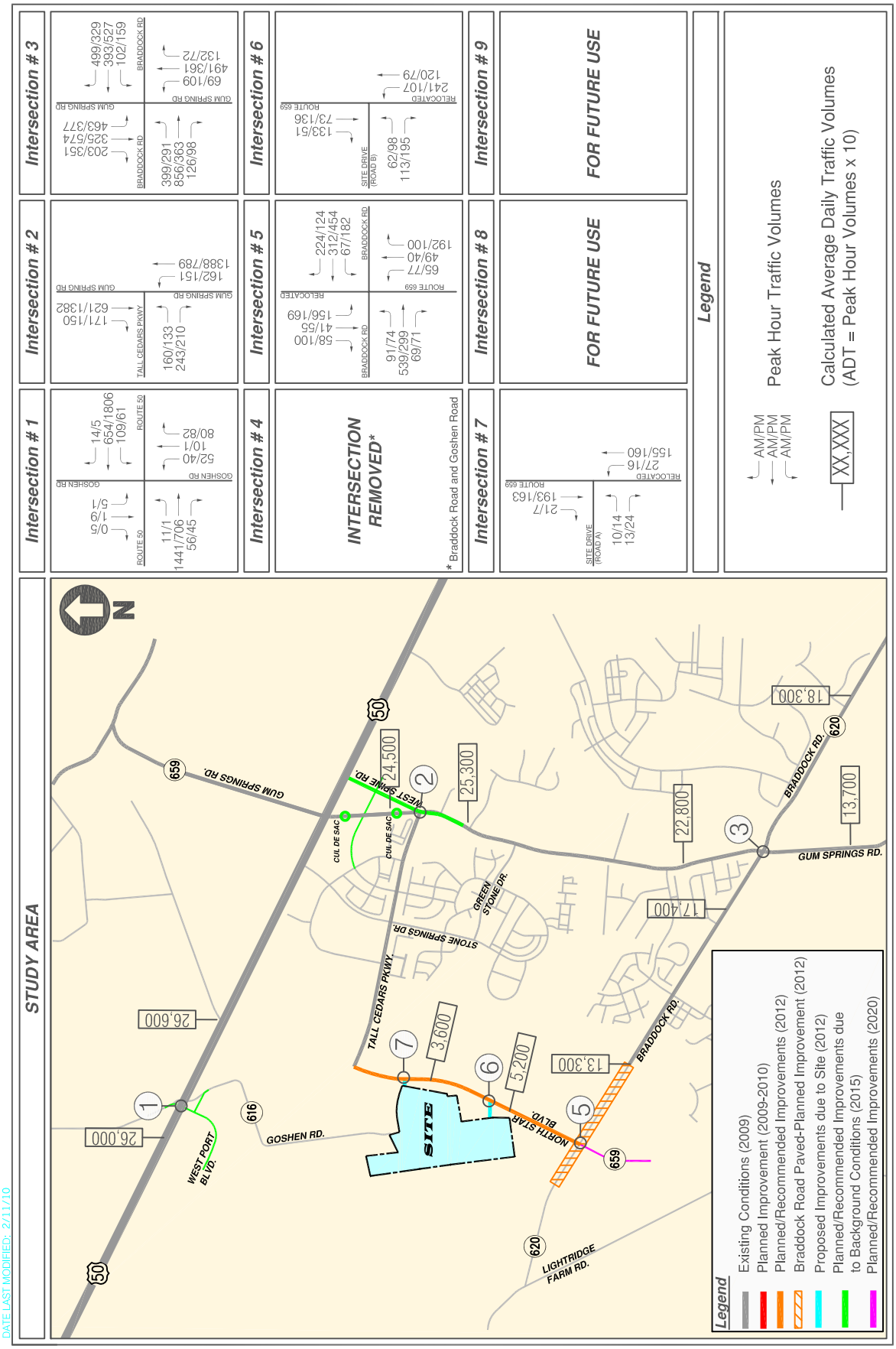

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Figure 37
Future with Development Traffic Volumes (2020)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1 : Mixed Feed

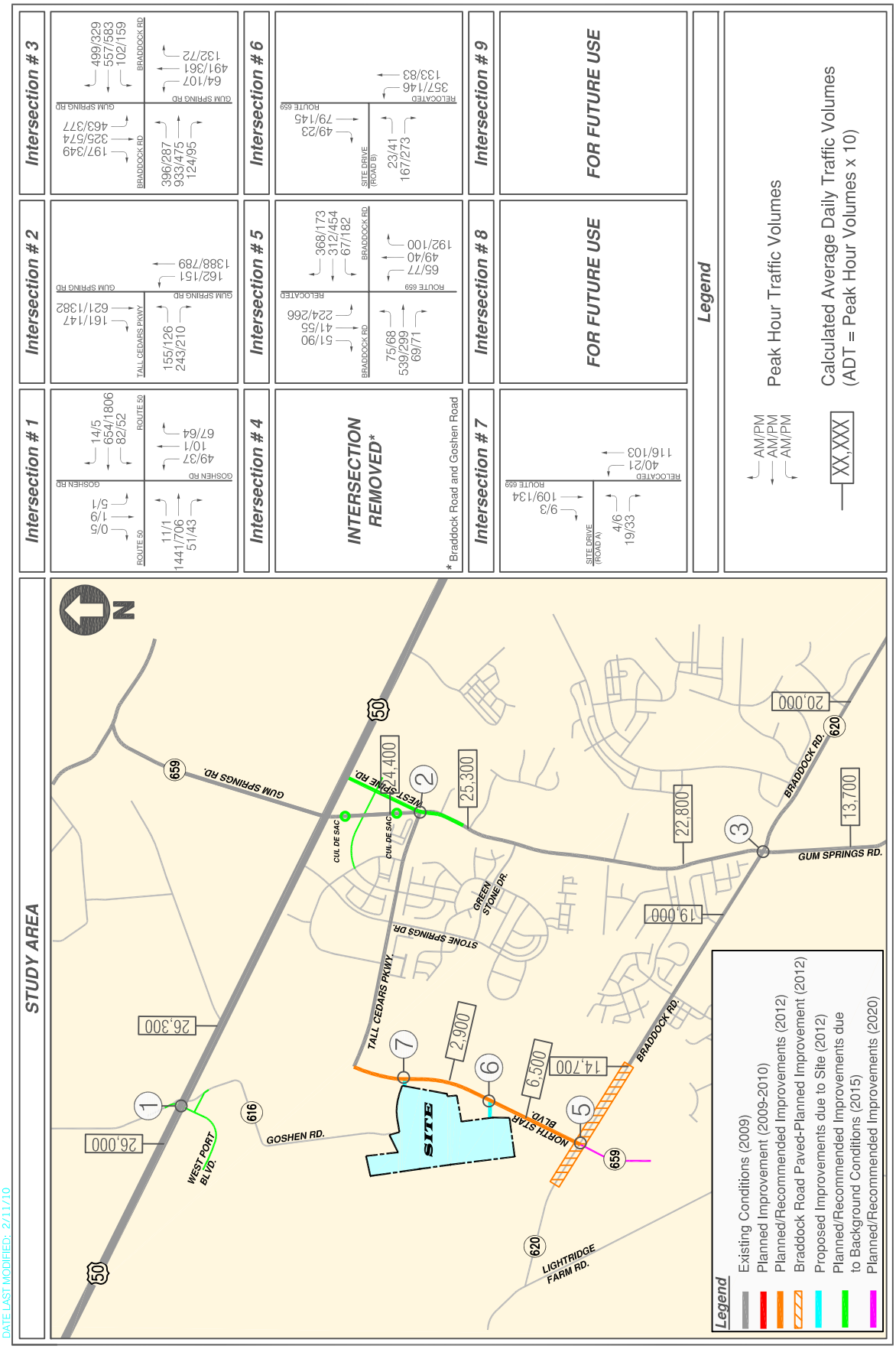

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Figure 38
Future with Development Traffic Volumes (2020)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2 : Pure Feed

