EXECUTIVE SUMMARY

TRANSPORTATION PLANNING REPORT
Improvements to SR 249/Luyben Hills Road
From South of I-40 to SR 249/Kingston Springs Road, Kingston Springs, TN
July 2009

SR 249/Luyben Hills Road, at Exit 188 off I-40, is an important corridor for the Town of Kingston Springs and Cheatham County. It serves as a link between I-40 and portions of Cheatham County and Dickson County (along US 70), including the towns of Kingston Springs, Pegram, and White Bluff. In addition, the corridor provides access from I-40 to the Harpeth River and Montgomery Bell State Parks. Finally, Exit 188 is a well-used interchange for semi-tractor trailer (truck) traffic. Trucks use this interchange frequently to access the truck stop south of I-40, which is the first truck stop west of Nashville. Trucks and other vehicles also utilize the SR 249/Luyben Hills Road corridor as a detour route when crashes occur on I-40.

As a result of a letter from the Kingston Springs Mayor, TDOT initiated a Transportation Planning Report (TPR) to study improvements to the interchange and corridor, and a kickoff meeting with stakeholders was held on November 7, 2008. The study area is SR 249/Luyben Hills Road from just south of I-40, through the SR 249/I 40 interchange and north to Kingston Springs Road, a distance of 2,250 feet (0.426 miles).

Purpose and Need

Through coordination with local officials and stakeholders, the preliminary need for the study has been identified:

- Improve vehicular, bicycle and pedestrian safety;
- Eliminate roadway deficiencies, such as the high number of access points;
- Address local mandate to improve aesthetics, safety and roadway functions of the corridor. Mandate was derived from a 2008 American Institute of Architects Blueprint for America Community Assessment Workshop.

Options Analyzed

The TPR presents one option for improvements to the SR 249/I-40 interchange, two options for improvements to the SR 249/Luyben Hills Road corridor, and an optional roundabout at the northern project terminus (Kingston Springs Road).

<u>SR 249/I-40 Interchange</u>: The improvement proposes to replace the existing shoulders with six-foot wide sidewalks through the interchange. A handrail will be attached to the top of the existing bridge rails. A signal warrant analysis has indicated that a traffic signal is supported at the I-40 westbound ramps. No additional Right-of-Way (ROW) is required for these improvements.

<u>SR 249/Luyben Hills Road Corridor</u>: No ROW is needed for either of the options to improve the roadway through the corridor. Both options involve two 12-foot travel lanes and a 12-foot center turn lane, access management improvements, and the installation of bicycle and pedestrian facilities and landscape buffers. Other streetscaping amenities will be considered in the project design phases. The difference between the two options is:

- Option 1 has: 6-foot wide sidewalks, on-street bike lanes, curbed islands and 6-foot shoulders; and
- Option 2 has a 10-foot multi use path to accommodate pedestrians and bikes, curb and gutter and no shoulders.

Roundabout: The construction of a roundabout at the SR 249/Luyben Hills Road and Kingston Springs Road intersection would improve safety and provide a place for misdirected truck traffic to turn around, while also creating a strong gateway to the Kingston Springs community. The concept involves an "Urban Compact" roundabout with a 100-foot inscribed diameter that would be of sufficient size to allow truck traffic to carefully make a U-turn while minimizing impacts to adjacent properties. The roundabout would have one 18-foot travel lane and a 16-foot truck apron. The center of the roundabout would be about 32 feet in diameter, and could be landscaped with low shrubs. Although it is a tight turn for truck traffic and they will likely make the turn at very low speeds, this size roundabout can accommodate truck traffic (as well as school bus traffic).

Costs

Cost estimates based on the preliminary concepts are provided in the table below. In order to account for variation in bid prices, both high and average totals are listed, resulting in a range of costs for each alternate. Inflation costs were applied to the total estimated construction and preliminary engineering costs at a rate of six percent over five years (as per TDOT TPR cost estimating guidance).

Planning Level Costs*	Average Total	High Total
SR 249/Luyben Hills Road Option 1 (includes interchange improvements)	**$2,365,421**	**$2,832,866**
SR 249/Luyben Hills Road Option 2 (includes interchange improvements)	**$2,603,216**	**$3,134,221**
SR 249/Luyben Hills Road and Kingston Springs Road Roundabout	**$504,819**	**$759,337**

*It is important to note that landscaping and streetscaping are typically not eligible for state or federal funding (with the exception of enhancement funds), so alternative funding sources would need to be identified.

TRANSPORTATION PLANNING REPORT

State Route 249/Luyben Hills Road

FROM INTERSTATE 40 TO STATE ROUTE 249/KINGSTON SPRINGS ROAD
KINGSTON SPRINGS, CHEATHAM COUNTY
PIN # 112162.00

PREPARED BY
GRESHAM, SMITH & PARTNERS
For the
TENNESSEE DEPARTMENT OF TRANSPORTATION
PROJECT PLANNING DIVISION

Approved by:	Signature	DATE
CHIEF OF ENVIRONMENT AND PLANNING	Ed Cole	7/2/09
TRANSPORTATION DIRECTOR PROJECT PLANNING DIVISION	Steve Allen	7-1-09
TRANSPORTATION MANAGER 2 PROJECT PLANNING DIVISION	Bill Hart	6/23/09

This document is covered by 23 USC § 409 and its production pursuant to fulfilling public planning requirements does not waive the provisions of § 409.

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1.0 PURPOSE OF THE TRANSPORTATION PLANNING REPORT

The subject of this Transportation Planning Report (TPR) is a 0.426 mile segment of the State Route (SR) 249/Luyben Hills Road corridor in the Town of Kingston Springs, Cheatham County, Tennessee. For the purposes of this TPR, the corridor improvements considered have been divided into three study sections: the Interstate 40 (I-40) and SR 249/Luyben Hills Road Interchange (I-40/SR 249 Interchange) (Exit 188); the SR 249/Luyben Hills Road corridor from the I-40/SR 249 Interchange to SR 249/Kingston Springs Road, and the SR 249/Luyben Hills Road and Kingston Springs Road intersection. Figure 1 depicts the project in its regional context, while Figures 2 and 3 depict the proposed project's location.

In a letter dated September 16, 2008, Kingston Springs' Mayor John McLeroy wrote to the Tennessee Department of Transportation (TDOT) requesting planning assistance for the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor. On October 7, 2008, TDOT Commissioner Gerald Nicely responded that the Department would work with the community to provide planning assistance for the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor. As a result, TDOT began the TPR process for the interchange and corridor, and a kickoff meeting with stakeholders was held on November 7, 2008.

This TPR is intended to identify:

- The proposed project's history;
- The context (setting) of the study area;
- The preliminary need and purpose (goals);
- Stakeholder issues identified early in planning;
- Options developed to satisfy the need;
- Costs of options;
- Potential environmental issues; and
- The proposed project's adherence to TDOT's guiding principles.

The completed TPR will provide the data needed to take the project to the next step, which may be a National Environmental Policy Act (NEPA) document if federal funding assistance is identified (or a Tennessee Environmental Evaluation Report [TEER] if state funding assistance is identified). As previously stated, this TPR will present and evaluate options developed in the planning process. It will also provide a planning level cost estimate that can be used for budgeting purposes. Lastly, through the use of screening for environmental issues, avoidance of sensitive resources or community impacts can be addressed and considered early in the planning process.

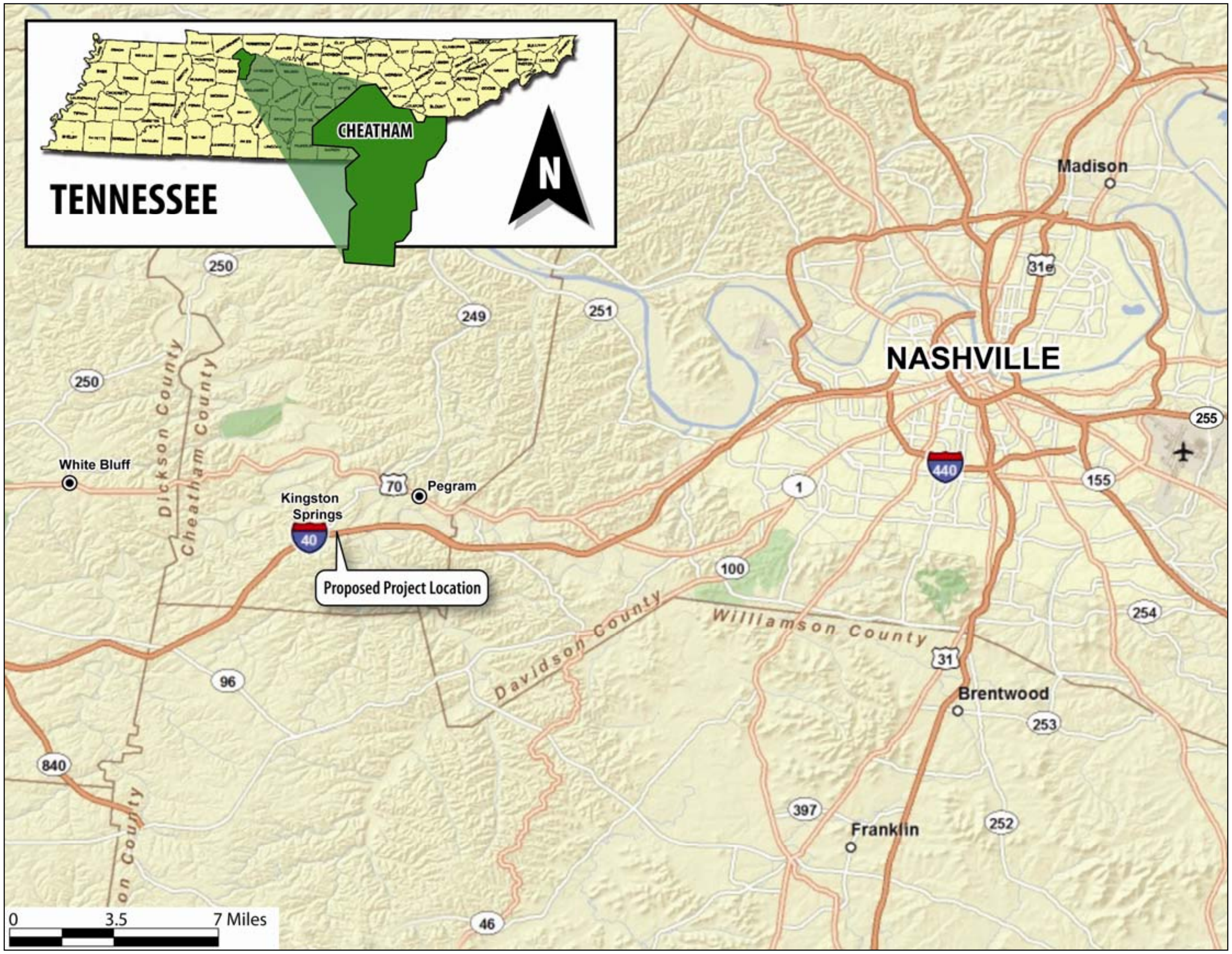


Figure 1. Proposed Project Within its Regional Context

Figure 2. Proposed Project Location Map

Figure 3. Aerial Photograph of Proposed Project Area and Setting

2.0 PROPOSED PROJECT BACKGROUND

SR 249/Luyben Hills Road, which is designated as a Rural Major Collector, is a critical corridor for the Town of Kingston Springs and Cheatham County. It serves as an important link between I-40 and portions of Cheatham County and Dickson County (along US 70); including the Towns of Kingston Springs, Pegram and White Bluff (refer to Figure 1). In addition, the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor provides access to the Harpeth River State Park and the Montgomery Bell State Park from I-40. The corridor, which is lined by gas stations, restaurants and hotels and provides access to some of the town's largest undeveloped commercially-zoned lots, is also a critical commercial corridor for the Town of Kingston Springs. Finally, the I-40/ SR 249 Interchange is a well-used interchange for semi-tractor trailer (truck) traffic. Trucks use this interchange frequently to access the truck stop south of I-40, which is the first truck stop west of Nashville. Trucks, as well as other vehicles, also utilize the SR 249/Luyben Hills Road corridor as a detour route when crashes occur on I-40.

The SR 249/Luyben Hills Road corridor and its deficiencies have been a matter of discussion in the Kingston Springs community for a long time. Over the years, community discussions revealed the fact that the corridor does not adequately act as a gateway reflecting the character of their community. Community discussions have also centered on how the corridor can safely accommodate its high volumes of truck traffic while also safely serving pedestrians and vehicles.

Over the years, the Town of Kingston Springs and its residents have had several conversations with TDOT about possible improvements to the SR 249/Luyben Hills Road corridor and the topic was discussed at the public hearing for improvements to SR 249/Kingston Springs Road. The installation of sidewalks along SR 249/Kingston Springs Road has resulted in an increased number of pedestrians in the area, including along the SR 249/Luyben Hills Road corridor. As the number of pedestrians along the SR 249/Luyben Hills Road has increased, the community's concerns about and desire for pedestrian accessibility and safety have continued to grow.

Participants of the AIA Workshop assessed the Town of Kingston Springs' strengths, weaknesses, opportunities and risks. (Source: *AIA 150 Blueprint for America Community Assessment and Visioning Workshop Summary Report*)

In March 2008, an American Institute of Architects (AIA) 150 Blueprint for America Community Assessment and Visioning Workshop (AIA Workshop) was conducted for the Town of Kingston Springs. This workshop was the result of a partnership between the Town of Kingston Springs, AIA Middle Tennessee, Cumberland Region Tomorrow, the Greater Nashville Regional Council (GNRC), the Nashville Civic Design Center and the University of Tennessee College of Architecture and Design. One of the main goals of this planning process was to address the interrelated challenges of revitalizing town centers and conserving open land. This issue is particularly salient in the Town of Kingston Springs, given its rapid growth in recent years. The I-40/SR 249

Interchange and corridor was a frequent topic of discussion over the course of the two-day AIA workshop, and there was consensus that, while the SR 249/Luyben Hills Road corridor is generally regarded as one of the town's two vital "town centers", the corridor is characterized by strip commercial development that the community finds unattractive and in conflict with Kingston Springs' quaint, small-town character. In addition, the community expressed consensus that the interchange and corridor do not function well. As a result, the workshop's report calls for the town's leadership to work with TDOT on roadway design recommendations that employ Context Sensitive Design (CSD) principles.

As discussed in Section 1.0 of this report, Mayor John McLeroy formally contacted TDOT requesting planning assistance for the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor on September 16, 2008. In a letter dated October 7, 2008, TDOT Commissioner Gerald Nicely responded that TDOT would work with the community to provide planning assistance for the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor. In response, TDOT began the TPR process for the interchange and corridor, and a kickoff meeting with stakeholders was held on November 7, 2008.

3.0 EXISTING CONDITIONS

3.1 Community Characteristics

As previously stated, the study area for the proposed project is located in the Town of Kingston Springs, Cheatham County, Tennessee. Kingston Springs is generally regarded as a bedroom community of Nashville, which is approximately 15 miles to the east. The Harpeth River flows through the town, and Kingston Springs is surrounded by farms and open space. Kingston Springs is known for its rich history, its small town character and its scenic beauty. According to the 2008 AIA Workshop, Kingston Springs' residents value its small town sense of community, its parks and natural resources and its convenient access to I-40.

Population and Growth

In 2007, Kingston Springs had a population of 2,923 people. For comparison purposes, the population for both Cheatham County and the State of Tennessee are shown in Table 1. Between 1990 and 2007, Kingston Springs experienced a 91.2 percent increase in population, as compared to 44.1 percent for Cheatham County and 26.2 percent in Tennessee as a whole.

Table 1: Population Growth

	Population			Percent Change 1990-2007
	1990	2000	2007	
Tennessee	4,877,185	5,689,283	6,156,719	26.2%
Cheatham County	27,140	35,912	39,112	44.1%
Kingston Springs	1,529	2,773	2,923	91.2%

Source: US Census 1990 and 2000 and 2007 US Census Population Estimates

According to the Tennessee Department of Economic and Community Development, the population in Cheatham County in 2008 is 39,957, and it is forecasted to grow by six percent to 42,355 by 2013.

As reflected in the above statistics, the Town of Kingston Springs (and Cheatham County as a whole) has faced a tremendous amount of growth pressure in recent years. During the 2008 AIA workshop, there was a clear consensus amongst participants that growth needs to be guided in a way that conserves open space and preserves community character.

Major Employers and Traffic Generators

The largest employment sector in Cheatham County is manufacturing. According to statistics compiled by the US Department of Labor, 35.0 percent of Cheatham County's employed population work in the manufacturing sector, which is considerably higher than the statewide percentage of 13.8; however, these manufacturing jobs (e.g., A.O. Smith, Triton Boats and Trinity Marine) are located in north Cheatham County and they rarely utilize the SR 249/Luyben Hills Road corridor. Instead, most of the traffic on SR 249/Luyben Hills Road is generated from the US 70 corridor, which connects Kingston Springs, Pegram and White Bluff to I-40, and from commercial activity along SR 249/Luyben Hills Road itself.

SR 249/Luyben Hills Road is a highway commercial corridor that serves as an important link in the region’s transportation system. It not only provides access to I-40 for the Town of Kingston Springs, it also connects I-40 and US 70, which serves the towns of Pegram and White Bluff. This is a critical link in the area’s transportation network given that 59 percent of Cheatham County residents commute to Nashville-Davidson County for work (2000 Census). The Town of Kingston Springs estimates that 75 percent of their workforce commutes to Nashville-Davidson County for work. Accordingly, the SR 249/Luyben Hills Road experiences considerable volumes of peak hour traffic as residents commute to and from work via I-40. SR 249/Luyben Hills Road also provides access to the Harpeth River State Park and the Montgomery Bell State Park, two important travel destinations in Middle Tennessee.

SR 249/Luyben Hills Road is a highway commercial corridor that serves as an important link between I-40 and US 70.

SR 249/Luyben Hills Road is also one of two primary commercial areas serving the Town of Kingston Springs (the other is downtown Kingston Springs). Residents frequently utilize the corridor to access commercial and retail services, such as the Kingston Springs U.S. Post Office, Heritage Bank and area restaurants.

Exit 188, the I-40/SR 249 Interchange, is a well-used interchange for truck traffic. A large truck stop, which is the first truck stop west of Nashville, is located south of I-40 on SR 249/Luyben Hills Road (see Figure 3). Truck traffic uses this interchange at all hours of the day to access the truck stop’s restaurant, gas station, weigh stations, or overnight parking. Often, trucks mistakenly turn north on SR 249/Luyben Hills Road and then have difficulty turning around. Truck traffic also utilizes the SR 249/Luyben Hills Road corridor as a detour route when there is a crash on I-40.

Finally, there is a mobile home park located on the west side of the corridor, behind the Midtown Inn and Suites (see Figure 3). While this development does not generate a substantial amount of traffic, Cheatham County school buses stop on SR 249/Luyben Hills Road in front of the Midtown Inn and Suites regularly during the school year.

Potential Future Coordination

Close coordination regarding utilities in the area must occur. In addition, Kingston Springs Elementary School, Harpeth Middle School and Harpeth High School are all located on Kingston Springs Road, at the north end of the project corridor. School buses regularly utilize the corridor, so coordination with the Cheatham County School District should be undertaken in future planning phases.

3.2 Land Use

The land uses along SR 249/Luyben Hills Road corridor consist of commercial land uses that are characteristic of a highway commercial district.

The subject segment of SR 249/Luyben Hills Road consists of commercial and retail land uses that are characteristic of a highway commercial district. Corridor businesses include gas stations, fast-food restaurants, motels, and restaurants. The Kingston Springs U.S. Post Office is located near the project's northern terminus (refer to Figure 3), and Harpeth Bank is located in the southwest quadrant of the SR 249/Luyben Hills Road and Kingston Springs Road intersection. Single-family residences are located north and south of the study corridor, and, as previously mentioned, a mobile home park is located on the west side of the corridor, behind the Midtown Inn and Suites. As shown on Figure 2 (page 3), three schools are located north of the study area as well, South Cheatham Junior High School, Harpeth Middle School and Harpeth High School.

According to the Town of Kingston Springs, several undeveloped or underdeveloped parcels are located in the vicinity of the project corridor. The parcel that was discussed at the greatest length during the field review is located east of the SR 249/Luyben Hills Road businesses, and is accessed via the gravel drive between the I-40 westbound exit ramp and McDonald's. This parcel, as well as the other undeveloped and underdeveloped parcels, represents an important future commercial development opportunity for the town. As previously stated, the Town of Kingston Springs is concerned with guiding growth and conserving open land. Since the study corridor is one of the town's two "Town Centers", much of the future growth will likely be directed towards this corridor.

3.3 Crash History

The Tennessee Roadway Information Management System (TRIMS) provides data for use in calculating crash rates for comparison to statewide averages. **Table 2** presents a summary of currently available crash data for the study segment.

Table 2. Crash Data

Location	Actual Crash Rate	Statewide Average	Total Crashes	Fatal Crashes	Incapacitating Injury Crashes
I-40 to Kingston Springs Road	9.830	1.701	33	0	1

The statewide average crash rate for a roadway of the same functional classification as SR 249/Luyben Hills Road (Rural Major Collector) is 1.701, while the actual rate for the corridor from I-40 to Kingston Springs Road is 9.830. The actual rate is derived from a formula that takes into account factors such as total number of crashes, length of roadway and the time period over which the crashes occurred. An actual crash rate three times greater than the statewide average for a similar roadway indicates a safety deficiency. In this case, the actual rate for this segment of roadway is much greater than three times the statewide average, indicating a safety deficiency along the SR 249/Luyben Hills Road corridor.

From 2004 to 2006, the most recent years for which data had been compiled at the start of this study, 33 crashes occurred along the subject segment of SR 249/Luyben Hills Road. Nine of those crashes were rear end crashes, eight were angle crashes, six were sideswipe same direction crashes, two were head-on crashes and one was a sideswipe opposite direction crash. The relatively high number of rear end, angle and sideswipe crashes can be attributed, in part, to the large numbers of curb cuts in the study area, which result in vehicles constantly slowing to turn in and out of parking lots.

Of the 33 crashes that occurred during the three study years, over half took place in the vicinity of the I-40/SR 249 Interchange. Thirteen took place along the SR 249/Luyben Hills Road corridor, and three occurred at the intersection of SR 249/Luyben Hills Road and Kingston Springs Road.

Finally, the number of crashes along the subject segment of SR 249/Luyben Hills Road grew each year between 2004 and 2006. In 2004, there were four crashes along this segment of roadway, compared to nine in 2005 and 20 in 2006. This represents a four hundred percent increase in the number of crashes between 2004 and 2006. According to TDOT traffic counts, the Annual Average Daily Traffic (AADT) grew by approximately 13 percent between 2004 and 2006. As the population and traffic in Kingston Springs and Cheatham County continues to grow, safety concerns associated with the I-40/SR 249 Interchange will likely continue to increase as well.

3.4 Geometrics

SR 249/Luyben Hills Road is classified as a Rural Major Collector. The study corridor is approximately 0.31 mile long, extending from the I-40/SR 249 Interchange at log mile 0.00 to SR 249's 90-degree turn onto Kingston Springs Road at log mile 0.31. Data from TDOT's Tennessee Roadway Information Management System (TRIMS) database was used as the basis for the geometric analysis. A field review was conducted to verify TRIMS data that was easily verifiable in the field. This field review was supplemented by a review of TDOT plans for the I-40/SR 249 Interchange (dated 1959) and Kingston Springs Road (dated May 17, 2001), as well as consulting GIS. The review of the plans has revealed that some areas along the roadway have right-of-way (ROW) that differs from that included in the TRIMS database.

A summary of geometric data is provided in Table 3. There are currently no provisions for bicycles or pedestrians along the corridor, which features rolling terrain and numerous commercial driveways. The only existing traffic signal in this segment is at Kingston Springs Road at the northern project terminus.

Table 3: Existing Roadway Geometrics

Roadways	Log Miles	ROW in Feet	Total Lanes	Average Lane Width in Feet	Average Shoulder Width in Feet	Median Type	Average Median Width in Feet	Bicycle Facilities	Average Sidewalk Width in Feet	Topography
Begin SR S49/Luyben Hills Road to I-40 Westbound Ramps	0.00 – 0.07	120'	2-3	12'	6'	Left Turn Lanes	0'-12'	None	None	Rolling
I-40 West Bound Ramps to Kingston Springs U.S. Post Office (USPS)	0.07 – 0.24	100'	3	12'	6'	2-Way Left Turn Lane	12'	None	None	Rolling
Kingston Springs USPS to Kingston Springs Road Intersection	0.24 – 0.31	70'-80'	3	11'	0' (curb & gutter)	2-Way Left Turn Lane/ Signalized Left Turn Lane	11'	None	None	Rolling

Source: TDOT TRIMS Database and February 5, 2009 field review by project team.

I-40/SR 249 Interchange

The I-40/SR 249 Interchange is a standard diamond interchange. A diamond interchange is a four-legged interchange with each leg operating as a one-way roadway into the intersection (see Figure 4). North of I-40, the interchange has two ramps for westbound traffic entering or exiting I-40. South of I-40, the interchange has two ramps for eastbound traffic entering or exiting I-40. SR 249/Luyben Hills Road is elevated over I-40, allowing thru traffic on the interstate to continue unimpeded. Through the interchange, SR 249/Luyben Hills Road consists of two 12-foot travel lanes with six-foot shoulders. In the vicinity of the eastbound I-40/SR 249 Interchange ramps, there is a striped median that transitions into a 12-foot left-turn lane for vehicles traveling westbound on I-40 (see photographs on page 12).

Currently, the interchange is unsignalized. A signal warrant analysis was prepared for the I-40/SR 249 Interchange, and is discussed in Section 3.5 of this report. Typically, as traffic increases on diamond interchanges, they are signalized so that the traffic operation for the vehicles turning left onto and off of the interchange is not impeded.

Figure 4. Aerial Photograph of the SR 249/Luyben Hills Road Interchange.
Source: Microsoft Live Search Maps

SR 249/Luyben Hills Road Corridor

From the I-40/SR 249 Interchange northward to the Kingston Springs U.S. Post Office, SR 249/Luyben Hills Road consists of two 12-foot travel lanes, a 12-foot two-way left-turn lane and six-foot shoulders within 100 feet of ROW.

Between the U.S. Post Office and the traffic signal for Kingston Springs Road, SR 249/Luyben Hills Road consists of a southbound 11-foot travel lane, an 11-foot dedicated right-turn lane, and 11-foot combined left-turn and through lane and curb and gutter within 70 to 80 feet of ROW.

Figure 5 contains photographs of the corridor.

Figure 5. SR 249/Luyben Hills Road Corridor

View of SR 249/Luyben Hills Road from the south.

View of the I-40 and SR 249/Luyben Hills Road interchange from north of I-40.

View north at the Kingston Springs Road and US 249/Luyben Hills Road intersection.

3.5 Level of Service Analysis & Traffic Signal Warrant Analysis

Traffic data for the SR 249/I-40 interchange was provided by TDOT for this study. The AADT and the Design Hour Volumes (DHV) for the AM and PM peak hours for the base year of 2010 and the design year of 2030 were provided for each of the major movements within the I-40/SR 249 Interchange area. The full traffic study, including a level of service (LOS) analysis and a signal warrant analysis, is in Appendix B. The growth rate used by TDOT to project the traffic to the design year was 2.686 percent.

In addition to the TDOT-provided traffic data, a 12-hour turning movement count at each of the intersections at the interchange was performed (SR 249/Luyben Hills Road and I-40 westbound ramps, and SR 249/Luyben Hills Road and I-40 eastbound ramps) as part of this study. The data, collected on February 4, 2009, is broken down by numbers of automobiles, trucks and buses and is included in Appendix B. The purpose of collecting 12 hours of traffic data was to have adequate data to perform a signal warrant analysis for each of the ramp intersections. The collected traffic data was projected to the base year of 2014 and the design year of 2034 using the same growth rate that TDOT used for SR 249/Luyben Hills Road (i.e., 2.686 percent). This growth rate was also used for the LOS analysis of SR 249/Luyben Hills Road and the ramp intersections.

SR 249/Luyben Hills Road, a two-lane highway with a two-way left-turn lane, is projected to carry a 2009 AADT of 6,330 (south) to 12,183 (north) vehicles per day, using the TDOT provided traffic data and the growth rate mentioned above, in the vicinity of the I-40/SR 249 Interchange. SR 249/Luyben Hills Road is projected to carry a 2014 AADT of 7,227 (south) to 13,910 (north) vehicles per day and a 2034 AADT of 12,280 (south) to 23,635 (north) vehicles per day in the vicinity of the I-40/SR 249 Interchange. From 2009 to 2014, the AADT is projected to increase 14.2 percent, and between 2009 and 2034, the increase projected is 94.0 percent. According to TDOT traffic data, the I-40/SR 249 Interchange carries approximately 18 percent truck traffic.

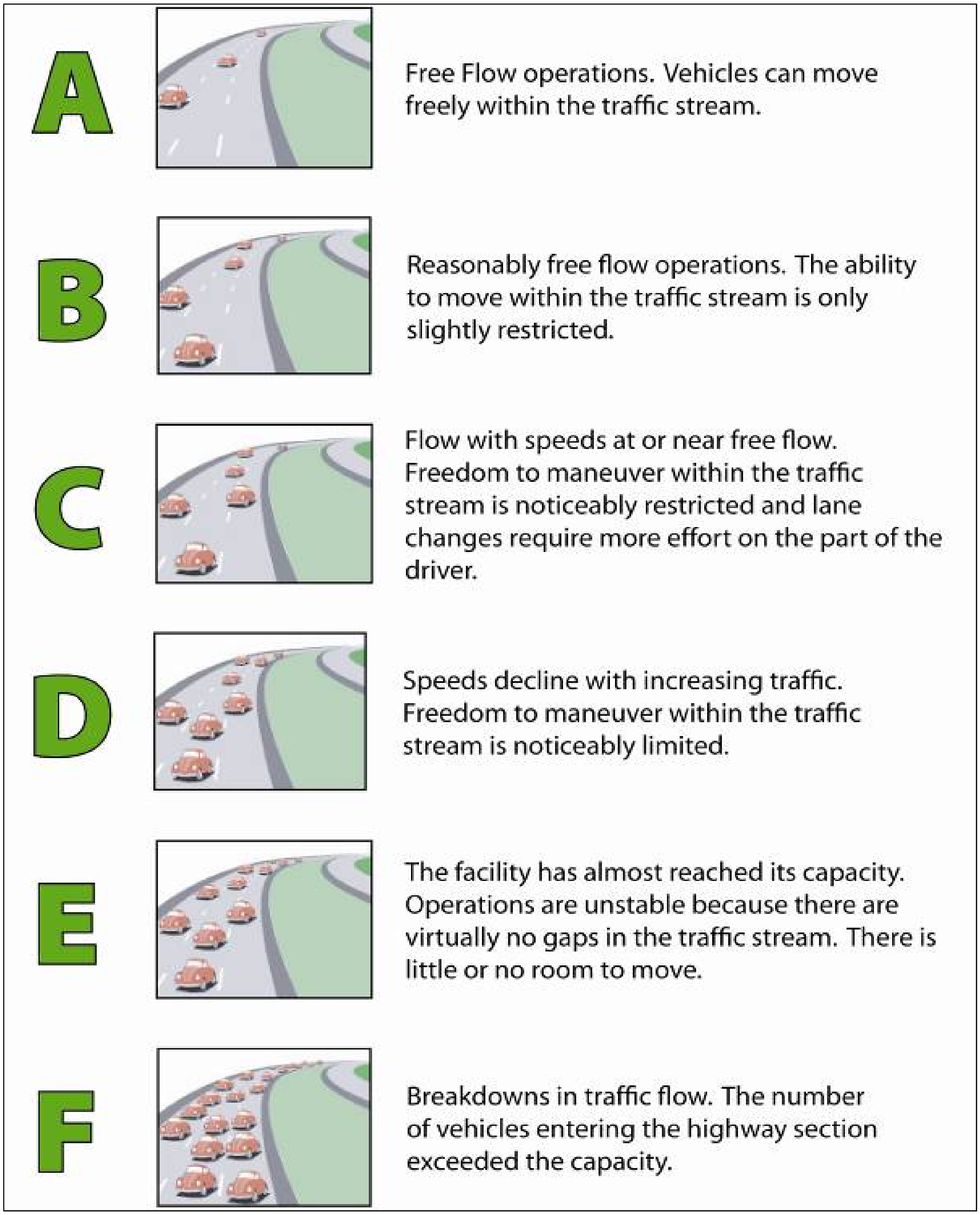
Level of Service Analysis of SR 249/Luyben Hills Road

An LOS analysis for SR 249/Luyben Hills Road was used to gauge the operational performance of the existing roadway. The proposed project's purpose and need is to address safety issues and roadway deficiencies along SR 249/Luyben Hills Road while improving pedestrian accessibility and safety (see Section 5.0 of this report). Because the study is not intended to address poor vehicle levels of service, the LOS analysis does not include a Build and No Build Scenario. Furthermore, there is no available traffic analysis tool that will analyze the impact of sidewalk and access management improvements on LOS.

LOS is a qualitative measure that describes traffic conditions related to speed and travel time, freedom to maneuver and traffic interruptions. There are six levels, ranging from "A" to "F" with "F" being the worst. Each level represents a range of operating conditions. Figure 6 illustrates the traffic flow conditions and approximate driver comfort level at each LOS.

The traffic analysis for the segment of SR 249/Luyben Hills Road from the I-40/SR 249 Interchange to the intersection with Kingston Springs Road was performed using HCS+ software for both the AM and PM Peak Hour conditions for the present year (2009), the base year (2014) and the design year (2034). The traffic collected on February 4, 2009

Figure 6. Definition of Level of Service



was used for the analysis and was projected to the base year and design year using the TDOT growth rate of 2.686 percent.

Table 4 summarizes the peak hour LOS analysis for the SR 249/Luyben Hills Road Corridor in the present year (2009), the base year (2014) and the design year (2034).

Table 4. Peak Hour LOS Analysis for SR 249/Luyben Hills Road Corridor

	Two-Way Flow Rate (pc/h)	Level of Service
2009 (AADT=18,513)		
AM	**1,138**	**C**
PM	**1,203**	**C**
2014 (AADT=21,137)		
AM	**1,285**	**D**
PM	**1,374**	**D**
2034 (AADT=35,915)		
AM	**1,977**	**D**
PM	**2,045**	**D**

Source: SR 249/Luyben Hills Road LOS Analysis (see Appendix B)

Unsignalized Intersection Analysis

In order to determine how the I-40/SR 249 Interchange is functioning in its current configuration, an unsignalized intersection analysis was performed using the Highway Capactiy Software (HCS+) for the AM and PM Peak Hour conditions for the present year (2009), the base year (2014) and the design year (2034). The traffic collected on February 4, 2009 was used for the analysis and was projected to the base year and design year using the TDOT growth rate of 2.686 percent. The HCS printouts are included in Appendix B. The results of the analysis are presented in terms of LOS and Approach Delay (seconds per vehicle) and are illustrated in Tables 5 and 6.

Table 5. Traffic and LOS Analysis for the I-40/SR 249 Interchange, Westbound Ramp

SR 249 and the I-40/SR 249 Interchange Westbound (WB) Ramp	
Analysis Year	**WB Approach LOS**
2009 (Unsignalized)	
AM	**B**
PM	**C**
2014 (Unsignalized)	
AM	**B**
PM	**C**
2034 (Unsignalized)	
AM	**D**
PM	**F**

Source: SR 249/Luyben Hills Road LOS Analysis (see Appendix B)

Table 6. Traffic and LOS Analysis for I-40/SR 249 Interchange, Eastbound Ramp

SR 249 and the I-40/SR 249 Interchange Eastbound (EB) Ramp*		
Analysis Year	Time of Day	EB Approach LOS
2009	AM	F
	PM	C
2014	AM	F
	PM	C
2034	AM	F
	PM	F
* It should be noted that, based on traffic volumes, this intersection does not meet the MUTCD signal warrant; however, a signal may be warranted based on engineering judgment due to the amount of delay experienced by the eastbound approach.		

Source: SR 249/Luyben Hills Road LOS Analysis (see Appendix B)

Traffic Signal Warrant Analysis for the I-40/SR 249 Interchange

The *Manual of Uniform Traffic Control Devices* (*MUTCD*), 2003 Edition developed eight traffic signal warrants to determine if a traffic signal is justified at a given location. The HCS+ Traffic Signal Warrant module, which is based on the eight traffic signal warrants developed for the *MUTCD*, was used to evaluate the need for a traffic signal at the eastbound and westbound ramps of I-40 and SR 249. The traffic volumes were obtained from 12 hours of turning movement counts that were collected on February 4, 2009. The results of the Signal Warrant Analysis are included in Appendix B (including the warrant volume sheets). It should be noted, based on guidance provided in the *MUTCD*, that a Signal Warrant Analysis should be performed within one year of putting the signal into operation. Therefore, it may be necessary to re-perform the traffic signal warrants within the year that the signal(s) will be installed.

<u>I-40 Westbound Ramps and SR 249:</u> Based on collected traffic counts, the intersection of SR 249/Luyben Hills Road and the I-40 westbound ramps meets Warrant 2 - Four Hour Vehicular Volume and Warrant 3 - Peak Hour. If four plotted points based on the approach volumes (vehicles per hour) are above the line shown in Figure 4C-2 in the *MUTCD*, then Warrant 2 is met. Five hours met this requirement:

- 7AM to 8AM;
- 2PM to 3PM;
- 3PM to 4PM;
- 4PM to 5PM; and
- 5PM to 6PM.

In order to meet Warrant 3 for peak hour, at least one hour must be above the line on Figure 4C-4 of the *MUTCD*. Based on the collected traffic, three hours met this requirement:

- 3PM to 4PM;
- 4PM to 5PM; and
- 5PM to 6PM.

<u>I-40 Eastbound Ramps and SR 249:</u> Based on the collected traffic counts, the intersection of SR 249/Luyben Hills Road and the I-40 eastbound ramps does not currently meet any of the eight traffic signal warrants; however, based on engineering judgment and the amount of approach delay experienced for the eastbound approach, a signal may be warranted at this location.

Furthermore, the truck/travel center, located in the southeast quadrant of the interchange, is a major attraction for large volumes of truck traffic. Due to these high volumes of trucks, the operation of the interchange may be negatively impacted if the westbound ramps are signalized and the eastbound ramps are not. If traffic signals are installed at both sets of ramps, they could be coordinated together allowing for all approaches of the interchange to operate efficiently, thereby reducing vehicular delay. During the design phase it is recommended that a detailed operational analysis of the interchange be performed both with a traffic signal located only at the westbound ramps and with traffic signals installed at both sets of ramps.

3.6 Control of Access

The west side of SR 249/Luyben Hills Road corridor has open highway frontage and undefined driveway access points.

