

COST DATA SHEET
STATE ROUTE 2 AT SHAW FERRY ROAD

PROJECT: INTERSECTION IMPROVEMENTS AT STATE ROUTE 2 AND SHAW FERRY ROAD NEAR LENOIR CITY, LOUDON COUNTY, TENNESSEE

Right-of-Way

Land, Improvement,, and Damages (0.25 Acres).....	\$ 15,000.00
Incidentals (6 Tracts).....	\$ 15,000.00
Relocation Payments (0 Residences, 0 Businesses, 0 Non-Profits)	\$ 0.00
Total Right-of-Way Cost.....	\$ 30,000.00

Utility Relocation

Reimbursable	\$ 0.00
Non-Reimbursable.....	\$ 70,000.00
Total Utility Adjustment Cost	\$ 70,000.00

Construction

Clearing and Grubbing	\$ 15,000.00
Earthwork	\$ 30,000.00
Pavement Removal	\$ 10,000.00
Drainage (Includes Erosion Control).....	\$ 65,000.00
Structures	\$ 0.00
Railroad Crossing or Separation	\$ 0.00
Paving	\$ 215,000.00
Retaining Walls.....	\$ 0.00
Maintenance of Traffic	\$ 15,000.00
Sodding	\$ 7,000.00
Signing	\$ 3,000.00
Lighting	\$ 0.00
Signalization	\$ 90,000.00
Fence	\$ 0.00
Guardrail.....	\$ 0.00
Rip Rap or Slope Protection	\$ 0.00
Other Construction Items (8.5%)	\$ 38,000.00
Mobilization.....	\$ 25,000.00
10% Engineering & Contingencies	\$ 51,000.00

Total Construction Cost..... \$ 564,000.00

Preliminary Engineering (10%)..... \$ 56,000.00

TOTAL COST..... \$ 720,000.00

INTRODUCTION

State Route 2 (US Route 11), which runs from southwest to northeast, is one of the primary routes across the City of Lenoir City in Loudon County. One of the major intersections in town is where State Route 2 crosses State Route 73 (US Route 321). This intersection is currently signalized and carries fairly large volumes of traffic on all four approaches. From this intersection, State Route 73 connects to Interstate 75 and eventually to Interstate 40 to the west and to Fort Loudon Dam and Maryville to the east. State Route 2 connects to Farragut and Knoxville to the north and to Loudon and downtown Lenoir City to the south. Less than two miles north of this intersection, Shaw Ferry Road crosses State Route 2 at-grade. Shaw Ferry Road extends west to Town Creek Road and east to Martel Road.

Many motorists use Shaw Ferry Road to avoid the congestion at the intersection of State Route 2 and State Route 73. This pattern has become more evident with the development of a new Wal-Mart and Home Depot on State Route 73 west of State Route 2. This development, by way of other streets, does have access to Shaw Ferry Road. These connections to Shaw Ferry Road from Wal-Mart and Home Depot allows traffic to and from the north along State Route 2 to access the Wal-Mart, Home Depot, and their support developments without traveling through the congested intersection at State Route 2 and State Route 73.

The purpose of this report is to assist the Tennessee Department of Transportation in determining some solutions for traffic problems that currently occur at the intersection of State Route 2 with Shaw Ferry Road. The solutions to be considered include signalization of the intersection as well as other geometric and safety improvements to the physical intersection. A Vicinity Map is provided in Figure 1 showing the location of the study area.

EXISTING CONDITIONS

State Route 2, in the study area, is a two-lane undivided roadway with a 45 mph posted speed limit. Lane widths on State Route 2 are currently 12-feet with ditches along both sides of the roadway. Both of the State Route 2 approaches to Shaw Ferry Road feature a single lane for left-turn movements, through movements, and right-turn movements.

Shaw Ferry Road, in the study area, is a two-lane undivided roadway with a 35 mph posted speed limit. Lane widths on Shaw Ferry Road are currently 10-feet with ditches along both sides of the roadway. Both of the Shaw Ferry Road approaches to State Route 2 feature a single lane for left-turn movements, through movements, and right-turn movements.