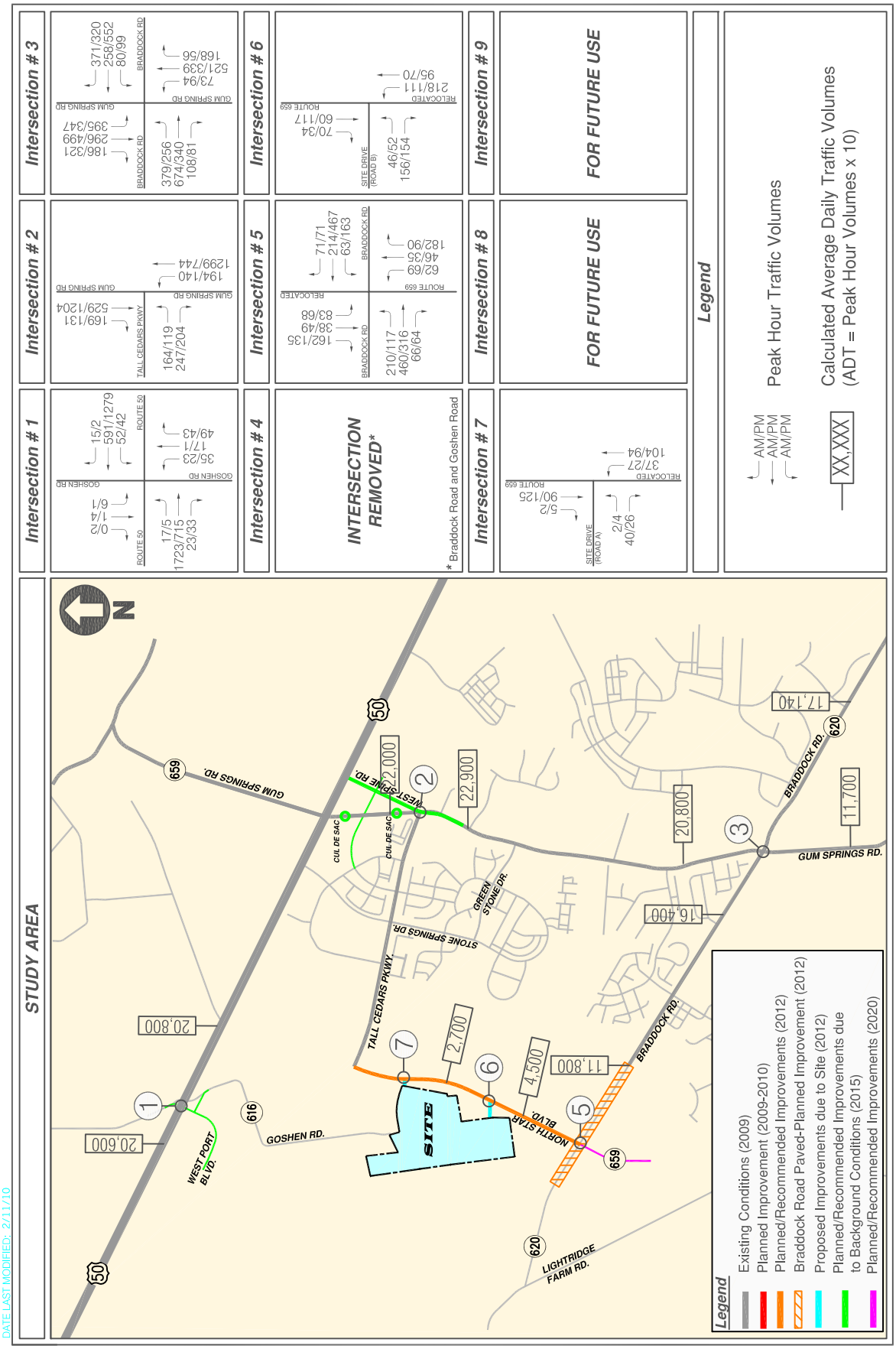

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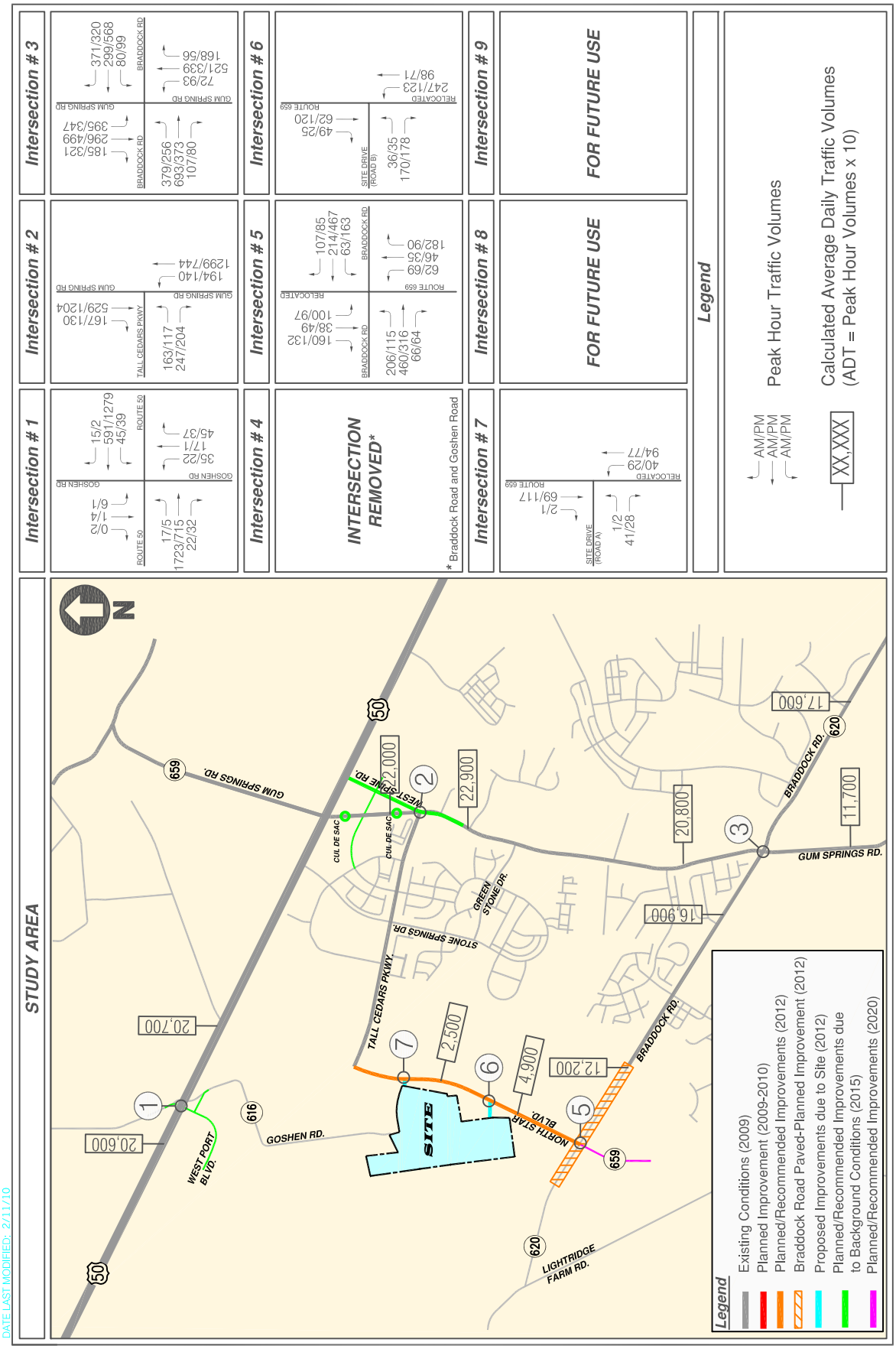
Figure 39
Future with Development Traffic Volumes (2020)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 1 : Mixed Feed



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DATE LAST MODIFIED: 2/11/10

Figure 40
Future with Development Traffic Volumes (2020)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 2 : Pure Feed

Future Conditions with Development Capacity Analysis (2020)

Capacity analyses were performed at the intersections contained within the study area during the weekday HS school peak hours, under the future with development conditions. Intersection capacity analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology.

The results of the intersection capacity analyses for the future with development conditions are summarized in **Tables 10A through 10D**. The description of the different LOS and delay and the detailed analysis worksheets for the future conditions with development are included in Appendix N-1 through N-4.