As previously discussed, the SR 249/Luyben Hills Road Corridor is a highway commercial corridor that provides access to numerous businesses, including gas stations, restaurants and hotels. Many of these businesses have no defined access points and instead have open frontage along SR 249, which creates numerous traffic conflict points and thereby reduces safety and may hinder traffic flow along the corridor.

There are several existing access points within 100 feet of the I-40 entrance and exit ramps that are in violation of TDOT's *Policy on Control of Access at Interchange Ramps*, including the Shell Gas Station, and the gravel access point to the undeveloped land between the I-40 westbound ramp and McDonald's. In addition, Harpeth Hills Drive (see Figure 2) is located immediately south of the eastbound exit ramp of the I-40/SR 249 Interchange and is also in violation of TDOT's *Policy on Control of Access at Interchange Ramps*. After discussions with TDOT, it was decided that the plan for sidewalks on the SR 249/Luyben Hills Road bridge over I-40 included in this report (see section 6.1.1 of this report) would not alter or change existing driveways and access to properties.

4.0 STAKEHOLDER MEETING AND FIELD REVIEW

A stakeholder meeting and field review of the study corridor were held on February 11, 2009 to gather input that would assist in the development of this TPR. Representatives from the Town of Kingston Springs and TDOT were in attendance. A summary of the meeting, including the sign-in sheet, is in Appendix C.

The meeting and field review provided a valuable venue for identifying issues, clearly defining the purpose and need for the study, and gathering information. Meeting participants were invited to comment on the project purpose and need, identify issues and constraints, and offer suggestions for corridor improvements.

The February 11, 2009 stakeholder meeting and field review provided a valuable venue for identifying issues, clearly defining the project need and gathering information.

The purpose and need discussion focused heavily on the need to accommodate the corridor's various users, including pedestrians, truck traffic, local traffic and through traffic. Additional input to the proposed project purpose and need included: safety, access control, aesthetics, and future development. Stakeholders identified issues and constraints in the study area including grade issues, drainage concerns, safety concerns and economic considerations.

Following the stakeholder meeting, attendees were invited to participate in a field review of the study area to visually examine many of the issues and constraints identified during the meeting and to ensure that none had been overlooked. A van carried representatives of Kingston Springs, TDOT and the project consultant through the study area. Access, land use, drainage and other constraints were noted.

During the kickoff meeting, the stakeholder meeting and the field review, the community also expressed safety concerns about the continuous center turn lane on SR 249/Kingston Springs Road, from the intersection of Kingston Springs Road and Luyben Hills Road to where SR 249/Kingston Springs Road transitions to a two-lane roadway east of Harpeth Middle School (see Figures 2 and 3). The existing typical section along this portion of SR 249/Kingston Springs Road consists of two 12-foot travel lanes, a 12-foot center turn lane, and six-foot shoulders with curb and gutter and sidewalks. The Town of Kingston Springs stated that drivers speed through the corridor, in which two schools are located, and drivers utilize the center turn lane as a passing lane. The conversion of the continuous center turn lane into a median was discussed at length and, as a result, a feasibility study is being prepared independent of this TPR to determine the possibility of converting the existing three-lane SR 249/Kingston Springs Road into a two-lane roadway with a landscaped median, bike lanes, curb and gutter, and sidewalks within the existing ROW.

5.0 PRELIMINARY PURPOSE AND NEED

Through coordination with local officials and stakeholders, the preliminary need for the study has been identified. The project is needed to improve safety, meet local mandates and correct roadway deficiencies. These identified needs are described below.

5.1 Safety

In its current configuration, the SR 249/Luyben Hills Road corridor lacks pedestrian accommodations, such as sidewalks and bicycle facilities. Although TDOT crash data does not contain evidence of crashes involving pedestrians, conversations with local officials and stakeholders, as well as a field review, provided evidence that pedestrians travel through the area and need safer accommodations.

According to local officials, the installation of sidewalks along SR 249/Kingston Springs Road has resulted in an increased number of pedestrians, including school-age children, walking along the shoulders of the SR 249/Luyben Hills Road corridor. In addition, pedestrians frequently travel from the Petro gas station and truck stop south of I-40 north to access restaurants and hotels located in the project corridor. To reach their destination, pedestrians walk across the bridge over I-40 on the shoulder, continuing north on the shoulders of SR 249/Luyben Hills Road. The SR 249/Luyben Hills Road corridor is an uncomfortable pedestrian environment due to the lack of pedestrian facilities and the frequent curb cuts.

As previously stated, school buses regularly utilize the SR 249/Luyben Hills Road corridor. They are typically present in the area between 6:00 and 8:00 a.m. and again in the afternoons between 2:30 and 4:00 p.m. During the field review, project planners witnessed a school bus dropping children off just north of the McDonald's. Children dropped off at this location travel either to the mobile home park on the west side of the corridor or cross SR 249/Luyben Hills Road to reach their ride or access McDonald's on the east side of the roadway. Improvements are needed along the corridor to safely accommodate pedestrians, particularly near school bus stops where children are present.

Children dropped off on SR 249/Luyben Hills Road either walk to the Mobile Home Park on the west side of the corridor, or cross to the east side of the road (as shown in the photograph above).

5.2 Local Mandate

There is no federal or state mandate for improvement of SR 249/Luyben Hills Road. On a local level, the Town of Kingston Springs participated in an AIA Workshop which resulted in a local mandate for improvements to the corridor.

In March 2008, the Town of Kingston Springs participated in the AIA Blueprint for America Workshop. ***(Source: AIA Blueprint for America Summary Report)***

The March 2008, AIA Workshop gave the Town of Kingston Springs the opportunity to develop the early stages of a plan to address the interrelated challenges of revitalizing town centers and conserving open land. As discussed in Section 3.1 of this report, the town has experienced rapid growth in recent years (see Table 1). The AIA workshop gave the community an opportunity to come to a consensus on a number of key Smart Growth strategies to accommodate growth while preserving the community's rural character.

After the workshop, the participating leadership of the workshop sponsors identified nine general observations. Three of the nine observations, which are listed in the workshop report, relate specifically to the study corridor. They are as follows:

- *There is a general perception of "two differing town centers", one historic near the former downtown rail depot and the other commercial strip leading north from the interstate interchange [SR 249/Luyben Hills Road Corridor];*
- *The interstate and commercial strip leading north from the interchange does not reflect the character of the town, is unattractive, and doesn't function well. Employ "Context Sensitive Design" on this strip, and engage in dialogue with TDOT environmental planning leadership regarding funding potential, using the workshop outcomes as a community consensus and mandate"; and*
- *Reinforce all of Kingston Springs as a walkable, interconnected community linking its town centers, neighborhoods, schools and natural features.*

The town's planning efforts have identified the SR 249/Luyben Hills Road Corridor as one of its two "town centers" where future commercial development is likely to be concentrated. The existing roadway, which lacks curb and gutter and sidewalks, is not reflective of the character of the rest of Kingston Springs. The community feels that the existing roadway does not provide an aesthetically pleasing gateway into the community or an attractive environment for businesses that might locate in the area. Improvements are needed to make this important commercial center a safe and attractive area for existing and future businesses. Attracting business to the already existing town centers will also help the community preserve its open space and rural character.

5.3 Roadway Deficiencies

Much of the corridor's west side has open highway frontage and undefined driveway access points

As discussed in Section 3.3 of this report, the crash rate for SR 249/Luyben Hills Road indicates a safety deficiency exists along the SR 249/Luyben Hills Road corridor. Between 2004 and 2006, 33 crashes occurred along this segment of roadway, 24 of which were either rear-end, angle or sideswipe crashes. These types of crashes are often associated with open highway frontage and undefined driveway access points such as those found along the west side of SR 249/ Luyben Hills Road.

The lack of access control along the corridor was mentioned frequently during conversations with local officials and stakeholders. The open highway frontage and undefined driveway access points along the corridor result in vehicles constantly slowing to turn in and out of parking lots and in vehicles entering the roadway from many locations. This lack of access control poses safety concerns, including:

- An uncomfortable/unsafe pedestrian and bicycling environment;
- Unclear driver expectations;
- A high number of potential conflict points;
- A lack of dedicated travel paths; and
- Unclear sight lines.

Access management strategies are needed to provide the necessary access points to the development along the corridor, but do so in a manner that preserves the safety and efficiency of the roadway system. Good access management strives to provide a reasonable distance between adjacent driveways, which will reduce the number of existing traffic conflict points and improve traffic flow along the corridor. If the corridor qualifies for safety funding, the proposed project will address access control issues.

When combined with the lack of sidewalks and bike facilities along the corridor, poor access management on SR 249/Luyben Hills Road also results in an unsafe environment for pedestrians and bicyclists. Restricted access would limit the number and type of conflicts between vehicles, vehicles and pedestrians, and vehicles and bicyclists.

Conversations with local officials and stakeholders revealed issues with truck traffic mistakenly turning northbound on SR 249/Luyben Hills Road from the I-40/SR 249 Interchange. Once trucks make this turn, it is very difficult for them to find a place to turn around. At times, the trucks end up in downtown Kingston Springs and someone from Town Hall has to come out and stop traffic while the truck turns around in the road. The Town has added signage that was intended to keep trucks from making the northbound turn onto SR 249/Luyben Hills Road, but it has not worked. This issue poses safety concerns for the community and interferes with the corridor's ability to function efficiently.

As the population and traffic in Kingston Springs and Cheatham County continue to grow (see Section 3.1 of this report), safety concerns associated with the SR 249/Luyben Hills Road corridor will likely continue to increase as well. According to TDOT crash data, the number of crashes along the roadway increased approximately 400 percent between 2004 and 2006 while traffic grew by only 13 percent over the same period.

In addition, there is no signalization at the intersection of the I-40 ramps with SR 249/Luyben Hills Road. This results in traffic back-ups during rush hours and at times when traffic must be detoured off I-40.

6.0 OPTIONS

Several options were considered and evaluated as a means of addressing the transportation needs within the study area, including a No Build Option.

The No Build Option involves making no improvements to the existing roadway other than regular maintenance activities. The No Build Option does not meet the identified purpose and need for the proposed project. It does not address safety issues, roadway deficiencies, or pedestrian accessibility. The No Build Option also does not help Kingston Springs with implementing its gateway vision and economic development plans.

The Build Options are slated to occur along the existing alignment of SR 249/Luyben Hills Road. Thus, the study corridor is centered on the existing roadway. For the purposes of this TPR, the corridor improvements considered were broken down into three sections: the I-40/SR 249 Interchange; the SR 249/Luyben Hills Road corridor (from the I-40/SR 249 Interchange to SR 249/Kingston Springs Road); and the SR 249/Luyben Hills Road and Kingston Springs Road intersection. Photographs representing the three study sections are included as Figures 7-9.

Early meetings with the Town of Kingston Springs and TDOT to develop Build Options revealed that ROW acquisition should be avoided or kept to a minimum. A traffic analysis was completed to assist with the study's purpose and need, and a signal warrant analysis was used to evaluate the need for a traffic signal at the eastbound and westbound ramps of the I-40/SR 249 Interchange (see Section 3.5 of this report). Research was then conducted to identify the existing ROW along the three segments of the study corridor. The next step involved fitting the appropriate typical sections into the existing ROW. Designers developed option(s) that would accomplish this for each proposed project segment. Finally, preliminary cost estimates were developed for each option.

The Build Options developed for each section are described below and are depicted in graphics that accompany the discussion. It is important to note that these sections are "typical," and variances from the typical are likely to occur as the proposed project moves forward in the planning and design stages.

6.1 Features of Build Option Concepts

6.1.1 SR 249/I-40 Interchange

One concept is under consideration for the I-40/SR 249 interchange. The proposed interchange improvements involve constructing six-foot wide sidewalks in place of the existing shoulders on SR 249/Luyben Hills Road through the I-40/SR 249 Interchange (see Figure 10). The existing bridge will not need to be widened as part of this option, nor will the lane widths through the interchange need to be modified; however, the existing barrier will need to have handrails attached to the tops in order to allow pedestrian-safe access across the bridge. The addition of the sidewalk between the existing guardrail and the travel lane may require the guardrail to be raised.

Figure 7. Views of I-40/SR 249 Interchange

View north from south side of I-40/SR 249 Interchange

View north of I-40/SR 249 Interchange

Figure 8. Views of SR 249/Luyben Hills Road

View north on SR 249/ Luyben Hills Road

View south toward I-40 on SR 249/Luyben Hills Road

View of commercial uses on SR 249/ Luyben Hills Road

Figure 9. Views of SR 249/Luyben Hills Road and Kingston Springs Road Intersection

View southeast at SR 249/Luyben Hills Road and Kingston Springs Road Intersection

View north along SR 249/Luyben Hills Road toward Intersection with Kingston Springs Road

As part of these improvements, a four- to six-foot wide sidewalk is proposed from the bridge over I-40 southward to the Petro gas station and truck stop (see Appendix D). The sidewalks will replace the existing paved shoulder and be placed between the existing guardrail and the edge of the travel lane. This width between the edge of the travel lane and the guardrail will be the limiting factor as to how wide the sidewalk can be. If the guardrail was relocated, the impact to the fill slope and stream below would be significant. A four-foot sidewalk is acceptable in this context and will greatly reduce construction costs. The roadway will not need to be widened as part of this option, nor will the lane widths through the interchange need to be modified.

Currently, the interchange is unsignalized. A signal warrant analysis was prepared for the I-40/SR 249 Interchange, and is discussed in Section 3.5 of this report. Based on the collected traffic counts, signals are warranted at this time for the intersection of SR 249/Luyben Hills Road and the I-40 westbound ramps; however, traffic signals are not warranted at this time for the intersection of SR 249/Luyben Hills Road and the I-40 eastbound ramps. As outlined in Section 3.5 of this report, a Signal Warrant Analysis should be performed within one year of putting the signal into operation. Therefore, it may be necessary to re-perform the traffic signal warrants within the year that the signal(s) will be installed. Typically, as traffic increases on diamond interchanges, they are signalized so that the traffic operation for the vehicles turning left onto and off of the interchange is not impeded.

As previously stated, pedestrians frequently travel from the Petro gas station and truck stop south of I-40 north to access restaurants and hotels located in the study corridor. The proposed improvements will improve pedestrian connectivity and safety through the I-40/SR 249 Interchange.

6.1.2 SR 249/Luyben Hills Road Corridor

The following text describes and depicts concept options for improvements to the SR 249/Luyben Hills Corridor between north of the I-40 ramps and Kingston Springs Road. The total project is 0.426 mile in length. Appendix D contains the business entrance layout plans, which illustrate the recommended driveway locations throughout the corridor.

All Options

This section describes features that are common to the two SR 249/Luyben Hills Corridor options (and also the roundabout discussed in the next section). It is important to note that landscaping and streetscaping are typically not eligible for state or federal funding (with the exception of enhancement funds), so alternative funding sources will need to be identified.

- *Landscaping:* Each option includes landscaped buffers of varying widths. Estimated landscaping costs, such as the installation of shrubs and street trees, are included in the planning level cost estimates outlined in Section 6.2 of this report. The exact nature of the corridor's landscaping will be determined in future phases of project development. Maintenance of landscaping in these buffers is an issue that will need to be worked out between TDOT, the Town of Kingston Springs and corridor business/property owners.

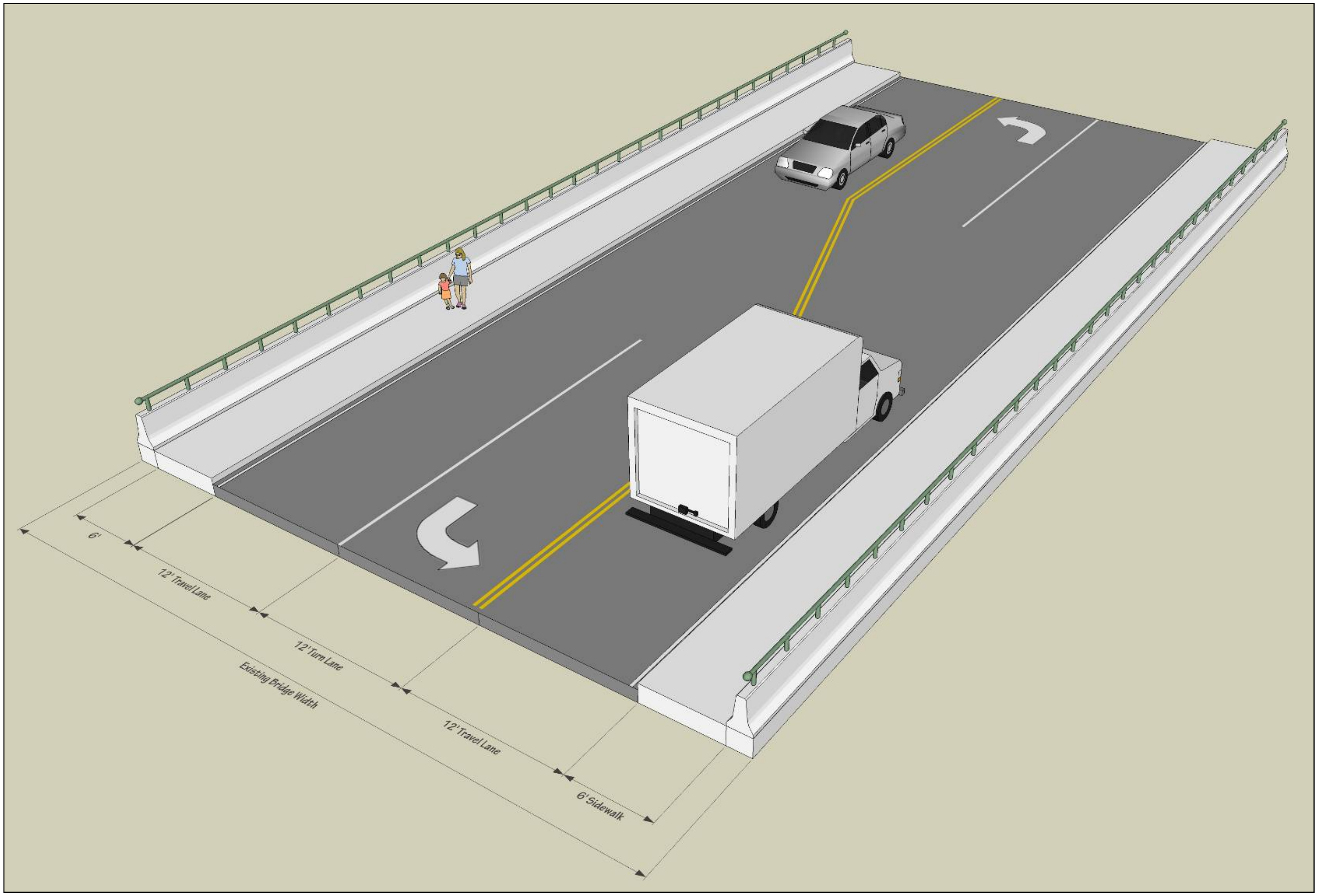


Figure 10. Proposed Improvements to SR 249/Luyben Hills Road Bridge over I-40

- *Streetscaping:* Each of the options for SR 249/Luyben Hills Road includes decorative, pedestrian-scaled lighting in the outside landscaping buffer of the typical sections, and the estimated cost of these lights are included in the planning level cost estimates. This type of lighting is typically spaced every 75 to 100 feet along the corridor, depending on the wattage and fixture type selected. These details, in addition to the style of lighting chosen, can vary in price and will be determined in future phases of project development. Other streetscaping elements, such as benches, trash receptacles and bicycle amenities (such as bicycle racks) which are not typically covered by TDOT funding, will be considered and addressed in the future project design phase, as funding availability permits.
- *Sidewalks:* Both options include the addition of sidewalks along the project corridor. The typical section for each option specifies the width of the landscape buffers on either side of the sidewalk. It should be noted, however, that the location of the sidewalk can vary throughout the corridor as the corridor's context deems appropriate (e.g., to avoid costly utility relocations).
- *Utilities:* Figures 11 and 12 illustrate the typical section for each option. Each typical section shows Nashville Electric Service (NES) utility poles along each side of the SR 249/Luyben Hills Road corridor. In some locations, the location of the utility poles may be an obstacle to the installation of sidewalks. In these instances, the sidewalk should be shifted to avoid the utility or the utility should be relocated. The cost of relocating aboveground utilities is not included in the preliminary cost estimates presented in Section 6.2 of this report.

Option 1—Six-foot Shoulders with Curbed Islands

Option 1 allows for access management improvements through the use of curbed islands and includes the installation of sidewalks and bicycle lanes on both sides of the roadway to accommodate pedestrians and bicyclists.

The proposal for this segment, shown in Figure 11, involves the following:

- Two 12-foot travel lanes;
- A 12-foot center turn lane;
- Six-foot bicycle lanes;
- A 10-foot landscape buffer between the shoulders and the sidewalk;
- Six-foot sidewalks; and
- A 10-foot buffer between the sidewalks and edge of ROW, which can accommodate landscaping and lighting.

Figure 11. SR 249/Luyben Hills Road Option 1 includes bike lanes and curbed islands.

Option 2— Curb & Gutter

Option 2 allows for access management improvements through the use of curb and gutter, and it includes the installation of multi-use paths on both sides of the roadway to accommodate pedestrians and bicyclists.

The proposal for this segment, shown in Figure 12, involves the following:

- Two 12-foot travel lanes;
- A 12-foot center turn lane;
- Two-foot curb and gutter on both sides of the roadway;
- A 10-foot landscape buffer between the curb and the sidewalk;
- Ten-foot multi-use paths on both sides of the roadway; and
- A 10-foot buffer between the sidewalks and edge of ROW, which can accommodate landscaping and lighting.

Comparison between Options 1 and 2

Both options fulfill the purpose and need for the project by:

1. Addressing safety issues and roadway deficiencies along SR 249/Luyben Hills Road through the use of access management;
2. Improving pedestrian accessibility and safety along the SR 249/Luyben Hills Road corridor by including sidewalks and landscape buffers (for a more comfortable walking environment); and
3. Implementing the results of the AIA Workshop by providing a more multi-modal and aesthetically pleasing gateway to Kingston Springs.

Table 7 describes elements of the two options that differ.

Table 7. Comparison of Typical Sections for Options 1 and 2

FEATURE	OPTION	
	1	2
Sidewalks	6 feet	10 feet
Drainage System	Curbed Islands with Shoulders	Curb and Gutter
Shoulder	6 feet	None
Bicycle Facilities	On-Street	Multi-Use Path

Figure 12. SR 249/Luyben Hills Road Option 2 includes multi-use path and curb and gutter.

6.1.3 SR 249/Luyben Hills Road and Kingston Springs Road Intersection

As previously stated, the Town of Kingston Springs has an issue with truck traffic mistakenly turning north on SR 249/Luyben Hills Road from I-40. Once truck traffic has made this turn, it is difficult for them to turn around. At the request of Kingston Springs, the possibility of constructing a roundabout at the intersection of SR 249/Luyben Hills Road and Kingston Springs Road was evaluated. Not only would a roundabout allow truck traffic to turn around, it would also create an opportunity for Kingston Springs to create a corridor that acts as a strong gateway and reflects the unique character of their community. This intersection is currently signalized.

As illustrated in Figure 13 and Appendix D, an "Urban Compact" roundabout with a 100-foot inscribed diameter would be of sufficient size to allow truck traffic to carefully make a U-turn while minimizing impacts to adjacent properties. The roundabout would have one 18-foot travel lane and a 16-foot truck apron. The center of the roundabout would be about 32 feet in diameter, and could be landscaped with low shrubs.

Although it is a tight turn for truck traffic and they will likely make the turn at very low speeds, this size roundabout can accommodate truck traffic (as well as school bus traffic). This design could accommodate the business entrance on the north side of the SR 249/Luyben Hills Road and Kingston Springs Road intersection; however, the residential drive north of Kingston Springs Road would need to be relocated, as shown in Appendix D.

A roundabout, requiring minimal maintenance, would reduce vehicular speeds and would likely also reduce crashes. A roundabout would also address the issue of long queues of cars at the light, particularly in the evenings and mornings. If, in the future, it is determined that the construction of a roundabout in this location is not preferred, the signal timing at the intersection could be adjusted to address some of the queuing issues at the intersection. However, adjusting the signal timing would not address the need for a place for truck traffic to turn around.

6.2 Costs

Planning level cost estimates for the two corridor options (including the interchange improvements in each option) and the roundabout have been developed and are summarized in Tables 8 through 10. In order to account for variation in bid prices, both high and average totals are listed, resulting in a range of costs for each alternate. Inflation costs were applied to the total estimated construction and preliminary engineering costs at a rate of six percent over five years (as per TDOT TPR cost estimating guidance).

As previously noted, landscaping and streetscaping are typically not eligible for state or federal transportation funding, so alternative funding sources would need to be identified.[1] A summary of total costs is included below. Detailed cost estimates are in Appendix E.

		Average Total / High Total
SR 249/I-40 Interchange and	Option 1	$2,365,421 / $2,832,886
SR 249/Luyben Hills Corridor	Option 2	$2,603,216 / $3,134,221
Roundabout at Kingston Springs Road and US 249 Intersection (Optional)		$504,819 / $759,337

[1] For example, Transportation Enhancement Funds will fund landscaping and streetscaping.

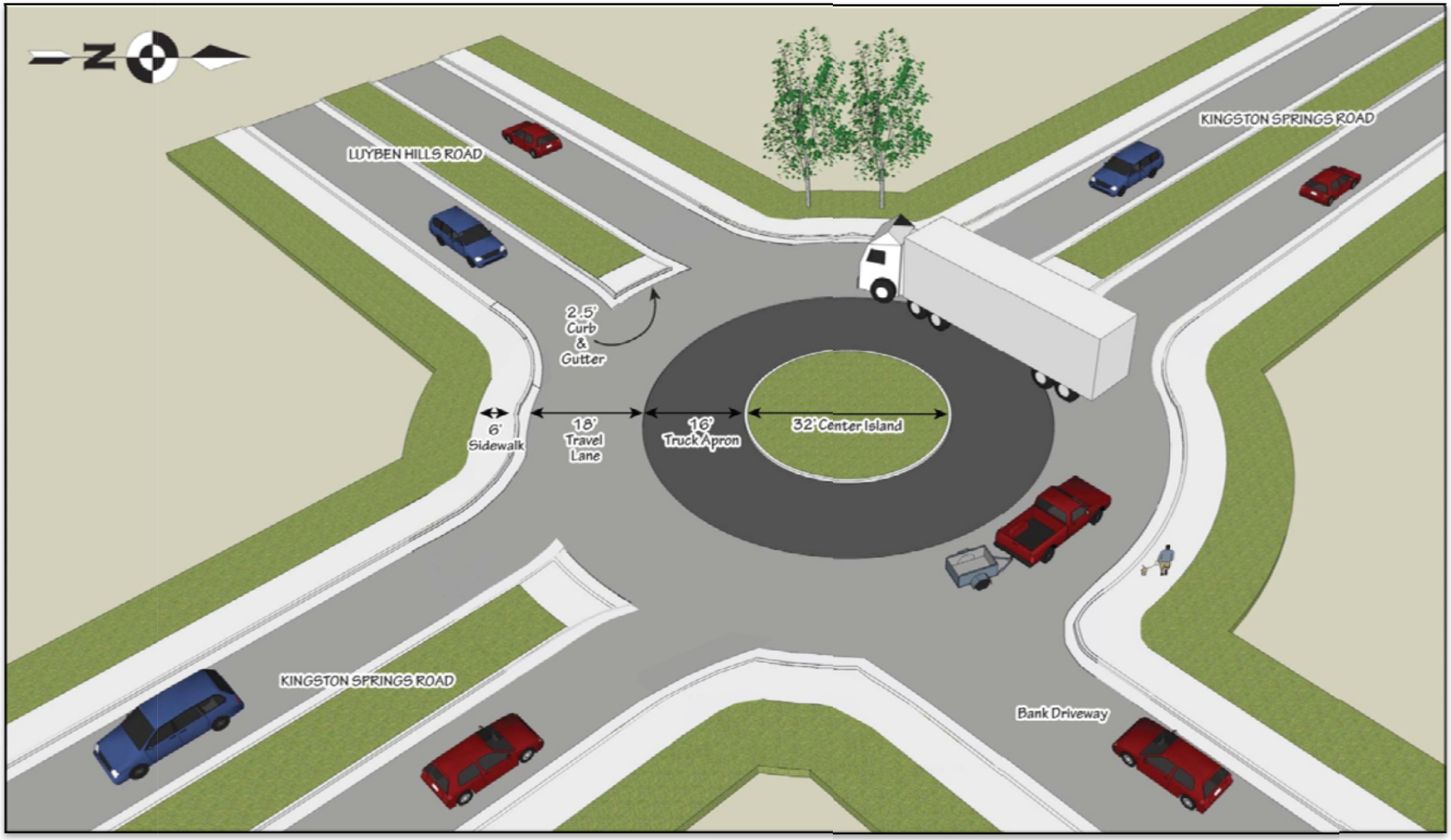


Figure 13. Roundabout at SR 249/Luyben Hills Road and Kingston Springs Road

Table 8. SR 249/Luyben Hills Road Option 1

	Option 1	
ITEM	**Average Total**	**High Total**
Right-of-Way[2]	$3,300	$4,400
Construction	$1,277,190	$1,516,232
Utilities	$63,859	$75,812
Mobilization	$62,474	$90,649
Contingency	$201,157	$238,807
Total Construction	$1,604,680	$1,921,500
Preliminary Engineering	$160,468	$192,150
BASE YEAR (2009) TOTAL	$1,765,148	$2,113,650
Inflation (6 % per year over 5 years)	$596,973	$714,836
TOTAL COSTS[3]	**$2,365,421**	**$2,832,886**

[2] The ROW costs shown only include costs associated with proposed ROW. The costs do not include costs for temporary easements.
[3] Detailed estimates can be found in Appendix E.

Table 9. SR 249/Luyben Hills Road Option 2

Option 2		
Item	**Average Total**	**High Total**
Right-of-Way[4]	$3,300	$4,400
Construction	$1,406,166	$1,680,327
Utilities	$70,308	$84,016
Mobilization	$68,277	$97,213
Contingency	$221,474	$264,651
Total Construction	$1,766,223	$2,126,208
Preliminary Engineering	$176,222	$212,621
BASE YEAR (2009) TOTAL	$1,942,845	$2,338,829
Inflation (6 % per year over 5 years)	$657,070	$790,992
TOTAL COSTS[5]	**$2,603,216**	**$3,134,221**

[4] The ROW costs shown only include costs associated with proposed ROW. The costs do not include costs for temporary easements.
[5] Detailed estimates can be found in Appendix E.

Table 10. SR 249/Luyben Hills Road and Kingston Springs Road Roundabout

	Roundabout	
Item	**Average Total**	**High Total**
Right-of-Way[6]	$0	$0
Construction	$269,815	$389,456
Utilities	$13,491	$19,473
Mobilization	$17,142	$45,578
Contingency	$42,496	$61,339
Total Construction	$342,943	$515,847
Preliminary Engineering	$32,294	$51,585
BASE YEAR (2009) TOTAL	$377,237	$567,431
Inflation (6 % per year over 5 years)	$127,582	$191,905
TOTAL COSTS[7]	**$504,819**	**$759,337**

[6] The ROW costs shown only include costs associated with proposed ROW. The costs do not include costs for temporary easements.
[7] Detailed estimates can be found in Appendix E.

7.0 POTENTIAL ENVIRONMENTAL IMPACTS

7.1 Wetlands and Floodplains

The United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) map (shown in Map A-1, Appendix A) was reviewed, and no known wetlands were identified in the project area.

Federal Emergency Management Association (FEMA) Flood Insurance Rate Map (FIRM) Number 47021C0280C (dated December 6, 1999) was reviewed, and there are no 100-year or 500-year floodplains located within the project area (shown in Map A-2, Appendix A).

7.2 Threatened and Endangered Species

The Tennessee Department of Environment and Conservation (TDEC) Division of Natural Areas maintains records of rare, threatened and endangered species located throughout the state. Division of Natural Areas' files were examined in an attempt to identify threatened and endangered species recorded in the general vicinity of the project. No federally listed, threatened or endangered species are known to exist in the general project area.

The TDEC Division of Natural Areas records check, conducted on January 20, 2009, revealed two state-listed species reported within one mile of the project study area. The Sweet-scented Indian-plantain (*Hasteola suaveolens*), a flowering plant found near alluvial woods and moist slopes, is listed threatened at the state level. The Geniculate River Snail (*Lithasia geniculata fuliginosa*), a flowering plant found in cultivated fields, is also listed threatened at the state level. The project area is fully developed and neither of these habitats is present in the project study area.

Thirteen additional state-listed plant species have been observed within four miles of the proposed project area; however, none these species habitat can be found in the project area due to extensive commercial development.

7.3 Hazardous Materials

Project planners reviewed Environmental Protection Agency (EPA) records and contacted the TDEC Nashville Environmental Field Office to check for the presence of any hazardous materials sites in the proposed project area. In addition, a field review of the project area was conducted on January 28, 2008 to check for the presence of dry cleaners and other services that are associated with potentially hazardous chemicals.

There are four gas stations located along the project corridor that have underground storage tanks (USTs). The locations of these facilities are depicted on Map A-3 in Appendix A. The approximate locations of the USTs along the study corridor are shown on the layout graphics in Appendix D. Three of the four gas stations have reported a Leaking Underground Storage Tank (LUST).

The Mapco gas station (111 Luyben Hills Road) has had five LUST cases, but all five cases are now closed (Facility ID 5-110078). The most recent case was a diesel release that spread into the soil and drainageway in front of the store. This case was closed in July 2008.

The BP gas station, located at 121A Luyben Hills Road, reported a LUST in October 2008 (Facility ID 5-110051)[8]. There was groundwater contamination on the entire site, but the contamination has been corrected and the case will be closed when the monitoring wells are abandoned.

There have been no cases filed at the Shell gas station located immediately north of the westbound entrance ramp to I-40.

The Petro gas station, located south of the I-40/SR 249 Interchange, is currently under an active ongoing investigation for a LUST; however contamination is limited to the area immediately surrounding the LUST and this area is located outside the study area for this project (Facility ID 5-110082).

Confirmation of potential UST and other hazardous site locations should be further identified in future phases of project development.

[8] The BP gas station is registered in the TDEC database as the “Former Loteurs #4”.

8.0 POTENTIAL CULTURAL IMPACTS

8.1 Historic Resources

A review of the Tennessee Historical Commission's (THC) National Register Geographic Information Systems (GIS) website was conducted on January 22, 2008 to check for the presence of historic resources. A review of State Historic Preservation Office (SHPO) records at the THC was also conducted. No properties listed in the NRHP are located within the project's Area of Potential Effect (APE).

A field review of the project area and its viewshed was conducted on January 28, 2008, and no structures over 50 years old were identified, so it is unlikely any sites within the project's study area would be eligible for the NRHP. Due to the developed nature of the project corridor, it is unlikely any archeological sites are present along the project corridor.

8.2 Community Resources

South Cheatham Junior High School and Harpeth Middle School are located northeast of the project area on SR 249/Kingston Springs Road. Harpeth High School is located northwest of the project area on Kingston Springs Road. The location of these schools is shown on Figure 2. As previously stated, school buses serving these schools travel the SR 249/Luyben Hills Road corridor, stopping in the vicinity of the Midtown Inn and Suites and McDonald's. Buses are typically present in the area between 6:00 and 8:00 a.m. and again in the afternoons between 2:30 and 4:00 p.m.

The Kingston Springs U.S. Post Office is located on the east side of the project corridor at 110 Luyben Hills Road (see Map A-4 in Appendix A).

8.3 Environmental Justice

U.S. Census Data was reviewed for the project area to determine whether the proposed project would have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. Based on information gathered and supported by a field review and conversations with local government, there are presently no minority or low income concentrations in the corridor.

Minority Populations

According to the 2000 US Census, approximately 2.2 percent of Kingston Springs' population considered themselves to be a minority. The county-wide minority population for Cheatham County was 2.5 percent. Both of these averages are considerably lower than the statewide average of 19.8 percent.

Map A-5 in Appendix A illustrates the minority population in the project area by Census Block for the 2000 US Census. The two Census Blocks that are located adjacent to the study corridor have minority population percentages higher than that of Cheatham County and Kingston Springs as a whole. The percentage of the population that identified themselves as a minority in these two Blocks is 4.0 percent (Block 5011) and 6.3 percent (Block 2003).

No impacts to minority populations are anticipated as a result of the proposed options discussed in Section 6.0 of this report because there are no minority populations in the immediate project area. The only residences in the vicinity of the study corridor are the homes in the mobile home park behind the Midtown Inn and Suites and the homes on Kingston Springs Road, north of the subject project's northern terminus (see Figure 3). Based on a review of Census data, conversations with local officials, and field reviews, these residences do not appear to constitute a minority population.

Low Income Populations

Table 11 outlines the percent of the population living below poverty in 2000 (based on 1999 income) for the two Census Block Groups that border the study area, the Town of Kingston Springs, Cheatham County, and the state of Tennessee. The percent of the population living below poverty within Kingston Springs averages 8.4 percent. This is slightly higher than the County average of 7.4 but considerably lower than the statewide average of 13.5 percent. The percent of the population below poverty in the two Census Block Groups that border the project area is considerably lower than the Town and County averages.

Table 11. Poverty Status in 1999 for Project Area, Kingston Springs, Cheatham County and Tennessee

Poverty Status in 1999			
Location	**Income Below Poverty Level**	**Total Population***	**Percent Living Below Poverty**
Census Tract 704, Block Group 2, Cheatham County	77	1,798	4.3%
Census Tract 704, Block Group 5, Cheatham County	182	2,948	6.2%
Kingston Springs	231	2,758	8.4%
Cheatham County	2,635	35,399	7.4%
Tennessee	746,789	5,539,896	13.5%

* *US Census data on poverty status is only provided for the portion of the population for which poverty status can be determined. Thus the percent living below poverty level is calculated using the population for which status can be determined rather than the total population of the Block Group in 2000.*

Source: U.S. Census Bureau Census 2000; Summary File 3; Table P87.

As previously stated, the only residences in the vicinity of the study corridor are the homes in the mobile home park behind the Midtown Inn and Suites and the homes on Kingston Springs Road, north of the subject project's northern terminus (see Figure 3). Although not reflected in the Census data, mobile home parks are sometime indicative of a low-income population. As a result, impacts to the mobile home park should be closely considered in future phases of project development.

9.0 ASSESSMENT OF OPTIONS

TDOT has adopted seven guiding principles against which all transportation projects are to be evaluated. These guiding principles address concerns for system management, mobility, economic growth, safety, community, environmental stewardship, and fiscal responsibility. These guiding principles are discussed in the following paragraphs as they relate to the options for the proposed SR 249/Luyben Hills Road improvements.

Guiding Principle 1:
Preserve and Manage the Existing Transportation System

SR 249/Luyben Hills Road is a critical corridor for the Town of Kingston Springs. It is not only a key commercial corridor for area residents and I-40 truck traffic, but it also connects portions of Cheatham and Dickson counties (including the Towns of Kingston Springs, Pegram, and White Bluff) to I-40 and the regional transportation network. The options discussed in this report are consistent with TDOT's goal of preserving and managing the existing transportation system. Kingston Springs' and Cheatham County's population is growing at a pace that far exceeds that of the State (see Table 1), and with that growth comes additional traffic on area roadways.