The intersection is currently unsignalized with STOP control on the two Shaw Ferry Road approaches. Both of the State Route 2 approaches feature horizontal and

vertical curves that tend to restrict the amount of available sight distance for motorists attempting to enter or cross State Route 2 from either approach of Shaw Ferry Road. In fact, a warning sign currently exists on southbound State Route 2 approaching Shaw Ferry Road to warn the southbound traffic that vehicles may be entering the upcoming intersection. Measured sight distance along State Route 2 to the south is 750 feet from the west approach of Shaw Ferry Road and 470 feet from the east approach. Likewise, the measured sight distance along State Route 2 to the north is 450 feet from the west approach of Shaw Ferry Road and 380 feet from the east approach.

Turning movement counts were collected by Tennessee Department of Transportation personnel at this intersection on Thursday, September 2, 2004. Observation times were from 7:00 to 9:00 AM, 11:00 AM to 1:00 PM, and 2:00 to 6:00 PM. A copy of the turning movement counts is contained in Appendix A. Counts are summarized on Figures 2-5.

CAPACITY ANALYSIS: EXISTING TRAFFIC

Capacity analysis is a methodology used to assess the vehicle-carrying capabilities of roadways and intersections at various "Levels-of-Service" (LOS). The LOS ranges from ideal, ("A"), to acceptable, ("C"), to failure, ("F"). An analysis was undertaken for the existing AM and PM peak periods at the existing State Route 2 intersection with Shaw Ferry Road. These analyses use the existing traffic volumes from Appendix A. The capacity analyses performed are based on procedures outlined in the Highway

Capacity Manual, published by the Transportation Research Board, 2000. To aid in the application of these procedures, Highway Capacity Software, a microcomputer software package developed in conjunction with the Highway Capacity Manual, was used.

Capacity analysis worksheets for the existing traffic volumes are provided in Appendix B. Results of these analyses are summarized in Table 1.

Table 1. Capacity Analysis Summary: Existing Traffic

Approach	Control	Peak	Level-of-Service
Northbound State Route 2	Unsignalized	AM	A (8.2)
Southbound State Route 2	Unsignalized	AM	A (8.0)
Westbound Shaw Ferry Road	Unsignalized	AM	D (25.2)
Eastbound Shaw Ferry Road	Unsignalized	AM	D (29.9)
Northbound State Route 2	Unsignalized	PM	A (8.7)
Southbound State Route 2	Unsignalized	PM	A (8.2)
Westbound Shaw Ferry Road	Unsignalized	PM	D (32.8)
Eastbound Shaw Ferry Road	Unsignalized	PM	F (374.0)

Note: Unsignalized LOS is a measurement of average intersection delay. This delay, shown in parentheses, is measured in seconds per vehicle and is shown for each movement that must stop at the intersection.

The LOS during both the AM and PM peak periods suggest that the Shaw Ferry Road approaches experience some delay. This is particularly evident on the eastbound Shaw Ferry Road approach to State Route 2 during the PM peak period. This would indicate that some sort of improvement needs to be considered to improve the operations through this intersection. Signalization is the most likely alternative. This will be evaluated first.

SIGNAL WARRANT ANALYSIS METHODOLOGY

The analyses presented in this report will utilize existing turning movement volumes and the minimum warrant criteria provided in the current edition of the MUTCD. The evaluation of all applicable signal warrants will be included in this report.

State Route 2, in the vicinity of the Shaw Ferry Road intersection, is a two-lane highway with a posted speed limit of 45 mph. As such, the major street currently has one lane for moving traffic in each direction. In addition, the 45 mph posted speed limit will allow for a reduction to 70 percent of the minimum warrant volumes. For analysis purposes, State Route 2 is considered to be the major street. The minor street, which will be the higher volume of the two Shaw Ferry Road approaches, is also assumed to have one lane for moving traffic as both approaches are single-lane approaches.

SIGNAL WARRANT ANALYSES: EXISTING CONDITIONS

Analyses were conducted based upon the turning movement counts obtained from TDOT. Copies of these analyses are contained in Appendix C. A discussion of each of the eight signal warrants, its applicability to the data collected, and the results of each applicable signal warrant compared to the observed data is provided in the following sections.