Table 10A: Future Conditions with Development (2020) Intersection Capacity Analysis, HS Peak Alternative 1

	Total Future Condition (2020)-HS Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**C**	**21.1**	**B**	**19.3**
Eastbound Approach	C	21.1	B	11.7
Westbound Approach	B	14.6	C	20.4
Northbound Approach	D	54.9	D	45.9
Southbound Approach	D	44.2	D	41.0
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	F	415.6	F	Err
Northbound Approach	A	4.6	B	11.6
Southbound Approach	A	0.0	A	0.0
Overall Mitigation - Add a Signal	**B**	**17.4**	**B**	**14.6**
Eastbound Approach	D	37.9	C	33.9
Northbound Approach	B	18.2	B	17.5
Southbound Right Turn	A	5.3	A	8.4
Braddock Road and Gum Spring Road				
Overall (Signalized)	**F**	**120.2**	**E**	**76.0**
Eastbound Approach	F	181.5	D	36.5
Westbound Approach	C	27.6	D	42.9
Northbound Approach	F	107.1	D	48.2
Southbound Approach	F	136.8	F	136.2
Overall Mitigations	**D**	**46.2**	**C**	**32.9**
Eastbound Approach **- Add 2nd through lane and 2nd left turn lane**	D	45.5	D	36.5
Westbound Approach**-Add 2nd through lane**	D	38.5	C	33.3

	Total Future Condition (2020)-HS Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Northbound Approach	D	51.4	D	38.4
Southbound Approach	D	51.3	C	28.3
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	9.6	A	9.3
Westbound Left Turn	A	9.2	A	8.8
Northbound Approach	F	61.2	F	302.2
Southbound Approach	F	Err	F	Err
Overall Mitigations (Add a Signal)	**C**	**24.2**	**C**	**25.7**
Eastbound Left Turn	C	27.7	C	25.7
Westbound Left Turn	B	16.0	C	26.8
Northbound Approach	C	32.3	C	28.5
Southbound Approach	C	24.4	C	21.2
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**8.2**	**A**	**8.2**
Eastbound Approach	A	8.0	A	8.7
Northbound Approach	A	8.1	A	8.2
Southbound Approach	A	8.2	A	8.1
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.5**	**A**	**8.9**
Eastbound Approach	A	8.6	A	8.9
Northbound Approach	B	10.9	A	9.0
Southbound Approach	A	8.0	A	9.0

Table 10B: Future Conditions with Development (2020) Intersection Capacity Analysis, HS Peak Alternative 2

	Total Future Condition (2020)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**B**	**19.1**	**B**	**18.3**
Eastbound Approach	B	19.6	B	11.2
Westbound Approach	B	12.6	B	19.6
Northbound Approach	D	50.6	D	44.3
Southbound Approach	D	42.5	D	40.5
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**

	Total Future Condition (2020)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Eastbound Approach	F	392.2	F	Err
Northbound Approach	A	4.6	B	11.6
Southbound Approach	A	0.0	A	0.0
Overall Mitigation - Add a Signal	**B**	**17.2**	**B**	**14.5**
Eastbound Approach	D	36.0	C	34.0
Northbound Approach	B	18.4	B	17.5
Southbound Right Turn	A	5.2	A	8.4
Braddock Road and Gum Spring Road				
Overall (Signalized)	**F**	**194.4**	**E**	**79.8**
Eastbound Approach	F	339.4	D	38.6
Westbound Approach	C	34.7	E	55.5
Northbound Approach	F	107.8	D	48.7
Southbound Approach	F	228.8	F	139.9
Overall Mitigations	**D**	**51.3**	**C**	**34.3**
Eastbound Approach **-Add 2nd through lane and 2nd left turn lane**	D	50.7	D	37.7
Westbound Approach **-Add 2nd through lane**	D	49.0	D	35.3
Northbound Approach	D	52.7	D	39.2
Southbound Approach	D	54.3	C	29.2
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	B	10.4	A	9.5
Westbound Left Turn	A	9.2	A	8.8
Northbound Approach	F	58.7	F	274.0
Southbound Approach	F	Err	F	Err
Overall Mitigations (Add a Signal)	**C**	**24.1**	**C**	**26.1**
Eastbound Left Turn	C	28.8	C	28.0
Westbound Left Turn	B	15.5	C	25.3
Northbound Approach	C	33.0	C	32.0
Southbound Approach	C	25.8	C	22.4
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.6**	**A**	**7.8**
Eastbound Approach	A	7.5	A	8.4
Northbound Approach	A	7.8	A	7.7
Southbound Approach	A	7.4	A	7.7
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**B**	**12.4**	**A**	**9.9**
Eastbound Approach	A	9.3	B	10.1

	Total Future Condition (2020)-HS Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Northbound Approach	B	14.7	A	9.7
Southbound Approach	A	8.2	A	9.7

Table 10C: Future Conditions with Development (2020) Intersection Capacity Analysis, ES Peak Alternative 1

	Total Future Condition (2020)-ES Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**C**	**26.8**	**B**	**14.3**
Eastbound Approach	C	28.6	B	11.8
Westbound Approach	B	16.4	B	15.0
Northbound Approach	D	55.0	C	27.2
Southbound Approach	D	46.9	C	25.2
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	F	375.5	F	Err
Northbound Approach	A	4.9	A	8.5
Southbound Approach	A	0.0	A	0.0
Overall Mitigation-Add a Signal	**B**	**16.9**	**B**	**12.1**
Eastbound Approach	D	35.1	C	26.2
Northbound Approach	B	17.2	B	13.6
Southbound Right Turn	A	5.4	A	7.7
Braddock Road and Gum Spring Road				
Overall (Signalized)	**F**	**81.7**	**E**	**66.4**
Eastbound Approach	E	66.4	C	29.3
Westbound Approach	C	22.1	D	43.9
Northbound Approach	F	149.0	D	44.8
Southbound Approach	F	91.7	F	115.6
Overall Mitigations	**D**	**37.4**	**C**	**31.5**
Eastbound Approach-**Add 2nd through lane and 2nd left turn lane**	D	39.5	C	33.5
Westbound Approach-**Add 2nd through lane**	C	32.7	C	33.0
Northbound Approach	D	46.1	D	37.4
Southbound Approach	C	30.8	C	26.8

	Total Future Condition (2020)-ES Peak Hour-Mixed Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.7	A	9.2
Westbound Left Turn	A	8.9	A	8.7
Northbound Approach	F	101.1	F	406.5
Southbound Approach	F	275.6	F	181.7
Overall Mitigation-Add a Signal	**C**	**21.8**	**C**	**22.5**
Eastbound Approach	C	22.2	C	20.8
Westbound Approach	B	15.9	C	22.1
Northbound Approach	C	26.7	C	25.7
Southbound Approach	C	23.1	C	24.4
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.5**	**A**	**7.6**
Eastbound Approach	A	6.9	A	8.4
Northbound Approach	A	7.7	A	7.4
Southbound Approach	A	7.3	A	7.6
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.2**	**A**	**8.3**
Eastbound Approach	A	8.5	A	8.0
Northbound Approach	B	10.4	A	8.6
Southbound Approach	A	7.6	A	8.5

Table 10D: Future Conditions with Development (2020) Intersection Capacity Analysis, ES Peak Alternative 2

	Total Future Condition (2020)-ES Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Goshen Road				
Overall (Signalized)	**C**	**26.2**	**B**	**14.2**
Eastbound Approach	C	28.1	B	11.7
Westbound Approach	B	15.7	B	14.9
Northbound Approach	D	54.0	C	27.1
Southbound Approach	D	46.4	C	25.1
Tall Cedars Parkway and West Spine Road				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Approach	F	371.3	F	Err

	Total Future Condition (2020)-ES Peak Hour-Pure Feed			
	AM Peak Hour		PM Peak Hour	
Intersection (Approach/Movement)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Northbound Approach	A	4.9	A	8.5
Southbound Approach	A	0.0	A	0.0
Overall Mitigation-Add a Signal	**B**	**16.9**	**B**	**12.1**
Eastbound Approach	C	35.0	C	26.3
Northbound Approach	B	17.3	B	13.6
Southbound Right Turn	A	5.4	A	7.7
Braddock Road and Gum Spring Road				
Overall (Signalized)	**F**	**85.8**	**E**	**67.1**
Eastbound Approach	F	80.6	C	29.5
Westbound Approach	C	22.7	D	47.8
Northbound Approach	F	149.1	D	44.7
Southbound Approach	F	91.8	F	115.6
Overall Mitigations	**D**	**38.1**	**C**	**31.8**
Eastbound Approach-**Add 2nd through lane and 2nd left turn lane**	D	39.6	C	33.6
Westbound Approach-**Add 2nd through lane**	D	33.5	C	33.6
Northbound Approach	D	47.5	D	37.5
Southbound Approach	C	32.0	C	26.9
Braddock Road and Goshen Road	**Intersection Closed**			
Braddock Road and Northstar Boulevard				
Overall (Unsignalized)	**N/A**	**N/A**	**N/A**	**N/A**
Eastbound Left Turn	A	8.9	A	9.7
Westbound Left Turn	A	8.9	A	8.7
Northbound Approach	F	99.0	F	396.2
Southbound Approach	F	Err	F	326.0
Overall Mitigation-Add a Signal	**C**	**23.5**	**C**	**24.4**
Eastbound Approach	C	26.2	C	23.8
Westbound Approach	B	17.1	C	24.9
Northbound Approach	C	27.1	C	26.8
Southbound Approach	C	21.5	C	22.9
Northstar Boulevard and Road A (Site Drive)				
Overall (Unsignalized)	**A**	**7.7**	**A**	**7.7**
Eastbound Approach	A	8.3	A	8.3
Northbound Approach	A	7.8	A	7.7
Southbound Approach	A	7.2	A	7.5
Northstar Boulevard and Road B (Site Drive)				
Overall (Unsignalized)	**A**	**9.7**	**A**	**8.5**
Eastbound Approach	A	8.7	A	8.2
Northbound Approach	B	11.0	A	8.8
Southbound Approach	A	7.7	A	8.7