The increased access management provided for in the options discussed in this report will reduce congestion and traffic flow issues that result from vehicles slowing to turn in and out of the corridor's numerous access points. The proposed roundabout discussed in Section 6.1.3 of this report will allow truck traffic that mistakenly turned northbound on SR 249/Luyben Hills Road to turn around more easily and will consequently reduce the number of misdirected trucks in downtown Kingston Springs.

The option to signalize one or both of the intersections at SR 249/Luyben Hills Road and the eastbound and westbound ramps of I-40 can also help to preserve the life of the interchange by better directing the flow of traffic on and off the interstate in the proposed project area, ensuring that the interchange continues to function at an adequate LOS in the future.

Guiding Principle 2:
Move a Growing, Diverse, and Active Population

As discussed in Section 3.1 of this report, the Town of Kingston Springs grew by 91.2 percent between 1990 and 2007 and Cheatham County grew by 44.1 percent, figures higher than the State of Tennessee as a whole (26.2 percent). This growth is anticipated to continue. According to the Tennessee Department of Economic and Community Development, the population in Cheatham County is forecasted to increase to 42,355 by 2013. The options presented in this report are intended to provide improved traffic flow to support the area's growing population and increasing amounts of externally generated traffic, such as truck traffic traveling on I-40.

The proposed improvements will also create a safer and more hospitable environment for pedestrians and bicyclists. The installation of sidewalks and access management will make it easier and more comfortable for both visitors and local residents to travel the corridor on foot or bicycle. The proposed improvements will support a diverse and active population by offering all citizens a safe roadway corridor environment, will consider all users and will improve multi-modal accessibility in the area.

Guiding Principle 3:
Support the State's Economy

SR 249/Luyben Hills Road is an important commercial corridor for residents of Kingston Springs. As one of Kingston Springs' two "town centers", the corridor houses retail and services that contribute to the town's economy and provide jobs for some area residents. The options discussed in this report will better manage access to properties along the roadway, making it easier for customers to access businesses and services along the corridor. The sidewalks and other proposed pedestrian improvements will enhance the safety and pedestrian appeal of the corridor and increase the foot traffic to existing businesses. The improvements will also help to transform the corridor into a more appropriate gateway for Kingston Springs which would serve to attract new businesses to the area. The additional infrastructure provided by the proposed project improvements will better accommodate existing pedestrian and vehicular traffic, ensuring that the SR 249/Luyben Hills Road corridor remains an economic asset to Kingston Springs and the surrounding region.

Guiding Principle 4:
Maximize Safety and Security

The proposed project will help address several different safety issues associated with the SR 249/Luyben Hills Road corridor. As discussed in Section 3.3 of this report, the relatively high number of rear end, angle and sideswipe crashes along the corridor can be attributed, in part, to the large numbers of curb cuts in the study area, which result in vehicles constantly slowing to turn in and out of parking lots. The access management improvements included in the options for the corridor are intended to improve safety by better controlling traffic flow and reducing the number of conflict points along the corridor. The proposed project will also result in improved pedestrian safety and mobility. The installation of sidewalks will result in a safe, attractive and welcoming pedestrian environment for those traveling through the corridor.

Guiding Principle 5:
Build Partnerships for Livable Communities

This project was initiated as a result of the AIA Blueprint for America Workshop in Kingston Springs. As discussed in Section 2.0 of this report, the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor was a frequent topic of discussion over the course of the two-day AIA workshop. There was consensus among attendees that, while the SR 249/Luyben Hills Road corridor is generally regarded as one of the town's two vital "town centers", the corridor is characterized by strip commercial development that the community finds unattractive and in conflict with Kingston Spring's quaint small-town character. In addition, the community expressed consensus that the interchange and corridor do not function well. As a result, the workshop's report called for the town's leadership to work with TDOT on roadway design recommendations that employ CSD principles.

Coordination with local leaders and stakeholders to identify their concerns and objectives for the proposed project was conducted throughout the planning process (see section 6.0 of this report). The Town of Kingston Springs expressed their concerns about safety and access along the SR 249/Luyben Hills Road corridor and the need to create a better gateway to the Kingston Springs community. Conversations with local officials and stakeholders revealed a desire for improvements that will increase the safety of the pedestrian environment and reduce access control issues while improving traffic flow. The proposed improvement options discussed in this report will work toward achieving better travel conditions for both pedestrians and motorists.

In keeping with TDOT's *Public Involvement Process*, the provisions of NEPA and *Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users* (*SAFETEA-LU*) and the provisions of the *Tennessee Environmental Streamlining Agreement* (*TESA*), this project will be coordinated with the public and additional governmental agencies, beginning in the next project phase (NEPA if federal funding is identified and a TEER is state funding is identified).

Guiding Principle 6:
Promote Stewardship of the Environment

Potential adverse environmental impacts have been considered in the development of the options included in this study. Detailed studies are needed to fully address the impacts of each option considered in this report. Sections 7.0 and 8.0 of this report outline potential environmental and cultural impacts based on preliminary environmental screening. Should federal funding be obtained for the project, a NEPA document will be prepared in future phases of the project. Should state funding be obtained for the project, a TEER will be prepared in future phases of the project. The NEPA document or TEER will assess the project's impacts on the natural, social and built environment. All efforts will be made to avoid adverse impacts to natural and cultural resources. If impacts cannot be avoided, they will be minimized and mitigated. Early and continuous coordination will continue to take place with the appropriate federal, state and local agencies and the public. This coordination will assist with the identification of important resources early in the planning process and help ensure the proposed project promotes stewardship of the environment.

Guiding Principle 7:
Promote Financial Responsibility

The cost estimates shown in Tables 8 through 10, pages 36 through 38 of this report, are offered for comparison purposes and will fluctuate with inflation and any unexpected conditions. It is the Department's goal to follow a comprehensive transportation planning process, promote coordination among public and private operators of transportation systems and support efforts to provide stable funding for the public component of the transportation system. This entails exercising financial responsibility in the development and implementation of roadway projects and minimizing cost to taxpayers.

10.0 SUMMARY

SR 249/Luyben Hills Road, which is designated as a Rural Major Collector, is a vital corridor for the Town of Kingston Springs and Cheatham County. It serves as an important link between I-40 and portions of Cheatham County and Dickson County (along US 70), including the Towns of Kingston Springs, Pegram, and White Bluff (see Figure 1). In addition, the I-40/SR 249 Interchange and SR 249/Luyben Hills Road corridor provides access to the Harpeth River State Park and the Montgomery Bell State Park from I-40. The corridor, which is lined by gas stations, restaurants and hotels and provides access to some of the town's largest undeveloped commercially-zoned lots, is also a vital commercial corridor for the Town of Kingston Springs. Finally, I-40 Exit 188 (the I-40/SR 249 Interchange) is a well-used interchange for semi-tractor trailer (truck) traffic. Trucks use this interchange frequently to access the truck stop south of I-40, which is the first truck stop west of Nashville. Trucks also utilize the SR 249/Luyben Hills Road corridor as a detour route when an accident occurs on I-40.

Through coordination with local officials and stakeholders, the preliminary need for the proposed project has been identified:

1. Address safety issues and roadway deficiencies on SR 249/Luyben Hills Road;
2. Improve pedestrian accessibility and safety along the SR 249/Luyben Hills Road corridor; and
3. Implement the results of the 2008 AIA Workshop.

Two options for the SR 249/Luyben Hills Road corridor were considered in this evaluation. Recommended improvements include access management improvements as well as the installation of bicycle and pedestrian facilities and landscape buffers. Other streetscaping amenities will be considered in later design phases.

In addition to the two options considered in this evaluation, recommendations for the I-40/SR 249 Interchange and the SR 249/Luyben Hills Road and Kingston Springs Road intersection were also developed. The installation of sidewalks on SR 249/Luyben Hills Road through the interchange would improve pedestrian accessibility and safety along the corridor. The construction of a roundabout at the SR 249/Luyben Hills Road and Kingston Springs Road intersection would provide a place for truck traffic to turn around, while also creating a strong gateway to the Kingston Springs community.

Issues identified in environmental screening are minimal as the project is to be undertaken within existing ROW or with a small amount of additional ROW, and improvements are intended to benefit the community by providing an attractive streetscape to support current economic development plans and enhance the surrounding community. No impacts to the natural environment are anticipated as the proposed project is in highly developed setting. However, if federal funding is identified for this proposed project, a NEPA document will be undertaken. If state funding is identified for this proposed project, a TEER will be undertaken. The NEPA document or TEER will fully address the impacts to the social and natural environment. In addition, the NEPA or TEER process will lead to the selection of an alternate. Although a detailed environmental study is needed to fully address the impacts of each option considered in this report, preliminary research was done to provide a basis for future environmental work. Table 12 summarizes the results from the environmental screening.

Table 12: Summary of Environmental Screening Results

Location	Wetlands	Floodplains	Threatened and Endangered Species	Hazardous Materials	NRHP Historic Resources	Community Resources	Environmental Justice
Interchange	None	None	No federally-listed species; some state-listed species may be present, but unlikely	Petro gas station to the south	None	None	None
Option 1 (Curbed Islands)	None	None	No federally-listed species; some state-listed species may be present, but unlikely	3 gas stations	None	U.S. Post Office	Impacts to the mobile home park should be closely considered in future phases of project development.
Option 2 (Curb & Gutter)	None	None	No federally-listed species; some state-listed species may be present, but unlikely	3 gas stations	None	U.S. Post Office	Impacts to the mobile home park should be closely considered in future phases of project development.
Roundabout	None	None	No federally-listed species; some state-listed species may be present, but unlikely	None	None	U.S. Post Office	None

Appendix A
Environmental Screening Maps

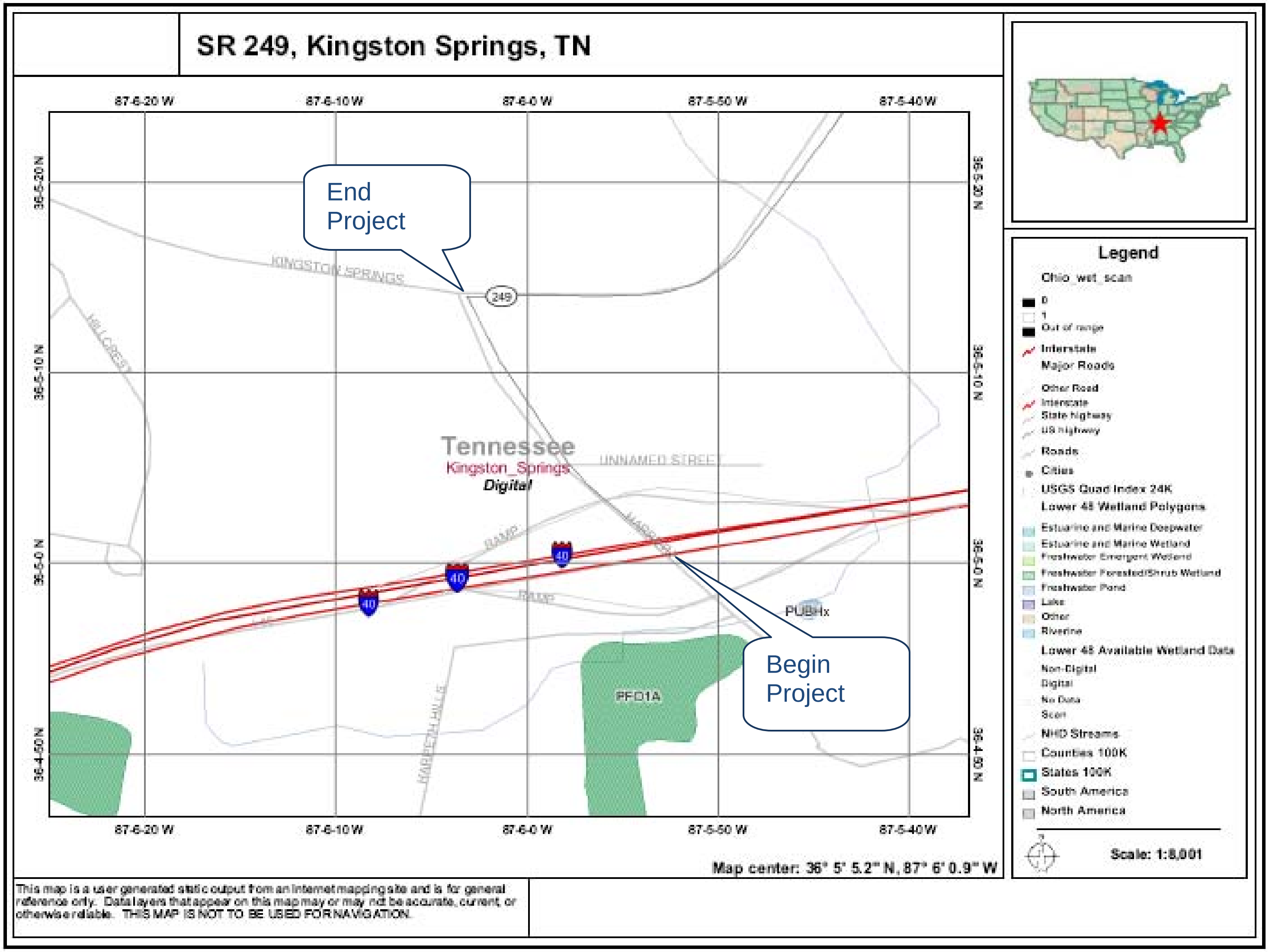


Figure A-1. United States Fish & Wildlife Service National Wetlands Inventory Map

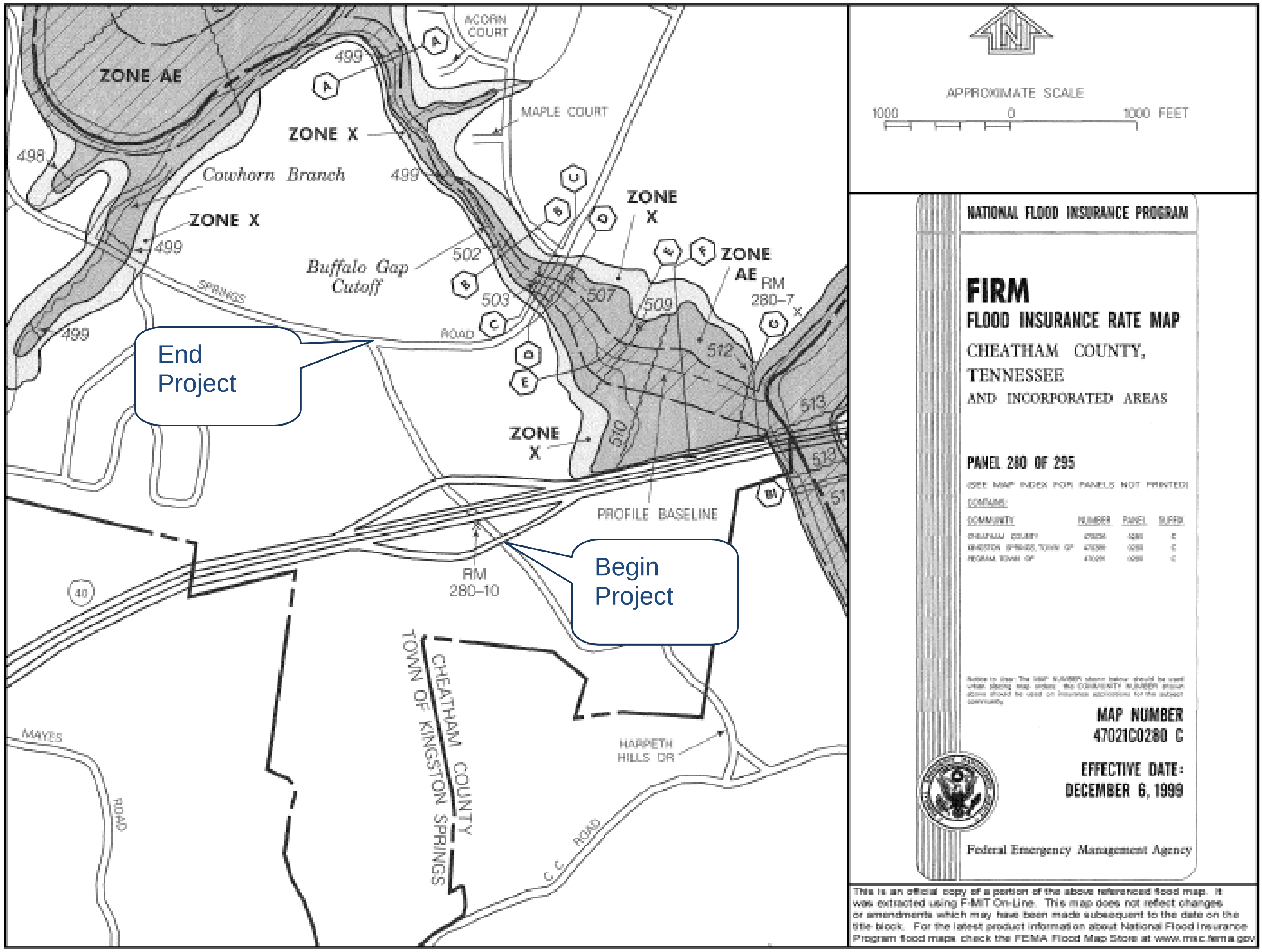


Figure A-2. Federal Emergency Management Agency Flood Insurance Rate Map 47021C0280C

Figure A-3. Project Corridor Gas Stations

Figure A-4. Community Facilities Map

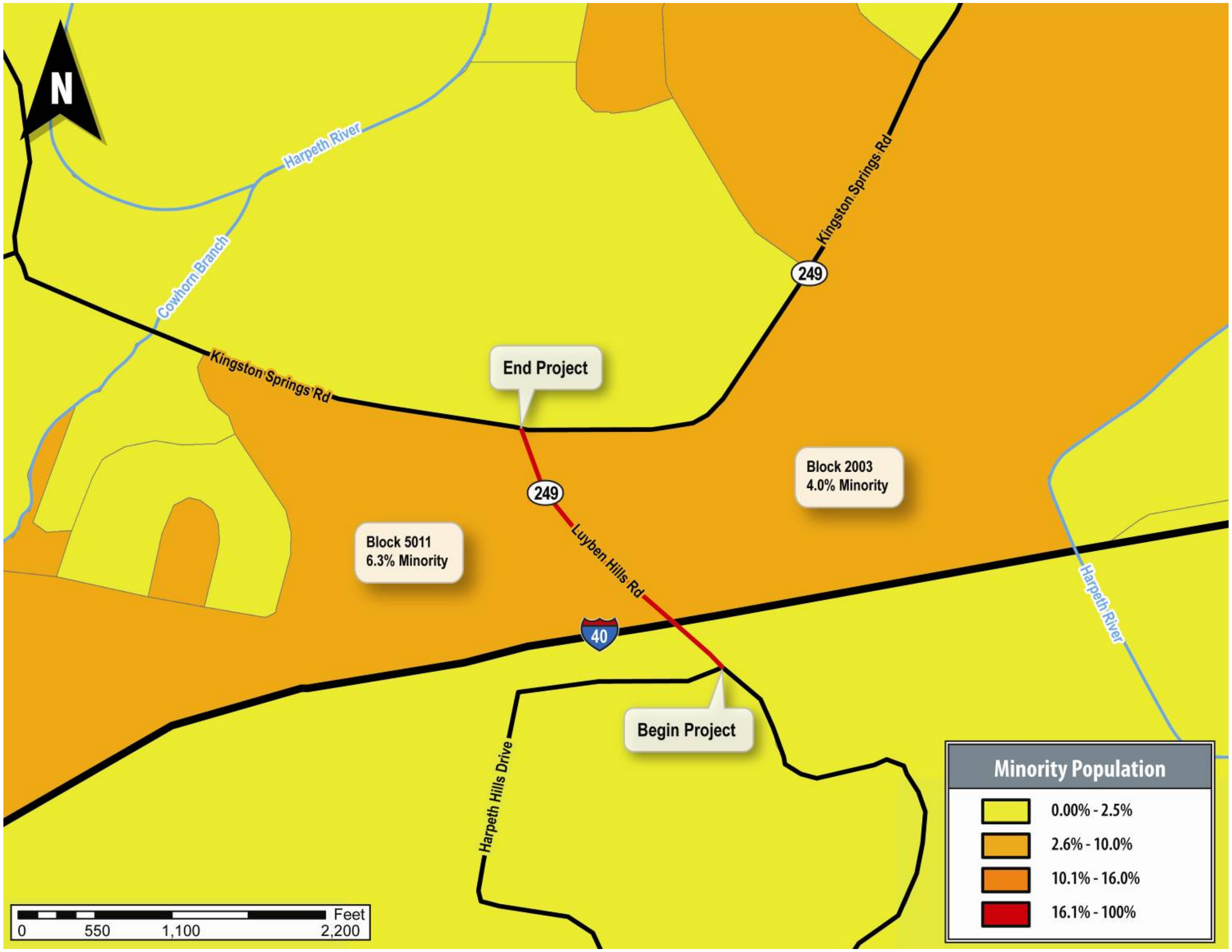


Figure A-5. Minority Populations Map, Census 2000

TDOT

Tennessee Department of Transportation

EARLY ENVIRONMENTAL SCREENING PROCESS (EES) PROJECT SCORING

Project Score Factors

	Total Impacts Evaluated	Total Impacts to Evaluate	EES Evaluation
Project Impact Areas:	15	15	Complete

Date of Evaluation:	June 17, 2009
Evaluation done by:	Gena Gilliam
	Transportation Planner 3
County:	Cheatham
Route:	State Route 249
PIN:	112162.00
Termini:	From Interstate 40 to Kingston Springs Road

Impact Ranking of Features Evaluated:	Total by Rank
Features with No Impact	14
Cemetery Sites & Cemetery Properties	
National Register Sites	
Bat	
Terrestrial Species	
Aquatic Species	
TDEC Conservation Sites & TDEC Scenic Waterways	
Large Wetland Impacts	
Superfund Sites	
Caves	
Pyritic Rock	
Railroads	
Tennessee Natural Areas Program	
Wildlife Management Areas	
TWRA Lakes & Other Public Lands	

Features with Low Impact	**0**
Features with Moderate Impact	**0**
Features with Substantial Impact	**0**

Community Impacts Present:

Institutions:

Populations:

EES Project Impact:	**Complete**

Impacts Evaluated Within 1,000 Ft of Study Area

CEMETERY SITES & CEMETERY PROPERTIES

Impact

Project Impact (Environmental, Time, Cost, Design, and Maintenance)	☑ **None** - No impact on the project as there are no known cemetery sites within or abutting the project study area or corridor. It is anticipated that a 'normal' effort to complete this environmental review as part of NEPA.

INSTITUTIONS & SENSITIVE COMMUNITY POPULATIONS

Sensitive Populations Project Impact:	Present	Not Present
Institutions:		
Hospital	☐	☑
School	☐	☑
Church	☐	☑
Public Building	☐	☑
Populations:		
No population present	☐	☑
65 and older populations	☐	☑
Disability populations	☐	☑
Households without a vehicle	☐	☑
Minority populations 24%	☐	☑
Linguistically isolated populations	☐	☑
Populations below poverty - State average - 13%	☐	☑
Populations below poverty - State average - 27%	☐	☑

BAT

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No project impact is anticipated. There is no occurrence of Indiana or gray bats within 4 miles of the proposed project study area or corridor.

RAILROADS

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No impact on the project is anticipated. There are no railroads located within the project study area or corridor.

Impacts Evaluated Within 2,000 Ft of Study Area

NATIONAL REGISTER SITES

Impact

Project Impact (Environmental, Time, Cost, Design, and Maintenance)	☑ **None** – No project impact is anticipated as there are no National Register listed properties abutting or within the project study area or corridor.

SUPERFUND SITES

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No project impact is anticipated as there are no known contaminated land tracts abutting or within the project study area or corridor.

PYRITIC ROCK

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No project impact is anticipated. Pyritic rock is not known to occur in the study area/corridor or project does not involve excavation. Limestone (symbolized as dark green) and dolomite (symbolized as light green) are present.

TWRA LAKES & OTHER PUBLIC LANDS

Impact

Project Impact (Environment, Time,	☑ **None** – No impact on the project is anticipated as there area no parks located within or

Cost, Design, and Maintenance)	abutting the project study area or corridor.

Impacts Evaluated Within 4,000 Ft of Study Area

TERRESTRIAL SPECIES

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** - No impact to the project is anticipated. There is no known occurrence of a rare, state, or federally-protected terrestrial species within the proposed transportation study area or corridor.

TDEC CONSERVATION SITES & TDEC SCENIC WATERWAYS

Impact

Project Impact (Environment, Time, Cost, Design, Maintenance)	☑ **None** – No project impact is expected as there are no scenic waterways or TDEC Conservation Sites within project study area or corridor.

LARGE WETLAND IMPACTS

Impact

Project Impact (Environment, Time, Cost, Design, Maintenance)	☑ **None** – No impact on the project is anticipated as there are no wetlands present in the project study area or corridor based on the GIS information reviewed.

TENNESSEE NATURAL AREAS PROGRAM

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No impact on the project is anticipated as the project study area or corridor does not include a Natural Area.

WILDLIFE MANAGEMENT AREAS

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No project impact is anticipated as a WMA does not abut nor is located within the project study area or corridor.

Impacts Evaluated Within 10,000 Ft of Study Area

AQUATIC SPECIES

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None -** No impact to the project is anticipated. There is no known occurrence of a rare, state, or federally-protected aquatic species within the project study area or corridor.

CAVES

Impact

Project Impact (Environment, Time, Cost, Design, and Maintenance)	☑ **None** – No project impact is anticipated as there are no caves in the project study area or corridor.

EES Report

PIN	112162.00	Study Line ID:	112162
1,000 Foot Corridor		Version Date:	May 01, 2009
		Created by:	Gilliam

Cemetery Sites & Cemetery Properties

Cemeteries	None were found
Cemetery Property	None were found

Institutions & Sensitive Community Populations

Institutions	None were found
Populations:	
No population present	None were found
65 & older populations	None were found
Disability populations	None were found
Households without a vehicle	None were found
Minority populuations 24%	None were found
Linguistically isolated populations	None were found
Populations below poverty-State average-13%	None were found
Populations below poverty-State average-27%	None were found

Bat	None were found
Railroads	None were found

EES Report

PIN	112162.00	Study Line ID:	112162
2,000 Foot Corridor		Version Date:	May 01, 2009
		Created by:	Gilliam

National Register Sites		None were found
Superfund Sites		None were found
Pyritic Rock	*Classification*	Total=
Pyritic Rock		None were found
TWRA Lakes & Other Public Lands		
TWRA Lakes		None were found
Other Public Lands		None were found

EES Report

PIN	112162.00	Study Line ID:	112162
4,000 Foot Corridor		Version Date:	May 1, 2009
		Created by:	Gilliam

Terrestrial Species	None were found
TDEC Conservation Sites & TDEC Scenic Waterways	
TDEC Conservation Sites	None were found
TDEC Scenic Waterways	None were found
Large Wetland Impacts	None were found
Tennessee Natural Areas Program	None were found
Wildlife Management Areas	None were found

EES Report

PIN	112162.00	Study Line ID:	112162
10,000 Foot Corridor		Version Date:	May 01, 2009
		Created by:	Gilliam

Aquatic Species	None were found
Caves	None were found

Appendix B

Level of Service Analysis and Signal Warrant Analysis

GRESHAM
SMITH AND
PARTNERS

MEMORANDUM

TO: Tennessee Department of Transportation

FROM: Gresham, Smith and Partners

DATE: March 31, 2009

SUBJECT: LEVEL OF SERVICE ANALYSIS & TRAFFIC SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD
TRANSPORTATION PLANNING REPORT
GS&P Project No. 27001.02

Traffic data for the State Route (SR) 249/Interstate 40 (I-40) interchange was provided by the Tennessee Department of Transportation (TDOT). The Annual Average Daily Traffic (AADT) and the Design Hour Volumes (DHV) for the AM and PM peak hours for the base year of 2010 and the design year of 2030 were provided for each of the major movements within the SR 249/Luyben Hills Road and I-40 interchange area. These traffic volumes are located in Appendix A of this Memorandum. It was determined that the growth rate used by TDOT to project the traffic to the design year was 2.686 percent.

In addition to the traffic obtained from TDOT, Gresham, Smith and Partners contracted Southern Traffic Services to perform a 12-hour turning movement count at each of the intersections at the interchange (SR 249 & I-40 westbound [WB] ramps and SR 249 & I-40 eastbound [EB] ramps). The traffic data was collected on February 4, 2009 and is broken down by numbers of automobiles, trucks and buses and is included in Appendix B. The purpose of collecting 12 hours of traffic data was to have adequate data to perform a signal warrant analysis for each of the ramp intersections. The collected traffic data was projected to the base year of 2014 and the design year of 2034 using the same growth rate that TDOT used (i.e., 2.686 percent) and was used for the capacity analysis of the ramp intersections and SR 249.

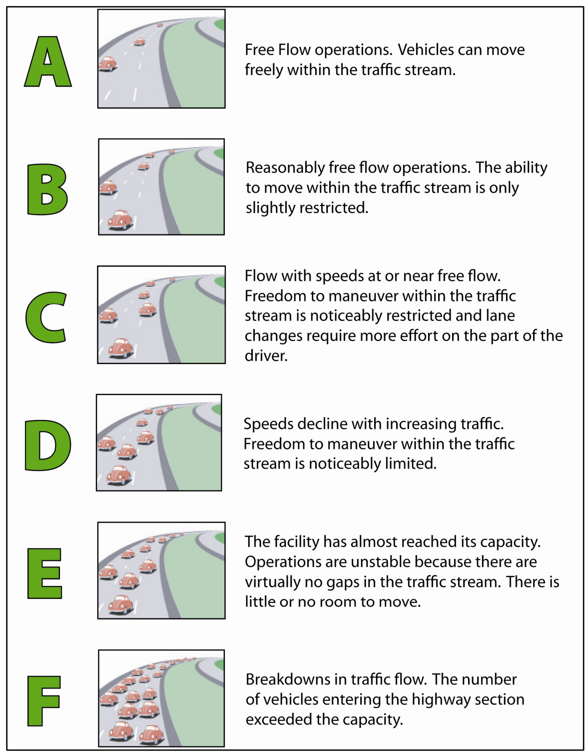
SR 249/Luyben Hills Road, a two-lane highway with a two-way left-turn lane, is projected to carry a 2009 AADT of 6,330 (south) to 12,183 (north) vehicles per day, using the TDOT provided traffic data and the growth rate mentioned above, in the vicinity of the I-40/SR 249 Interchange. SR 249/Luyben Hills Road is projected to carry a 2014 AADT of 7,227 (south) to 13,910 (north) vehicles per day and a 2034 AADT of 12,280 (south) to 23,635 (north) vehicles per day in the vicinity of the I-40/SR 249 Interchange.

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

Level of Service Analysis of SR 249/Luyben Hills Road

A level of service (LOS) analysis for SR 249/Luyben Hills Road was used to gauge the operational performance of the existing roadway. LOS is a qualitative measure that describes traffic conditions related to speed and travel time, freedom to maneuver and traffic interruptions. There are six levels, ranging from "A" to "F" with "F" being the worst. Each level represents a range of operating conditions. Figure 1 illustrates the traffic flow conditions and approximate driver comfort level at each LOS.

Figure 1. Definition of Level of Service



The traffic analysis for the segment of SR 249/Luyben Hills Road from the I-40 interchange to the intersection with Kingston Springs Road was performed using the Highway Capacity Software (HCS+) for both the AM and PM Peak Hour conditions for the present year (2009), the base year (2014) and the design year (2034). The traffic collected on February 4, 2009 was used for the analysis and was projected to the base year and design year using the TDOT growth rate of 2.686 percent.

The traffic analysis used procedures from the Highway Capacity Manual 2000 (HCM) for evaluation of two-way, two-lane highway segments. The two-way segment methodology estimates measures of traffic operation along a section of highway, based on terrain, number of access points, geometric design and traffic conditions. Terrain is classified as either level or rolling. Traffic data needed to apply the two-way segment methodology include the two-way hourly volume, a peak hour factor, the directional distribution of traffic flow as well as the percentage of trucks and recreational vehicles in the traffic stream. The HCS printouts are included in Appendix C.

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

Table 1 summarizes the traffic data and peak hour LOS analysis for the Build and No Build Alternatives in the present year (2009), the base year (2014) and the design year (2034)[1].

Table 1. Peak Hour LOS Analysis for SR 249/Luyben Hills Road Corridor

	Two Way Flow Rate (pc/h)	Level of Service
2009 (AADT=18,513)		
AM	1,138	C
PM	1,203	C
2014 (AADT=21,137)		
AM	1,285	D
PM	1,374	D
2034 (AADT=35,915)		
AM	1,977	D
PM	2,045	D

Unsignalized Intersection Analysis

In order to determine how the I-40 and SR 249/Luyben Hills Road interchange is functioning in its current configuration, an unsignalized intersection analysis was performed using the HCS+ Software for the AM and PM Peak Hour conditions for the present year (2009), the base year (2014) and the design year (2034). The traffic collected on February 4, 2009 was used for the analysis and was projected to the base year and design year using the TDOT growth rate of 2.686 percent. The HCS printouts are included in Appendix C.

The results of the analysis are presented in terms of LOS and Approach Delay (seconds per vehicle) and are illustrated in Tables 2 and 3.

[1] The project's purpose and need is to address safety issues and roadway deficiencies along SR 249/Luyben Hills Road while improving pedestrian accessibility and safety. Because the project is not intended to address poor vehicle levels of service, the LOS analysis does not include a Build and No Build Scenario. Furthermore, there is no available traffic analysis tool that will analyze the impact of sidewalk and access management improvements on LOS.

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

Table 2. Traffic and LOS Analysis for I-40 and SR 249/Luyben Hills Road Interchange, Westbound Ramp

SR 249 and the I 40/SR 249 Interchange Westbound (WB) Ramp	
Analysis Year	**WB Approach LOS**
2009 (Unsignalized)	
AM	B
PM	C
2014 (Unsignalized)	
AM	B
PM	C
2034 (Unsignalized)	
AM	D
PM	F

Table 3. Traffic and LOS Analysis for I-40 and SR 249/Luyben Hills Road Interchange, Eastbound Ramp

SR 249 and the I 40/SR 249 Interchange Eastbound (EB) Ramp*	
Analysis Year	**EB Approach LOS**
2009	
AM	F
PM	C
2014	
AM	F
PM	C
2034	
AM	F
PM	F
* It should be noted that, based on traffic volumes, this intersection does not meet the MUTCD signal warrant; however, a signal may be warranted based on engineering judgment due to the amount of delay experienced by the eastbound approach.	

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

Traffic Signal Warrant Analysis for the Interchange

The *Manual of Uniform Traffic Control Devices* (*MUTCD*), 2003 Edition developed eight traffic signal warrants to determine if a traffic signal is justified at a given location. The HCS+ Traffic Signal Warrant module, which is based on the eight traffic signal warrants developed for the *MUTCD*, was used to evaluate the need for a traffic signal at the EB and WB ramps of I-40 and SR 249. The traffic volumes were obtained from 12 hours of turning movement counts that were collected on February 4, 2009. The results of the Signal Warrant Analysis are included in Appendix C.

It should be noted, based on guidance provided in the *MUTCD*, that a Signal Warrant Analysis should be performed within one year of putting the signal into operation. Therefore, it may be necessary to re-perform the traffic signal warrants within the year that the signal(s) will be installed.

I-40 WB Ramps and SR 249/Luyben Hills Road

Based on the collected traffic counts, the intersection of SR 249/Luyben Hills Road and the I-40 WB ramps meets Warrant 2 - Four Hour Vehicular Volume and Warrant 3 - Peak Hour. If four plotted points based on the approach volumes (vehicles per hour) are above the line shown in Figure 4C-2 in the *MUTCD*, then Warrant 2 is met. Based on the traffic collected, five hours met this requirement:

- 7AM to 8AM,
- 2PM to 3PM,
- 3PM to 4PM,
- 4PM to 5PM,
- and 5PM to 6PM.

In order to meet Warrant 3 for peak hour, at least one hour must be above the line on Figure 4C-4 of the *MUTCD*. Based on the collected traffic, three hours met this requirement: 3PM to 4PM, 4PM to 5PM, and 5PM to 6PM. (See Warrant Volume sheets located in Appendix C).

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

I-40 EB Ramps and SR 249/Luyben Hills Road

Based on the collected traffic counts, the intersection of SR 249/Luyben Hills Road and the I-40 EB ramps does not currently meet any of the eight traffic signal warrants. (See Warrant Volume sheets located in Appendix C). However, based on engineering judgment and the amount of approach delay experienced for the EB approach, a signal may be warranted at this location.

Furthermore, the truck/travel center, located in the southeast quadrant of the interchange, is a major attraction for large volumes of truck traffic. Due to these high volumes of trucks, the operation of the interchange may be negatively impacted if the WB ramps are signalized and the EB ramps are not. If traffic signals are installed at both sets of ramps, they could be coordinated together allowing for all approaches of the interchange to operate efficiently, thereby reducing vehicular delay. During the design phase it is recommended that a detailed operational analysis of the interchange be performed both with a traffic signal located only at the WB ramps and with traffic signals installed at both sets of ramps.

Attachment

Copy File – 27001.02

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

APPENDIX A

TENNESSEE DEPARTMENT OF TRANSPORTATION
PROJECT PLANNING DIVISION

PROJECT NO.: ______ ROUTE: S.R. 249 @ I-40
COUNTY: CHEATHAM CITY: KINGSTON SPRINGS
PROJECT PIN NUMBER: ______
PROJECT DESCRIPTION: S.R. 249 AND I-40 RAMPS

DIVISION REQUESTING:

MAINTENANCE ☐
PLANNING ☒
PROG. DEVELOPMENT & ADM. ☐
PUBLIC TRANS. & AERO. ☐
PAVEMENT DESIGN ☐
STRUCTURES ☐
SURVEY & DESIGN ☐
TRAFFIC SIGNAL DESIGN ☐
OTHER ______ ☐

YEAR PROJECT PROGRAMMED FOR CONSTRUCTION: ______
PROJECTED LETTING DATE: ______

TRAFFIC ASSIGNMENT:

BASE YEAR		DESIGN YEAR					DESIGN ROADWAY % TRUCKS		DESIGN AVERAGE DAILY LOADS	
ADT	YEAR	ADT	DHV	%	YEAR	DIR.DIST.	DHV	ADT	FLEX	RIGID
9,510	2010	16,160	1,778	11	2030	70-30	12	18		

REQUESTED BY: NAME RON BAKER DATE 9/15/05
DIVISION PLANNING
ADDRESS 900 J.K. POLK BLDG.