Warrant 1, Eight-Hour Vehicular Volume

Warrant 1, Eight-Hour Vehicular Volume, is an eight-hour volume warrant where both the major and minor street volumes must exceed predetermined warrant minimums. Within Warrant 1, there is a Condition A, Minimum Vehicular Volume, and a Condition B, Interruption of Continuous Traffic. The warrant minimums are different for the two conditions. Based upon the geometric conditions that exist at this intersection, the major street minimum is 350 vehicles per hour (vph) for Condition A and 525 vph for Condition B. Meanwhile, the minor street minimum is 105 vph for Condition A and 53 vph for Condition B. Based on these criteria, all of the observed eight hours surpass the minimum requirements for the major street volumes under both conditions. Four of the observed eight hours surpass the minor street minimum requirements for Condition A. However, all of the observed eight hours surpass the minor street minimum requirements for Condition B. As such, the existing traffic through this intersection does not satisfy the requirements for Warrant 1, Condition A but does satisfy the requirements for Condition B. A copy of the signal warrant analysis for Warrant 1, is contained in Appendix C-1.

Warrant 2, Four-Hour Vehicular Volume

Warrant 2, Four-Hour Vehicular Volume, deals with high volumes occurring on both the major and minor streets during four hours of an average weekday. Observed volumes are compared with Figure 4C-2 in the MUTCD. A copy of this figure, with the volumes from each of the observed eight hours plotted (shown as filled in triangles), is contained

in Appendix C-2. From this figure, seven of the observed eight hours fall above the appropriate line on the graph (shown as circled, filled in triangles). As a result, the existing traffic volumes at this intersection meet the requirements for Warrant 2.

Warrant 3, Peak Hour

Warrant 3, Peak Hour, deals with high volumes occurring on both the major and minor streets during the peak hour of an average weekday. The observed volumes are compared with Figure 4C-4 in the MUTCD. A copy of this figure, with the volumes from all of the observed eight hours plotted (again, shown as filled in triangles), is contained in Appendix C-3. From this figure, four of the observed eight hours fall above the appropriate line on the graph (again, shown as circled, filled in triangles). As a result, the existing traffic volumes at this intersection meet the requirements for Warrant 3.

Warrant 4, Pedestrian Volume

Warrant 4, Pedestrian Volume, deals with pedestrian volumes crossing the major streets and the conflicts which are likely to occur. Pedestrian activity was not recorded during the data collection effort. As a result, the pedestrian signal warrant is not applicable to the data as collected.

Warrant 5, School Crossing

Warrant 5, School Crossing, deals with an established school crossing. The conditions which exist at this intersection exclude the existence of an established school crossing.

As a result, the requirements for Warrant 5 are not applicable at this intersection.

Warrant 6, Coordinated Signal System

Warrant 6, Coordinated Signal System, deals with the lack of platooning in the existing traffic volumes that should normally be provided in a traffic signal system. There was no effort made to sample the degree of platooning that occurs along State Route 2 during the data collection process. As a result, the requirements for Warrant 6 could not be applied to this intersection.

Warrant 7, Crash Experience

Warrant 7, Crash Experience, deals with a combination of vehicular and pedestrian minimum volumes as well as a certain number of accidents occurring within a 12-month period that would be susceptible to correction by the installation of a traffic signal. A collision diagram was prepared for the accidents occurring at the intersection. This collision diagram is provided in Appendix D. There are an insufficient number of accidents occurring within a twelve month period to satisfy the accident portion of this warrant. As a result, the requirements for Warrant 7 are not satisfied by the conditions present at this intersection.

Warrant 8, Roadway Network

Warrant 8, Roadway Network, deals with minimum entering weekday and weekend vehicular volumes and a desire to encourage concentration and organization of traffic flow networks. This warrant also deals with the intersection of two major routes. As this is not the case at this intersection, application of the requirements of this warrant to the traffic conditions at this intersection are not applicable.

CAPACITY ANALYSIS: SIGNALIZED CONDITION

Analyses were undertaken for the AM and PM peak periods under existing traffic conditions at the intersection of State Route 2 with Shaw Ferry Road. These analyses assume that the intersection will operate under traffic signal control. Capacity analysis worksheets, for the operations under traffic signal control, are provided in Appendix E. The results of the analyses are summarized in Table 2.