As previously mentioned, it is desirable to achieve a level of service (LOS) D or better per approach at each intersection. The following improvements are recommended in order to meet the acceptable LOS criteria:

- *Intersection of Braddock Road and West Spine Road/Gum Spring Road:*
  - Add 2nd eastbound through lane;
  - Add 2nd westbound through lane;
  - Add 2nd eastbound left turn lane.
- *Intersection of Tall Cedars Parkway and West Spine Road:*
  - Add a traffic signal.
- *Intersection of Braddock Road and Relocated Route 659 (Northstar Boulevard):*
  - Add a traffic signal.

The results of the intersection capacity analyses and recommended improvements are shown graphically in **Figures 41 through 45.**

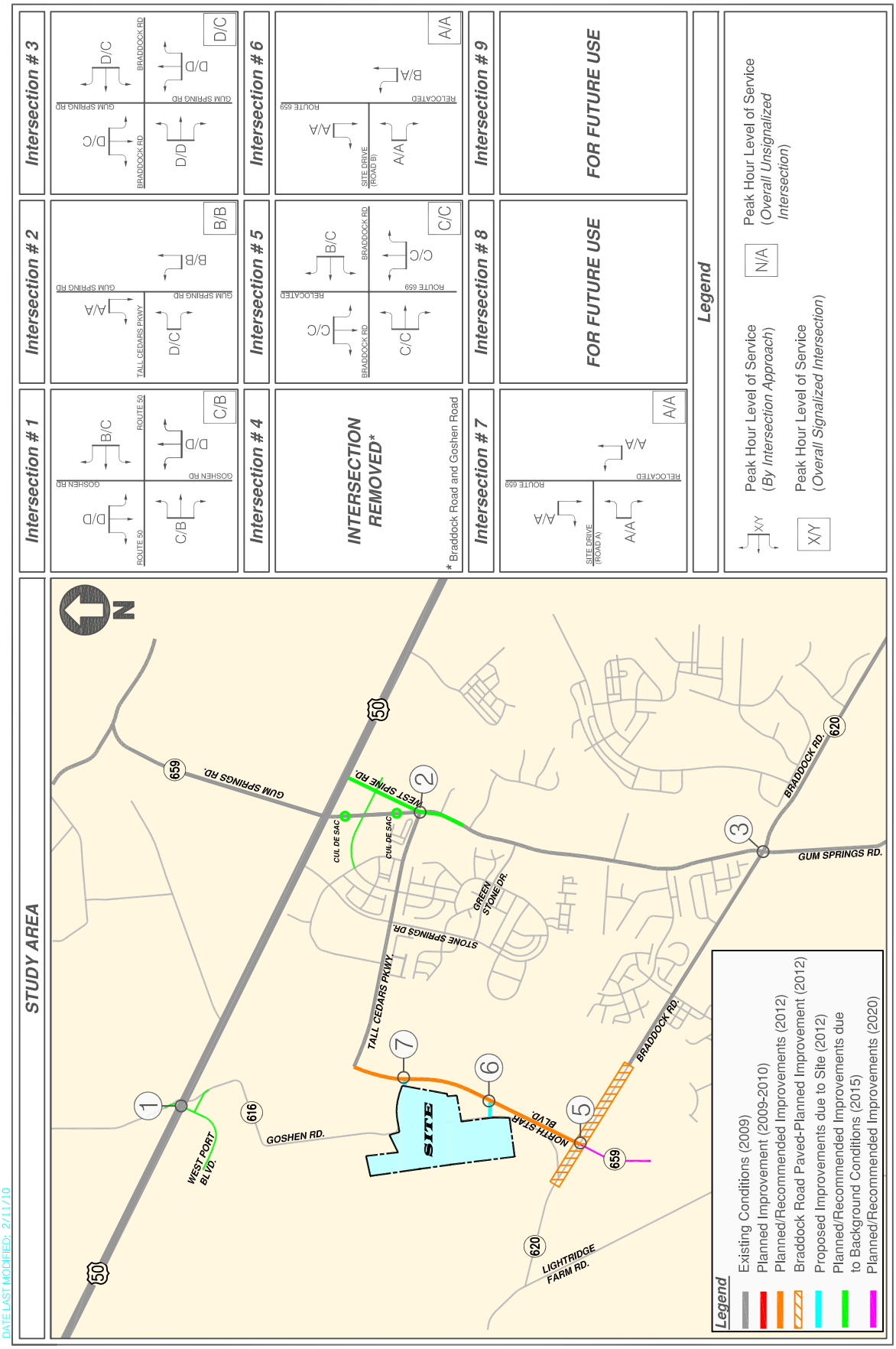

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Figure 41
Future with Development Levels of Service (2020)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 1 : Mixed Feed

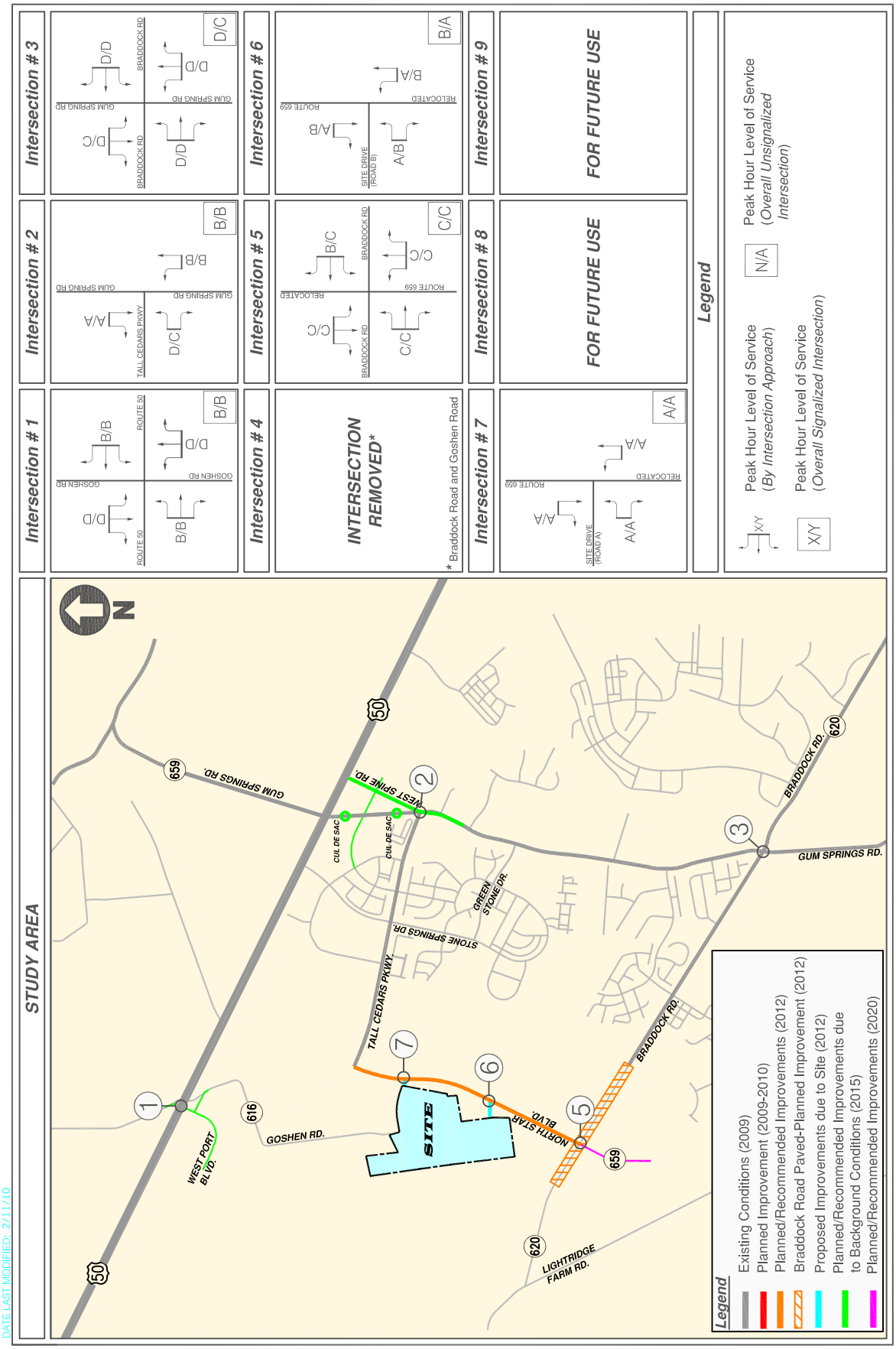

Figure 42
Future with Development Levels of Service (2020)
High School Peak Hour (8:00 AM to 9:00 AM and 3:30 PM to 4:30 PM)
Alternative 2 : Pure Feed