REVIEWED BY: TONY ARMSTRONG *Tony Armstrong* DATE 12-5-05
TRANSPORTATION MANAGER 1
SUITE 1000, JAMES K. POLK BUILDING

APPROVED BY: (VACANT) *[signature]* DATE 12-5-05
TRANSPORTATION MANAGER 2
SUITE 1000, JAMES K. POLK BUILDING

3 LANES

COMMENTS:

THIS TRAFFIC BASED ON 2005 CYCLE COUNTS, 2-12 HOUR (NOV. 05) TURNING MOVEMENT COUNTS AND GROWTH TRENDS FROM THE ADAM COMPUTER PROGRAM.

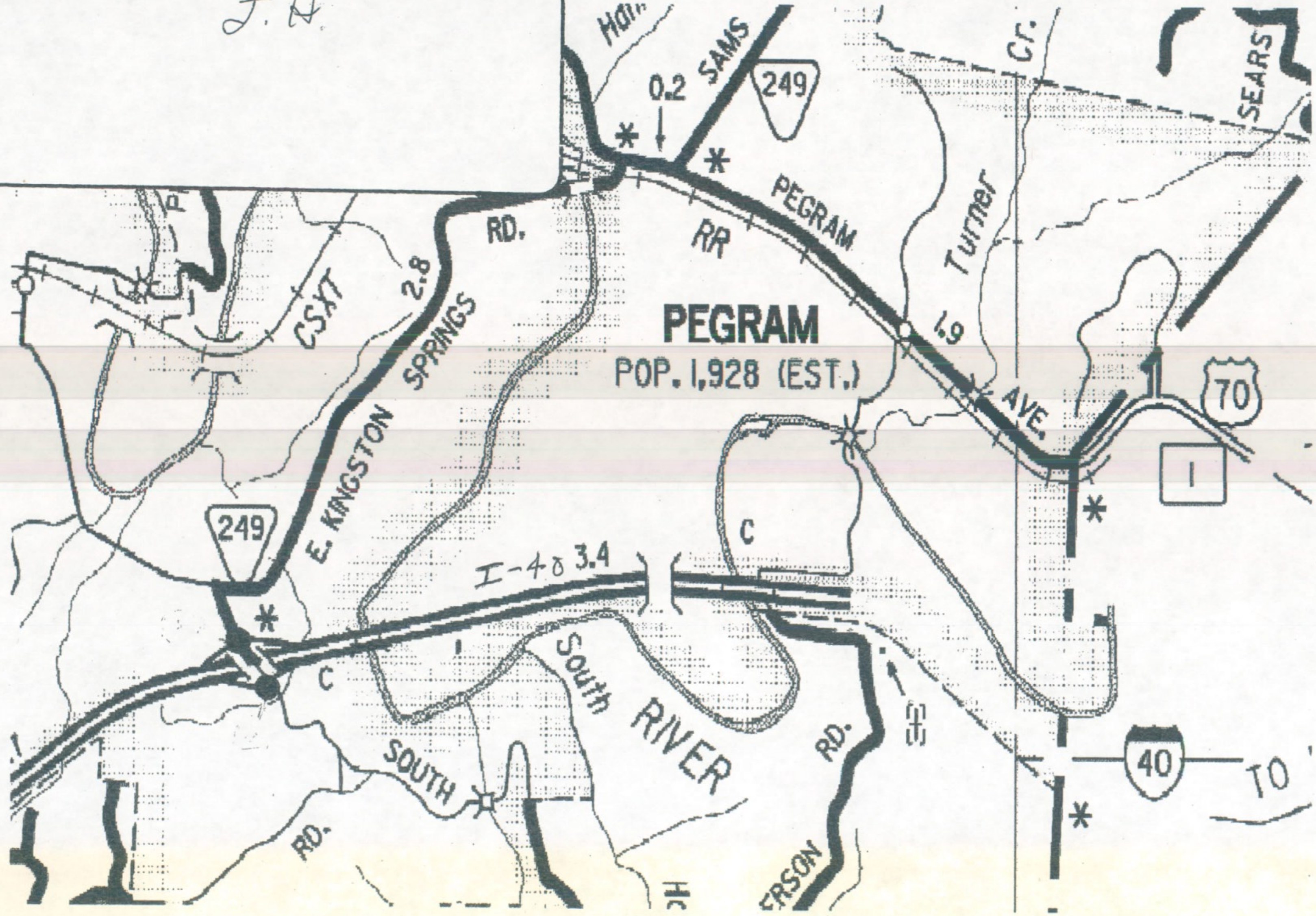
DHV'S ARE NOT REQUIRED FOR SIDE ROADS LESS THAN 1000 ADT.

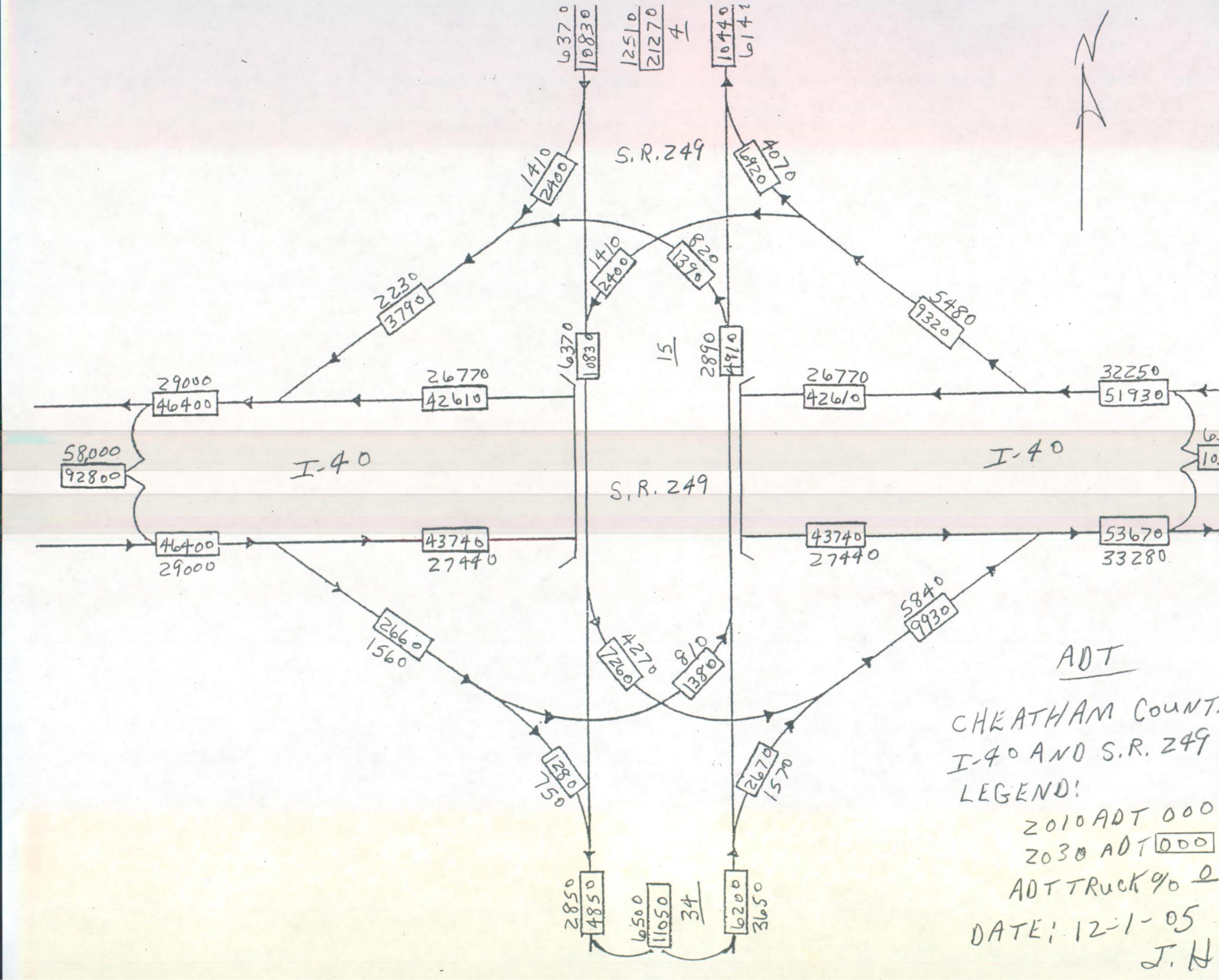
NOTE: FOR BRIDGE REPLACEMENT PROJECTS, ADLs ARE NOT REQUIRED FOR ADTs OF 1000 OR LESS AND PERCENTAGE OF TRUCKS OF 7% OR LESS.
SEE ATTACHMENTS FOR TURNING MOVEMENTS AND/OR OTHER DETAILS. (REV. 12/2/05)

CHEATHAM COUNTY

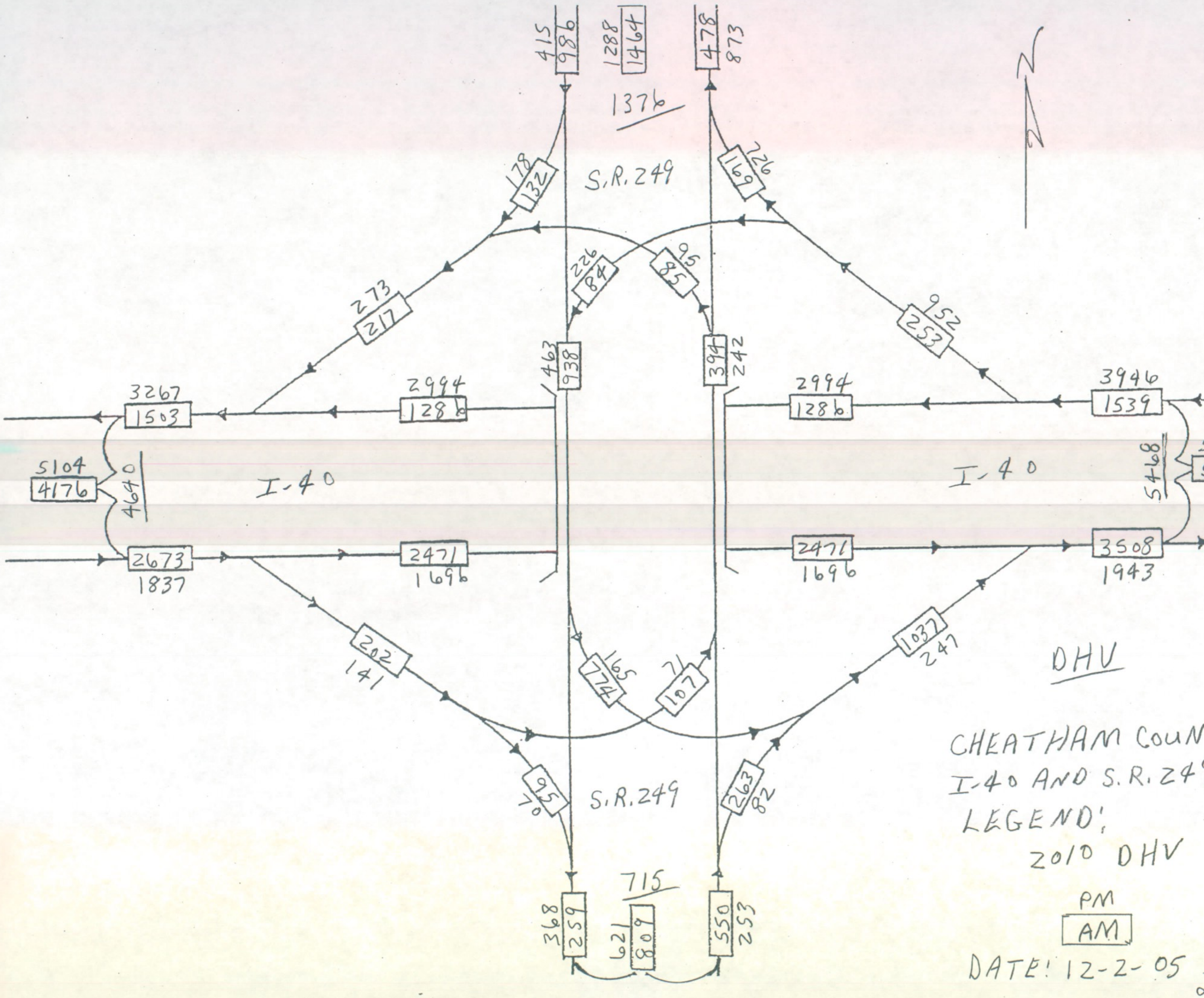
I-40 @ S.R.-249 (KINGSTON SPRINGS RD.)

DATE: 12-1-05
J. H.





ADT
CHEATHAM COUNT
I-40 AND S.R. 249
LEGEND:
2010 ADT 000
2030 ADT 000
ADT TRUCK % 0
DATE: 12-1-05
J. H
S.R. 249
S.R. 249
I-40
I-40
6370
10830
12510
21270
4
10440
6141
1410
2400
4070
6920
1410
2400
820
1390
2230
3790
5480
9320
6370
1083
15
2890
4910
29000
46400
26770
42610
26770
42610
32250
51930
58000
92800
46400
29000
43740
27440
43740
27440
53670
33280
5840
9930
2660
1560
4270
7260
810
1380
1280
750
2670
1570
2850
4850
6500
11050
34
6200
3650

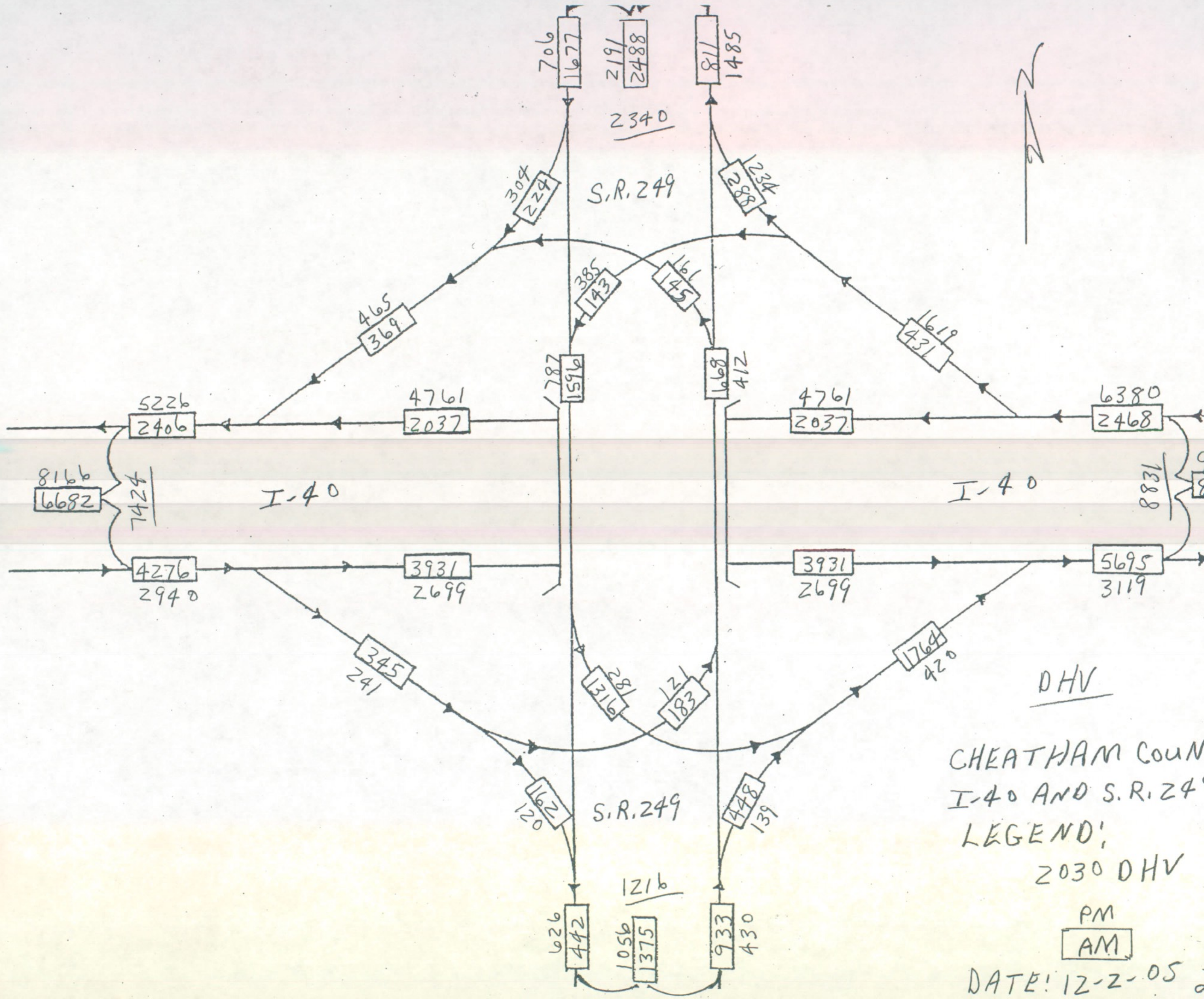


DHU

CHEATHAM COUNTY
I-40 AND S.R. 249
LEGEND:
2010 DHV

PM
AM

DATE: 12-2-05



DHV

CHEATHAM COUN
I-40 AND S.R. 24
LEGEND:
2030 DHV
PM
AM
DATE: 12-2-05

MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

APPENDIX B

Southern Traffic Services, Inc.
2911 Westfield Rd.
Gulf Breeze, FL 32563
1-800-786-3374

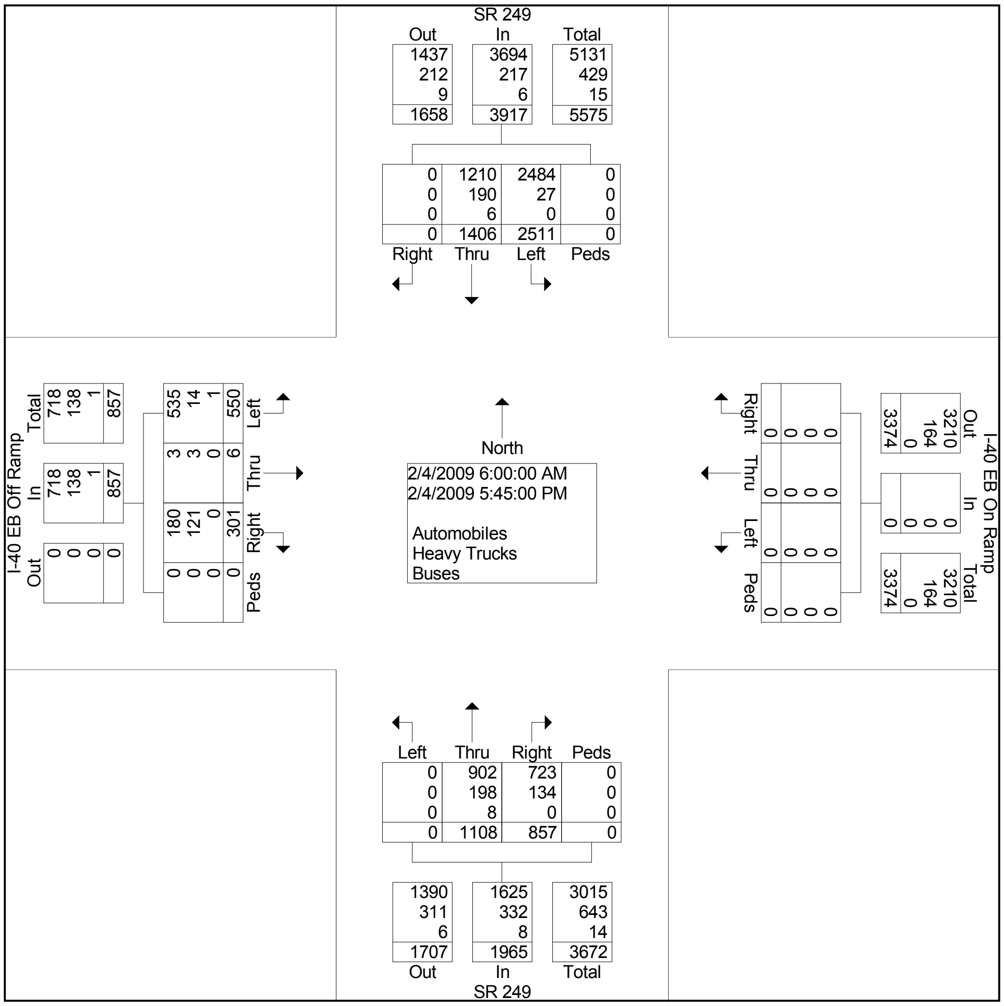
SR 249 @ I-40 EB Ramps
Kingston Springs, TN

File Name : 9026-1 SR 249 @ I-40 EB Ramps
Site Code : 90260001
Start Date : 02/04/2009
Page No : 1

Groups Printed- Automobiles - Heavy Trucks - Buses

	SR 249 Southbound				I-40 EB On Ramp Westbound				SR 249 Northbound				I-40 EB Off Ramp Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:00	76	15	0	0	0	0	0	0	0	7	29	0	11	0	1	0	139
06:15	113	9	0	0	0	0	0	0	0	11	30	0	15	0	2	0	180
06:30	113	9	0	0	0	0	0	0	0	17	51	0	14	0	5	0	209
06:45	115	24	0	0	0	0	0	0	0	23	38	0	19	0	17	0	236
Total	417	57	0	0	0	0	0	0	0	58	148	0	59	0	25	0	764
07:00	114	20	0	0	0	0	0	0	0	34	42	0	12	0	7	0	229
07:15	149	16	0	0	0	0	0	0	0	71	40	0	11	1	7	0	295
07:30	164	31	0	0	0	0	0	0	0	46	34	0	10	0	5	0	290
07:45	118	31	0	0	0	0	0	0	0	15	21	0	14	0	3	0	202
Total	545	98	0	0	0	0	0	0	0	166	137	0	47	1	22	0	1016
08:00	75	13	0	0	0	0	0	0	0	14	36	0	22	0	14	0	174
08:15	78	19	0	0	0	0	0	0	0	14	26	0	18	0	10	0	165
08:30	64	25	0	0	0	0	0	0	0	17	20	0	7	0	8	0	141
08:45	55	15	0	0	0	0	0	0	0	12	26	0	11	0	8	0	127
Total	272	72	0	0	0	0	0	0	0	57	108	0	58	0	40	0	607
09:00	53	21	0	0	0	0	0	0	0	14	12	0	13	0	6	0	119
09:15	41	15	0	0	0	0	0	0	0	16	15	0	11	0	5	0	103
09:30	50	15	0	0	0	0	0	0	0	17	14	0	4	0	4	0	104
09:45	40	20	0	0	0	0	0	0	0	11	18	0	3	0	5	0	97
Total	184	71	0	0	0	0	0	0	0	58	59	0	31	0	20	0	423
10:00	33	22	0	0	0	0	0	0	0	15	13	0	5	0	3	0	91
10:15	35	19	0	0	0	0	0	0	0	14	15	0	12	0	5	0	100
10:30	37	21	0	0	0	0	0	0	0	21	11	0	14	0	6	0	110
10:45	34	23	0	0	0	0	0	0	0	16	19	0	4	0	4	0	100
Total	139	85	0	0	0	0	0	0	0	66	58	0	35	0	18	0	401
11:00	47	28	0	0	0	0	0	0	0	23	13	0	11	0	1	0	123
11:15	30	20	0	0	0	0	0	0	0	19	11	0	7	0	6	0	93
11:30	41	23	0	0	0	0	0	0	0	34	16	0	5	0	7	0	126
11:45	28	30	0	0	0	0	0	0	0	22	10	0	7	0	12	0	109
Total	146	101	0	0	0	0	0	0	0	98	50	0	30	0	26	0	451
12:00	25	23	0	0	0	0	0	0	0	16	16	0	13	0	9	0	102
12:15	37	31	0	0	0	0	0	0	0	30	11	0	11	0	3	0	123
12:30	26	24	0	0	0	0	0	0	0	26	13	0	13	0	2	0	104
12:45	42	39	0	0	0	0	0	0	0	25	8	0	12	0	5	0	131
Total	130	117	0	0	0	0	0	0	0	97	48	0	49	0	19	0	460
13:00	21	29	0	0	0	0	0	0	0	22	16	0	10	1	3	0	102
13:15	39	19	0	0	0	0	0	0	0	21	10	0	11	0	9	0	109
13:30	28	24	0	0	0	0	0	0	0	21	18	0	17	0	5	0	113
13:45	31	21	0	0	0	0	0	0	0	12	9	0	6	0	5	0	84
Total	119	93	0	0	0	0	0	0	0	76	53	0	44	1	22	0	408
14:00	32	31	0	0	0	0	0	0	0	20	6	0	6	1	10	0	106
14:15	29	34	0	0	0	0	0	0	0	26	14	0	15	0	4	0	122
14:30	30	25	0	0	0	0	0	0	0	27	8	0	6	0	7	0	103
14:45	34	47	0	0	0	0	0	0	0	31	13	0	13	0	8	0	146
Total	125	137	0	0	0	0	0	0	0	104	41	0	40	1	29	0	477
15:00	50	55	0	0	0	0	0	0	0	29	9	0	16	0	5	0	164
15:15	43	43	0	0	0	0	0	0	0	29	11	0	15	0	3	0	144
15:30	44	38	0	0	0	0	0	0	0	39	20	0	15	0	7	0	163
15:45	28	43	0	0	0	0	0	0	0	27	17	0	11	0	11	0	137
Total	165	179	0	0	0	0	0	0	0	124	57	0	57	0	26	0	608
16:00	26	46	0	0	0	0	0	0	0	16	8	0	9	0	6	0	111
16:15	27	40	0	0	0	0	0	0	0	27	10	0	12	0	7	0	123
16:30	42	34	0	0	0	0	0	0	0	22	19	0	10	0	4	0	131
16:45	31	43	0	0	0	0	0	0	0	27	10	0	11	0	14	0	136
Total	126	163	0	0	0	0	0	0	0	92	47	0	42	0	31	0	501

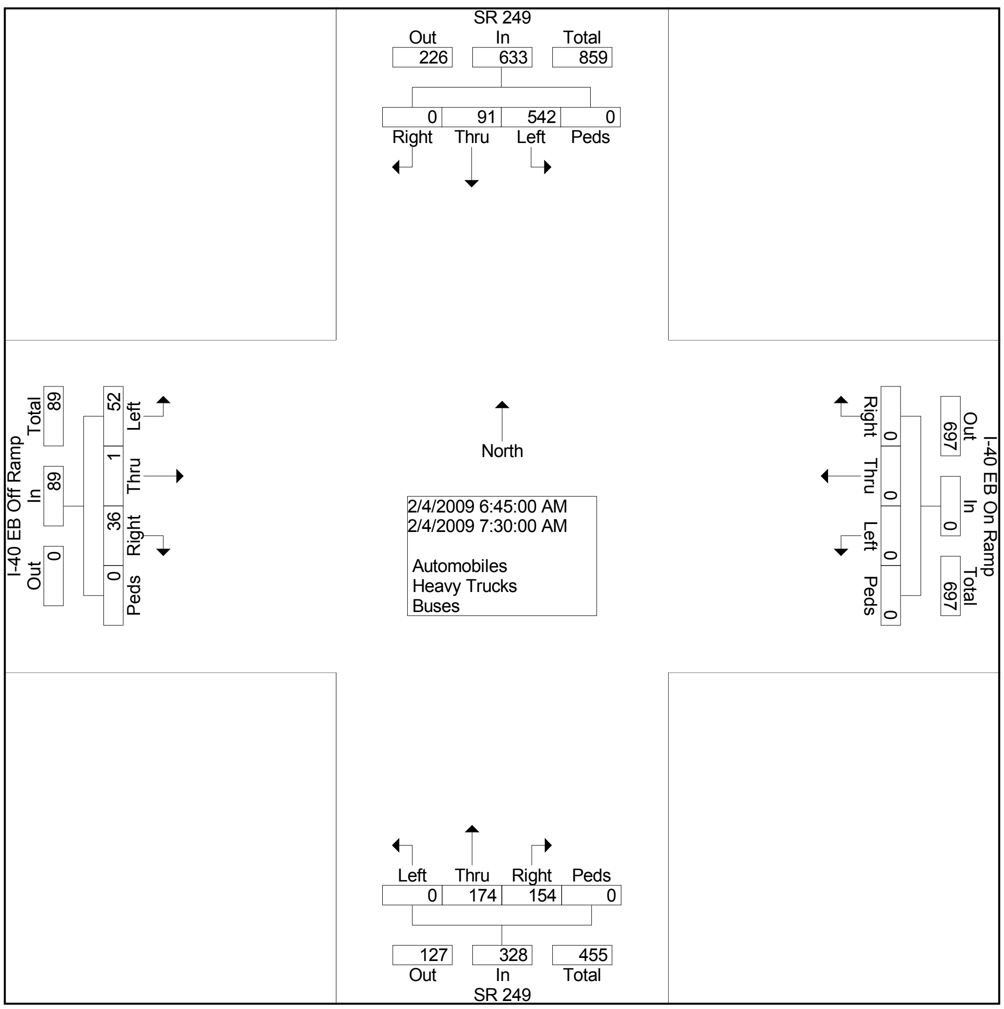
17:00	36	68	0	0	0	0	0	0	0	26	10	0	9	0	5	0	154
17:15	37	46	0	0	0	0	0	0	0	38	12	0	13	3	7	0	156
17:30	36	63	0	0	0	0	0	0	0	24	16	0	21	0	5	0	165
17:45	34	56	0	0	0	0	0	0	0	24	13	0	15	0	6	0	148
Total	143	233	0	0	0	0	0	0	0	112	51	0	58	3	23	0	623
Grand Total	2511	1406	0	0	0	0	0	0	0	1108	857	0	550	6	301	0	6739
Apprch %	64.1	35.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.4	43.6	0.0	64.2	0.7	35.1	0.0	
Total %	37.3	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4	12.7	0.0	8.2	0.1	4.5	0.0	



SR 249 @ I-40 EB Ramps
Kingston Springs, TN

File Name : 9026-1 SR 249 @ I-40 EB Ramps
Site Code : 90260001
Start Date : 02/04/2009

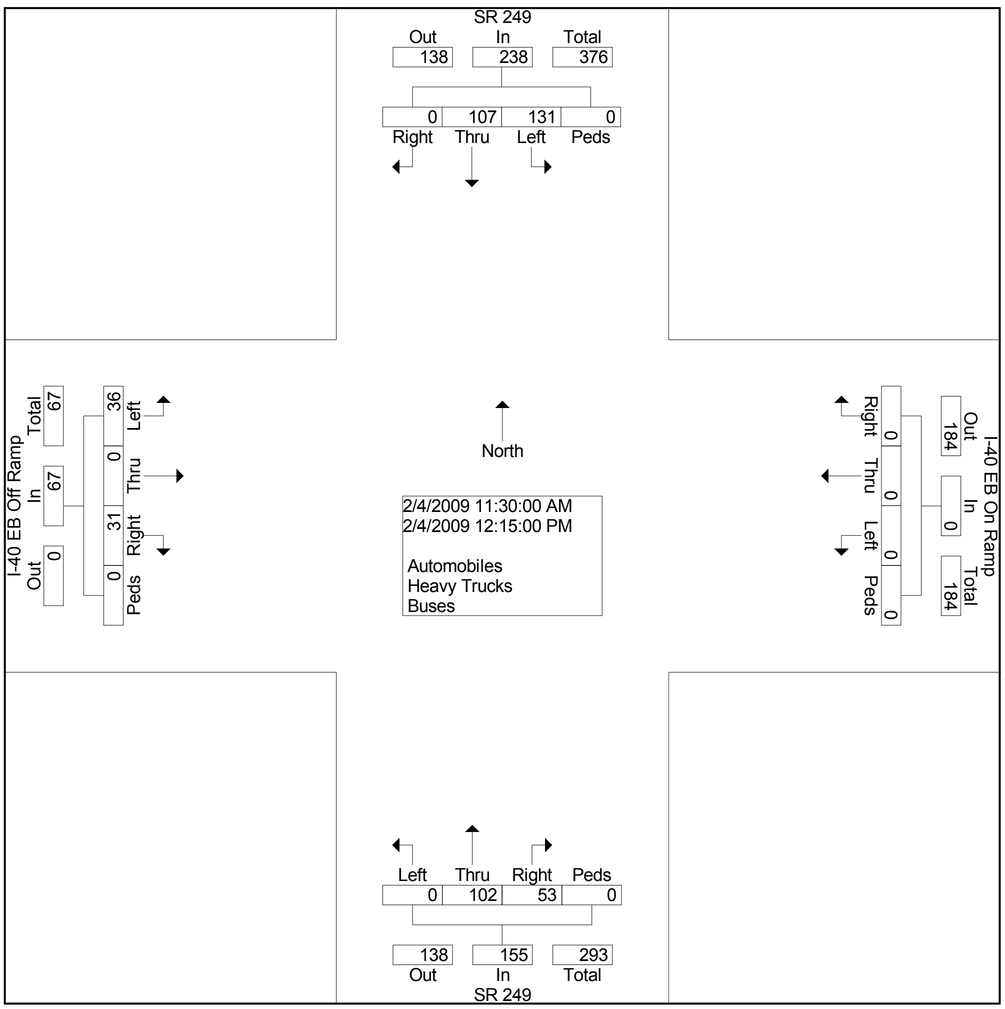
	SR 249 Southbound					I-40 EB On Ramp Westbound					SR 249 Northbound					I-40 EB Off Ramp Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 06:00 to 09:45 - Peak 1 of 1																					
Intersection	06:45																				
Volume	542	91	0	0	633	0	0	0	0	0	0	174	154	0	328	52	1	36	0	89	1050
Percent	85.6	14.4	0.0	0.0		0.0	0.0	0.0	0.0		0.0	53.0	47.0	0.0		58.4	1.1	40.4	0.0		
Volume	542	91	0	0	633	0	0	0	0	0	0	174	154	0	328	52	1	36	0	89	1050
Volume	149	16	0	0	165	0	0	0	0	0	0	71	40	0	111	11	1	7	0	19	295
Peak Factor																					0.890
High Int.	07:30					5:45:00 AM					07:15					06:45					
Volume	164	31	0	0	195	0	0	0	0	0	0	71	40	0	111	19	0	17	0	36	
Peak Factor					0.812										0.739					0.618	



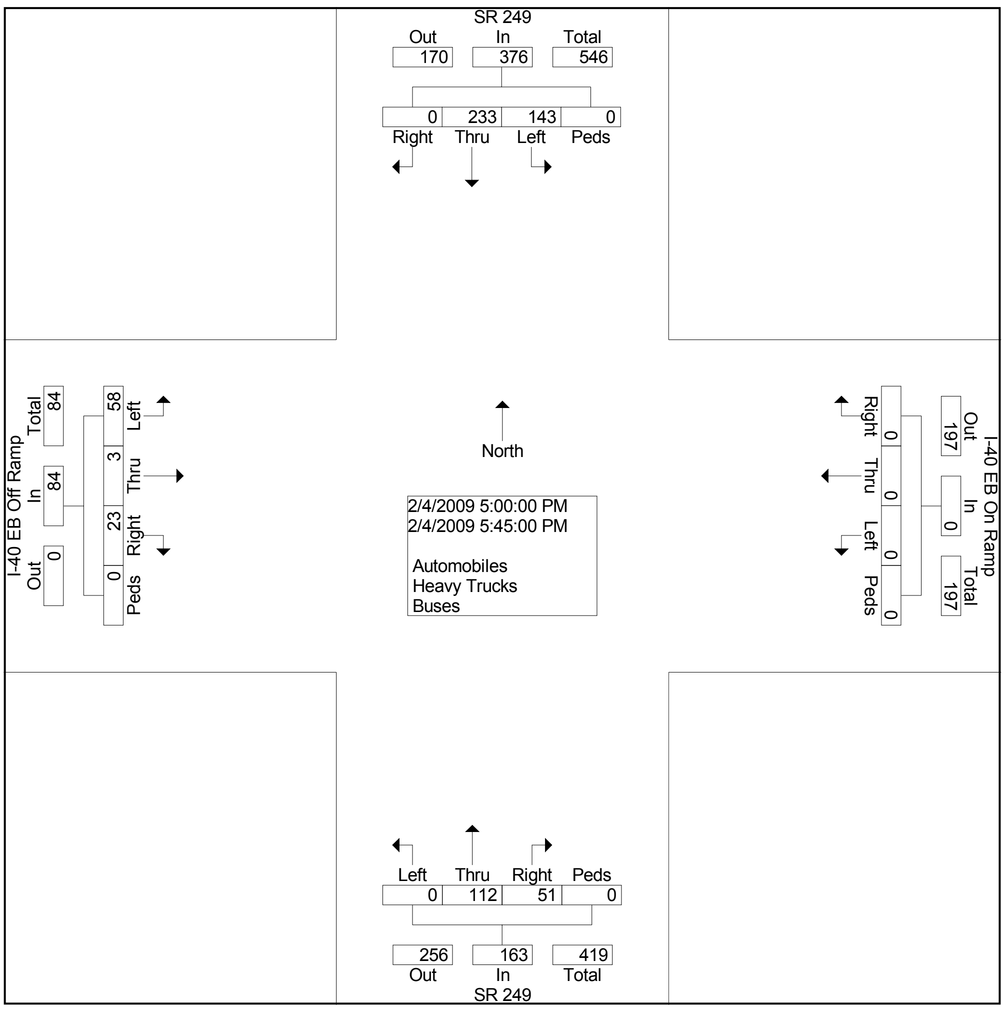
Southern Traffic Services, Inc.
2911 Westfield Rd.
Gulf Breeze, FL 32563
1-800-786-3374

SR 249 @ I-40 EB Ramps
Kingston Springs, TN

	SR 249 Southbound					I-40 EB On Ramp Westbound					SR 249 Northbound					I-40 EB Off Ramp Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 10:00 to 13:45 - Peak 1 of 1																					
Intersection	11:30																				
Volume	131	107	0	0	238	0	0	0	0	0	0	102	53	0	155	36	0	31	0	67	460
Percent	55.0	45.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	65.8	34.2	0.0		53.7	0.0	46.3	0.0		
Volume	131	107	0	0	238	0	0	0	0	0	0	102	53	0	155	36	0	31	0	67	460
Volume	41	23	0	0	64	0	0	0	0	0	0	34	16	0	50	5	0	7	0	12	126
Peak Factor																					0.913
High Int.	12:15										11:30					12:00					
Volume	37	31	0	0	68	0	0	0	0	0	0	34	16	0	50	13	0	9	0	22	
Peak Factor					0.875										0.775					0.761	