Table 2. Capacity Analysis Summary: Signalized Control

Intersection	Level-of-Service	
	A.M. Peak	P.M. Peak
State Route 2 @ Shaw Ferry Road	B (11.3)	B (12.0)

Note: Signalized LOS is a measurement of average intersection delay. This delay, shown in parentheses, is measured in seconds per vehicle. These LOS contain no geometric improvements to the intersection.

Signalizing this intersection results in good levels-of-service provided at the intersection under both AM and PM peak traffic volumes. Evaluations will proceed to determine if geometric improvements should be incorporated with plans to signalize the intersection.

QUEUE LENGTHS

At the time of the field visit to the intersection, observations took place during both the AM and PM peak periods. In general, queues on the Shaw Ferry Road approaches were longer during the PM peak than they were during the AM peak. In fact, queues of twelve vehicles in length were observed on the eastbound Shaw Ferry Road approach.

Shorter queues of three or four vehicles in length were observed on the westbound Shaw Ferry Road approach. Both of these lengths occurred during the PM peak.

There were almost no queues observed during the AM peak. The presence of these queues would suggest that turn lanes may be beneficial on the Shaw Ferry Road approaches.

SIGHT DISTANCE

One of the main concerns with the operation of this intersection is the amount of available sight distance in both directions along State Route 2. The alignment of State Route 2 features a combination of horizontal and vertical curvature in both directions from the Shaw Ferry Road intersection. In fact, there is a caution sign on southbound State Route 2 to warn motorists that vehicles are entering the highway. During the field

observations, sight distance measurements were recorded. These measurements are summarized in Table 3.

Table 3. Summary of Sight Distance Measurements

Movement	Sight Distance	
	Measured	Required
Eastbound Shaw Ferry Road Looking South Along SR 2	750'	555'
Eastbound Shaw Ferry Road Looking North Along SR 2	450'	555'
Southbound SR 2 Left-Turn Onto Shaw Ferry Road	750'	405'
Northbound SR 2 Left-Turn Onto Shaw Ferry Road	450'	405'
Westbound Shaw Ferry Road Looking South Along SR 2	470'	555'
Westbound Shaw Ferry Road Looking North Along SR 2	380'	555'

As this table clearly shows, there are sight distance deficiencies at this intersection. These deficiencies are experienced by traffic eastbound on Shaw Ferry Road looking to the north along State Route 2, on westbound Shaw Ferry Road looking to the south along State Route 2, and on westbound Shaw Ferry Road looking to the north along State Route 2. Because these deficiencies exist, the traffic signal installed at the intersection of State Route 2 with Shaw Ferry Road should incorporate advance warning signs on all four approaches to the intersection. Static "Signal Ahead" symbol signs are sufficient on each of the two Shaw Ferry Road approaches to State Route 2. However, the two State Route 2 intersection approaches should be equipped with active signs that warn motorists to "Prepare to Stop When Flashing."

NEED FOR LEFT-TURN LANES

The installation of left-turn lanes on State Route 2 may not be needed from a capacity standpoint. However, these lanes are needed from a safety standpoint. Without these lanes, there will be tremendous potential for rear-end collisions as through traffic queues up behind a left-turning vehicle waiting to turn left on a permitted phase. With the sight distance limitations that exist at this intersection, it is advisable to have some exclusive left-turn storage space available on the two State Route 2 approaches.

NEED FOR RIGHT-TURN LANES

Based upon existing cross-sections, there will be no right-turn deceleration lanes on any of the four intersection approaches unless such lanes are constructed. The requirements for a right-turn deceleration lane at these locations were verified using the 2003 Federal Highway Administration IHSDM Intersection Diagnostic Review Model. Utilizing the referenced procedure, and the traffic volumes from Figures 2-5, indicates that right-turn deceleration lanes are required on the southbound State Route 2 approaches to Shaw Ferry Road. This lane should be constructed with 100 feet of right-turn storage. How the right-turn lane warrants are satisfied for each approach and for each of the eight hours of data collection are summarized in Table 4.