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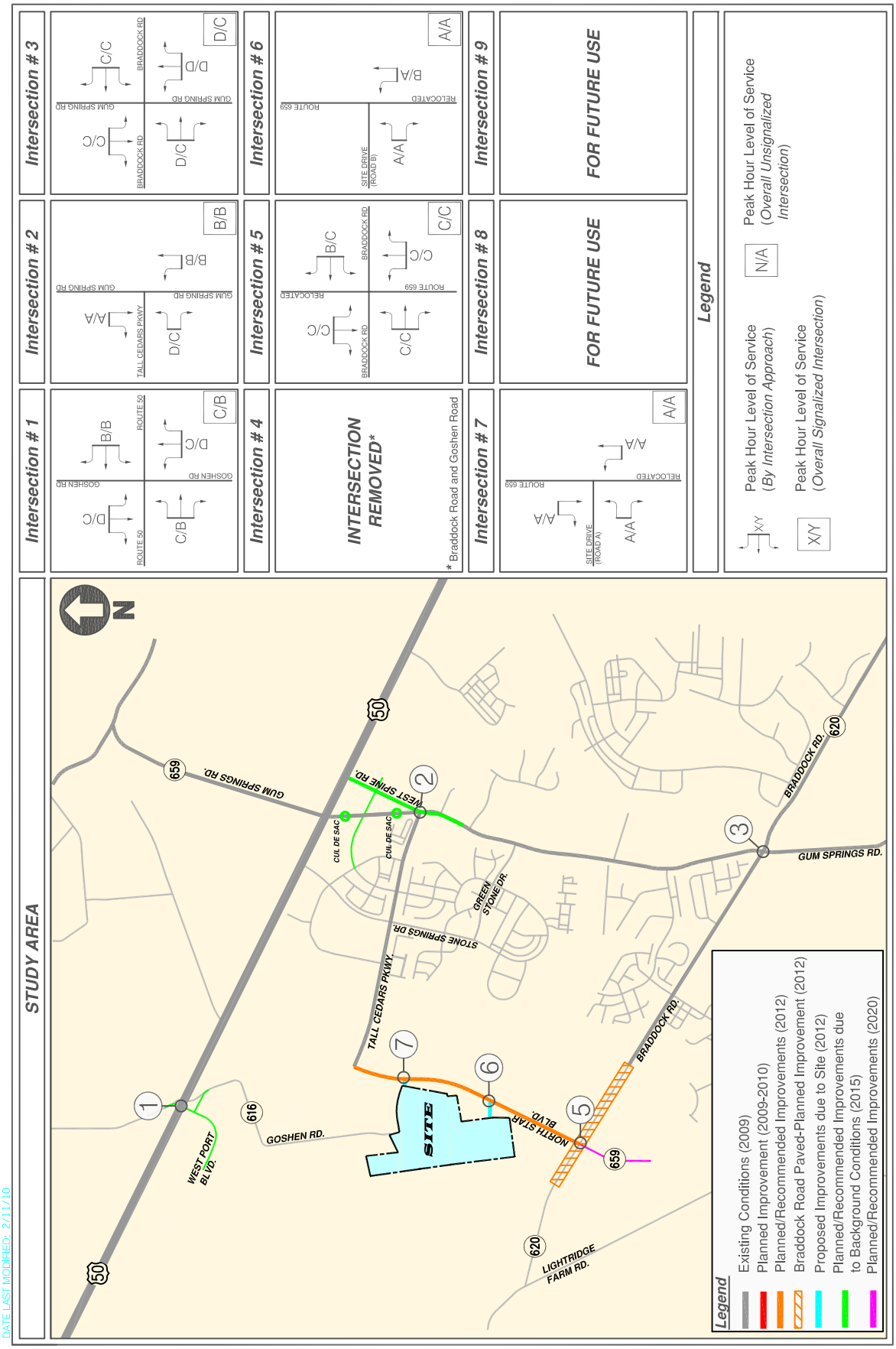

Figure 43
Future with Development Levels of Service (2020)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 1 : Mixed Feed

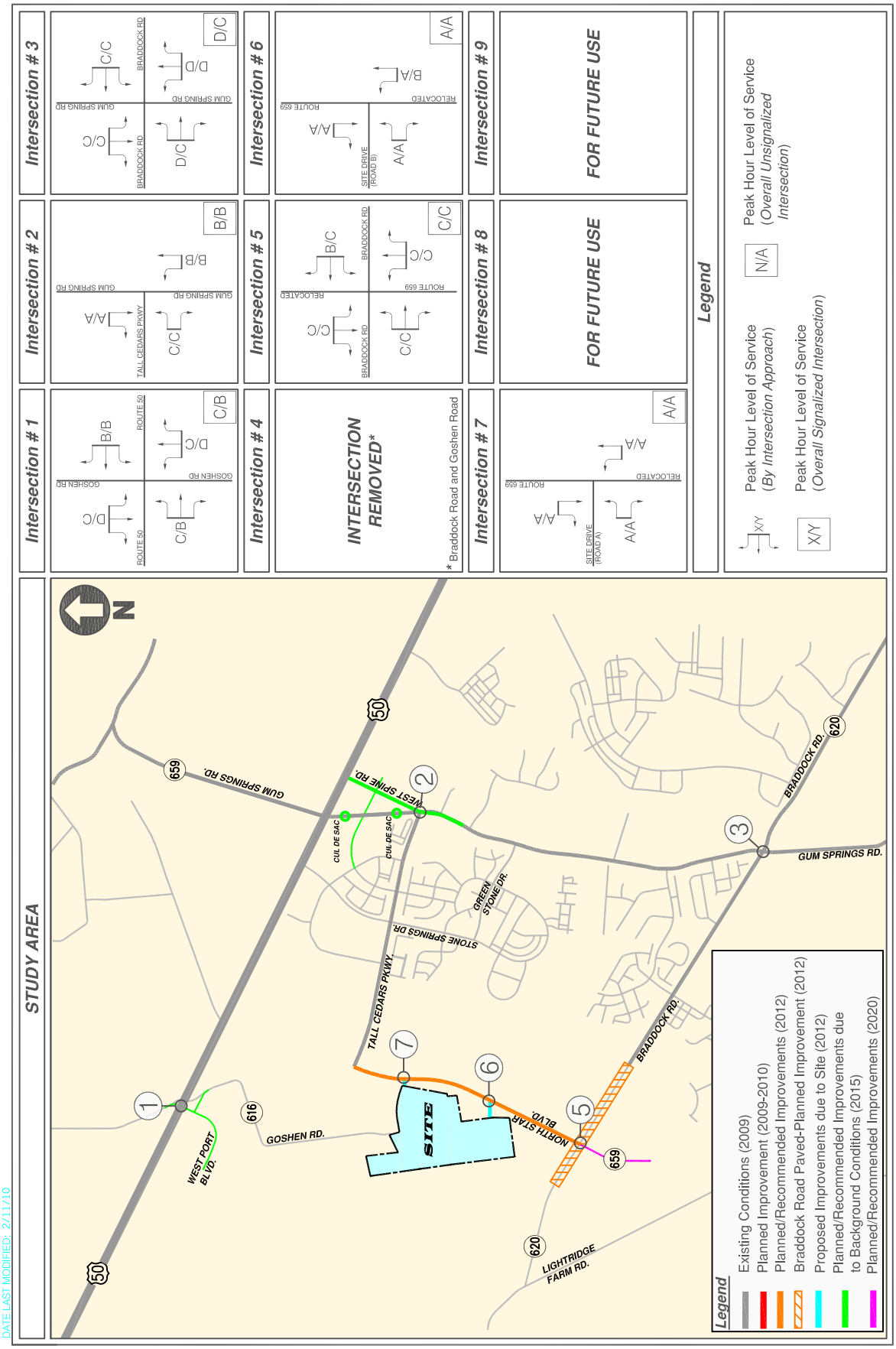

Figure 44
Future with Development Levels of Service (2020)
Elementary School Peak Hour (7:00 AM to 8:00 AM and 2:15 PM to 3:15 PM)
Alternative 2 : Pure Feed