	SR 249 Southbound					I-40 EB On Ramp Westbound					SR 249 Northbound					I-40 EB Off Ramp Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 14:00 to 17:45 - Peak 1 of 1																					
Intersection	17:00																				
Volume	143	233	0	0	376	0	0	0	0	0	0	112	51	0	163	58	3	23	0	84	623
Percent	38.0	62.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	68.7	31.3	0.0		69.0	3.6	27.4	0.0		
Volume	143	233	0	0	376	0	0	0	0	0	0	112	51	0	163	58	3	23	0	84	623
Volume	36	63	0	0	99	0	0	0	0	0	0	24	16	0	40	21	0	5	0	26	165
Peak Factor																					0.944
High Int.	17:00										17:15					17:30					
Volume	36	68	0	0	104	0	0	0	0	0	0	38	12	0	50	21	0	5	0	26	
Peak Factor					0.904										0.815					0.808	



Southern Traffic Services, Inc.
2911 Westfield Rd.
Gulf Breeze, FL 32563
1-800-786-3374

SR 249 @ I-40 WB Ramps
Kingston Springs, TN

File Name : 9026-2 SR 249 @ I-40 WB Ramps
Site Code : 90260002
Start Date : 02/03/2009
Page No : 1

Groups Printed- Automobiles - Heavy Trucks - Buses

	SR 249 Southbound				I-40 WB Off Ramp Westbound				SR 249 Northbound				I-40 WB On Ramp Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:00	0	82	9	0	3	0	10	0	4	13	0	0	0	0	0	0	121
06:15	0	94	8	0	5	0	14	0	4	11	0	0	0	0	0	0	136
06:30	0	130	14	0	7	0	21	0	3	31	0	0	0	0	0	0	206
06:45	0	135	9	0	5	0	27	0	8	33	0	0	0	0	0	0	217
Total	0	441	40	0	20	0	72	0	19	88	0	0	0	0	0	0	680
07:00	0	117	16	0	6	0	29	0	12	42	0	0	0	0	0	0	222
07:15	0	158	18	0	6	0	31	0	16	67	0	0	0	0	0	0	296
07:30	0	182	24	0	7	0	40	0	5	50	0	0	0	0	0	0	308
07:45	0	125	23	0	2	0	22	0	3	27	0	0	0	0	0	0	202
Total	0	582	81	0	21	0	122	0	36	186	0	0	0	0	0	0	1028
08:00	0	103	16	0	7	1	23	0	3	34	0	0	0	0	0	0	187
08:15	0	96	15	0	6	0	17	0	8	26	0	0	0	0	0	0	168
08:30	0	65	15	0	8	0	26	0	4	28	0	0	0	0	0	0	146
08:45	0	78	18	0	14	0	30	0	7	18	0	0	0	0	0	0	165
Total	0	342	64	0	35	1	96	0	22	106	0	0	0	0	0	0	666
09:00	0	56	15	0	11	1	26	0	8	21	0	0	0	0	0	0	138
09:15	0	54	23	0	7	1	27	0	6	19	0	0	0	0	0	0	137
09:30	0	54	14	0	9	0	27	0	8	21	0	0	0	0	0	0	133
09:45	0	58	21	0	12	0	30	0	5	26	0	0	0	0	0	0	152
Total	0	222	73	0	39	2	110	0	27	87	0	0	0	0	0	0	560
10:00	0	48	24	0	6	0	26	0	9	22	0	0	0	0	0	0	135
10:15	0	36	12	0	11	0	21	0	7	21	0	0	0	0	0	0	108
10:30	0	43	20	0	5	0	36	0	8	14	0	0	0	0	0	0	126
10:45	0	36	20	0	9	1	26	0	4	19	0	0	0	0	0	0	115
Total	0	163	76	0	31	1	109	0	28	76	0	0	0	0	0	0	484
11:00	0	46	15	0	9	0	26	0	2	22	0	0	0	0	0	0	120
11:15	0	43	11	0	11	0	40	0	12	27	0	0	0	0	0	0	144
11:30	0	49	13	0	19	0	36	0	2	16	0	0	0	0	0	0	135
11:45	0	39	29	0	13	1	41	0	7	20	0	0	0	0	0	0	150
Total	0	177	68	0	52	1	143	0	23	85	0	0	0	0	0	0	549
12:00	0	62	14	0	11	0	29	0	8	28	0	0	0	0	0	0	152
12:15	0	45	17	0	9	0	34	0	6	36	0	0	0	0	0	0	147
12:30	0	38	19	0	9	0	25	0	5	16	0	0	0	0	0	0	112
12:45	0	44	15	0	8	1	37	0	2	18	0	0	0	0	0	0	125
Total	0	189	65	0	37	1	125	0	21	98	0	0	0	0	0	0	536
13:00	0	35	12	0	12	0	47	0	6	28	0	0	0	0	0	0	140
13:15	0	47	24	0	20	0	46	0	10	27	0	0	0	0	0	0	174
13:30	0	39	22	0	11	0	47	0	8	24	0	0	0	0	0	0	151
13:45	0	47	19	0	15	0	42	0	6	28	0	0	0	0	0	0	157
Total	0	168	77	0	58	0	182	0	30	107	0	0	0	0	0	0	622
14:00	0	48	20	0	14	2	48	0	2	14	0	0	0	0	0	0	148
14:15	0	42	28	0	11	0	58	0	9	25	0	0	0	0	0	0	173
14:30	0	48	27	0	10	1	69	0	3	31	0	0	0	0	0	0	189
14:45	0	64	20	0	8	0	72	0	10	28	0	0	0	0	0	0	202
Total	0	202	95	0	43	3	247	0	24	98	0	0	0	0	0	0	712
15:00	0	100	24	0	14	0	71	0	13	30	0	0	0	0	0	0	252
15:15	0	66	25	0	16	1	63	0	7	32	0	0	0	0	0	0	210
15:30	0	57	27	0	17	0	91	0	10	28	0	0	0	0	0	0	230
15:45	0	48	35	0	23	0	92	0	9	20	0	0	0	0	0	0	227
Total	0	271	111	0	70	1	317	0	39	110	0	0	0	0	0	0	919

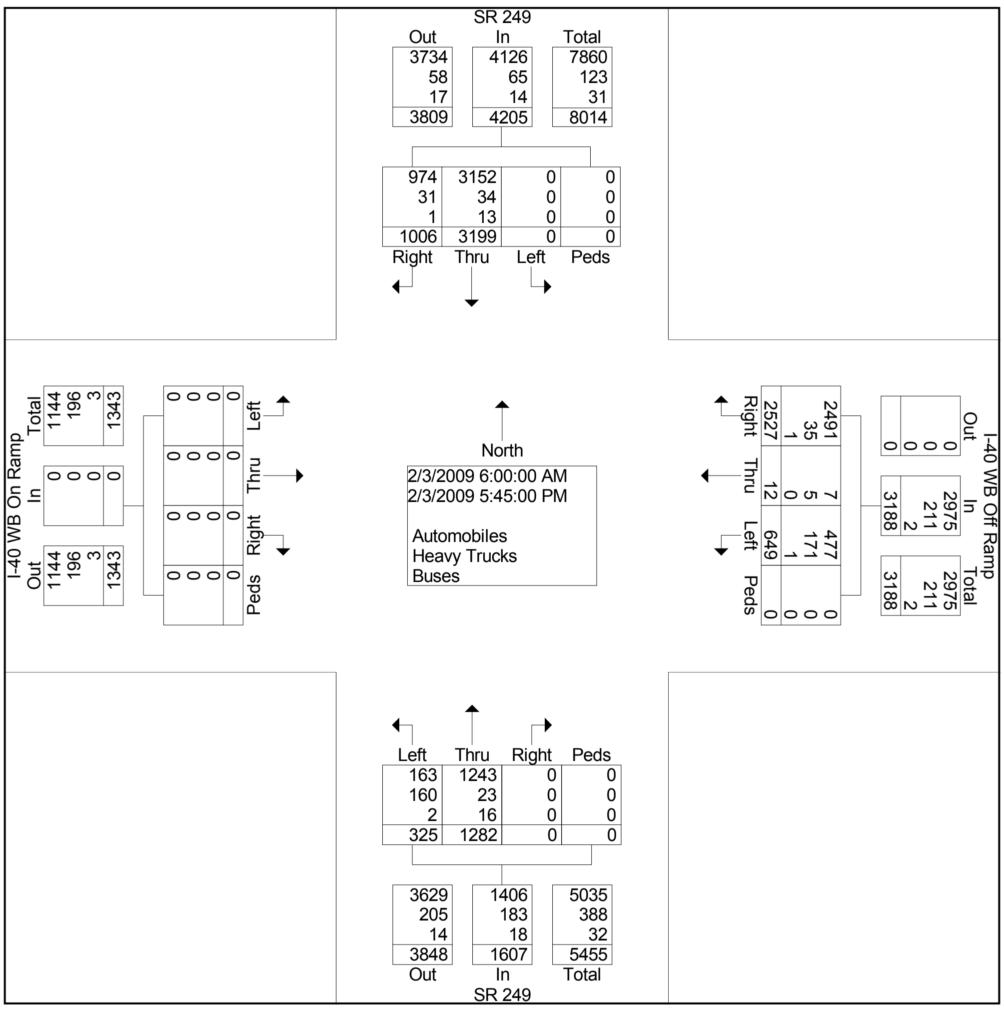
Southern Traffic Services, Inc.
2911 Westfield Rd.
Gulf Breeze, FL 32563
1-800-786-3374

SR 249 @ I-40 WB Ramps
Kingston Springs, TN

File Name : 9026-2 SR 249 @ I-40 WB Ramps
Site Code : 90260002
Start Date : 02/03/2009
Page No : 2

Groups Printed- Automobiles - Heavy Trucks - Buses

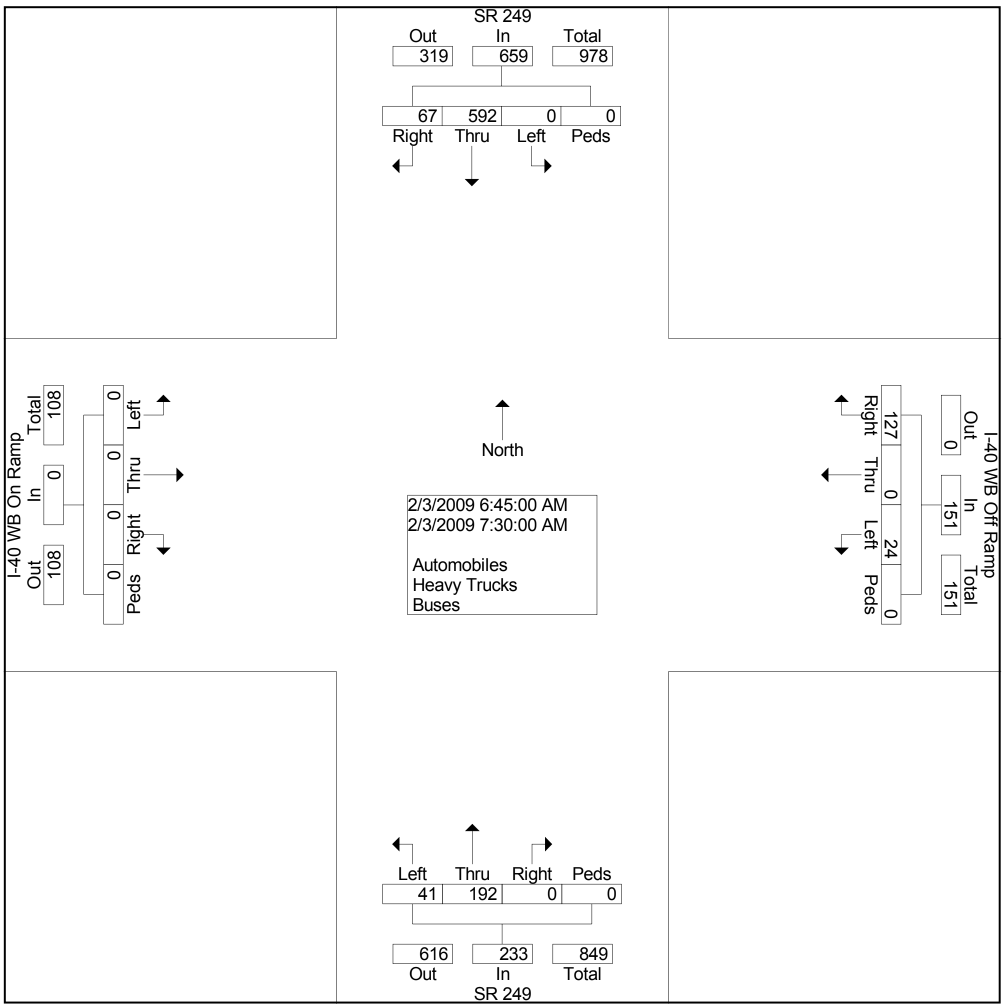
	SR 249 Southbound				I-40 WB Off Ramp Westbound				SR 249 Northbound				I-40 WB On Ramp Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
16:00	0	48	27	0	23	2	110	0	9	39	0	0	0	0	0	0	258
16:15	0	54	40	0	31	0	112	0	8	20	0	0	0	0	0	0	265
16:30	0	47	35	0	29	0	121	0	9	35	0	0	0	0	0	0	276
16:45	0	54	30	0	38	0	125	0	2	27	0	0	0	0	0	0	276
Total	0	203	132	0	121	2	468	0	28	121	0	0	0	0	0	0	1075
17:00	0	72	33	0	32	0	143	0	12	40	0	0	0	0	0	0	332
17:15	0	58	33	0	12	0	120	0	6	36	0	0	0	0	0	0	265
17:30	0	63	33	0	44	0	153	0	9	26	0	0	0	0	0	0	328
17:45	0	46	25	0	34	0	120	0	1	18	0	0	0	0	0	0	244
Total	0	239	124	0	122	0	536	0	28	120	0	0	0	0	0	0	1169
Grand Total	0	3199	1006	0	649	12	2527	0	325	1282	0	0	0	0	0	0	9000
Apprch %	0.0	76.1	23.9	0.0	20.4	0.4	79.3	0.0	20.2	79.8	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	35.5	11.2	0.0	7.2	0.1	28.1	0.0	3.6	14.2	0.0	0.0	0.0	0.0	0.0	0.0	



SR 249 @ I-40 WB Ramps
Kingston Springs, TN

File Name : 9026-2 SR 249 @ I-40 WB Ramps
Site Code : 90260002
Start Date : 02/03/2009

	SR 249 Southbound					I-40 WB Off Ramp Westbound					SR 249 Northbound					I-40 WB On Ramp Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 06:00 to 09:45 - Peak 1 of 1																					
Intersection	06:45																				
Volume	0	592	67	0	659	24	0	127	0	151	41	192	0	0	233	0	0	0	0	0	1043
Percent	0.0	89.8	10.2	0.0		15.9	0.0	84.1	0.0		17.6	82.4	0.0	0.0		0.0	0.0	0.0	0.0		
Volume	0	592	67	0	659	24	0	127	0	151	41	192	0	0	233	0	0	0	0	0	1043
Volume	0	182	24	0	206	7	0	40	0	47	5	50	0	0	55	0	0	0	0	0	308
Peak Factor																					0.847
High Int.	07:30					07:30					07:15					5:45:00 AM					
Volume	0	182	24	0	206	7	0	40	0	47	16	67	0	0	83						
Peak Factor					0.800					0.803					0.702						

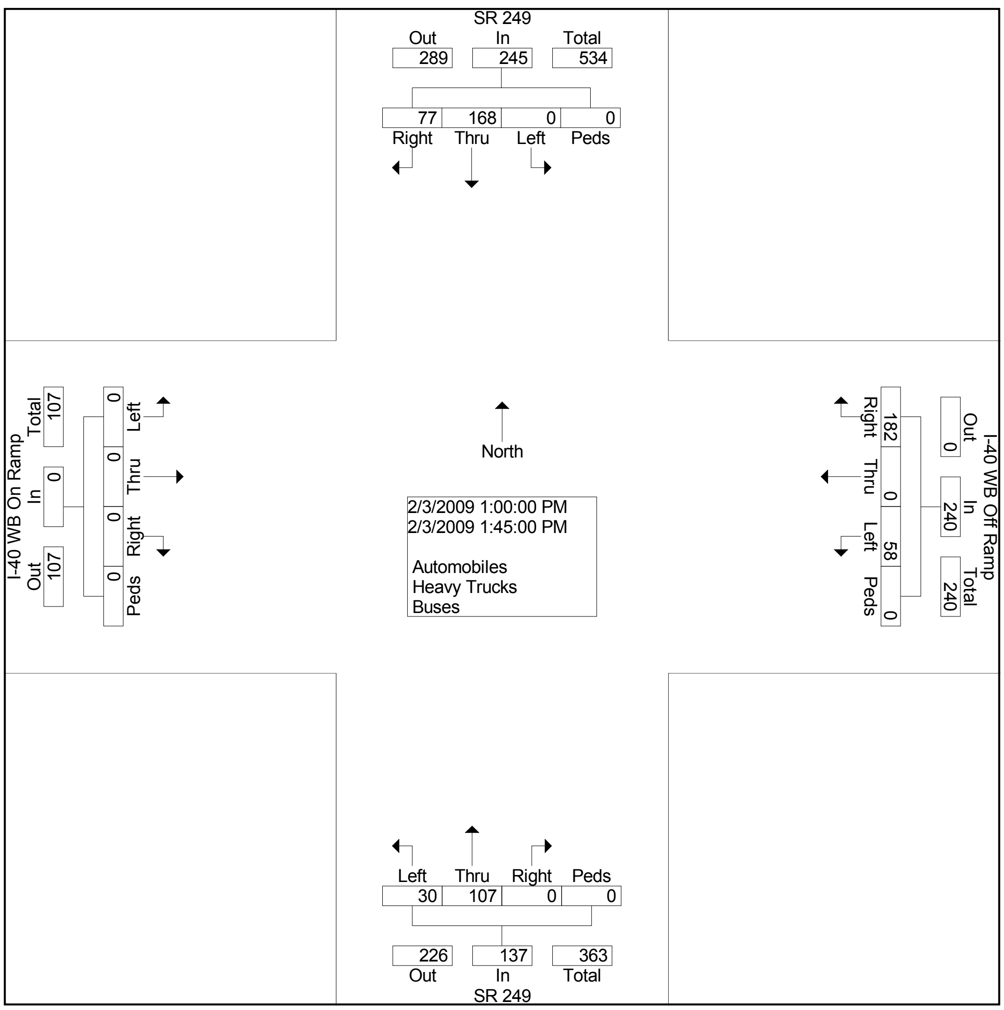


Southern Traffic Services, Inc.
2911 Westfield Rd.
Gulf Breeze, FL 32563
1-800-786-3374

SR 249 @ I-40 WB Ramps
Kingston Springs, TN

File Name : 9026-2 SR 249 @ I-40 WB Ramps
Site Code : 90260002
Start Date : 02/03/2009

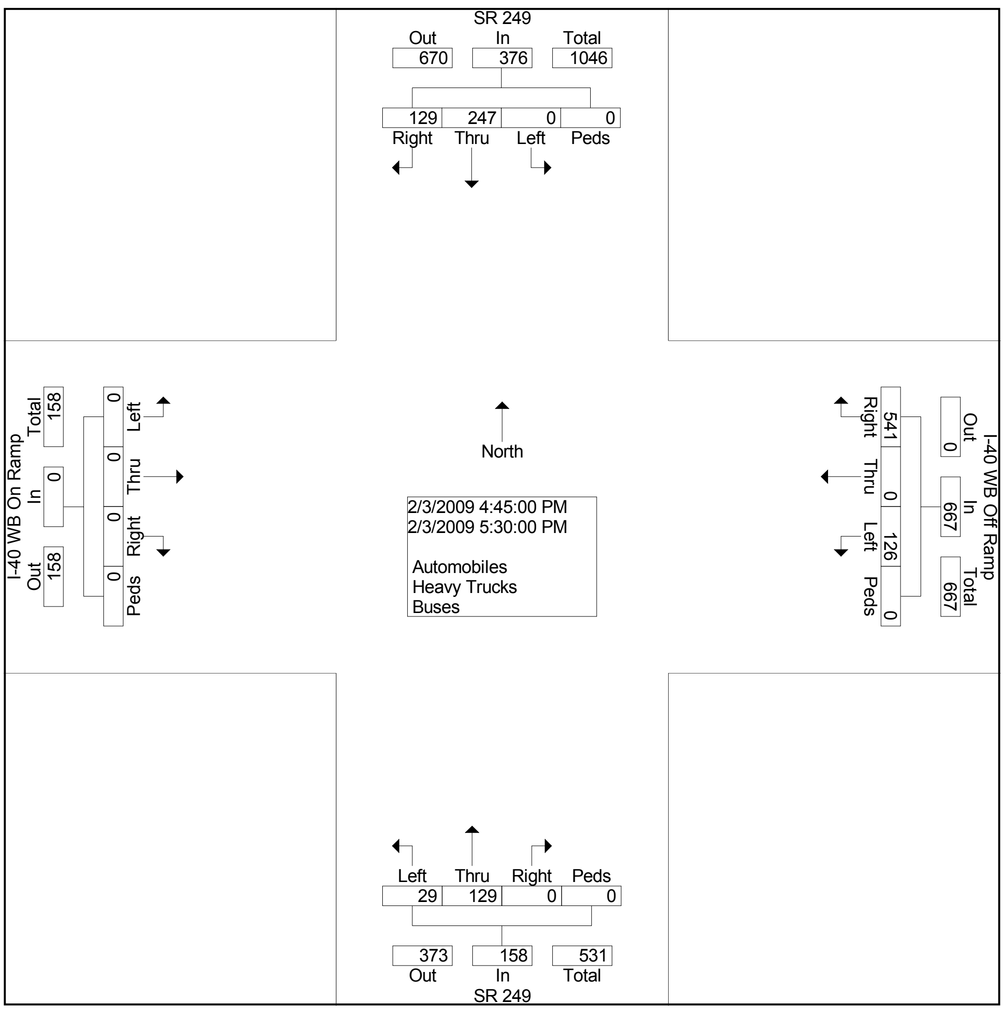
	SR 249 Southbound					I-40 WB Off Ramp Westbound					SR 249 Northbound					I-40 WB On Ramp Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 10:00 to 13:45 - Peak 1 of 1																					
Intersection	13:00																				
Volume	0	168	77	0	245	58	0	182	0	240	30	107	0	0	137	0	0	0	0	0	622
Percent	0.0	68.6	31.4	0.0		24.2	0.0	75.8	0.0		21.9	78.1	0.0	0.0		0.0	0.0	0.0	0.0		
Volume	0	168	77	0	245	58	0	182	0	240	30	107	0	0	137	0	0	0	0	0	622
Volume	0	47	24	0	71	20	0	46	0	66	10	27	0	0	37	0	0	0	0	0	174
Peak Factor																					0.894
High Int.	13:15					13:15					13:15										
Volume	0	47	24	0	71	20	0	46	0	66	10	27	0	0	37						
Peak Factor					0.863					0.909					0.926						



SR 249 @ I-40 WB Ramps
Kingston Springs, TN

File Name : 9026-2 SR 249 @ I-40 WB Ramps
Site Code : 90260002
Start Date : 02/03/2009

	SR 249 Southbound					I-40 WB Off Ramp Westbound					SR 249 Northbound					I-40 WB On Ramp Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 14:00 to 17:45 - Peak 1 of 1																					
Intersection	16:45																				
Volume	0	247	129	0	376	126	0	541	0	667	29	129	0	0	158	0	0	0	0	0	1201
Percent	0.0	65.7	34.3	0.0		18.9	0.0	81.1	0.0		18.4	81.6	0.0	0.0		0.0	0.0	0.0	0.0		
Volume	0	247	129	0	376	126	0	541	0	667	29	129	0	0	158	0	0	0	0	0	1201
Volume	0	72	33	0	105	32	0	143	0	175	12	40	0	0	52	0	0	0	0	0	332
Peak Factor																					0.904
High Int.	17:00					17:30					17:00										
Volume	0	72	33	0	105	44	0	153	0	197	12	40	0	0	52						
Peak Factor					0.895					0.846					0.760						



MEMORANDUM
LOS ANALYSIS AND SIGNAL WARRANT ANALYSIS
SR 249/LUYBEN HILLS ROAD, KINGSTON SPRINGS, TN
GS&P Project No. 27001.02
March 31, 2009
Appendices

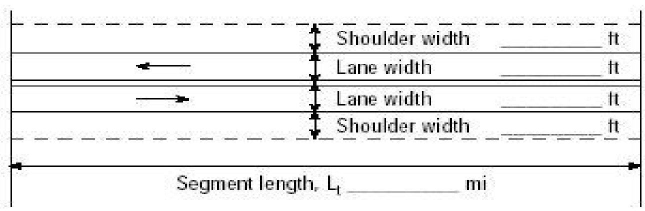
APPENDIX C

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*DHS*	Highway	*SR 249*
Agency or Company	*GSP*	From/To	*I-40 / Kingston Springs Rd*
Date Performed	*2/13/2009*	Jurisdiction	*Kingston Springs, TN*
Analysis Time Period	*AM Peak*	Analysis Year	*2009*

Project Description: *SR 249 -- 2009 AM*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*978* veh/h
Directional split	*70 / 30*
Peak-hour factor, PHF	*0.88*
No-passing zone	*0*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*40*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.977*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1138*
v_p * highest directional split proportion[2] (pc/h)	*797*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Field Measured speed, S_{FM}	*mi/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*0.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for access points, f_A (Exhibit 20-6)	*10.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*35.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*0.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*26.2*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1111*
v_p * highest directional split proportion[2] (pc/h)	*778*
Base percent time-spent-following, BPTSF(%)=100($1-e^{-0.000879v_p}$)	*62.3*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*0.0*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*62.3*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.36*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*83*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*293*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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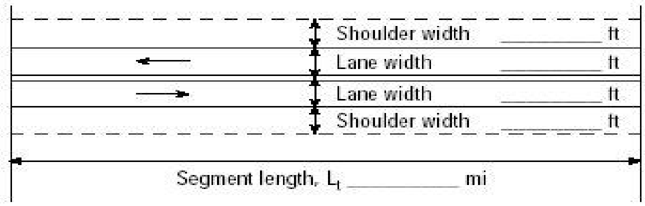
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*DHS*	Highway	*SR 249*
Agency or Company	*GSP*	From/To	*I-40 / Kingston Springs Rd*
Date Performed	*2/13/2009*	Jurisdiction	*Kingston Springs, TN*
Analysis Time Period	*PM Peak*	Analysis Year	*2009*

Project Description: *SR 249 -- 2009 PM*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1046* veh/h
Directional split	*70 / 30*
Peak-hour factor, PHF	*0.88*
No-passing zone	*0*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*40*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1203*
v_p * highest directional split proportion[2] (pc/h)	*842*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*0.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*10.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*35.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*0.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*25.7*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1189*
v_p * highest directional split proportion[2] (pc/h)	*832*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*64.8*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*0.0*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*64.8*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.38*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*89*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*314*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.5*

Notes

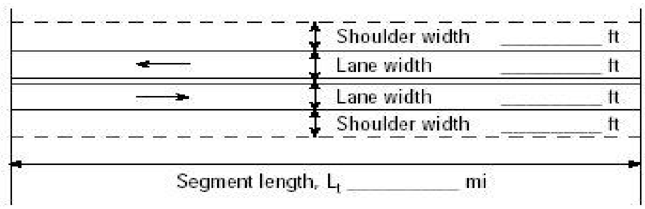
1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*DHS*	Highway	*SR 249*
Agency or Company	*GSP*	From/To	*I-40 / Kingston Springs Rd*
Date Performed	*2/13/2009*	Jurisdiction	*Kingston Springs, TN*
Analysis Time Period	*AM Peak*	Analysis Year	*2014*

Project Description: *SR 249 -- 2014 AM*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1117* veh/h
Directional split	*70 / 30*
Peak-hour factor, PHF	*0.88*
No-passing zone	*0*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*40*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1285*
v_p * highest directional split proportion[2] (pc/h)	*900*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*0.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*10.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*35.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*0.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*25.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1269*
v_p * highest directional split proportion[2] (pc/h)	*888*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*67.2*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*0.0*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*67.2*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.40*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*95*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*335*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.8*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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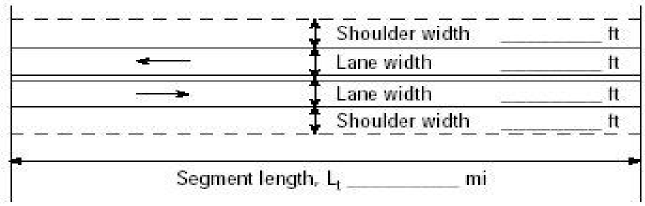
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*DHS*	Highway	*SR 249*
Agency or Company	*GSP*	From/To	*I-40 / Kingston Springs Rd*
Date Performed	*2/13/2009*	Jurisdiction	*Kingston Springs, TN*
Analysis Time Period	*PM Peak*	Analysis Year	*2014*

Project Description: *SR 249 -- 2014 PM*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1195* veh/h
Directional split	*70 / 30*
Peak-hour factor, PHF	*0.88*
No-passing zone	*0*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*40*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1374*
v_p * highest directional split proportion[2] (pc/h)	*962*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*0.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*10.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*35.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*0.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*24.3*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1358*
v_p * highest directional split proportion[2] (pc/h)	*951*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*69.7*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*0.0*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*69.7*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.43*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*102*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*359*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*4.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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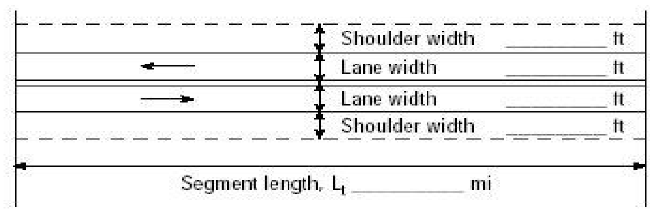
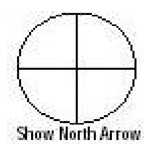
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*DHS*	Highway	*SR 249*
Agency or Company	*GSP*	From/To	*I-40 / Kingston Springs Rd*
Date Performed	*2/13/2009*	Jurisdiction	*Kingston Springs, TN*
Analysis Time Period	*AM Peak*	Analysis Year	*2034*

Project Description: *SR 249 -- 2034 AM*

Input Data





☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1719* veh/h
Directional split	*70 / 30*
Peak-hour factor, PHF	*0.88*
No-passing zone	*0*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*40*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1977*
v_p * highest directional split proportion[2] (pc/h)	*1384*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*0.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*10.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*35.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*0.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*19.7*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1953*
v_p * highest directional split proportion[2] (pc/h)	*1367*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*82.0*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*0.0*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*82.0*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.62*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*147*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*516*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*7.5*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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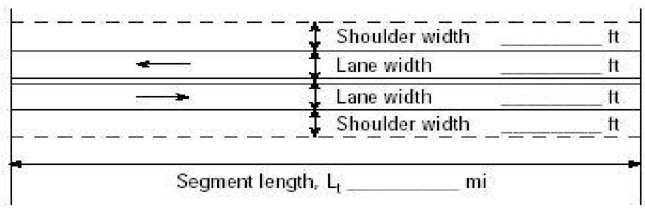
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*DHS*	Highway	*SR 249*
Agency or Company	*GSP*	From/To	*I-40 / Kingston Springs Rd*
Date Performed	*2/13/2009*	Jurisdiction	*Kingston Springs, TN*
Analysis Time Period	*PM Peak*	Analysis Year	*2034*

Project Description: *SR 249 -- 2034 PM*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1778* veh/h
Directional split	*70 / 30*
Peak-hour factor, PHF	*0.88*
No-passing zone	*0*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*40*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2045*
v_p * highest directional split proportion[2] (pc/h)	*1432*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*0.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*10.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*35.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*0.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*19.1*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2020*
v_p * highest directional split proportion[2] (pc/h)	*1414*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*83.1*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*0.0*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*83.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.64*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*152*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*533*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*7.9*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DHS*
Agency/Co.	*GSP*
Date Performed	*2/17/2009*
Analysis Time Period	*2009 AM Peak*

Site Information

Intersection	*SR 249 & I-40 EB Ramps*
Jurisdiction	*Kingston Springs, TN*
Analysis Year	*2009*

Project Description *SR 249 & I-40 EB Ramps -- 2009 AM Peak*

East/West Street: *I-40 Ramps* | North/South Street: *SR 249*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*174*	*154*	*542*	*91*	
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*59*	*0*	*40*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*12*	*--*	*--*
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*52*		*36*			
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*615*	*103*	*0*	*0*	*197*	*175*
Percent Heavy Vehicles	*12*	*0*	*12*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*615*				*59*		*40*
C (m) (veh/h)		*1134*				*49*		*925*
v/c		*0.54*				*1.20*		*0.04*
95% queue length		*3.38*				*5.37*		*0.14*
Control Delay (s/veh)		*11.9*				*329.1*		*9.1*
LOS		*B*				*F*		*A*
Approach Delay (s/veh)	--	--				*199.8*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DHS*
Agency/Co.	*GSP*
Date Performed	*2/17/2009*
Analysis Time Period	*2009 PM Peak*

Site Information

Intersection	*SR 249 & I-40 EB Ramps*
Jurisdiction	*Kingston Springs, TN*
Analysis Year	*2009*

Project Description *SR 249 & I-40 EB Ramps -- 2009 PM Peak*

East/West Street: *I-40 Ramps* North/South Street: *SR 249*

Intersection Orientation: *North-South* Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		112	51	143	233	
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	65	0	26	0	0	0
Percent Heavy Vehicles	0	--	--	12	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration			TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	58		23			
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	162	264	0	0	127	57
Percent Heavy Vehicles	12	0	12	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L				L		R
v (veh/h)		162				65		26
C (m) (veh/h)		1333				323		751
v/c		0.12				0.20		0.03
95% queue length		0.41				0.74		0.11
Control Delay (s/veh)		8.1				18.9		10.0
LOS		A				C		A
Approach Delay (s/veh)	--	--				16.4		
Approach LOS	--	--				C		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*DHS*	Intersection	*SR 249 & I-40 EB Ramps*
Agency/Co.	*GSP*	Jurisdiction	*Kingston Springs, TN*
Date Performed	*2/17/2009*	Analysis Year	*2014*
Analysis Time Period	*2014 AM Peak*		

Project Description *SR 249 & I-40 EB Ramps -- 2014 AM Peak*	
East/West Street: *I-40 Ramps*	North/South Street: *SR 249*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*199*	*176*	*619*	*104*	
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*68*	*0*	*47*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	--	--	*12*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*60*		*42*			
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*703*	*118*	*0*	*0*	*226*	*200*
Percent Heavy Vehicles	*12*	*0*	*12*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*703*				*68*		*47*
C (m) (veh/h)		*1082*				*27*		*908*
v/c		*0.65*				*2.52*		*0.05*
95% queue length		*5.03*				*8.23*		*0.16*
Control Delay (s/veh)		*14.3*				*997.5*		*9.2*
LOS		*B*				*F*		*A*
Approach Delay (s/veh)	--	--				*593.6*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*DHS*	Intersection	*SR 249 & I-40 EB Ramps*
Agency/Co.	*GSP*	Jurisdiction	*Kingston Springs, TN*
Date Performed	*2/17/2009*	Analysis Year	*2014*
Analysis Time Period	*2014 PM Peak*		

Project Description *SR 249 & I-40 EB Ramps -- 2014 PM Peak*

East/West Street: *I-40 Ramps* | North/South Street: *SR 249*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*128*	*59*	*164*	*266*	
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*76*	*0*	*30*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	--	--	*12*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*67*		*27*			
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*186*	*302*	*0*	*0*	*145*	*67*
Percent Heavy Vehicles	*12*	*0*	*12*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*186*				*76*		*30*
C (m) (veh/h)		*1301*				*272*		*715*
v/c		*0.14*				*0.28*		*0.04*
95% queue length		*0.50*				*1.11*		*0.13*
Control Delay (s/veh)		*8.2*				*23.3*		*10.3*
LOS		*A*				*C*		*B*
Approach Delay (s/veh)	--	--				*19.6*		
Approach LOS	--	--				*C*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*DHS*	Intersection	*SR 249 & I-40 EB Ramps*
Agency/Co.	*GSP*	Jurisdiction	*Kingston Springs, TN*
Date Performed	*2/17/2009*	Analysis Year	*2034*
Analysis Time Period	*2034 AM Peak*		

Project Description *SR 249 & I-40 EB Ramps -- 2034 AM Peak*	
East/West Street: *I-40 Ramps*	North/South Street: *SR 249*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*296*	*262*	*921*	*155*	
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*101*	*0*	*70*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	--	--	*12*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*89*		*62*			
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*1046*	*176*	*0*	*0*	*336*	*297*
Percent Heavy Vehicles	*12*	*0*	*12*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*1046*				*101*		*70*
C (m) (veh/h)		*904*				*0*		*842*
v/c		*1.16*						*0.08*
95% queue length		*30.58*						*0.27*
Control Delay (s/veh)		*102.0*						*9.7*
LOS		*F*				*F*		*A*
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	DHS
Agency/Co.	GSP
Date Performed	2/17/2009
Analysis Time Period	2034 PM Peak

Site Information

Intersection	SR 249 & I-40 EB Ramps
Jurisdiction	Kingston Springs, TN
Analysis Year	2034

Project Description *SR 249 & I-40 EB Ramps -- 2034 PM Peak*

East/West Street: *I-40 Ramps* | North/South Street: *SR 249*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		191	87	243	396	
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	112	0	44	0	0	0
Percent Heavy Vehicles	0	--	--	12	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration			TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	99		39			
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	276	450	0	0	217	98
Percent Heavy Vehicles	12	0	12	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L				L		R
v (veh/h)		276				112		44
C (m) (veh/h)		1191				136		589
v/c		0.23				0.82		0.07
95% queue length		0.90				5.15		0.24
Control Delay (s/veh)		8.9				98.5		11.6
LOS		A				F		B
Approach Delay (s/veh)	--	--				74.0		
Approach LOS	--	--				F		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DHS*
Agency/Co.	*GSP*
Date Performed	*2/17/2009*
Analysis Time Period	*2009 AM Peak*

Site Information

Intersection	*SR 249 & I-40 WB Ramps*
Jurisdiction	*Kingston Springs, TN*
Analysis Year	*2009*

Project Description *SR 249 & I-40 WB Ramps -- 2009 AM Peak*

East/West Street: *I-40 Ramps*	North/South Street: *SR 249*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*41*	*192*			*592*	*67*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*27*	*0*	*144*
Percent Heavy Vehicles	*12*	--	--	*12*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*1*	*0*	*0*	*1*	*0*
Configuration	*L*	*T*				*TR*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*24*		*127*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*672*	*76*	*46*	*218*	*0*
Percent Heavy Vehicles	*12*	*0*	*12*	*12*	*0*	*12*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*46*		*27*		*144*			
C (m) (veh/h)	*817*		*237*		*797*			
v/c	*0.06*		*0.11*		*0.18*			
95% queue length	*0.18*		*0.38*		*0.66*			
Control Delay (s/veh)	*9.7*		*22.1*		*10.5*			
LOS	*A*		*C*		*B*			
Approach Delay (s/veh)	--	--	*12.3*					
Approach LOS	--	--	*B*					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DHS*
Agency/Co.	*GSP*
Date Performed	*2/17/2009*
Analysis Time Period	*2009 PM Peak*