Table 4. Summary of Right-Turn Lane Storage Requirements

Hour	NB Approach	SB Approach	EB Approach	WB Approach
7:00-8:00	No	Yes	No	No
8:00-9:00	No	No	No	No
11:00-12:00	No	No	No	No
12:00-1:00	No	No	No	No
2:00-3:00	No	Yes	No	No
3:00-4:00	No	Yes	No	No
4:00-5:00	No	Yes	No	No
5:00-6:00	No	Yes	No	No

IMPLEMENTATION OF RECOMMENDED IMPROVEMENTS

The construction of exclusive left-turn lanes is recommended on all four intersection approaches, and an exclusive right-turn lane is recommended for the southbound approach. In addition, the installation of a traffic signal is also recommended. The storage length required in each lane was determined based upon the 95th percentile queuing that is expected to occur. Left-turn storage lengths are 75-feet on eastbound Shaw Ferry Road, 100-feet on westbound Shaw Ferry Road, 175-feet on northbound State Route 2, and 200-feet on southbound State Route 2. Right-turn storage lengths are 200-feet on southbound State Route 2. 12-foot lane widths are recommended for both State Route 2 left-turn lanes and for the State Route 2 right-turn lane. Meanwhile, 11-foot lane widths are recommended for both Shaw Ferry Road left-turn lanes.

Transition lengths should be 270-feet on both of State Route 2 left-turn lanes, 120-feet on the State Route 2 right-turn lane, and 120-feet on both of the Shaw Ferry Road left-turn lanes. In conjunction with the traffic signal to be installed at the intersection, "Stop Ahead" signs are recommended for the two Shaw Ferry Road approaches. Meanwhile,

"Prepare to Stop When Flashing" signs are recommended for the two State Route 2 approaches. A copy of the conceptual plan for these improvements is provided on Figure 6.

OTHER NEEDED IMPROVEMENTS

Sight distance availability is limited at this intersection. This is particularly true to the north along State Route 2. During the preparation of this report, the prospects for improvements to increase the amount of available sight distance in this direction were explored. However, the location of the sight distance limitation generally falls outside the limits of the proposed construction. As such, it would be necessary to rebuild a portion of State Route 2 that would not otherwise be located within the limit of construction. Therefore, it was decided that the potential for roadway improvements to improve this sight distance should be dismissed as cost prohibitive in terms of the limits of this study.

The eastbound approach of Shaw Ferry Road to the intersection features some rather complex vertical alignment. There currently exists a dip and a hump in the roadway prior to reaching the intersection. This should be corrected with the construction that will occur at the intersection.

ENVIRONMENTAL CONSIDERATIONS

While detailed environmental technical studies were not prepared for this project, preliminary investigations were conducted to identify environmentally sensitive areas for historic, archaeological, ecological, and hazard material considerations. The initial field review did not reveal any environmentally sensitive areas that needed unusual historic, archaeological, ecological, or hazardous material considerations.

COSTS ASSOCIATED WITH CONSTRUCTION

There will be construction costs and right-of-way costs associated with the construction of the recommended improvements at this intersection. These costs have been calculated using a procedure adopted for use in standard Advance Planning Reports. A copy of the estimated costs is provided in Appendix F.

RECOMMENDATIONS

The construction of exclusive left-turn lanes is recommended on all four intersection approaches as well as an exclusive right-turn lane on the southbound approach. Storage lengths will be 75-feet and 100-feet for the eastbound and westbound Shaw Ferry Road left-turn lanes, respectively. Meanwhile, storage lengths will be 175-feet and 200-feet for the northbound and southbound State Route 2 left-turn lanes, respectively. Finally, the southbound right-turn lane on State Route 2 should include 200-feet of storage. 12-foot lane widths are recommended for the new State Route 2 lanes. Meanwhile, 11-foot lane widths are recommended for the new Shaw Ferry Road

lanes. Transition lengths should be 270-feet for both of the State Route 2 left-turn lanes, 120-feet for the State Route 2 right-turn lane, and 120-feet for both of the Shaw Ferry Road left-turn lanes. There will likely be some right-of-way required along the two Shaw Ferry Road approaches to accommodate these new lanes. However, sufficient right-of-way should exist along State Route 2. To minimize the right-of-way to be taken, curb and gutter will be installed rather than ditches.

In conjunction with the left-turn lanes, a traffic signal should be installed at the intersection. This traffic signal installation should include "Stop Ahead" signs on both of the Shaw Ferry Road approaches and "Prepare to Stop When Flashing" signs on both of the State Route 2 approaches.