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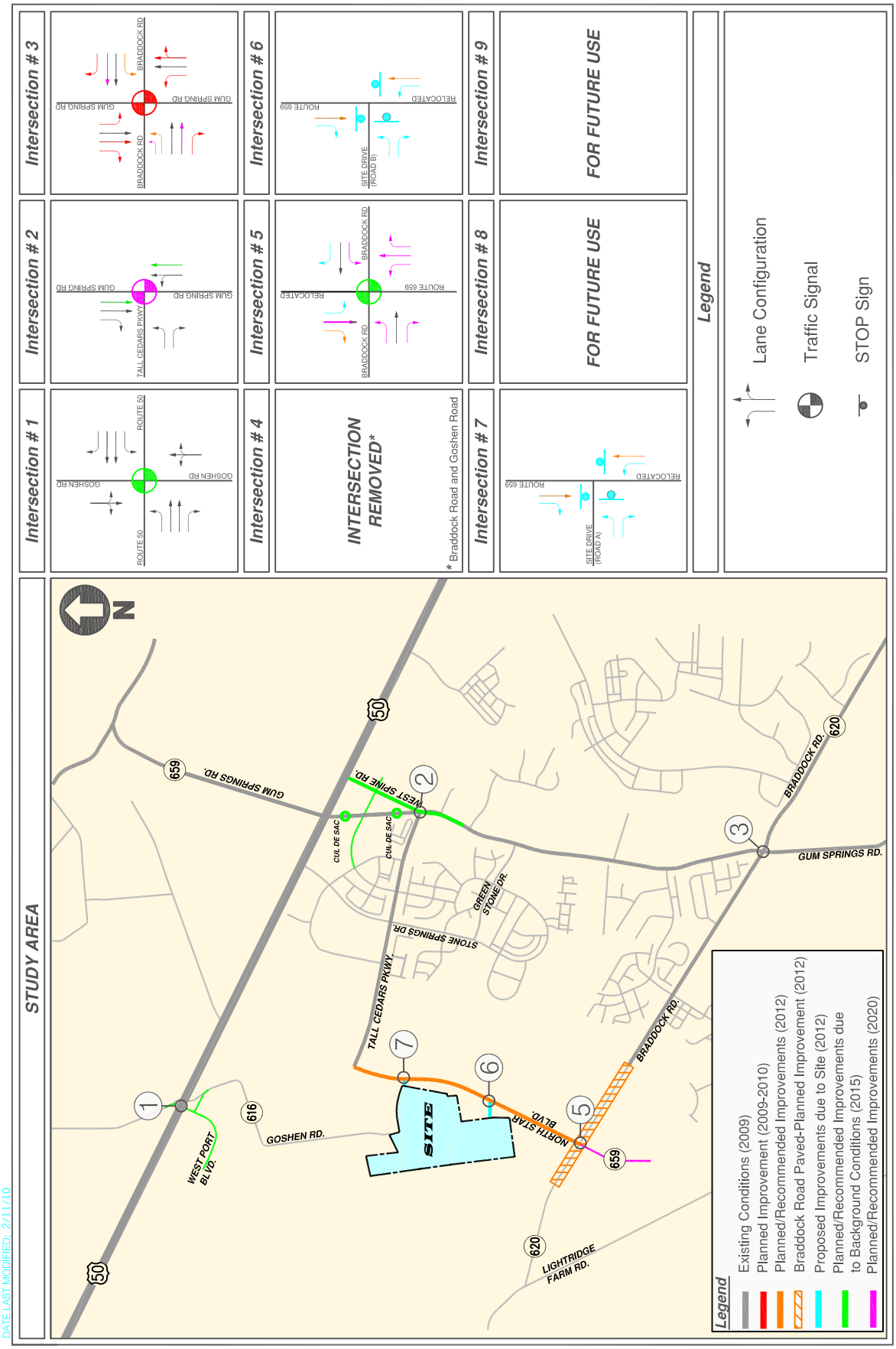

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Figure 45
Future with Development Recommended Improvements (2020)

RIGHT TURN LANE ANALYSIS

Based on Virginia Department of Transportation (VDOT) Road Design Manual, warrant analysis for right turn lanes into the proposed Elementary and High School site entrances was performed to determine if a right turn lane is required. It should be noted that the VDOT Road Design Manual provides a guideline for left-turn and right-turn facilities to be considered on two-lane and four-lane highways. In addition to the site entrances, a right turn lane analysis was also conducted at the intersection of Relocated Rt. 659 and Braddock Road. **Tables 11 and 12** present the results of the Right Turn Lane analysis for 2012 and 2015 Alternatives 1 and 2 respectively. The detailed worksheets are included in the Technical Appendix O.

Table 11: Warrant Analysis for Right Turn Lane (Alternative 1, Mixed Feed)

Intersection	Approach Volume *HS AM School/ HS PM School*	Right Turn Volume *HS AM School/ HS PM School*	Right Turn Warrant Analysis
Northstar Boulevard and Road A (SB Right Turn)-2012	157/53	21/7	Right turn **Lane Not** Required
Northstar Boulevard and Road B (SB Right Turn)-2012	149/64	133/45	Right turn **Lane** Required
Northstar Boulevard and Road A (EB Right Turn)-2012	23/32	13/18	Right turn **Lane Not** Required
Northstar Boulevard and Road A (EB Right Turn)-2015	23/32	13/18	Right turn **Lane Not** Required
Northstar Boulevard and Road B (EB Right Turn)-2012	175/253	113/163	Right turn **Lane** Required
Northstar Boulevard and Braddock Road (WB Right Turn)-2012	395/230	224/124	Right turn **Lane** Required

Notes: 1. Source: VDOT Road Design Manual (Figure C-1-8; C-1-9).

Table 12: Warrant Analysis for Right Turn Lane (Alternative 2, Pure Feed)

Intersection	Approach Volume *HS AM School/ HS PM School*	Right Turn Volume *HS AM School/ HS PM School*	Right Turn Warrant Analysis
Northstar Boulevard and Road A (SB Right Turn)-2012	61/20	9/3	Right turn **Lane Not** Required
Northstar Boulevard and Road B (SB Right Turn)-2012	71/44	49/16	Right turn **Lane Not** Required
Northstar Boulevard and Road B (SB Right Turn)-2015	80/53	49/23	Right turn **Lane Not** Required
Northstar Boulevard and Road A (EB Right Turn)-2012	23/33	19/27	Right turn **Lane Not** Required
Northstar Boulevard and Road A (EB Right Turn)-2015	23/33	19/27	Right turn **Lane Not** Required
Northstar Boulevard and Road B (EB Right Turn)-2012	190/275	167/242	Right turn **Lane** Required
Northstar Boulevard and Braddock Rd (WB Right Turn)-2012	539/279	368/173	Right turn **Lane** Required

Notes: 1. Source: VDOT Road Design Manual (Figure C-1-8; C-1-9).

LEFT TURN LANE ANALYSIS

Based on Virginia Department of Transportation (VDOT) Road Design Manual, warrant analysis for left turn lanes into the Loudoun County Public School development site entrances was performed to determine if a left turn lane is required. It should be noted that the VDOT Road Design Manual provides a guideline for left-turn and right-turn facilities to be considered on two-lane and four-lane highways. In addition to the site entrances, a left turn lane analysis was also conducted at the intersection of Relocated Rt. 659 and Braddock Road. **Tables 13 and 14** present the results of the Left Turn Lane analysis for 2012 and 2015 Alternatives 1 and 2 respectively. The detailed worksheets are included in the Technical Appendix P.