Site Information

Intersection	*SR 249 & I-40 WB Ramps*
Jurisdiction	*Kingston Springs, TN*
Analysis Year	*2009*

Project Description *SR 249 & I-40 WB Ramps -- 2009 PM Peak*

East/West Street: *I-40 Ramps* | North/South Street: *SR 249*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	29	129			247	129
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	0	0	143	0	614
Percent Heavy Vehicles	12	--	--	12	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				126		541
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	280	146	32	146	0
Percent Heavy Vehicles	12	0	12	12	0	12
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L		L		R			
v (veh/h)	32		143		614			
C (m) (veh/h)	1082		457		875			
v/c	0.03		0.31		0.70			
95% queue length	0.09		1.32		5.97			
Control Delay (s/veh)	8.4		16.4		18.2			
LOS	A		C		C			
Approach Delay (s/veh)	--	--	17.8					
Approach LOS	--	--	C					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DHS*
Agency/Co.	*GSP*
Date Performed	*2/17/2009*
Analysis Time Period	*2014 AM Peak*

Site Information

Intersection	*SR 249 & I-40 WB Ramps*
Jurisdiction	*Kingston Springs, TN*
Analysis Year	*2014*

Project Description *SR 249 & I-40 WB Ramps -- 2014 AM Peak*

East/West Street: *I-40 Ramps*	North/South Street: *SR 249*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	47	220			676	77
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	0	0	31	0	164
Percent Heavy Vehicles	0	--	--	12	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				28		145
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	768	87	53	250	0
Percent Heavy Vehicles	12	0	12	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L		L		R			
v (veh/h)	53		31		164			
C (m) (veh/h)	793		202		794			
v/c	0.07		0.15		0.21			
95% queue length	0.21		0.53		0.77			
Control Delay (s/veh)	9.9		26.0		10.7			
LOS	A		D		B			
Approach Delay (s/veh)	--	--	13.1					
Approach LOS	--	--	B					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	DHS	Intersection	SR 249 & I-40 WB Ramps
Agency/Co.	GSP	Jurisdiction	Kingston Springs, TN
Date Performed	2/17/2009	Analysis Year	2014
Analysis Time Period	2014 PM Peak		

Project Description *SR 249 & I-40 WB Ramps -- 2014 PM Peak*	
East/West Street: *I-40 Ramps*	North/South Street: *SR 249*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	34	148			282	148
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	0	0	163	0	702
Percent Heavy Vehicles	12	--	--	12	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				144		618
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	320	168	38	168	0
Percent Heavy Vehicles	12	0	12	12	0	12
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L		L		R			
v (veh/h)	38		163		702			
C (m) (veh/h)	1025		404		851			
v/c	0.04		0.40		0.82			
95% queue length	0.12		1.91		9.40			
Control Delay (s/veh)	8.6		19.8		25.7			
LOS	A		C		D			
Approach Delay (s/veh)	--	--	24.6					
Approach LOS	--	--	C					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	DHS
Agency/Co.	GSP
Date Performed	2/17/2009
Analysis Time Period	2034 AM Peak

Site Information

Intersection	SR 249 & I-40 WB Ramps
Jurisdiction	Kingston Springs, TN
Analysis Year	2034

Project Description *SR 249 & I-40 WB Ramps -- 2034 AM Peak*

East/West Street: *I-40 Ramps* | North/South Street: *SR 249*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	70	327			1006	114
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	0	0	46	0	245
Percent Heavy Vehicles	0	--	--	12	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				41		216
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR (veh/h)	0	1143	129	79	371	0
Percent Heavy Vehicles	12	0	12	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L		L		R			
v (veh/h)	79		46		245			
C (m) (veh/h)	553		83		679			
v/c	0.14		0.55		0.36			
95% queue length	0.50		2.44		1.64			
Control Delay (s/veh)	12.6		92.6		13.3			
LOS	B		F		B			
Approach Delay (s/veh)	--	--	25.8					
Approach LOS	--	--	D					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DHS*
Agency/Co.	*GSP*
Date Performed	*2/17/2009*
Analysis Time Period	*2034 PM Peak*

Site Information

Intersection	*SR 249 & I-40 WB Ramps*
Jurisdiction	*Kingston Springs, TN*
Analysis Year	*2034*

Project Description *SR 249 & I-40 WB Ramps -- 2034 PM Peak*

East/West Street: *I-40 Ramps*	North/South Street: *SR 249*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*50*	*220*			*420*	*220*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*243*	*0*	*1045*
Percent Heavy Vehicles	*12*	--	--	*12*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*1*	*0*	*0*	*1*	*0*
Configuration	*L*	*T*				*TR*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*214*		*920*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*477*	*250*	*56*	*250*	*0*
Percent Heavy Vehicles	*12*	*0*	*12*	*12*	*0*	*12*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*56*		*243*		*1045*			
C (m) (veh/h)	*832*		*254*		*765*			
v/c	*0.07*		*0.96*		*1.37*			
95% queue length	*0.22*		*8.88*		*43.92*			
Control Delay (s/veh)	*9.6*		*88.1*		*190.4*			
LOS	*A*		*F*		*F*			
Approach Delay (s/veh)	--	--	*171.1*					
Approach LOS	--	--	*F*					

Warrants Summary

Information			
Analyst	DHS	Intersection	SR 249 & I-40 EB Ramps
Agency/Co	GSP	Jurisdiction	Kingston Springs, TN
Date Performed	2/13/2009	Units	U.S. Customary
Project ID	SR 249 & I-40 EB Ramps	Time Period Analyzed	
East/West Street	I-40	North/South Street	SR 249
File Name	I-40 EB_SR 249.xhy	Major Street	North-South

Project Description *SR 249 & I-40 EB Ramps*

General				Roadway Network	
Major Street Speed (mph)	30	☑	Population < 10,000	Two Major Routes	☐
Nearest Signal (ft)	1400	☐	Coordinated Signal System	Weekend Count	☐
Crashes (per year)	0	☐	Adequate Trials of Alternatives	5-yr Growth Factor	2

Geometry and Traffic	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of lanes, N	1	0	1	0	0	0	0	1	0	1	1	0
Lane usage	L		R					TR		L	T	
Vehicle Volume Averages (vph)	45	0	25	0	0	0	0	92	71	209	117	0
Peds (ped/h) / Gaps (gaps/h)	--	/	--	--	/	--	--	/	--	--	/	--
Delay (s/veh) / (veh-hr)	--	/	--	--	/	--	--	/	--	--	/	--

Warrant 1: Eight-Hour Vehicular Volume	☐
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	☐
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	☐
1 80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 2: Four-Hour Vehicular Volume	☐
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 3: Peak Hour	☐
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--	☐
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 4: Pedestrian Volume	☐
4 A. Pedestrian Volumes (Four hours --or-- one hour) --and--	☐
4 B. Gaps Same Period (Four hours --or-- one hour)	☐
Warrant 5: School Crossing	☐
5. Student Volumes --and--	☐
5. Gaps Same Period	☐
Warrant 6: Coordinated Signal System	☐
6. Degree of Platooning (Predominant direction or both directions)	☐
Warrant 7: Crash Experience	☐
7 A. Adequate trials of alternatives, observance and enforcement failed --and--	☐
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--	☐
7 C. 80% Volumes for Warrants 1A, 1B --or-- 4 are satisfied	☐

Warrant 8: Roadway Network	☐
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	☐
8 B. Weekend Volume (Five hours total)	☐

Warrants Volume

Information

Analyst	DHS
Agency/Co	GSP
Date Performed	2/13/2009
Project ID	SR 249 & I-40 EB Ramps
East/West Street	I-40
File Name	I-40 EB_SR 249.xhy

Intersection	SR 249 & I-40 EB Ramps
Jurisdiction	Kingston Springs, TN
Units	U.S. Customary
Time Period Analyzed	
North/South Street	SR 249
Major Street	North-South

Project Description *SR 249 & I-40 EB Ramps*

Warrant 1

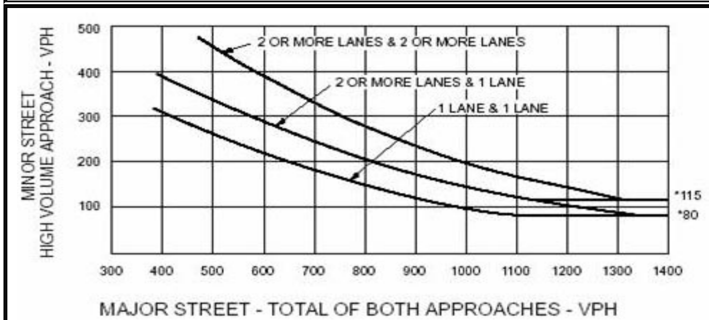
Condition A - Minimum Vehicular Volume

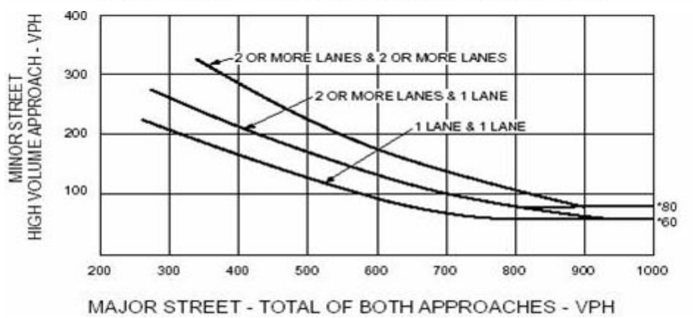
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)			Vehicles per hour on higher-volume minor-street approach (one direction only)		
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	100%[a]	80%[b]	70%[c]
1.................	1.................	500	400	350	150	120	105
2 or more...	1.................	600	480	420	150	120	105
2 or more...	2 or more ...	600	480	420	200	160	140
1.................	2 or more	500	400	350	200	160	140

Condition B - Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)			Vehicles per hour on higher-volume minor-street approach (one direction only)		
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	100%[a]	80%[b]	70%[c]
1.................	1.................	750	600	525	75	60	53
2 or more...	1.................	900	720	630	75	60	53
2 or more...	2 or more ...	900	720	630	100	80	70
1.................	2 or more	750	600	525	100	80	70

Warrant 2





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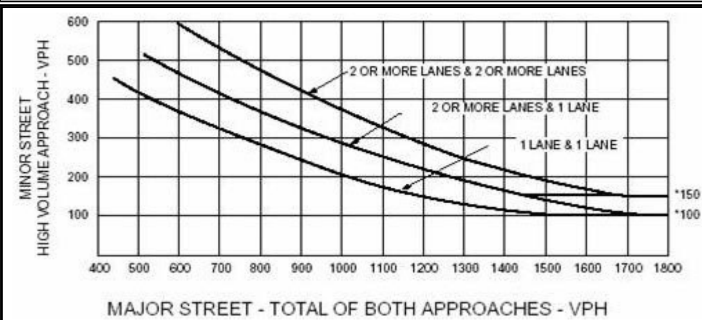

Volume Summary

Major Street Lanes 2+ **Minor Street Lanes** 2+ **Speed** 30 **Population** <10000

Hours	Major Volume	Minor Volume	Total Volume	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (70%)
06-07	680	84	764	No	No	Yes	Yes	No	No	No
07-08	946	69	1015	No	No	No	Yes	No	No	No
08-09	509	98	607	No	No	No	Yes	No	No	No
09-10	372	51	423	No	No	No	No	No	No	No
10-11	348	53	401	No	No	No	No	No	No	No
11-12	395	56	451	No	No	No	No	No	No	No
12-13	392	68	460	No	No	No	No	No	No	No
13-14	341	66	407	No	No	No	No	No	No	No
14-15	407	69	476	No	No	No	No	No	No	No
15-16	525	83	608	No	No	No	Yes	No	No	No
16-17	428	73	501	No	No	No	No	No	No	No
17-18	539	81	620	No	No	No	Yes	No	No	No
Totals	5882	851	6733	0	0	1	5	0	0	0

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Warrants Summary

Information			
Analyst	DHS	Intersection	SR 249 & I-40 WB Ramps
Agency/Co	GSP	Jurisdiction	Kingston Springs, TN
Date Performed	2/13/2009	Units	U.S. Customary
Project ID	SR 249 & I-40 WB Ramps	Time Period Analyzed	
East/West Street	I-40	North/South Street	SR 249
File Name	I-40 WB_SR 249.xhy	Major Street	North-South

Project Description *SR 249 & I-40 WB Ramps*

General				Roadway Network	
Major Street Speed (mph)	30	☑	Population < 10,000	Two Major Routes	☐
Nearest Signal (ft)	1400	☐	Coordinated Signal System	Weekend Count	☐
Crashes (per year)	0	☐	Adequate Trials of Alternatives	5-yr Growth Factor	2

Geometry and Traffic	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of lanes, N	0	0	0	1	0	1	1	1	0	0	1	0
Lane usage				L		R	L	T			TR	
Vehicle Volume Averages (vph)	0	0	0	54	0	210	27	106	0	0	266	83
Peds (ped/h) / Gaps (gaps/h)	--	/	--	--	/	--	--	/	--	--	/	--
Delay (s/veh) / (veh-hr)	--	/	--	--	/	--	--	/	--	--	/	--

Warrant 1: Eight-Hour Vehicular Volume	☐
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	☐
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	☐
1 80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 2: Four-Hour Vehicular Volume	☑
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☑
Warrant 3: Peak Hour	☑
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--	☐
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☑
Warrant 4: Pedestrian Volume	☐
4 A. Pedestrian Volumes (Four hours --or-- one hour) --and--	☐
4 B. Gaps Same Period (Four hours --or-- one hour)	☐
Warrant 5: School Crossing	☐
5. Student Volumes --and--	☐
5. Gaps Same Period	☐
Warrant 6: Coordinated Signal System	☐
6. Degree of Platooning (Predominant direction or both directions)	☐
Warrant 7: Crash Experience	☐
7 A. Adequate trials of alternatives, observance and enforcement failed --and--	☐
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--	☐
7 C. 80% Volumes for Warrants 1A, 1B --or-- 4 are satisfied	☐

Warrant 8: Roadway Network	☐
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	☐
8 B. Weekend Volume (Five hours total)	☐

Warrants Volume

Information

Analyst	DHS	Intersection	SR 249 & I-40 WB Ramps
Agency/Co	GSP	Jurisdiction	Kingston Springs, TN
Date Performed	2/13/2009	Units	U.S. Customary
Project ID	SR 249 & I-40 WB Ramps	Time Period Analyzed	
East/West Street	I-40	North/South Street	SR 249
File Name	I-40 WB_SR 249.xhy	Major Street	North-South

Project Description *SR 249 & I-40 WB Ramps*

Warrant 1

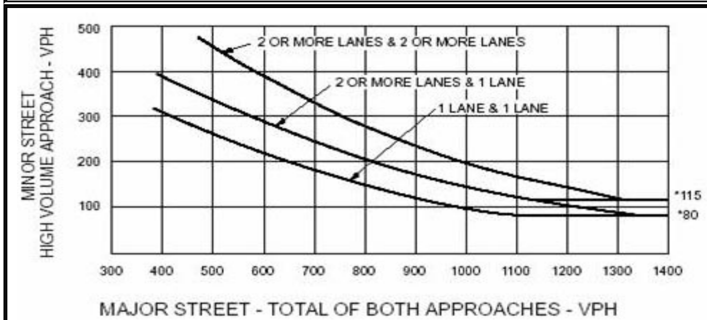
Condition A - Minimum Vehicular Volume

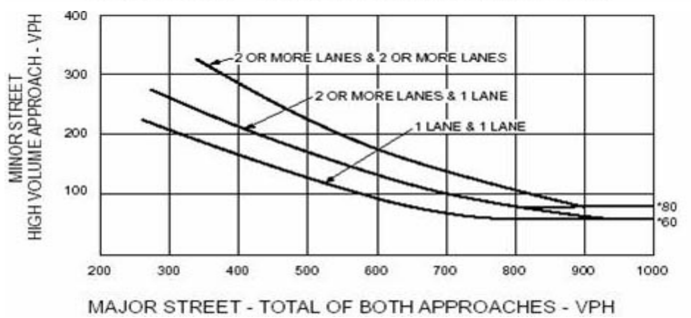
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)			Vehicles per hour on higher-volume minor-street approach (one direction only)		
Major Street	Minor Street	100%ª	80%ᵇ	70%ᶜ	100%ª	80%ᵇ	70%ᶜ
1................	1................	500	400	350	150	120	105
2 or more...	1................	600	480	420	150	120	105
2 or more...	2 or more ...	600	480	420	200	160	140
1................	2 or more	500	400	350	200	160	140

Condition B - Interruption of Continuous Traffic

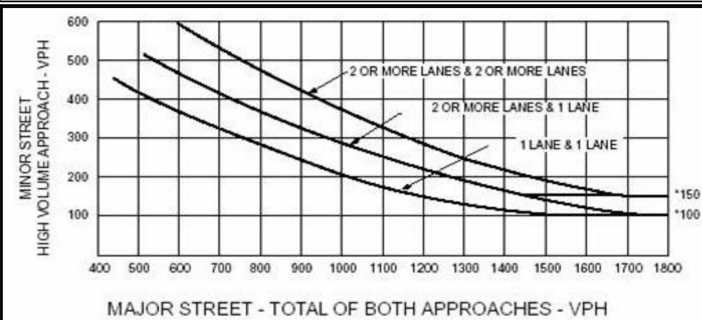
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)			Vehicles per hour on higher-volume minor-street approach (one direction only)		
Major Street	Minor Street	100%ª	80%ᵇ	70%ᶜ	100%ª	80%ᵇ	70%ᶜ
1................	1................	750	600	525	75	60	53
2 or more...	1................	900	720	630	75	60	53
2 or more...	2 or more ...	900	720	630	100	80	70
1................	2 or more	750	600	525	100	80	70

Warrant 2





Warrant 3



Volume Summary

Major Street Lanes 2+ **Minor Street Lanes** 2+ **Speed** 30 **Population** <10000

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06-07	588	92	680	No	No	No	Yes	No	No	No
07-08	885	143	1028	Yes	Yes	Yes	Yes	Yes	No	No
08-09	534	131	665	No	Yes	No	Yes	No	No	No
09-10	409	149	558	No	Yes	No	No	No	No	No
10-11	343	140	483	No	Yes	No	No	No	No	No
11-12	353	195	548	No	Yes	No	No	No	No	No
12-13	373	162	535	No	Yes	No	No	No	No	No
13-14	382	240	622	No	Yes	No	No	No	No	No
14-15	419	290	709	No	Yes	No	No	Yes	No	No
15-16	531	387	918	Yes	Yes	No	Yes	Yes	No	Yes
16-17	484	589	1073	Yes	Yes	No	No	Yes	No	Yes
17-18	511	658	1169	Yes	Yes	No	Yes	Yes	No	Yes
Totals	5812	3176	8988	4	11	1	5	5	0	3

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Appendix C
Stakeholder Coordination and Field Review Summary

GRESHAM
SMITH AND
PARTNERS

November 7, 2008

STAKEHOLDER MEETING NOTES

EXIT 188 ON INTERSTATE 40 & STATE ROUTE 249/ LUYBEN HILLS ROAD, FROM I-40 TO SR 249/KINGSTON SPRINGS ROAD, KINGSTON SPRINGS, CHEATHAM COUNTY, TENNESSEE

MEETING DATE: November 7, 2008

PARTICIPANTS: Steve Allen — TDOT
Bill Hart — TDOT
Bridget Jones — Cumberland Region Tomorrow
Jim Schippers — Kingston Springs City Council
John McLeroy — Mayor, Kingston Springs
Pam Lorenz — Vice Mayor, Kingston Springs
Laurie Cooper — City Manager, Kingston Springs
Mike Flatt — Gresham, Smith and Partners
Lori Lange — Gresham, Smith and Partners
Margaret Tyler — Gresham, Smith and Partners

DISCUSSION: TDOT PLANNING ASSISTANCE FOR EXIT 188 ON I-40 IN KINGSTON SPRINGS, CHEATHAM COUNTY, TENNESSEE

In a letter dated September 16, 2008, the town of Kingston Springs requested planning assistance from the Tennessee Department of Transportation (TDOT) to evaluate the functionality and appearance of Exit 188 on Interstate 40 (I-40) in Kingston Springs, Cheatham County, Tennessee. On October 7, 2008, TDOT agreed to assist with this planning effort. Through an on-call planning contract with TDOT, Gresham, Smith and Partners (GS&P) was contacted to assist with this work.

The purpose of the subject meeting was to gather additional information from Kingston Springs about their issues and concerns with Exit 188 and State Route (SR) 249/Luyben Hills Road, and for Gresham, Smith and Partners (GS&P) to gather the information needed to develop a scope of work and budget for the project.

A summary of the discussion is outlined below.

1. In spring 2008, Cumberland Region Tomorrow (CRT) and the American Institute of Architects (AIA) collaborated with the Town of Kingston Springs though the AIA 150 Blueprint/Quality Growth Toolbox Pilot Project. *(At the request of GS&P, Laurie Cooper brought a copy of the report to the meeting for GS&P use.)*

2. As discussed by the Town of Kingston Springs representatives, in its current state Exit 188 does not represent the character that the Town of Kingston Springs desires. Specifically, the Town of Kingston Springs has safety, aesthetics, and traffic flow concerns. The Town of Kingston Springs want a safe, walkable, attractive interchange and corridor that functions effectively. The SR 249/Kingston Springs Road corridor should address safety, accommodate pedestrians and address access management issues. Access to undeveloped parcels behind existing commercial development is important to the town and needs to be considered.

3. Kingston Springs values and hopes to grow its open space network/greenway network – particularly connecting the subject segment of SR 249 and downtown Kingston Springs. Any proposed recommendations will need to allow for (and contribute to) the future development of this network.

4. A Transportation Planning Report (TPR) will be prepared for Exit 188 and SR 249/ Luyben Hills Road, from I-40 to SR 249/Kingston Springs Road. The Scope of Work should be broken down into two elements: the interstate interchange and the SR 249 corridor. Steve Allen explained the current funding issues TDOT is facing, and explained that less expensive projects have a greater chance of being implemented. The TPR will break the recommended improvements down into discrete projects so that they can be constructed individually as money becomes available.

5. The interstate interchange scope of work will need to assess the interchange's operational deficiencies and functionality of the ramp proper. Work should also include traffic counts (including turning movement counts and truck counts), and signal warrant analysis. Specifically, the turning radius at the ramp intersections will be reviewed. The existing bridge crossing I-40 will be evaluated to determine if sidewalks could be constructed within the existing bridge limits. Also, the existing directional signage off the interstate will be reviewed.

6. The scope of work for State Route 249/Luyben Hills Road to SR 249/Kingston Springs Road should include assessment of a curb and gutter typical section with driveway access per TDOT standards. As an alternative, defined curbing limiting access points for each property will be studied. The recommendations should be oriented towards "greening" the corridor, and accommodating pedestrian and truck movement. Signage and provisions for additional streetlights along the corridor should be considered. At the intersection of Luyben Hills Road and Kingston Springs Road, GS&P will check how recent the traffic counts are at this location, and review the capacity provided through this existing section. The

existing signage will be reviewed. Limits of the State Route to the south side will be checked.

7. Truck traffic is an issue along the corridor. Trucks traveling north off the interstate on Luyben Hills Road have difficulty turning around back towards the interstate once they have stopped at adjacent businesses. There was a discussion about the possibility of a roundabout at the intersection of Luyben Hills Road and Kingston Springs Road to address safety concerns, while also acting as an attractive gateway to the community and a good visual focal point traveling north on SR 249/Luyben Hills Road from I-40. This will be evaluated in the TPR. Any existing safety issues at this intersection will also be reviewed by consulting TDOT crash data.

8. The town of Kingston Springs should talk to Shawn Bible at TDOT about interchange beautification. Her phone number is 615.532.3488, and her email address is shawn.a.bible@state.tn.us.

9. The planning process will not include public involvement; the group present at the meeting will act as a stakeholder committee and will meet several times during the project. The group will meet after the feasibility of a roundabout is determined and it is determined whether a traffic signal is warranted at the interchange. A field visit will also be completed. A final meeting will be held after approval of the TPR.

10. GS&P will get aerial mapping from TDOT and GIS data from Cheatham County.

11. The deliverable will be a TPR and boards illustrating the proposed recommendations for use by Kingston Springs.

12. When a field review is conducted, the possibility of turning the continuous center turn lane on SR 249/Kingston Springs Road into a median will be evaluated. This can be handled as a separate task.

13. GS&P is to investigate if an existing 27 acre parcel off of the interstate has an agreement for access off of the state right-of-way; the tract owner is Joyce Wiley.

14. Bi-weekly progress reports will be sent to TDOT and the Town of Kingston Springs.

15. The Town of Ridgeway was mentioned by the Town of Kingston Springs as a possible example of aesthetic improvements.

This represents our understanding of the items discussed at this meeting. If you have any questions or comments concerning any of the information contained herein, please contact Lori Lange at (615)770-8554 or me at (615)770-8476.

Prepared by: Margaret Bass Tyler
Gresham, Smith and Partners

Copy Participants
Margaret Slater, Gresham, Smith and Partners

STAKEHOLDER MEETING AND FIELD REVIEW SUMMARY
FEBRUARY 11, 2009
STATE ROUTE 249/LUYBEN HILLS ROAD TRANSPORTATION IMPROVEMENTS
TOWN OF KINGSTON SPRINGS, TENNESSEE

The Tennessee Department of Transportation (TDOT) conducted a stakeholder meeting and field review for the State Route (SR) 249/Luyben Hills corridor on Wednesday, February 11, 2009 from 10:00 a.m. to 12:00 p.m. at the Kingston Springs City Hall. The meeting was facilitated by TDOT's subconsultant, Gresham, Smith & Partners (GS&P). The purpose of the meeting was to gather input that would assist TDOT and GS&P in the preparation of a *Transportation Planning Report* (*TPR*). The *TPR* is an early planning study that will:

- Establish the need for the project;
- Identify environmental and other constraints and issues; and
- Develop and evaluate project concepts.

Stakeholder Meeting

Sixteen people attended the meeting (see attached list), including Mayor John McLeroy, Vice Mayor Pam Lorenz and City Manager Laurie Cooper. Other attendees represented:

- Kingston Springs City Commission;
- Kingston Springs Planning Commission;
- TDOT; and
- GS&P.

Meeting attendees were invited to sign in and were given a handout, which included:

- A meeting agenda;
- An 8.5x11 aerial map of the project corridor; and
- An 11x17 map of the project corridor illustrating a conceptual layout developed by GS&P for a 100-foot diameter roundabout at the intersection of SR 249/Luyben Hills Road and Kingston Springs Road.

The meeting opened with a call to order by Mayor John McLeroy. He thanked everyone for their attendance and expressed the Town's appreciation of the work being conducted on the SR 249/Luyben Hills Road corridor. He expressed hope that the concepts can be implemented quickly.

Following Mayor John McLeroy's introductory comments, Margaret Tyler, GS&P Project Planner, reviewed the agenda for the meeting, briefly explained the TPR process, and asked that attendees introduce themselves. Following introductions, Margaret Tyler led a discussion on project needs and corridor issues. Jeremy Kubac and Jonathan Haycraft, GS&P Project Engineers, then discussed ideas for project concepts, issues and constraints in the project area. The group discussed the possibility of constructing a roundabout at the intersection of SR 249/Luyben Hills Road and Kingston Springs Road. The group also discussed the possibility of turning the continuous center turn lane on SR 249/East Kingston Springs Road into a raised median. Margaret Tyler then summarized the path forward for the project. Finally, thirteen attendees drove the project corridor in a van. These discussions are summarized below.

<u>Purpose and Need</u>:

Margaret Tyler explained the importance of the clearly identifying the need for the project early in the planning and project development process. Stakeholders were asked to provide input regarding why they think the project is needed. The responses below were recorded on an easel pad:

- Trucks mistakenly turn northbound on SR 249/Luyben Hills Road from Interstate 40 (I-40) and then have no place to turn around. Kingston Springs put up a sign that says no truck turnaround (with TDOT's approval), but trucks still make northbound turning movements. It is difficult to say why this is happening.
- If there is a wreck on I-40, truck traffic detours through the project corridor (this is also a problem downtown).
- There is pedestrian traffic throughout the SR 249/Luyben Hills Road corridor (including pedestrians crossing the interstate bridge to and from the truck stop) but there are no pedestrian facilities. This poses safety concerns for pedestrians and drivers. Often, the pedestrians are truckers getting something to eat or people walking to and from the hotels. Pedestrians need their own defined space/path within this commercial corridor.
- It is difficult to take a left-turn from businesses along the corridor in the mornings and evenings (particularly the Sonic, the Kingston Springs United States Post Office, and Heritage Bank).
- There is poor access control throughout the corridor. This poses safety concerns.
- There is a steep grading issue by El Jardin that poses safety issues.
- Truck signage and commercial signage along the corridor needs improvement.
- In its current condition, the corridor does not reflect the unique character of Kingston Springs. It needs aesthetic improvements, and it needs to act as a better gateway to the community.
- The truck stop south of the interchange regularly fills up by dark (it is the first big truck stop outside of Nashville). As a result, there are issues with trucks parking in the grassy areas along the interchange ramps. The grassy areas have tall weeds and trash thrown out by the truckers accumulates there.
- School buses use the corridor and they stop immediately north of the McDonalds. Kids are getting off and going to the Mobile Home Park on the west side of the corridor. They are also crossing SR 249/Luyben Hills Road in that location. School buses and children need to be safely accommodated in this location.
- The *TPR* should consider the future commercial development of the parcel east/south of the McDonalds. There was a discussion about the possibility of making the TDOT access road into a local street. There would be traffic implications associated with this access point, and all agreed that this road should only accommodate right-in/right-out movements.
- There is a constant flow of northbound traffic on SR 249/Luyben Hills Road from I-40.

Concepts, Issues and Constraints:

Jeremy Kubac, GS&P Project Engineer, then discussed some of the issues GS&P has identified along the corridor. Issues discussed are summarized below:

- Harpeth Hills Drive, which is located in the southwest quadrant of the I-40 interchange, is located very close to the Interchange. Eugene Ivey, Kingston Springs Public Safety Chief, stated that cars do “dart across the intersection”.
- Sidewalks can be constructed within the existing right-of-way (ROW) throughout the project corridor, including across I-40, with the exception of two problem locations. The parking spaces in front of the liquor and wine store will be blocked and work would take place close to the building. As a result, the installation of sidewalks would require close coordination with the property owner. In addition, small portions of ROW may be needed from the landscaped areas in front of the Mapco. Sidewalks can be constructed on the bridge, but the installation of handrails on the existing barrier would be needed.
- The SR 249/Luyben Hills Road Corridor needs defined access points. There is a state policy on access regulations that must be followed.
- There is a grade issue in front of El Jardin that needs to be addressed.
- Curb and gutter would work well for the corridor.

Ron Baker (TDOT) asked about signalization at the ramp. GS&P responded that a signal warrant analysis is being prepared for the interchange.

Participants expressed their desire that the decision-making process not be guided solely by vehicles; the community desires solutions that safely accommodate pedestrians while also enhancing the aesthetics of the project corridor.

Participants also expressed the desire for the concepts to include landscaping between the curb and sidewalk. There was a discussion that the typical section can vary throughout the corridor.

Roundabout

The Town of Kingston Springs has an issue with truck traffic mistakenly turning north on SR 249/Luyben Hills Road from I-40. Once truck traffic has made this turn, it is difficult for them to turn around. At the request of Kingston Springs, the possibility of constructing a roundabout at the intersection of SR 249/Luyben Hills Road and Kingston Springs Road was evaluated. This intersection is currently signalized.

GS&P found that an “Urban Compact” roundabout with a 100-foot inscribed diameter would be of sufficient size to allow for truck traffic to carefully make a U-turn while minimizing impacts to adjacent properties. A handout was distributed that illustrates the conceptual design on aerial photography. The roundabout would have one 16-foot travel lane and an 18-foot truck apron. The center of the roundabout would be about 30 feet in diameter, and could be landscaped with low shrubs. A roundabout this exact size can be seen at the intersection of Briley Parkway and Two Rivers Parkway in Nashville. Although it is a tight turn for truck traffic and they will likely make the turn at low speeds, this size roundabout can accommodate truck traffic (as well as school bus traffic). This design could accommodate the business entrance on the north side of the intersection; however, the residential drive north of Kingston Springs Road would need to be relocated.

A roundabout would eliminate T-bone (side) collisions and reduce vehicular speeds. Roundabouts also require minimal maintenance. It would also address the issue of long queues of cars at the light, particularly in the evenings and mornings. There was a discussion that queuing issues might also be addressed by adjusting the signal timing. The roundabout will not, however, improve the situation for people turning left onto SR 249/Luyben Hills Road from the Sonic and the Kingston Springs Post Office.

Meeting attendees asked whether a roundabout of this size can adequately handle the intersection's traffic volumes. GS&P explained that this is just a preliminary analysis and no detailed traffic analysis was conducted; however, a review of FHWA standards indicates that this roundabout should be able to adequately accommodate the traffic travelling through the intersection.

Jim Schippers asked if the roundabout could be larger. Project engineers responded that, in order for it to function as a larger roundabout, the roundabout (and footprint) would have to be considerably larger. Also, the graphic distributed to meeting attendees is not based on a survey, so the roundabout may be shifted five to 10 feet in various directions.

A median would need to be constructed at the roundabout approaches, and this would block left-turns into Heritage Bank. This access point would need to be closed and access could be redirected to their existing access point of Kingston Springs Road. The existing access point on SR 249/Luyben Hills Road could become a right-in/right-out, but there are safety issues associated with an access point being located that close to the roundabout. Minimal ROW, if any, would be needed from the Heritage Bank.

It was stressed that these are planning level discussions, and no decisions are being made. All questions regarding this project should be directed to Laurie Cooper so that questions are answered consistently.

Pam Lorenz stated that there seems to be two issues Kingston Springs can keep moving forward independent of the SR 249/Luyben Hills Road *TPR*: adjusting the signal at SR 249/Luyben Hills Road and Kingston Springs Road, and working with TDOT to obtain the access road north of I-40 with hopes of eventually converting it to a local road.

Conversion of East Kingston Springs Road Center Turn Lane into a Median

During the Stakeholder meeting held in November 2008, Kingston Springs asked that TDOT consider whether the center turn lane on SR 249/East Kingston Springs Road could be converted into a landscaped median because cars use it as a passing lane. They are also concerned about cars driving too fast past the schools. They also think it is aesthetically unpleasing.

Several alternatives were discussed in this area. A median would be possible, due to the relatively low number of access points along the corridor. (There isn't an issue with cars backing up in the center turn lane during school pick-up and drop-off hours.)

Another option that was discussed was to sign the existing 8-foot shoulders as bike lanes. Conversations during the field review indicated that this is a popular area for recreational bikers, and there are bike lanes on US 70 near Montgomery Bell State Park.

One attendee suggested the construction of a roundabout at Harpeth View Trail to slow traffic down. During the field review it was discussed that one problem with a roundabout in this location is that roundabouts are not as suitable for pedestrian crossings. Pedestrians are an important consideration because children from the schools regularly cross SR 249/East Kingston Springs Road in this location (to access sports fields).

A memorandum detailing this discussion and the issues and opportunities associated with the various options will be drafted and submitted to TDOT. This issue will not be addressed in the SR 249/Luyben Hills Road *TPR*.

Path Forward:

Margaret Tyler then discussed the next steps in completion of the TPR.

- The meeting notes will be distributed next week;
- A purpose and need for the project will be developed next week;

- Preliminary concepts will be developed and coordinated with TDOT in the next three weeks;
- Once the preliminary concepts are approved, GS&P will begin the preparation of the TPR;
- A memorandum prepared by GS&P for TDOT documenting the discussion about the possibility of turning the continuous turn lane on SR 249/East Kingston Springs Road into a median will be prepared and submitted to TDOT. It will outline the various options that were discussed and summarize their advantages and disadvantages; and
- The TPR will include a discussion about the possibility of constructing a roundabout at the intersection of SR 249/Luyben Hills Road and Kingston Springs Road. It will document the type of roundabout discussed and it will summarize the advantages and disadvantages of a roundabout in that location.

Prepared by: Margaret Tyler, Gresham Smith and Partners, February 20, 2009

Appendix D
Corridor Typical Sections and Business Entrance Layout Plan Sheets

TENNESSEE D.O.T. DESIGN DIVISION

FILE NO.

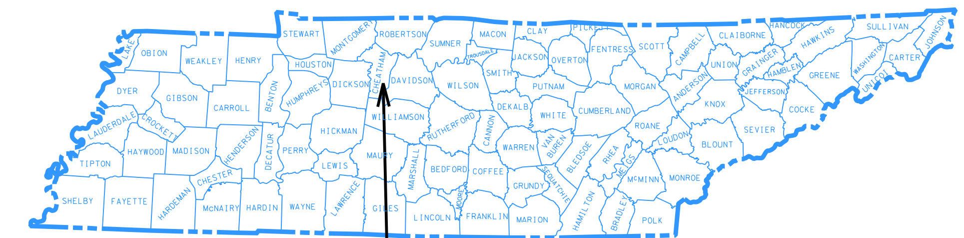
TENN.	YEAR	SHEET NO.
	2009	1
FED. AID PROJ. NO.		
STATE PROJ. NO.		

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING

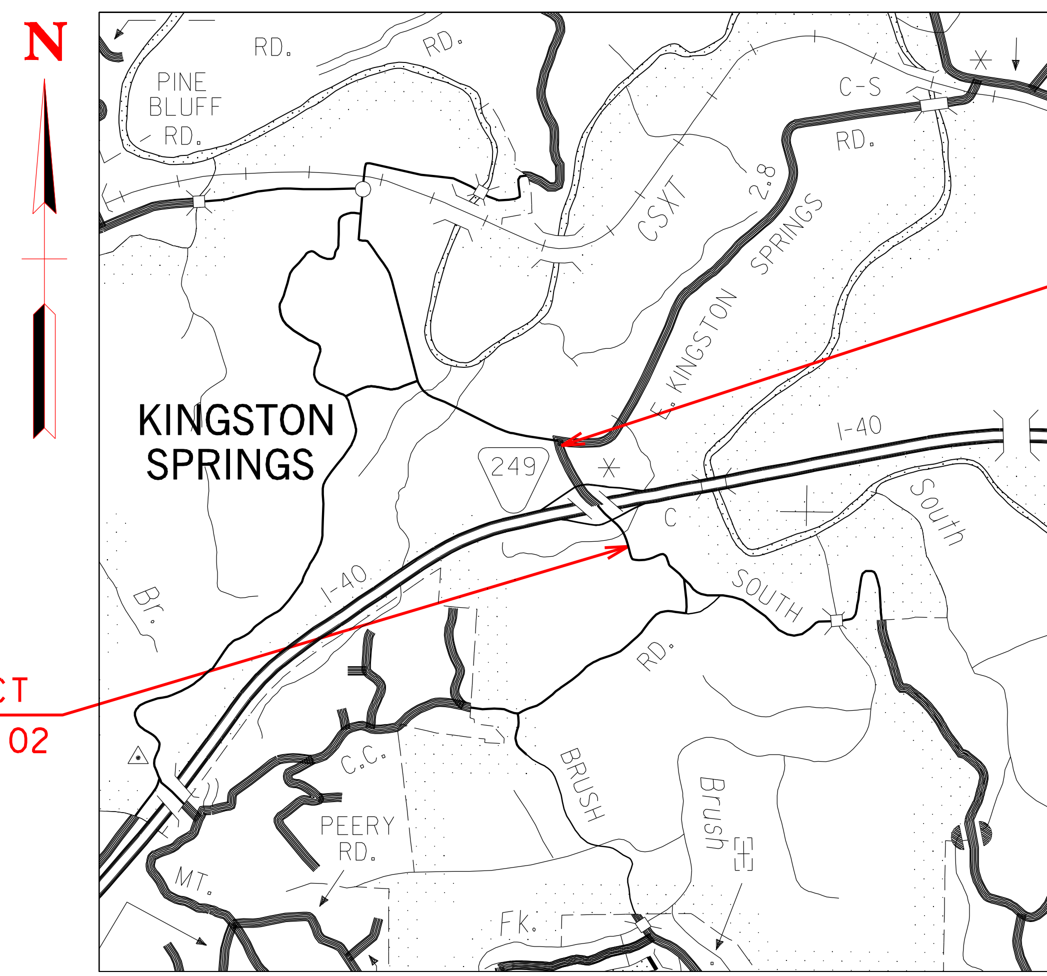
CHEATHAM COUNTY

STATE ROUTE 249
LUYBEN HILLS ROAD
TRANSPORTATION IMPROVEMENTS

Index Of Sheets



PROJECT LOCATION



END PROJECT
STA. 126+04.24

BEGIN PROJECT
STA. 103+53.02

SCALE: 1"=4000'

SPECIAL NOTES

PROPOSALS MAY BE REJECTED BY THE COMMISSIONER IF ANY OF THE UNIT PRICES CONTAINED THEREIN ARE OBVIOUSLY UNBALANCED, EITHER EXCESSIVE OR BELOW THE REASONABLE COST ANALYSIS VALUE.

THIS PROJECT TO BE CONSTRUCTED UNDER THE STANDARD SPECIFICATIONS OF THE TENNESSEE DEPARTMENT OF TRANSPORTATION DATED MARCH 1, 2006 AND ADDITIONAL SPECIFICATIONS AND SPECIAL PROVISIONS CONTAINED IN THE PLANS AND IN THE PROPOSAL CONTRACT.

TDOT C.E. MANAGER 1 OR
TDOT TRANSPORTATION MANAGER 1 ____________
TDOT ROAD SP. SV. 2 ____________
DESIGNED BY ____________
DESIGNER GRESHAM, SMITH AND PARTNERS CHECKED BY ____________
P.E. NO. ____________
PIN NO. ____________

APPROVED: ____________ CHIEF ENGINEER

DATE: ____________

APPROVED: ____________ COMMISSIONER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

DIVISION ADMINISTRATOR DATE

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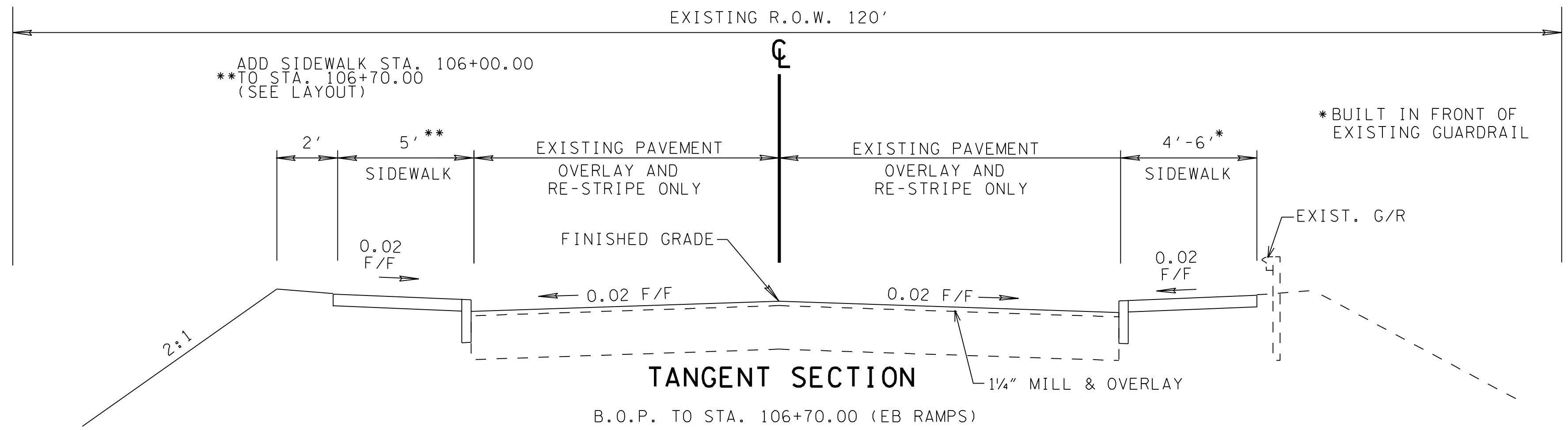
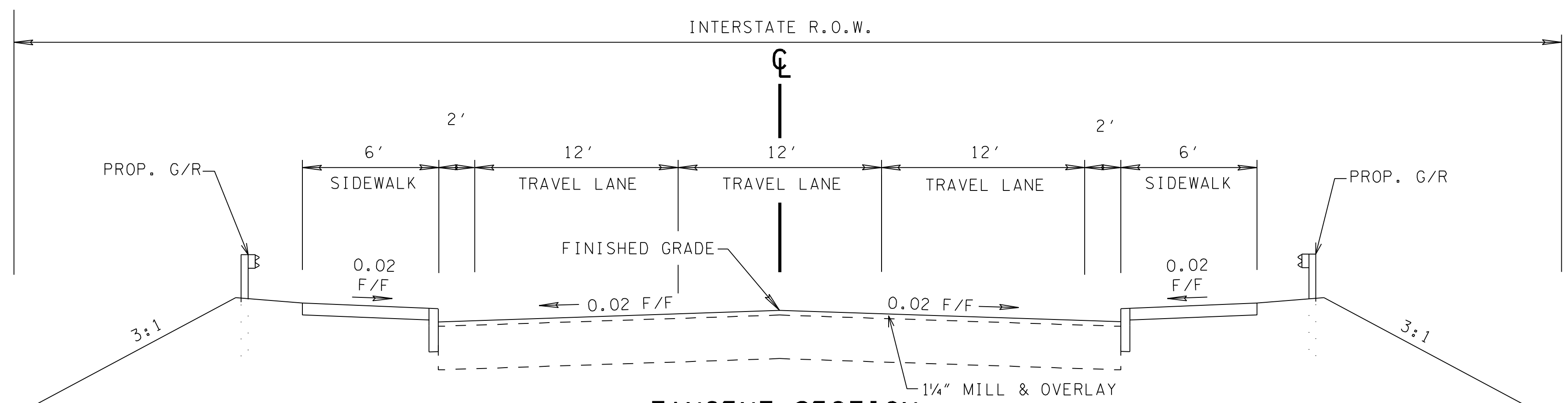
TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.



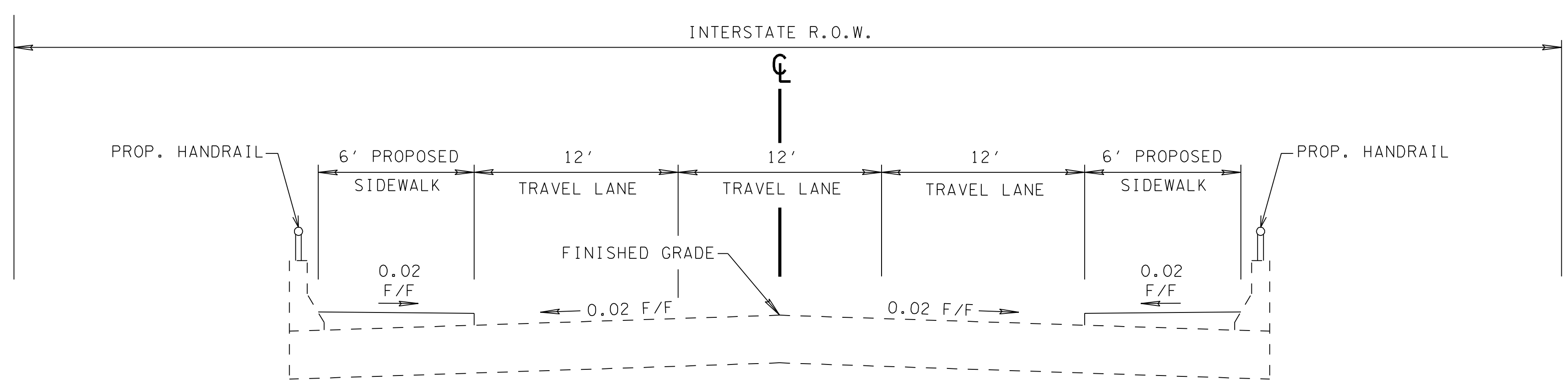
TANGENT SECTION

B.O.P. TO STA. 106+70.00 (EB RAMPS)



TANGENT SECTION

STA. 106+70.00 (EB RAMPS) TO STA. 108+78.37 (BRIDGE)
STA. 111+74.96 (BRIDGE) TO STA. 113+82.00 (WB RAMPS)



BRIDGE SECTION

STA. 108+78.37 TO STA. 111+74.96

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

TYPICAL SECTIONS

SEGMENT 1
N.T.S.

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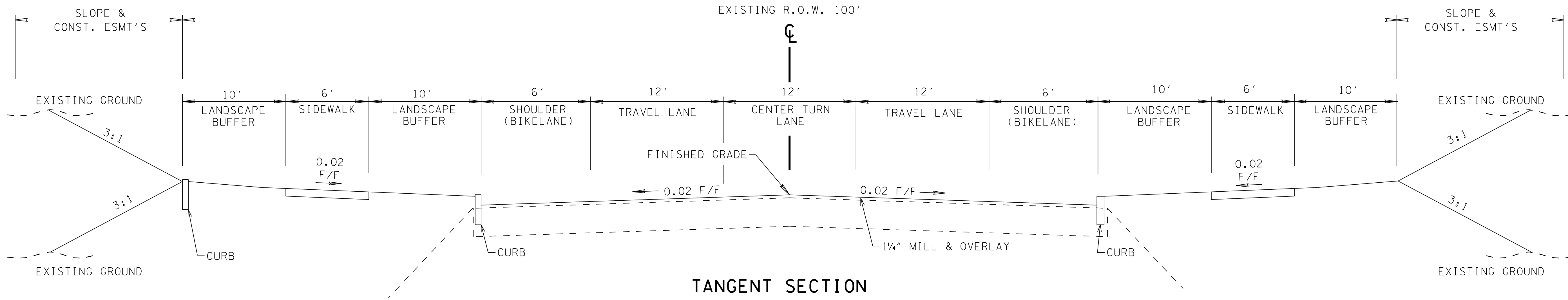
TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2A

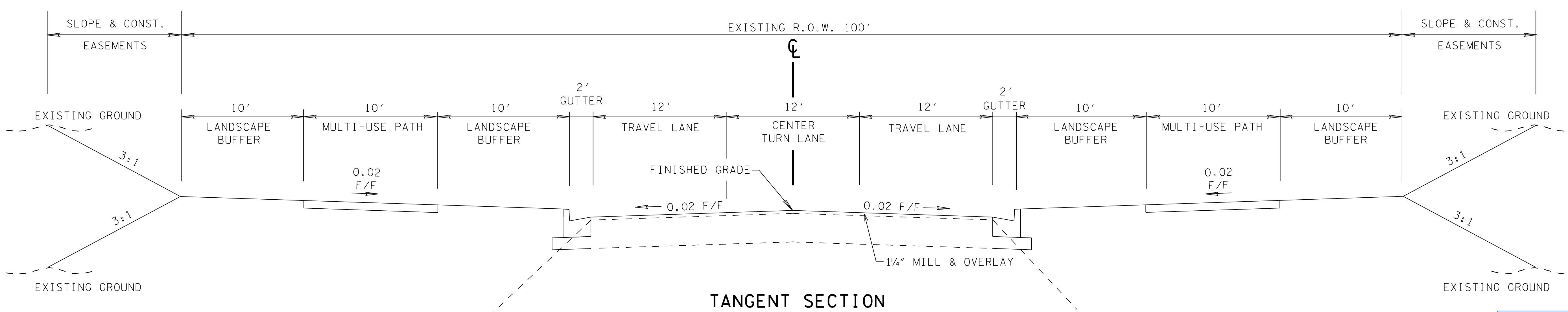


TANGENT SECTION

STA. 113+82.00 TO STA. 123+30.00

OPTION 1

NOTE: FOR BOTH OPTIONS, THE LANDSCAPE BUFFERS AND SIDEWALK WIDTHS AND LOCATIONS CAN VARY DEPENDING ON THE CONTEXT (UTILITIES, ETC.) AND THE NEED FOR LARGER OR SMALLER WIDTHS OF THE BUFFERS. IT IS IMPORTANT TO KEEP A CONSISTENT THEME THROUGH THE PROJECT CORRIDOR.



TANGENT SECTION

STA. 113+82.00 TO STA. 123+30.00

OPTION 2

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STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

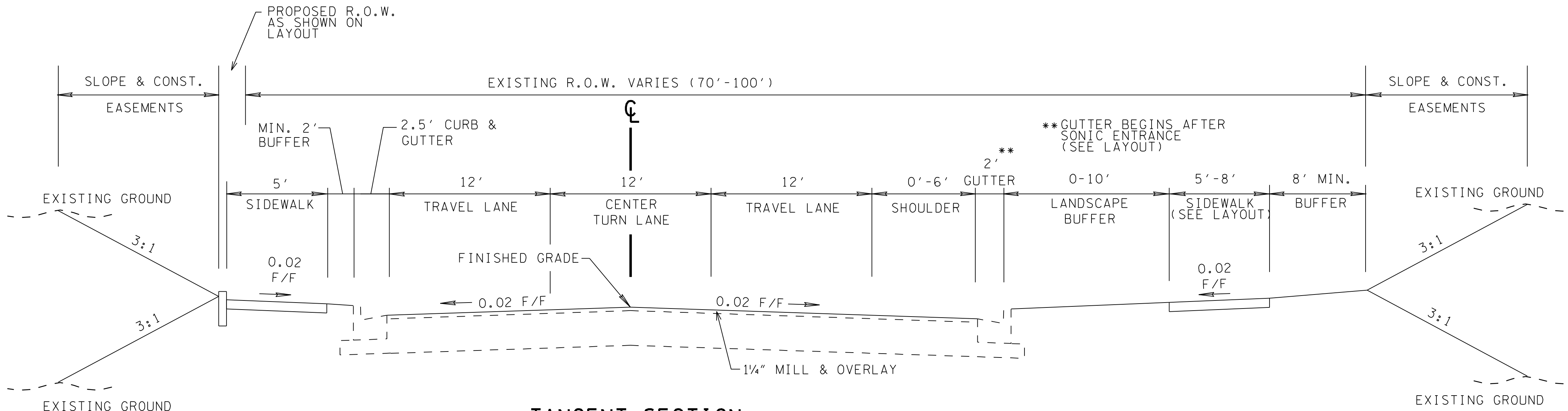
TYPICAL SECTIONS

SEGMENT 2

N.T.S.

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

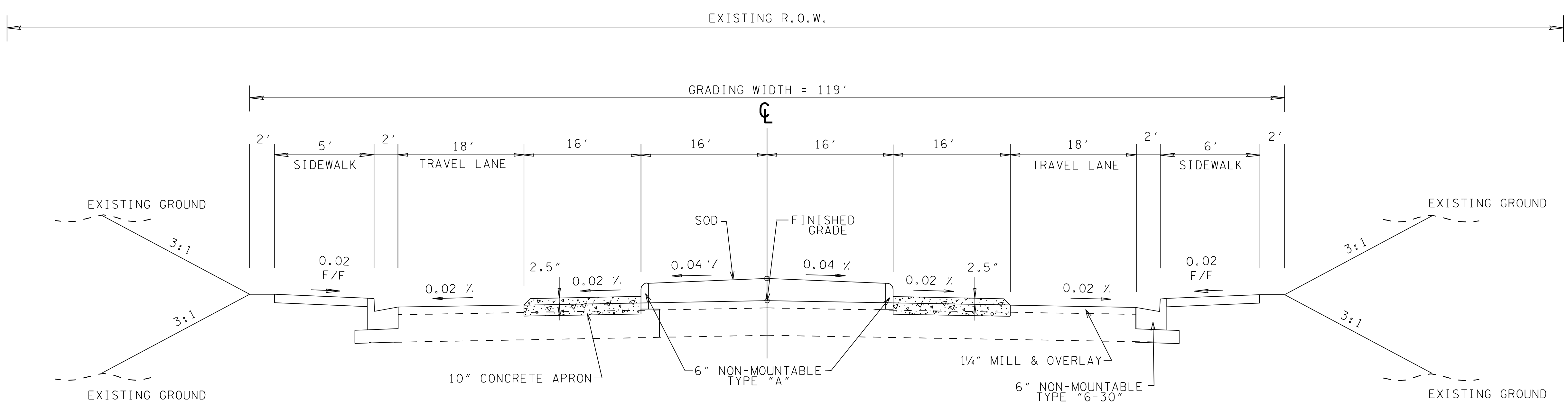
TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2B



TANGENT SECTION

STA. 123+30.00 TO E.O.P.

SEGMENT 3



ROUNDABOUT SECTION

(ROUNDABOUT OPTION)

(INTERSECTION OF LUYBEN HILLS ROAD AND KINGSTON SPRINGS ROAD)

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

TYPICAL SECTIONS

SEGMENT 3 & ROUNDABOUT OPT.

N.T.S.

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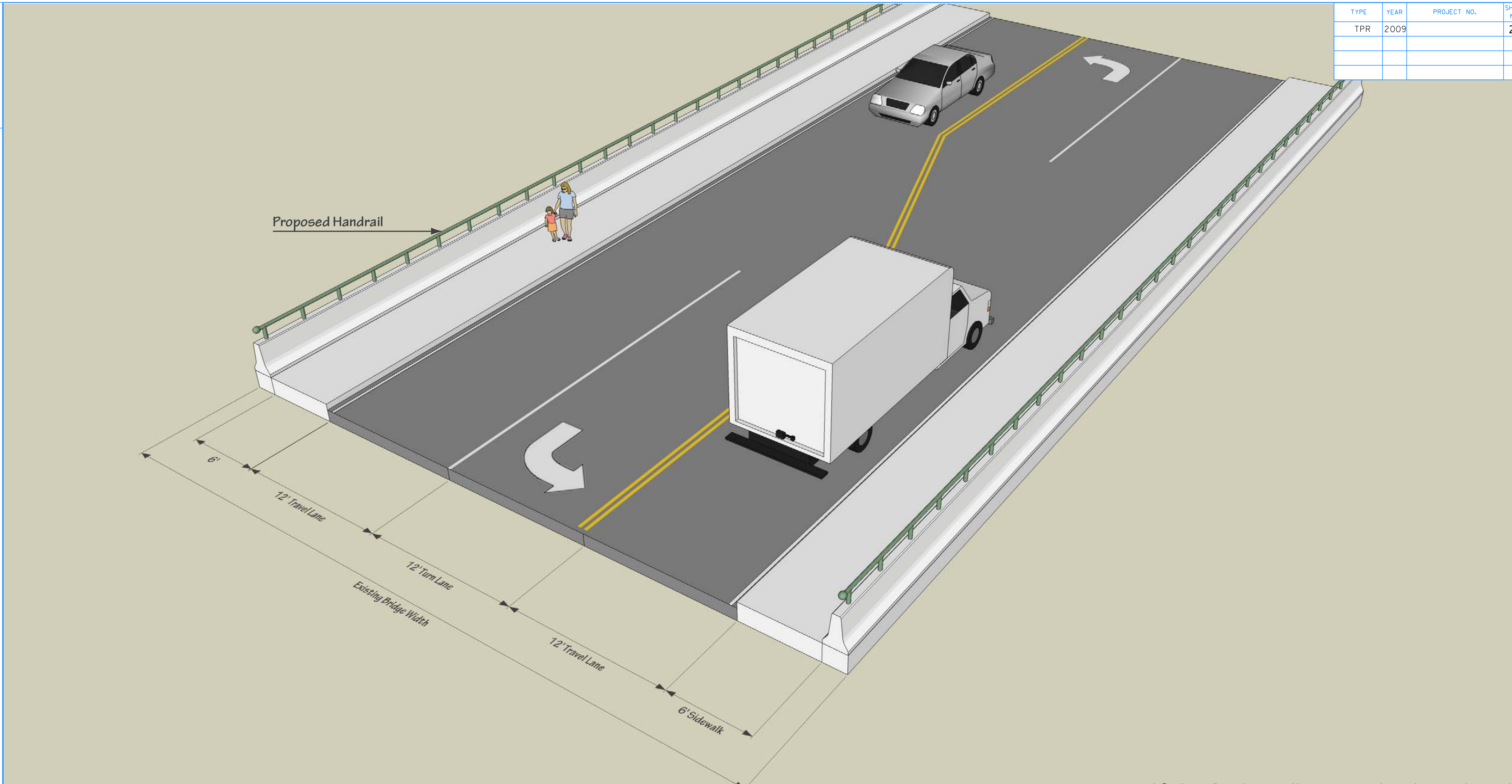
TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2c



NOTE: Bridge will not need to be widened

State Route 249
Bridge over Interstate 40
2-12' Travel Lanes and 12' Turn Lane with 6' Sidewalks

Kingston Springs

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GRAPHICAL TYPICAL SECTION

TENNESSEE D.O.T. DESIGN DIVISION	FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2D

State Route 249 - OPTION 1

Road Segment from I-40 Interchange to Approximately 450' South of Kingston Springs Road

6' Shoulder with 8' Sidewalk and Landscaped Buffers

STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION

GRAPHICAL TYPICAL SECTION

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2E

Kingston Springs

State Route 249 - OPTION 2

Road Segment from I-40 Interchange to Kingston Springs Road

Curb & Gutter with Landscaped Buffers and 10' Multi-Use Path

Kingston Springs TENNESSEE

G S & P

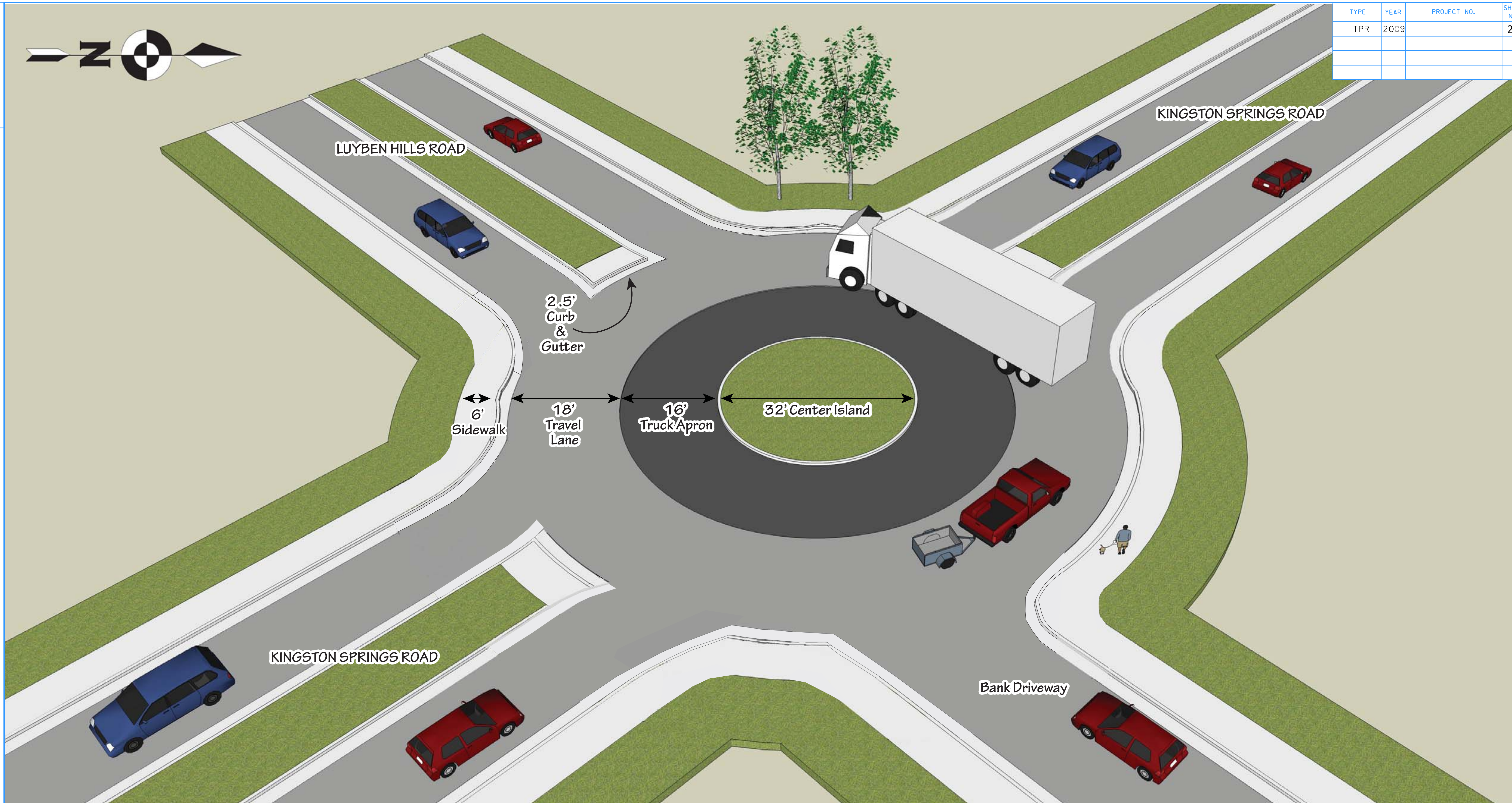
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GRAPHICAL TYPICAL SECTION

TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		2F



State Route 249 - ROUNDABOUT OPTION

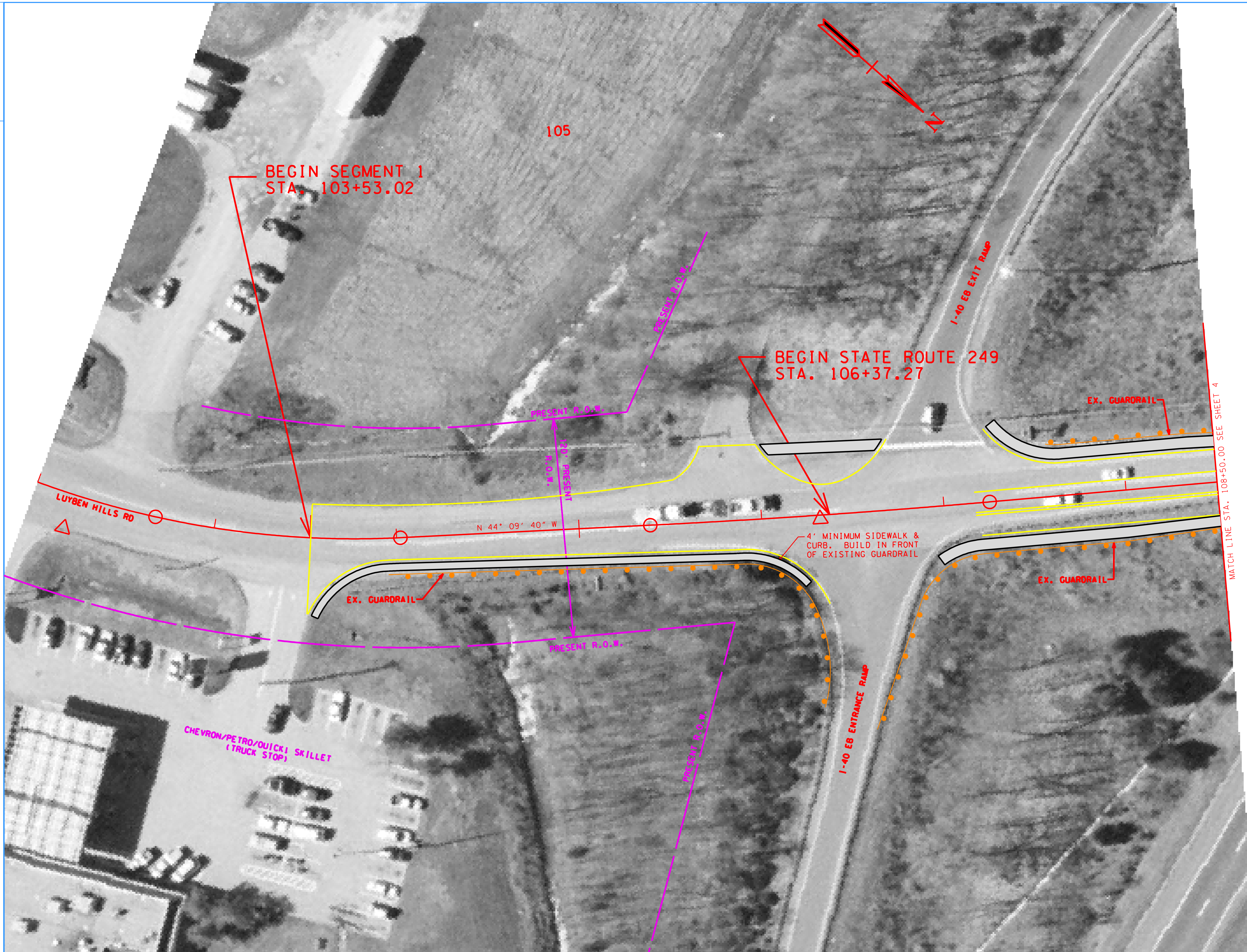
Intersection of Luyben Hills Road and Kingston Springs Road

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GRAPHICAL TYPICAL SECTION

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		3



NOTE: FROM BEGINNING OF PROJECT TO BEGINNING OF S.R. 249 WILL NOT BE PAID BY TDOT, BUT RATHER AS A "LOCAL PROJECT".

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

S.R. 249 AT I-40 INTERCHANGE

B.O.P. TO STA.108+50

SCALE: 1"=50'

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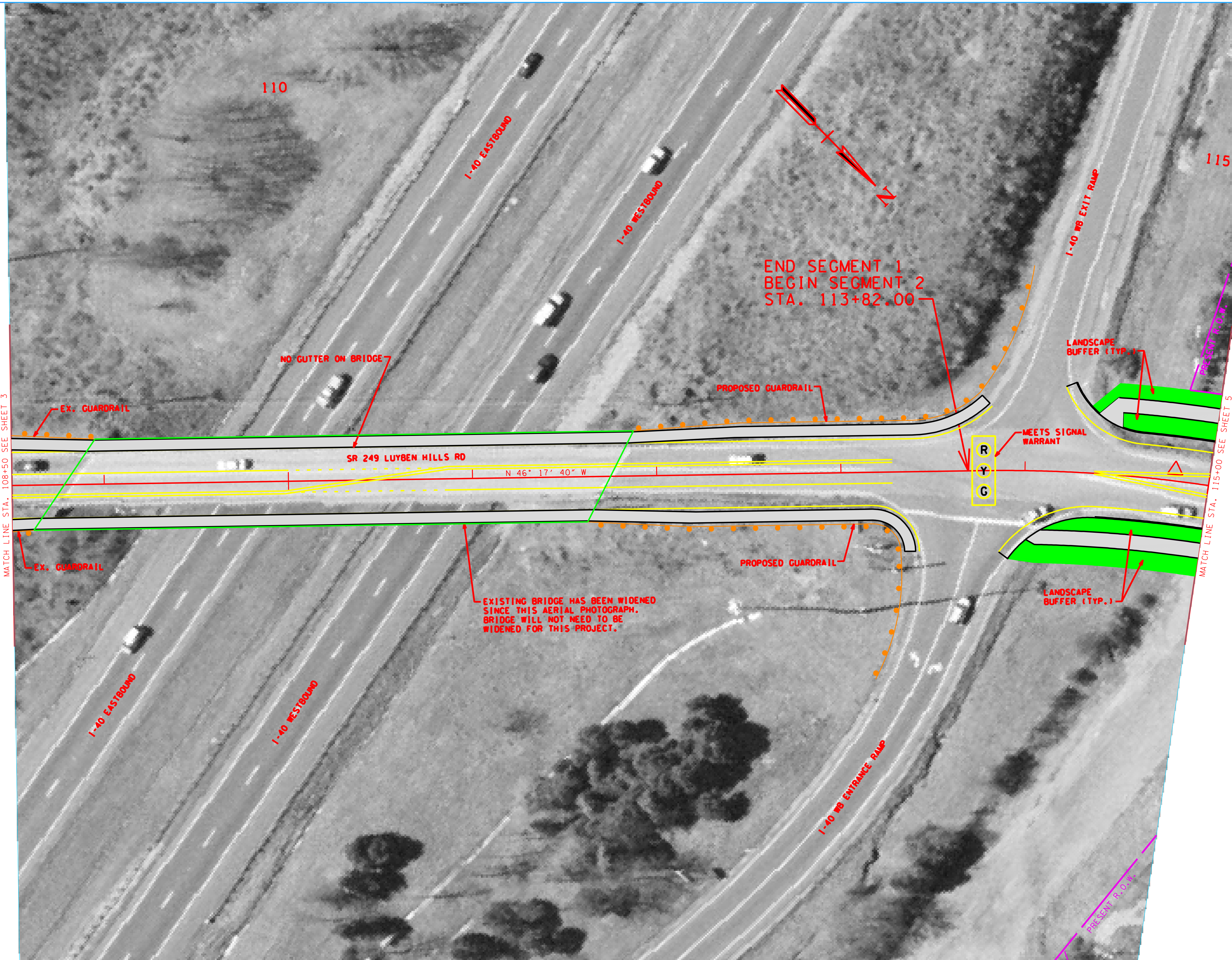
TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		4

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

S.R. 249 AT I-40 INTERCHANGE

STA. 108+50 TO STA. 115+00

SCALE: 1"=50'

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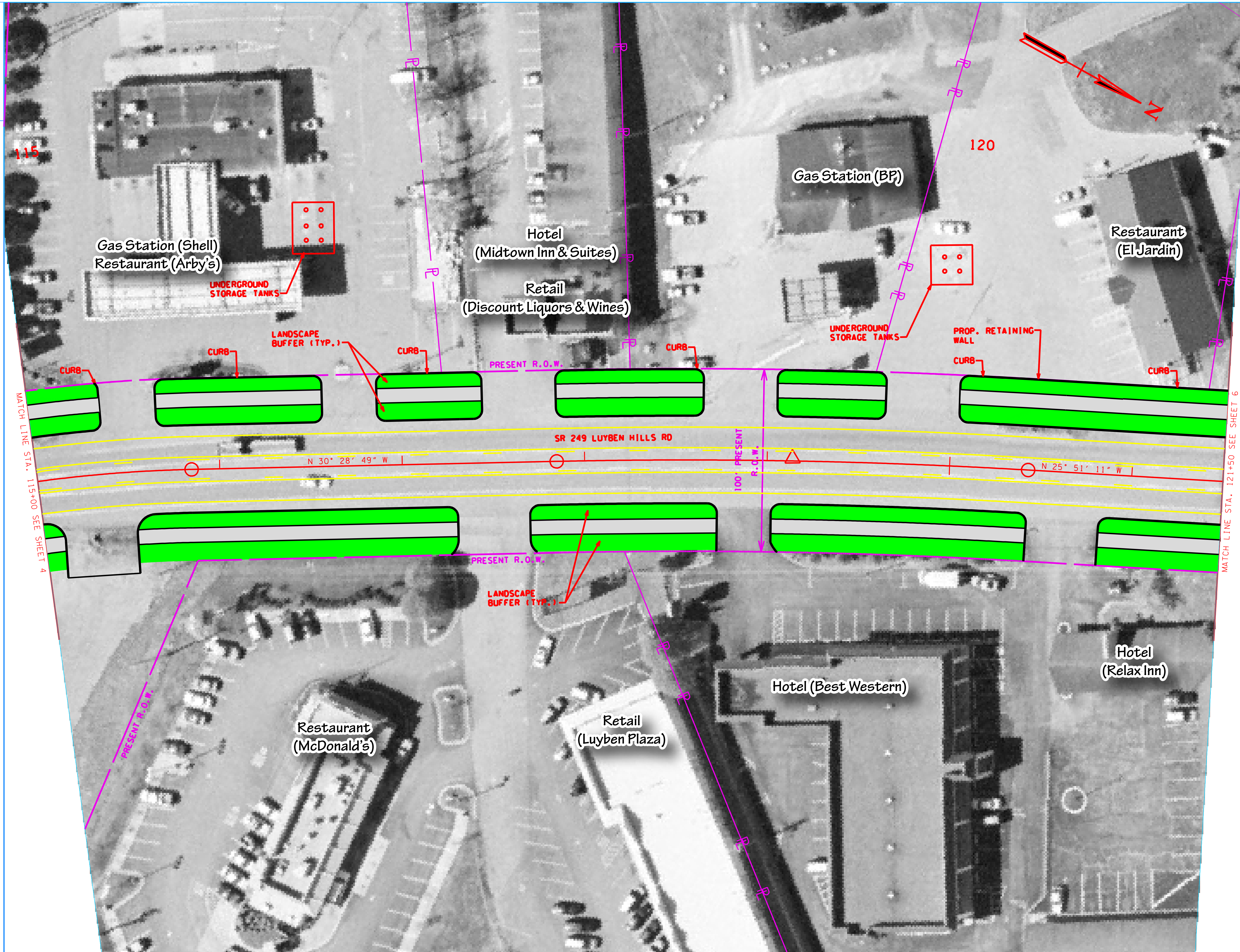
TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		5



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STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