Table 13: Warrant Analysis for Left Turn Lane (Alternative 1, Mixed Feed)

Intersection	Left Turn Volume *HS AM School/ HS PM School*	Advancing Volume *HS AM School/ HS PM School*	Opposing Volume *HS AM School/ HS PM School*	Left Turn Warrant Analysis
Northstar Boulevard and Road A (NB Left Turn)-2012	27/9	92/101	157/53	Left Turn **Lane Not** Required
Northstar Boulevard and Road A (NB Left Turn)-2015	27/16	95/110	160/55	Left Turn **Lane Not** Required
Northstar Boulevard and Road B (NB Left Turn)-2012	241/81	271/92	149/64	Left Turn **Lane Not** Required
Northstar Boulevard and Road B (NB Left Turn)-2015	241/107	280/120	158/72	Left Turn **Lane Not** Required
Northstar Boulevard and Braddock Rd. (SB Left Turn)-2012	156/169	220/238	461/243	Left Turn **Lane** Required

Notes: 1. Source: VDOT Road Design Manual (Figure C-1-1.3).

Table 14: Warrant Analysis for Left Turn Lane (Alternative 2, Pure Feed)

Intersection	Left Turn Volume *HS AM School/ HS PM School*	Advancing Volume *HS AM School/ HS PM School*	Opposing Volume *HS AM School/ HS PM School*	Left Turn Warrant Analysis
Northstar Boulevard and Road A (NB Left Turn)-2012	40/13	66/48	61/20	Left Turn **Lane Not** Required
Northstar Boulevard and Road A (NB Left Turn)-2015	40/21	69/58	64/22	Left Turn **Lane Not** Required
Northstar Boulevard and Road B (NB Left Turn)-2012	357/120	400/135	71/44	Left Turn **Lane** Required
Northstar Boulevard and Braddock Rd. (SB Left Turn)-2012	224/266	281/324	445/238	Left Turn **Lane** Required

Notes:
1. Source: VDOT Road Design Manual (Figure C-1-1.3).

SIGNAL WARRANT ANALYSIS

Based on the Manual on Traffic Signal Design (MTSD), traffic signal warrants were reviewed for the unsignalized site access intersections.

The capacity analysis presented for the future with development conditions reveals that a signal is not required at the school entrances along Northstar Boulevard. The next step outlined by the VDOT guidelines is to check whether the signal is warranted based on the traffic volumes projected at that intersection. The warrant analysis also reveals that a signal is not warranted under the 2012 and 2015 traffic scenario. The traffic signal warrant analysis worksheets are included in the Technical Appendix Q.

QUEUING ANALYSIS

Queuing analyses was performed for the intersection of Route 50 and Goshen Road as requested in the scoping meeting. Queuing analyses were performed using *Synchro version* 7 based on the latest Highway Capacity Manual (HCM 2000) data and methodology. The 95% and 50% queue results for the intersection of Route 50 and Goshen Road are presented in Table 15. The queue results are expressed in feet and are included in Appendix R.

Table 15: Queuing Analysis for Route 50 and Goshen Road

	Turn	HS AM Peak Hour		HS PM Peak Hour		ES AM Peak Hour		ES PM Peak Hour	
(Approach/Movement)	Bay Length	Avg Queue	95th Queue	Avg Queue	95th Queue	Avg Queue	95th Queue	Avg Queue	95th Queue
Existing Conditions (2009)									
Eastbound Left Turn	150	n/a	1	n/a	0	n/a	1	n/a	0
Eastbound Right Turn	190	n/a	0	n/a	0	n/a	0	n/a	0
Westbound Left Turn	120	n/a	2	n/a	1	n/a	2	n/a	1
Westbound Right Turn	120	n/a	0	n/a	0	n/a	0	n/a	0
Northbound Approach		n/a	16	n/a	4	n/a	21	n/a	1
Southbound Approach		n/a	5	n/a	9	n/a	7	n/a	4
Future Background Conditions (2012)									
Eastbound Left Turn	150	n/a	1	n/a	0				
Eastbound Right Turn	190	n/a	0	n/a	0				
Westbound Left Turn	120	n/a	3	n/a	2				
Westbound Right Turn	120	n/a	0	n/a	0				
Northbound Approach		n/a	24	n/a	6				
Southbound Approach		n/a	3	n/a	9				
Total Future Conditions (2012) - Mixed Feed									
Eastbound Left Turn	150	n/a	1	n/a	0				
Eastbound Right Turn	190	n/a	0	n/a	0				
Westbound Left Turn	120	n/a	11	n/a	4				
Westbound Right Turn	120	n/a	0	n/a	0				
Northbound Approach		n/a	75	n/a	32				
Southbound Approach		n/a	4	n/a	10				
Total Future Conditions (2012) - Pure Feed									
Eastbound Left Turn	150	n/a	1	n/a	0				
Eastbound Right Turn	190	n/a	0	n/a	0				
Westbound Left Turn	120	n/a	7	n/a	3				
Westbound Right Turn	120	n/a	0	n/a	0				
Northbound Approach		n/a	53	n/a	24				
Southbound Approach		n/a	3	n/a	9				
Future Background Conditions (2015) - Mixed Feed									
Eastbound Left Turn	150	5	25	0	7	9	36	1	11
Eastbound Through		217	353	61	112	288	454	28	98
Eastbound Right Turn	190	3	25	0	18	2	15	0	14
Westbound Left Turn	120	44	109	21	84	27	80	8	43
Westbound Through		41	113	159	421	33	96	67	199
Westbound Right Turn	120	0	9	0	6	0	9	0	3
Northbound Through		55	135	27	114	42	114	6	46
Southbound Through		3	15	3	25	4	20	1	11

(Approach/Movement)	Turn Bay Length	HS AM Peak Hour Avg Queue	HS AM Peak Hour 95th Queue	HS PM Peak Hour Avg Queue	HS PM Peak Hour 95th Queue	ES AM Peak Hour Avg Queue	ES AM Peak Hour 95th Queue	ES PM Peak Hour Avg Queue	ES PM Peak Hour 95th Queue
Future Background Conditions (2015) - Pure Feed									
Eastbound Left Turn	150	5	24	0	6	8	35	1	11
Eastbound Through		201	326	58	105	283	444	28	97
Eastbound Right Turn	190	2	22	0	17	2	15	0	14
Westbound Left Turn	120	28	80	17	73	24	71	7	40
Westbound Through		38	110	151	403	33	96	66	198
Westbound Right Turn	120	0	9	0	6	0	9	0	3
Northbound Through		44	118	21	97	40	110	5	43
Southbound Through		2	14	3	25	4	20	1	11
Total Future Conditions (2015) - Mixed Feed									
Eastbound Left Turn	150	5	25	0	7	9	38	1	12
Eastbound Through		218	355	62	115	304	482	31	104
Eastbound Right Turn	190	3	25	0	19	4	23	0	17
Westbound Left Turn	120	45	110	22	84	29	83	8	45
Westbound Through		41	114	167	437	36	103	73	210
Westbound Right Turn	120	0	9	1	6	0	9	0	3
Northbound Through		55	135	32	123	57	143	12	65
Southbound Through		3	15	3	25	4	20	1	11
Total Future Conditions (2015) - Pure Feed									
Eastbound Left Turn	150	5	24	0	7	9	37	1	12
Eastbound Through		202	327	60	108	298	471	31	103
Eastbound Right Turn	190	2	22	0	18	4	23	0	17
Westbound Left Turn	120	28	80	18	74	25	75	8	43
Westbound Through		38	111	157	416	35	102	72	209
Westbound Right Turn	120	0	9	0	6	0	9	0	3
Northbound Through		45	119	25	105	54	137	11	61
Southbound Through		2	14	3	25	4	21	1	12
Total Future Conditions (2020) - Mixed Feed									
Eastbound Left Turn	150	8	35	1	9	16	51	2	15
Eastbound Through		453	697	150	218	738	917	113	188
Eastbound Right Turn	190	8	32	0	16	9	26	0	16
Westbound Left Turn	120	82	182	38	127	51	117	15	63
Westbound Through		77	195	413	834	136	174	145	393
Westbound Right Turn	120	0	9	1	5	0	9	0	3
Northbound Through		87	195	55	190	94	204	20	87
Southbound Through		4	20	6	37	6	27	2	16
Total Future Conditions (2020) - Pure Feed									
Eastbound Left Turn	150	8	34	1	9	16	52	2	15
Eastbound Through		416	665	140	217	730	900	112	186
Eastbound Right Turn	190	7	29	0	16	8	26	0	16
Westbound Left Turn	120	57	140	31	114	44	104	13	59
Westbound Through		72	187	381	834	136	174	144	391
Westbound Right Turn	120	0	9	1	5	0	9	0	3
Northbound Through		71	173	43	161	90	196	18	81
Southbound Through		4	19	6	37	6	27	2	16

PEDESTRIAN ACCESS

An effective pedestrian circulation plan will be implemented to encourage a safe and accessible walking path for students residing within a 0.8 to 1.0 mile radius from the school. The following components will be implemented:

- In order for students residing on the east side of Relocated Route 659, wanting to walk to the school, pedestrian crossings will be provided at both the school entrances (Road A and Road B) on Relocated Route 659.
- All-Way stop controls (based on VDOT review and approval) will be implemented at the intersections of Road A and Road B with Route 659, to allow for the safe east-west passage of students across Relocated Route 659.
- Adult school crossing guards will be required during school opening and closing hours, to guide children safely across Route 659 relocated. These safe and accessible crosswalks will link the school campus with the surrounding community.
- Key areas of the school campus will be connected with sidewalks, trails and pathways. Road A and Road B will provide the predominant routes for vehicles to access the schools, however the internal roads will have traffic calming measures to limit speeds and allow for a safer pedestrian environment.
- The plan will extend the sidewalk/trail along the north side of the Elementary School parking lot and continue around the softball field to the western school property boundary to allow for a connection to the adjacent Westport Residential development.
- The ultimate configuration (long term plan) for Relocated Route 659 in the vicinity of the proposed schools calls for a six-lane divided section from Route 50 to Braddock Road. It is designated as a minor arterial and anticipated to carry local and regional traffic, with a planned interchange at Route 50. The ultimate configuration for Route 659 relocated is anticipated to trigger the need for traffic and pedestrian signals at the school entrances to allow for a safe passage of students across relocated Route 659.

CONCLUSIONS

This report presents the findings of a traffic impact analysis for the proposed Elementary School (ES) and High School (HS-7) to be located in Loudoun County, Virginia. The proposed schools will be located along Goshen Road, west of Gum Spring Road (Route 659), north of Braddock Road (Route 620) and south of Route 50 in Loudoun County, Virginia. The schools will be built on an assemblage of properties of approximately 97 acres. A special exception on the property is being proposed to allow for the construction of a High School and an Elementary School, comprising of approximately 1,800 students and 875 students, respectively. The proposed development will be phased, with the High School (HS) anticipated to open in 2012 and the Elementary School (ES) anticipated to open in 2015.

The analysis presented in this report supports the following major conclusions:

- The proposed development plan consists of approximately 97 acres and proposes a special exception on the property to allow for the construction of a High School and Elementary School comprising of approximately 1,800 and 875 students, respectively.
- The proposed High School is anticipated to be open by 2012.
- The proposed Elementary School is anticipated to be open by 2015.
- The following is a summary of the planned improvements/mitigations required to accommodate existing and future regional and local traffic:
    - **Existing Conditions (2009):**

      All study intersections operate at acceptable levels of service under existing conditions, except for the intersection of Braddock Road and Gum Spring Road. At the time, the traffic counts were conducted in November 2009; construction for the following planned improvements was in progress. Hence, the following planned improvements were included as planned mitigation measures for this intersection *(These improvements are part of the transportation proffers for the approved Kirkpatrick Farms development – ZMAP 1995-0014/ZCPA 2004-0009. Please refer to Appendix T)*:

      Intersection of Braddock Road and Gum Spring Road:

      - Add a traffic signal (planned),
      - Modify eastbound approach to a separate right turn lane and a shared through-left turn lane (planned),
      - Modify westbound approach to a separate right turn lane and a shared through-left turn lane (planned),
      - Modify northbound approach to a separate left turn lane and a separate through lane and a shared through-right turn lane (planned), and,

- Modify southbound approach to a separate right turn lane, two separate through lanes and a separate left turn lane (planned)
- With the planned improvements listed above in place, the intersection of Braddock Road and Gum Spring Road will operate at acceptable levels of service.

o **Future Conditions without Development (2012):**

The following improvement in the vicinity of the proposed development were assumed to be in place by 2012:

- Planned construction of a two-lane section of Relocated Route 659 (Northstar Boulevard) from Tall Cedars Parkway to Braddock Road
- Planned paving of Braddock Road from Great Berkhamstead Drive to Goshen Road (approx. 0.3 mile section). Great Berkhamstead Drive provides access to the Stratshire Crossing (Braddock Crossing) residential development

All study intersections operate at acceptable levels of service under future conditions without development, except for the intersection of Braddock Road with Gum Spring Road and Goshen Road with Route 50. The following improvements are recommended under this scenario:

Intersection of Braddock Road and Gum Spring Road:

- Add a separate eastbound left turn lane (planned);
- Add a separate westbound left turn lane (planned);
- Adjust signal timings and phasing (recommended)

The minor approach (Goshen Road) at the intersection of Route 50 and Goshen Road continues to operate at unacceptable levels of service conditions, however a traffic signal is not warranted. The queuing results show that the maximum queue does not exceed the turn bay lengths.

o **Future Conditions with Development (High School Build Out – 2012)**

All study intersections operate at acceptable levels of service under future conditions with development (2012) conditions**.** The following improvements are recommended under this scenario:

Intersection of Braddock Road and Relocated Rt. 659 (Northstar Boulevard):

- Add a westbound right turn lane *(Based on turn lane warrant analysis)*
- Add a southbound left turn lane *(Based on turn lane warrant analysis)*

Intersection of Relocated Gum Spring Road and Road A:

- Add a separate northbound left turn lane;

- Add a separate southbound right turn lane.

Intersection of Relocated Gum Spring Road and Road B:

- Add a separate northbound left turn lane;
- Add a separate southbound right turn lane.

The minor approach (Goshen Road) at the intersection of Route 50 and Goshen Road continues to operate at unacceptable levels of service conditions, however a traffic signal is not warranted. The queuing results show that the maximum queue does not exceed the turn bay lengths.

With the proposed School development in place, the existing section of Goshen Road between Braddock Road and Road A just north of the High School building on the school property will be abandoned. The planned construction of Relocated Route 659 will replace this section of Goshen Road and provide a safer and paved north south access.

o Future Conditions without Development (2015)

The following planned improvements in the vicinity of the proposed development were assumed to be in place by 2015:

- West Spine Road: is a planned four-lane corridor to run between Route 50 just east of existing Route 659, and continuing south to join the present alignment of existing Route 659 at Tall Cedars Parkway. As part of this planned roadway, existing Route 659 connection to Route 50 will be eliminated.
- As part of the Westport By-Right Development, there are plans to eliminate the existing severe curve on Goshen Road just south of Route 50 with a four-leg 90-degree intersection. Goshen Road will terminate at the proposed Westport Boulevard, which will form the southern leg of the new 90-degree intersection. A signal is also planned at this intersection.

All study intersections operate at acceptable levels of service under future conditions without development (2105). The following planned improvements were incorporated under this scenario:

Intersection of Rt. 50 and Goshen Road:

- Eliminate existing severe curve on Goshen Road just south of Route 50 with a four-leg 90-degree intersection (planned)
- Goshen Road will terminate at the proposed Westport Boulevard, which will form the southern leg of the new 90-degree intersection (planned)
- Add traffic signal (Signal is warranted - planned)

Intersection of Tall Cedars Parkway and West Spine Road:

- Realign northbound leg (planned)
- Add 2nd through lane in northbound and southbound direction (planned)

- **Future Conditions with Development (Elementary School Build Out - 2015)**

  All study intersections operate at acceptable levels of service under future conditions with development (2015) conditions.

- **Future Conditions with Development plus five years (2020)**

  All study intersections operate at acceptable levels of service under future conditions with development (2020) conditions with the following recommended improvements in place:

  Intersection of Braddock Road and West Spine Road/Gum Spring Road:

  - Add 2nd eastbound through lane (recommended)
  - Add 2nd westbound through lane (recommended)
  - Add 2nd eastbound left turn lane (recommended)

  Intersection of Tall Cedars Parkway and West Spine Road:

  - Add a traffic signal (recommended)

  Intersection of Braddock Road and Relocated Route 659 (Northstar Boulevard):

  - Add a traffic signal (recommended)

- The analysis presented in the traffic study shows that with the planned and recommended improvements in place, all study intersections will operate at acceptable levels of service conditions. The improvements identified under future conditions with development plus five years (2020) are due solely to background traffic, not traffic to and from the proposed school. Loudoun County Public Schools is not responsible for correcting the background traffic related impacts post build out of the proposed schools.