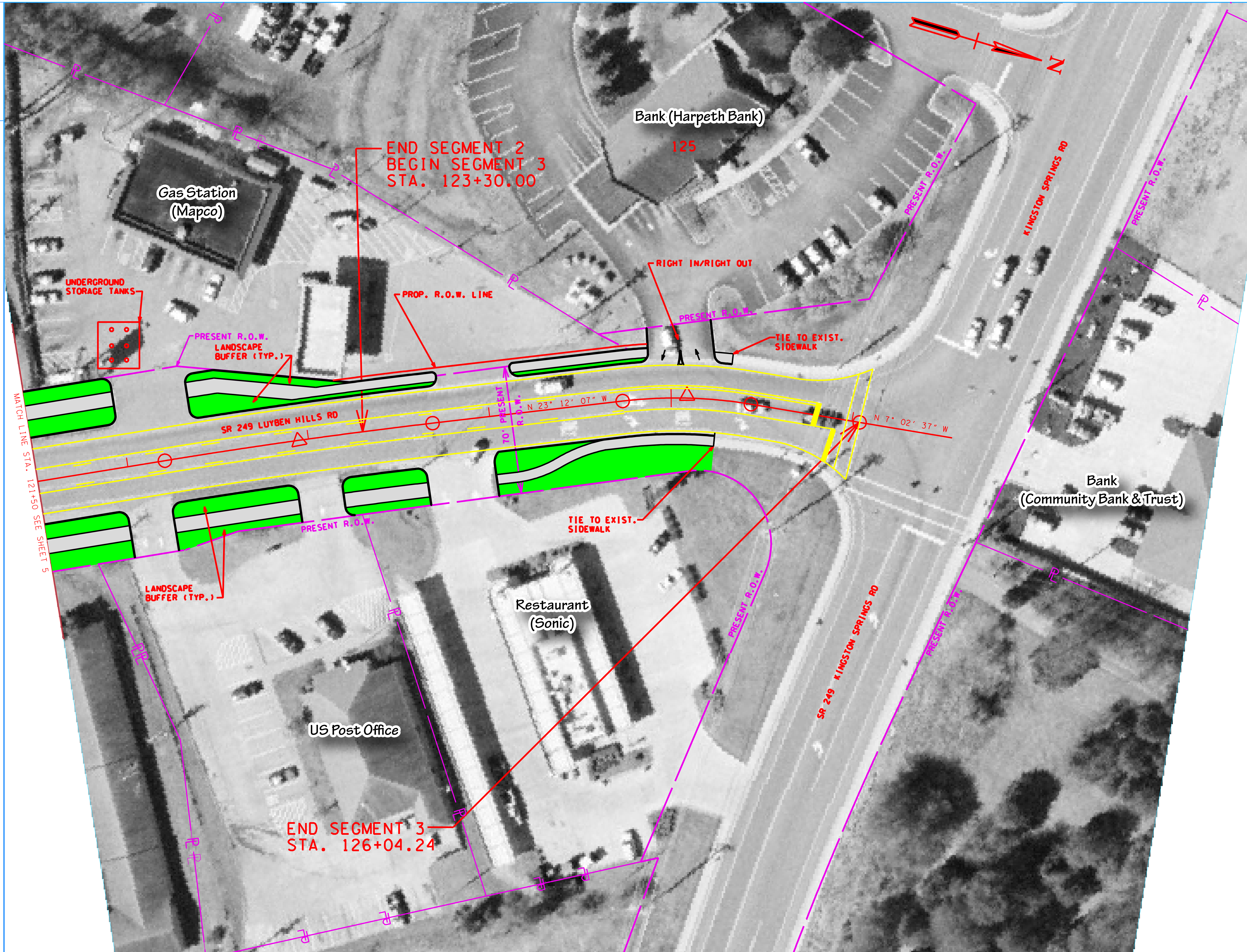
BUSINESS ENTRANCE LAYOUT

STA. 115+00 TO STA. 121+50

SCALE: 1"=50'

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		6



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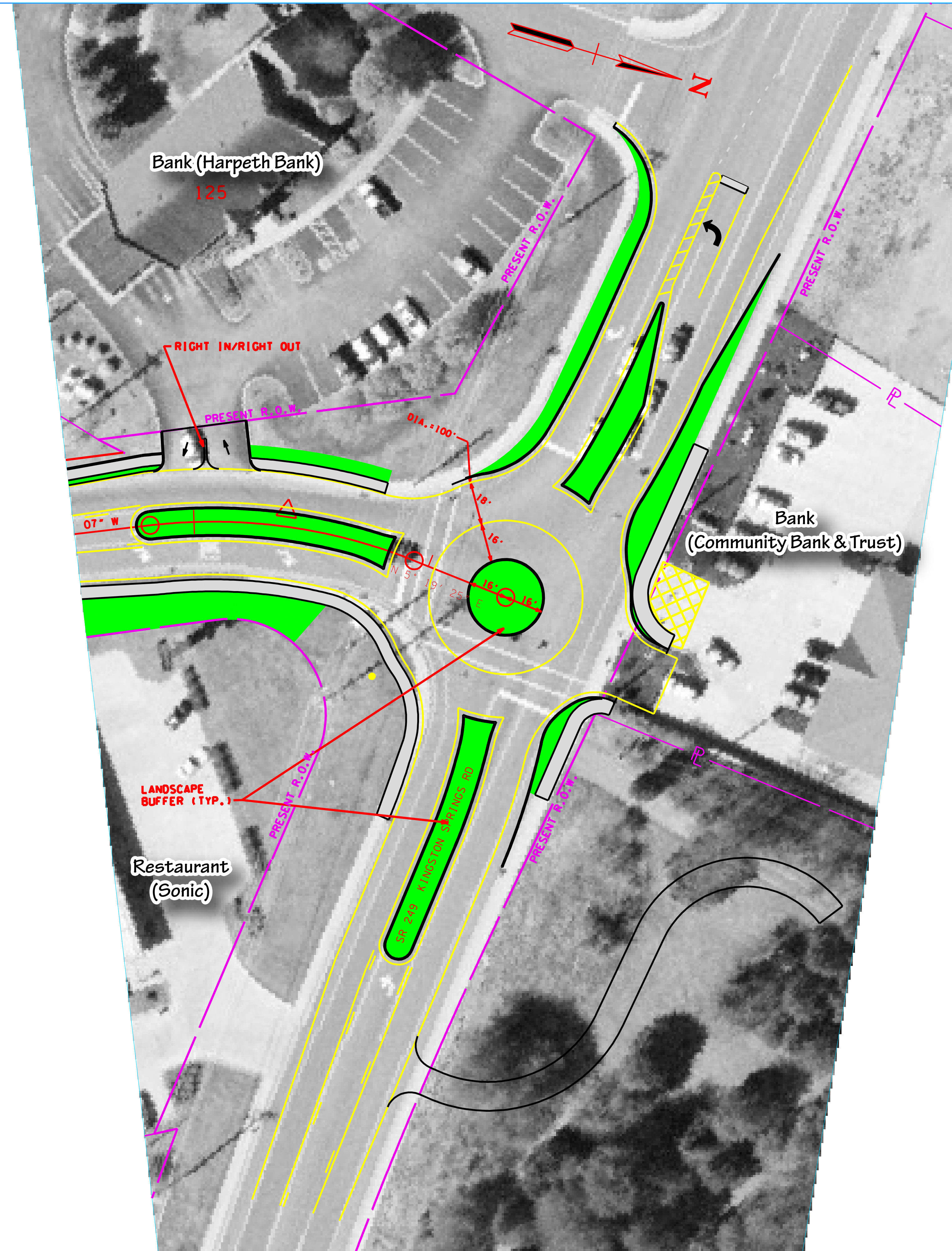
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BUSINESS
ENTRANCE
LAYOUT

STA. 121+50 TO E.O.P
SCALE: 1"=50'

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		7



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

ROUNDABOUT LAYOUT

STA.121+50 TO E.O.P

SCALE: 1"=50'

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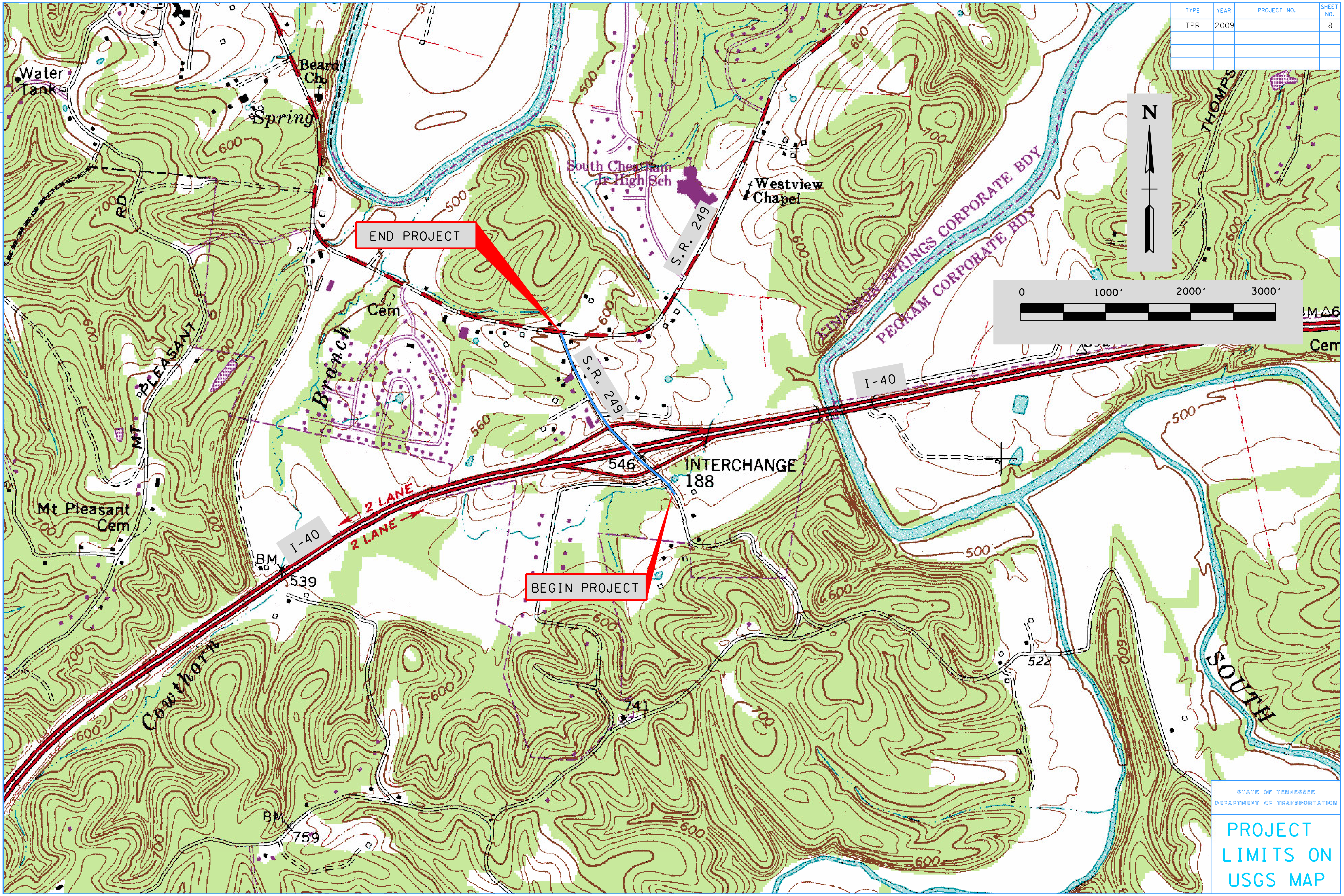
TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
TPR	2009		8



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

PROJECT LIMITS ON USGS MAP

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Appendix E
Preliminary Cost Estimates

OPTION 1
SR 249 - 0.426 Miles from Truck Stop to Intersection with Kingston Springs Road
2-12' Lanes with 12' Turn Lane, 6' Shoulders, Curbed Islands with Buffer Strips and 6' Sidewalks

	OPTION 1 **RIGHT-OF-WAY COST**						
	DESCRIPTION RIGHT-OF-WAY COST	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**HIGH UNIT PRICE**	**AVG. COST EST.**	**HIGH COST EST.**
	LAND	ACRES	0.022	$150,000.00	$200,000.00	$3,300	$4,400
					SUB-TOTAL	$3,300	$4,400

	OPTION 1 **CONSTRUCTION COST**						
ITEM NO.	**DESCRIPTION**	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**HIGH UNIT PRICE**	**AVG. COST EST.**	**HIGH COST EST.**
105-01	CONSTRUCTION STAKES, LINES AND GRADES	L.S.	1	$24,000.00	$30,000.00	$24,000	$30,000
203-06	WATER	M.G.	235	$7.90	$9.50	$1,857	$2,233
203-10	EMBANKMENT (COMPACTED IN PLACE)	C.Y.	9460	$7.60	$8.30	$71,896	$78,518
209-05	SEDIMENT REMOVAL	C.Y.	50	$5.90	$7.10	$295	$355
209-08.02	TEMPORARY SILT FENCE (WITH BACKING)	L.F.	2500	$4.90	$5.30	$12,250	$13,250
209-40.30	CATCH BASIN PROTECTION (TYPE A)	EACH	11	$425.00	$450.00	$4,675	$4,950
303-01	MINERAL AGGREGATE, TYPE A BASE, GRADING D	TON	480	$16.20	$18.80	$7,776	$9,024
303-01.03	GRANULAR BACKFILL (RETAINING WALLS)	TON	120	$41.50	$55.20	$4,980	$6,624
307-02.01	ASPHALT CONCRETE MIX (PG70-22) (BPMB-HM) GRADING A	TON	146	$68.40	$79.00	$9,986	$11,534
307-02.02	ASPHALT CEMENT (P70-22) (BPMB-HM) GRADING A-S	TON	4	$770.00	$910.00	$3,080	$3,640
307-02.03	AGGREGATE (BPMB-HM) GRADING A-S MIX	TON	110	$38.00	$42.10	$4,180	$4,631
307-02.08	ASPHALT CONCRETE MIX (PG70-22) (BPMB-HM) GRADING B-M2	TON	955	$74.20	$83.10	$70,861	$79,361
402-01	BITUMINOUS MATERIAL FOR PRIME COAT (PC)	TON	1	$456.70	$562.30	$594	$731
402-02	AGGREGATE FOR COVER MATERIAL (PC)	TON	5	$26.70	$28.00	$136	$143
403-01	BITUMINOUS MATERIAL FOR TACK COAT (TC)	TON	1	$396.20	$475.40	$475	$570
407-20.05	SAW CUTTING ASPHALT PAVEMENT	L.F.	700	$2.30	$3.20	$1,610	$2,240
411-02.10	ACS MIX(PG70-22) GRADING D	TON	660	$75.50	$79.00	$49,830	$52,140
415-01.02	COLD PLANING BITUMINOUS PAVEMENT	S.Y.	10000	$1.70	$2.60	$17,000	$26,000
604-01.04	1-1/2" STEEL PIPE HANDRAIL	L.F.	610	$127.50	$155.00	$77,775	$94,550
604-07.01	RETAINING WALL	S.F.	600	$90.00	$120.00	$54,000	$72,000
607-03.02	18" CONCRETE PIPE CULVERT (CLASS III)	L.F.	1500	$41.50	$50.00	$62,250	$75,000
607-05.02	24" CONCRETE PIPE CULVERT (CLASS III)	L.F.	800	$49.60	$55.50	$39,680	$44,400
611-09.01	ADJUSTMENT OF EXISTING CATCHBASIN	EACH	2	$625.00	$1,000.00	$1,250	$2,000
611-12.02	CATCH BASINS, TYPE 12, > 4' - 8' DEPTH	EACH	9	$2,010.00	$2,500.00	$18,090	$22,500
611-16.02	CATCH BASINS, TYPE 16, > 4' - 8' DEPTH	EACH	2	$4,320.00	$5,300.00	$8,640	$10,600
701-01.01	CONCRETE SIDEWALK (4")	S.F.	24000	$3.35	$3.45	$80,400	$82,800
701-02	CONCRETE DRIVEWAY	S.F.	2700	$5.80	$7.00	$15,660	$18,900
701-02.03	CONCRETE HANDICAP RAMP	S.F.	3800	$9.80	$11.70	$37,240	$44,460
702-01	CONCRETE CURB	C.Y.	160	$292.50	$355.40	$46,800	$56,864
702-03	CONCRETE COMBINED CURB & GUTTER	C.Y.	75	$202.50	$245.00	$15,188	$18,375
705-01.01	GUARDRAIL AT BRIDGE ENDS	L.F.	50	$56.50	$65.00	$2,825	$3,250
705-02.02	SINGLE GUARDRAIL (TYPE 2)	L.F.	500	$18.50	$19.50	$9,250	$9,750
705-04.05	GUARDRAIL TERMINAL (TYPE-IN-LINE)	EACH	2	$585.00	$670.00	$1,170	$1,340
707-08.10	TEMPORARY CONSTRUCTION FENCE	L.F.	4400	$15.25	$16.00	$67,100	$70,400
710-02	AGGREGATE UNDERDRAINS (WITH PIPE)	L.F.	1600	$2.85	$3.10	$4,560	$4,960
712-01	TRAFFIC CONTROL	LS	1	$16,000.00	$19,000.00	$16,000	$19,000
712-04.01	FLEXIBLE DRUMS (CHANNELIZING)	EACH	125	$38.20	$46.90	$4,775	$5,863
712-05.01	WARNING LIGHTS (TYPE A)	EACH	40	$36.35	$46.60	$1,454	$1,864
712-05.03	WARNING LIGHTS (TYPE C)	EACH	40	$39.60	$50.70	$1,584	$2,028
712-06	SIGNS (CONSTRUCTION)	S.F.	500	$9.75	$11.25	$4,875	$5,625
72-02.02	INTERCONNECTED PORTABLE BARRIER RAIL	L.F.	200	$21.20	$31.30	$4,240	$6,260
712-08.03	ARROW BOARD (TYPE C)	EACH	2	$1,325.00	$1,510.00	$2,650	$3,020
713-16.01	CHANGEABLE MESSAGE SIGN UNIT	EACH	2	$7,550.00	$11,100.00	$15,100	$22,200
713-16.20	SIGNS (STREET NAME SIGNS)	EACH	4	$233.00	$270.00	$932	$1,080
713-16.24	SIGNS (STOP)	EACH	1	$275.00	$300.00	$275	$300
716-02.01	PLASTIC PAVEMENT MARKING (4" LINE)	L.M.	2.0	$3,050.00	$3,300.00	$6,100	$6,600
716-02.04	PLASTIC PAVEMENT MARKING (CHNZ STRIPING)	S.Y.	60.0	$19.40	$22.50	$1,164	$1,350
716-02.05	PLASTIC PAVEMENT MARKING (STOP LINE)	L.F.	200	$13.00	$16.00	$2,600	$3,200
716-02.06	PLASTIC PAVEMENT MARKING (TURN LANE ARROW)	EACH	15	$152.50	$172.70	$2,288	$2,591
716-02.09	PLASTIC PAVEMENT MARKING (LONGITUDINAL CROSS-WALK)	L.F.	380	$26.90	$33.10	$10,222	$12,578
716-03.01	PLASTIC WORD PVMT MARKING (ONLY)	EACH	2	$180.30	$207.10	$361	$414
801-01	SEEDING (WITH MULCH)	UNIT	9	$30.00	$32.40	$270	$292
801-01.07	TEMPORARY SEEDING (WITH MULCH)	UNIT	7	$26.00	$29.80	$182	$209
801-03	WATER (SEEDING & SODDING)	M.G.	35	$20.00	$30.50	$700	$1,068
803-01	SODDING (NEW SOD)	S.Y.	1200	$2.55	$3.00	$3,060	$3,600
SP-1	TRAFFIC SIGNAL AT WESTBOUND INTERCHANGE RAMP	LS	1	$80,000.00	$100,000.00	$80,000	$100,000
SP-2	LANDSCAPE BUFFERS (PLANTINGS & STREET FURNITURE)	LS	1	$135,000.00	$151,000.00	$135,000	$151,000
SP-3	LAMP FIXTURES/POSTS INSTALLATION/WIRING	EACH	26	$6,000.00	$8,000.00	$156,000	$208,000
					SUB-TOTAL	$1,277,190	$1,516,232

OPTION 1, UTILITY COST
Assumes no utility relocations, due to roadway width staying the same and sidewalk can be shifted around power poles as needed. A contingency for possible utility issues involving the underground drainage system is included below.

			AVG. COST EST.	HIGH COST EST.
	MOBILIZATION		$62,474	$90,649

Low = $50,000 + 4.5% OF TOTAL CONST. EST. OVER $1 MILLION EXC. MOBILIZATION
High = $230,000 + 4% OF TOTAL CONST. EST. OVER $5 MILLION EXC. MOBILIZATION

			AVG. COST EST.	HIGH COST EST.
	UTILITY CONTINGENCY (5% OF CONSTRUCTION COST)		$63,859	$75,812
	CONTINGENCY (15% OF CONSTRUCTION COST + UTILITY COST)		$201,157	$238,807
	TOTAL CONSTRUCTION COST		$1,604,680	$1,921,500
	PRELIMINARY ENGINEERING (10% OF TOTAL CONST. COST)		$160,468	$192,150
	TOTAL (WITHOUT INFLATION)		$1,765,148	$2,113,650
	INFLATION (6% PER YEAR OVER 5 YEARS)		$596,973	$714,836
	TOTAL COSTS OPTION 1		$2,365,421	$2,832,886

OPTION 2
SR 249 - 0.426 Miles from Truck Stop to Intersection with Kingston Springs Road
CURB & GUTTER WITH LANDSCAPED BUFFERS AND 10' MULTI-USE PATHS

	OPTION 2 **RIGHT-OF-WAY COST**						
	DESCRIPTION RIGHT-OF-WAY COST	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**HIGH UNIT PRICE**	**AVG. COST EST.**	**HIGH COST EST.**
	LAND	ACRES	0.022	$150,000.00	$200,000.00	$3,300	$4,400
					SUB-TOTAL	$3,300	$4,400

	OPTION 2 **CONSTRUCTION COST**						
ITEM NO.	**DESCRIPTION**	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**HIGH UNIT PRICE**	**AVG. COST EST.**	**HIGH COST EST.**
105-01	CONSTRUCTION STAKES, LINES AND GRADES	L.S.	1	$24,000.00	$30,000.00	$24,000	$30,000
202-03.01	REMOVAL OF ASPHALT PAVEMENT	S.Y.	1200	$16.20	$31.20	$19,440	$37,440
203-06	WATER	M.G.	235	$7.90	$9.50	$1,857	$2,233
203-10	EMBANKMENT (COMPACTED IN PLACE)	C.Y.	8500	$7.60	$8.30	$64,600	$70,550
209-05	SEDIMENT REMOVAL	C.Y.	50	$5.90	$7.10	$295	$355
209-08.02	TEMPORARY SILT FENCE (WITH BACKING)	L.F.	2500	$4.90	$5.30	$12,250	$13,250
209-40.30	CATCH BASIN PROTECTION (TYPE A)	EACH	19	$425.00	$450.00	$8,075	$8,550
303-01	MINERAL AGGREGATE, TYPE A BASE, GRADING D	TON	720	$16.20	$18.80	$11,664	$13,536
303-01.03	GRANULAR BACKFILL (RETAINING WALLS)	TON	120	$41.50	$55.20	$4,980	$6,624
307-02.01	ASPHALT CONCRETE MIX (PG70-22) (BPMB-HM) GRADING A	TON	215	$68.40	$79.00	$14,706	$16,985
307-02.02	ASPHALT CEMENT (P70-22) (BPMB-HM) GRADING A-S	TON	6	$770.00	$910.00	$4,620	$5,460
307-02.03	AGGREGATE (BPMB-HM) GRADING A-S MIX	TON	165	$38.00	$42.10	$6,270	$6,947
307-02.08	ASPHALT CONCRETE MIX (PG70-22) (BPMB-HM) GRADING B-M2	TON	1,400	$74.20	$83.10	$103,880	$116,340
402-01	BITUMINOUS MATERIAL FOR PRIME COAT (PC)	TON	2	$456.70	$562.30	$913	$1,125
402-02	AGGREGATE FOR COVER MATERIAL (PC)	TON	8	$26.70	$28.00	$200	$210
403-01	BITUMINOUS MATERIAL FOR TACK COAT (TC)	TON	1	$396.20	$475.40	$475	$570
407-20.05	SAW CUTTING ASPHALT PAVEMENT	L.F.	700	$2.30	$3.20	$1,610	$2,240
411-02.10	ACS MIX(PG70-22) GRADING D	TON	660	$75.50	$79.00	$49,830	$52,140
415-01.02	COLD PLANING BITUMINOUS PAVEMENT	S.Y.	10000	$1.70	$2.60	$17,000	$26,000
604-01.04	1-1/2" STEEL PIPE HANDRAIL	L.F.	610	$127.50	$155.00	$77,775	$94,550
604-07.01	RETAINING WALL	S.F.	600	$90.00	$120.00	$54,000	$72,000
607-03.02	18" CONCRETE PIPE CULVERT (CLASS III)	L.F.	1700	$41.50	$50.00	$70,550	$85,000
607-05.02	24" CONCRETE PIPE CULVERT (CLASS III)	L.F.	1100	$49.60	$55.50	$54,560	$61,050
611-09.01	ADJUSTMENT OF EXISTING CATCHBASIN	EACH	2	$625.00	$1,000.00	$1,250	$2,000
611-12.02	CATCH BASINS, TYPE 12, > 4' - 8' DEPTH	EACH	15	$2,010.00	$2,500.00	$30,150	$37,500
611-16.02	CATCH BASINS, TYPE 16, > 4' - 8' DEPTH	EACH	4	$4,320.00	$5,300.00	$17,280	$21,200
701-01.01	CONCRETE SIDEWALK (4")	S.F.	27600	$3.35	$3.45	$92,460	$95,220
701-02	CONCRETE DRIVEWAY	S.F.	2700	$5.80	$7.00	$15,660	$18,900
701-02.03	CONCRETE HANDICAP RAMP	S.F.	3800	$9.80	$11.70	$37,240	$44,460
702-01	CONCRETE CURB	C.Y.	95	$292.50	$355.40	$27,788	$33,763
702-03	CONCRETE COMBINED CURB & GUTTER	C.Y.	200	$202.50	$245.00	$40,500	$49,000
705-01.01	GUARDRAIL AT BRIDGE ENDS	L.F.	50	$56.50	$65.00	$2,825	$3,250
705-02.02	SINGLE GUARDRAIL (TYPE 2)	L.F.	500	$18.50	$19.50	$9,250	$9,750
705-04.05	GUARDRAIL TERMINAL (TYPE-IN-LINE)	EACH	2	$585.00	$670.00	$1,170	$1,340
707-08.10	TEMPORARY CONSTRUCTION FENCE	L.F.	4400	$15.25	$16.00	$67,100	$70,400
710-02	AGGREGATE UNDERDRAINS (WITH PIPE)	L.F.	800	$2.85	$3.10	$2,280	$2,480
712-01	TRAFFIC CONTROL	LS	1	$16,000.00	$19,000.00	$16,000	$19,000
712-04.01	FLEXIBLE DRUMS (CHANNELIZING)	EACH	125	$38.20	$46.90	$4,775	$5,863
712-05.01	WARNING LIGHTS (TYPE A)	EACH	40	$36.35	$46.60	$1,454	$1,864
712-05.03	WARNING LIGHTS (TYPE C)	EACH	40	$39.60	$50.70	$1,584	$2,028
712-06	SIGNS (CONSTRUCTION)	S.F.	500	$9.75	$11.25	$4,875	$5,625
72-02.02	INTERCONNECTED PORTABLE BARRIER RAIL	L.F.	200	$21.20	$31.30	$4,240	$6,260
712-08.03	ARROW BOARD (TYPE C)	EACH	2	$1,325.00	$1,510.00	$2,650	$3,020
713-16.01	CHANGEABLE MESSAGE SIGN UNIT	EACH	2	$7,550.00	$11,100.00	$15,100	$22,200
713-16.20	SIGNS (STREET NAME SIGNS)	EACH	4	$233.00	$270.00	$932	$1,080
713-16.24	SIGNS (STOP)	EACH	1	$275.00	$300.00	$275	$300
716-02.01	PLASTIC PAVEMENT MARKING (4" LINE)	L.M.	1.5	$3,050.00	$3,300.00	$4,575	$4,950
716-02.04	PLASTIC PAVEMENT MARKING (CHNZ STRIPING)	S.Y.	60.0	$19.40	$22.50	$1,164	$1,350
716-02.05	PLASTIC PAVEMENT MARKING (STOP LINE)	L.F.	200	$13.00	$16.00	$2,600	$3,200
716-02.06	PLASTIC PAVEMENT MARKING (TURN LANE ARROW)	EACH	15	$152.50	$172.70	$2,288	$2,591
716-02.09	PLASTIC PAVEMENT MARKING (LONGITUDINAL CROSS-WALK)	L.F.	380	$26.90	$33.10	$10,222	$12,578
716-03.01	PLASTIC WORD PVMT MARKING (ONLY)	EACH	2	$180.30	$207.10	$361	$414
801-01	SEEDING (WITH MULCH)	UNIT	9	$30.00	$32.40	$270	$292
801-01.07	TEMPORARY SEEDING (WITH MULCH)	UNIT	7	$26.00	$29.80	$182	$209
801-03	WATER (SEEDING & SODDING)	M.G.	35	$20.00	$30.50	$700	$1,068
803-01	SODDING (NEW SOD)	S.Y.	1340	$2.55	$3.00	$3,417	$4,020
SP-1	TRAFFIC SIGNAL AT WESTBOUND INTERCHANGE RAMP	LS	1	$80,000.00	$100,000.00	$80,000	$100,000
SP-2	LANDSCAPE BUFFERS (PLANTINGS & STREET FURNITURE)	LS	1	$144,000.00	$162,000.00	$144,000	$162,000
SP-3	LAMP FIXTURES/POSTS INSTALLATION/WIRING	EACH	26	$6,000.00	$8,000.00	$156,000	$208,000
					SUB-TOTAL	$1,406,166	$1,680,327

OPTION 2, UTILITY COST
Assumes no utility relocations, due to roadway width staying the same and sidewalk can be shifted around power poles as needed. A contingency for possible utility issues involving the underground drainage system is included below.

	MOBILIZATION		$68,277	$97,213

Low = $50,000 + 4.5% OF TOTAL CONST. EST. OVER $1 MILLION EXC. MOBILIZATION
High = $230,000 + 4% OF TOTAL CONST. EST. OVER $5 MILLION EXC. MOBILIZATION

	UTILITY CONTINGENCY (5% OF CONSTRUCTION COST)		$70,308	$84,016
	CONTINGENCY (15% OF CONSTRUCTION COST + UTILITY COST)		$221,471	$264,651
	TOTAL CONSTRUCTION COST		$1,766,223	$2,126,208
	PRELIMINARY ENGINEERING (10% OF TOTAL CONST. COST)		$176,622	$212,621
	TOTAL (WITHOUT INFLATION)		$1,942,845	$2,338,829
	INFLATION (6% PER YEAR OVER 5 YEARS)		$657,070	$790,992
	TOTAL COSTS OPTION 2		$2,603,216	$3,134,221

ROUNDABOUT OPTION
Roundabout Intersection Improvement at Kingston Springs Road
Only the costs for changing intersection to a roundabout

	Roundabout Option RIGHT-OF-WAY COST						
	DESCRIPTION RIGHT-OF-WAY COST	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**HIGH UNIT PRICE**	**AVG. COST EST.**	**HIGH COST EST.**
	LAND	ACRES	0	$150,000.00	$200,000.00	$0	$0
					SUB-TOTAL	$0	$0

	ROUNDABOUT OPTION CONSTRUCTION COST						
ITEM NO.	**DESCRIPTION**	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**HIGH UNIT PRICE**	**AVG. COST EST.**	**HIGH COST EST.**
202-03.01	REMOVAL OF ASPHALT PAVEMENT	S.Y.	215	$16.20	$31.20	$3,483	$6,708
203-06	WATER	M.G.	1	$7.90	$9.50	$8	$10
203-10	EMBANKMENT (COMPACTED IN PLACE)	C.Y.	200	$7.60	$8.30	$1,520	$1,660
209-05	SEDIMENT REMOVAL	C.Y.	10	$5.90	$7.10	$59	$71
209-08.02	TEMPORARY SILT FENCE (WITH BACKING)	L.F.	1100	$4.90	$5.30	$5,390	$5,830
209-40.30	CATCH BASIN PROTECTION (TYPE A)	EACH	2	$425.00	$450.00	$850	$900
303-01	MINERAL AGGREGATE, TYPE A BASE, GRADING D	TON	29	$16.20	$18.80	$470	$545
307-02.01	ASPHALT CONCRETE MIX (PG70-22) (BPMB-HM) GRADING A	TON	9	$68.40	$79.00	$616	$711
307-02.02	ASPHALT CEMENT (P70-22) (BPMB-HM) GRADING A-S	TON	0.3	$770.00	$910.00	$193	$228
307-02.03	AGGREGATE (BPMB-HM) GRADING A-S MIX	TON	7	$38.00	$42.10	$266	$295
307-02.08	ASPHALT CONCRETE MIX (PG70-22) (BPMB-HM) GRADING B-M2	TON	57	$74.20	$83.10	$4,229	$4,737
402-01	BITUMINOUS MATERIAL FOR PRIME COAT (PC)	TON	0.1	$456.70	$562.30	$46	$56
402-02	AGGREGATE FOR COVER MATERIAL (PC)	TON	0.3	$26.70	$28.00	$8	$8
403-01	BITUMINOUS MATERIAL FOR TACK COAT (TC)	TON	0.4	$396.20	$475.40	$139	$166
407-20.05	SAW CUTTING ASPHALT PAVEMENT	L.F.	200	$2.30	$3.20	$460	$640
411-02.10	ACS MIX(PG70-22) GRADING D	TON	206	$75.50	$79.00	$15,553	$16,274
415-01.02	COLD PLANING BITUMINOUS PAVEMENT	S.Y.	3100	$1.70	$2.60	$5,270	$8,060
501-01.03	PORTLAND CEMENT CONCRETE PAVEMENT (PLAIN) 10"	S.Y.	330	$46.40	$164.30	$15,312	$54,219
502-03.13	CONCRETE PAVEMENT REMOVAL	S.Y.	75	$34.00	$50.00	$2,550	$3,750
607-03.02	18" CONCRETE PIPE CULVERT (CLASS III)	L.F.	100	$41.50	$50.00	$4,150	$5,000
611-09.01	ADJUSTMENT OF EXISTING CATCHBASIN	EACH	1	$625.00	$1,000.00	$625	$1,000
611-12.02	CATCH BASINS, TYPE 12, > 4' - 8' DEPTH	EACH	2	$2,010.00	$2,500.00	$4,020	$5,000
701-01.01	CONCRETE SIDEWALK (4")	S.F.	2550	$3.35	$3.45	$8,543	$8,798
701-02	CONCRETE DRIVEWAY	S.F.	950	$5.80	$7.00	$5,510	$6,650
701-02.03	CONCRETE HANDICAP RAMP	S.F.	1000	$9.80	$11.70	$9,800	$11,700
702-01	CONCRETE CURB	C.Y.	8	$292.50	$355.40	$2,340	$2,843
702-03	CONCRETE COMBINED CURB & GUTTER	C.Y.	98	$202.50	$245.00	$19,845	$24,010
707-08.10	TEMPORARY CONSTRUCTION FENCE	L.F.	1400	$15.25	$16.00	$21,350	$22,400
710-02	AGGREGATE UNDERDRAINS (WITH PIPE)	L.F.	600	$2.85	$3.10	$1,710	$1,860
712-04.01	FLEXIBLE DRUMS (CHANNELIZING)	EACH	50	$38.20	$46.90	$1,910	$2,345
712-05.01	WARNING LIGHTS (TYPE A)	EACH	25	$36.35	$46.60	$909	$1,165
712-05.03	WARNING LIGHTS (TYPE C)	EACH	25	$39.60	$50.70	$990	$1,268
712-06	SIGNS (CONSTRUCTION)	S.F.	200	$9.75	$11.25	$1,950	$2,250
72-02.02	INTERCONNECTED PORTABLE BARRIER RAIL	L.F.	100	$21.20	$31.30	$2,120	$3,130
712-08.03	ARROW BOARD (TYPE C)	EACH	3	$1,325.00	$1,510.00	$3,975	$4,530
713-16.01	CHANGEABLE MESSAGE SIGN UNIT	EACH	3	$7,550.00	$11,100.00	$22,650	$33,300
713-16.20	SIGNS (STREET NAME SIGNS)	EACH	3	$233.00	$270.00	$699	$810
713-16.24	SIGNS (STOP)	EACH	1	$275.00	$300.00	$275	$300
716-02.01	PLASTIC PAVEMENT MARKING (4" LINE)	L.M.	0.6	$3,050.00	$3,300.00	$1,830	$1,980
716-02.04	PLASTIC PAVEMENT MARKING (CHNZ STRIPING)	S.Y.	45.0	$19.40	$22.50	$873	$1,013
716-02.05	PLASTIC PAVEMENT MARKING (STOP LINE)	L.F.	50	$13.00	$16.00	$650	$800
716-02.06	PLASTIC PAVEMENT MARKING (TURN LANE ARROW)	EACH	5	$152.50	$172.70	$763	$864
716-02.09	PLASTIC PAVEMENT MARKING (LONGITUDINAL CROSS-WALK)	L.F.	130	$26.90	$33.10	$3,497	$4,303
730-01.02	REMOVAL OF SIGNAL EQUIPMENT	EACH	13	$842.00	$1,882.00	$10,946	$24,466
801-01.07	TEMPORARY SEEDING (WITH MULCH)	UNIT	3	$26.00	$29.80	$78	$89
801-03	WATER (SEEDING & SODDING)	M.G.	12	$20.00	$30.50	$240	$366
803-01	SODDING (NEW SOD)	S.Y.	450	$2.55	$3.00	$1,148	$1,350
SP-2	LANDSCAPE BUFFERS (PLANTINGS & STREET FURNITURE)	LS	1	$32,000.00	$47,000.00	$32,000	$47,000
SP-3	LAMP FIXTURES/POSTS INSTALLATION/WIRING	EACH	8	$6,000.00	$8,000.00	$48,000	$64,000
					SUB-TOTAL	$269,815	$389,456

ROUNDABOUT OPTION, UTILITY COST
Assumes no utility relocations, due to roadway width staying the same and sidewalk can be shifted around power poles as needed. A contingency for possible utility issues involving the underground drainage system is included below.

	MOBILIZATION		$17,142	$45,578

Low = $50,000 + 4.5% OF TOTAL CONST. EST. OVER $1 MILLION EXC. MOBILIZATION
High = $230,000 + 4% OF TOTAL CONST. EST. OVER $5 MILLION EXC. MOBILIZATION

	UTILITY CONTINGENCY (5% OF CONSTRUCTION COST)		$13,491	$19,473
	CONTINGENCY (15% OF CONSTRUCTION COST + UTILITY COST)		$42,496	$61,339
	TOTAL CONSTRUCTION COST		$342,943	$515,847
	PRELIMINARY ENGINEERING (10% OF TOTAL CONST. COST)		$34,294	$51,585
	TOTAL (WITHOUT INFLATION)		$377,237	$567,431
	INFLATION (6% PER YEAR OVER 5 YEARS)		$127,582	$191,905
	TOTAL COSTS ROUNDABOUT OPTION		$504,819	$759,337