Traffic Analysis

FOR:

3 Tees, LLC

Horse Creek Quarry

Commercial Entrance

LOCATED ON:

3725 Sullivan Gardens Parkway

SULLIVAN COUNTY, TENNESSEE

DESIGNED BY:

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March 23, 2024

Executive Summary

A commercial entrance has been designed for the proposed quarry at 3725 Sullivan Gardens Parkway, Kingsport Tennessee in accordance with American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design of Highways and Streets (Green Book) based on site conditions and a traffic analysis. No deceleration or acceleration lanes are proposed. Entrance shall accommodate WB-62 type trucks.

Proposed Location

The proposed location is at 3725 Sullivan Gardens Parkway (Route 93) between Regional Park Drive and Rock Springs Road. This entrance is approximately 1.8 miles South of Interstate 26. The purpose of this entrance is to provide access to the proposed 3 Tees, LLC Horse Creek Quarry.

Topography

Route 93 is an undivided five (5) lane Principal Urban Arterial Route, with a continuous center turn lane. The new commercial entrance will be a two (2) lane entrance leading into a rock quarry. The surrounding land use is primarily a combination of residential and farmland. In the vicinity of the proposed entrance, the Route 93 profile is nearly level, with no grades over 1% or crests or sags from vertical curves.

Site Drainage

There are no drainage structures within TDOT R.O.W. The entrance will be graded to direct the drainage away from Route 93. Therefore, the post development run-off on TDOT R.O.W. is less than or equal to the pre-development run-off.

Sight Distance

As noted above in the Topography Section, Route 93 is an undivided 5-lane highway, with a dedicated turn lane. In the location of the proposed entrance the road is nearly level and straight with no sags or crests. The sight distances were measured in accordance with the AASHTO criteria for eye level height, object height, and measuring location. All aspects of sight distance at this location are well within the design criteria of the AASHTO Manual. The sight distances are summarized in the table below:

Aspect	Speed Limit	Grade	Sight Distance	Min. Req'd
Stopping Westbound	45 mph	0.4 % up	>1,000 ft	360 ft
Stopping Eastbound	45 mph	0.0 %	580 ft	360ft
Left	45 mph	0.0 %	580 ft	565 ft
Right	45 mph	0.4 % down	>1,000 ft	600 ft

The entrance is designed to accommodate WB-62 trucks; however, the majority of vehicles on Route 92 are passenger vehicles that must react to vehicles using the entrance. Therefore, minimum requirements are for passenger vehicles.

Vehicle Volume

Vehicle volumes for this section of Route 93 were acquired from 2023 Tennessee Department of Transportation (TDOT) Traffic Count Database System (TCDS). TDOT continuously collects traffic information on Tennessee's roadways as part of the Department's responsibility to monitor, collect, analyze, manage, and disseminate transportation data. Traffic data includes volume counts, vehicle classification counts, and speed data (see attached Appendix B). Annual Average Daily Traffic (AADT) volume is used throughout the Long-Range Planning process. TDOT collects Average Daily Traffic (ADT), which is based on a 24-hour count. This information is transformed in AADT by using the raw traffic data, which is statistically corrected by a seasonal variation factor that considers time of year and day of the week, as well as adjustments for vehicle type, determined by seasonal and axle correction factors. The peak hour volume (PHV) was determined as follows: (AADT) x (K) x (Direction Factor); where, K is a factor is based on the 30th highest hour of the year and is used to compute design hour volumes. Directional factors (D-factor) are measures of the peak hour directionality. They are based on the average weekday peak hour.

PHV = (13,614) x (0.10) x (0.59) = 803 vpd ÷ 8 hrs ≈ 100 vehicles per hour.

This value was used for traffic in both directions as worst case scenario for designing the entrance.

Vehicular Speeds

The Posted Speed Limit at this location on Route 93 is 45 MPH.

Types of Vehicles

The type of vehicle used for the worst case design would be a WB-62 Truck.

Entrance Geometry

The entrance has been designed to accommodate the WB-62 Truck. This is an Interstate Semi type truck. This is not the typical truck in and out of a quarry but would be an infrequent basis such as special shipment or delivery. The entrance design is a 3 centered compound curve, with radii of 200 ft, 50 ft, and 600 ft. from the AASHTO Design Manual. This design ensures that the path of the outer front wheel and the inner rear wheel of the vehicle are maintained in the designated paved lane.

Pedestrian Movements

No crosswalks are present at the proposed entrance location. Due to the nature of the entrance, few pedestrians are anticipated.

Trip Generation

The traffic generation of the proposed entrance was determined by assuming production/sales = 200,000 tpy or 770 tpd and 20 tons per truck; 770/20=39 trucks per day + employees, salesmans, etc. say 55 vpd. A maximum of 55 vehicles per day was determined. A total of 22 vehicles per peak hour were determined by the following: If all truck drivers and quarry employees were to arrive at the same time for work that day as well as any additional deliveries that may come in for that day, then that should be a maximum of 40% of the total daily vehicle trips; thus, (0.4) x (55) = 22. Table 2 summarizes the estimated peak hour generation based on the proposed development.

Since 22 vph is the peak amount, and Interstate 26 is 1.8 miles north and Interstate 81 is 6.6 miles south, it is assumed that there are 80% of vehicles turning left into site and 20% turning right into site. Similarly, egress traffic will be 80% right turn onto 93 and 20% left onto 93.

Table 2
Trip Generation Volumes for
the Proposed Entrance

Parking Spaces	Ample Parking	
Period	Entering	Exiting
Peak	22	22
Daily Total	55	55

Highway 93, being a 5-lane undivided highway with a dedicated continuous center turn lane, no improvements will be necessary for traffic turning left into the quarry. As noted above, an estimated 20% of the traffic volume will turn right into the quarry. At the peak volume this would be 5 vph (20% of 22). According to AASHTO Design Manual, no left turn lanes or tapers are required (see attached Appendix). The entrance is proposed to be constructed to provide adequate site distance in both directions (+500 left and +1000 right).

Conclusion

The proposed commercial entrance will have a use of 55 vpd and have a peak hour volume of 22 vph, and will not require a right or left turn lane. There is adequate sight distance in both directions and an entrance geometry is proposed for larger trucks than will use the entrance.

PREPARED BY: Stephen E. Maxfield, P. E.
March 23, 2024

Record 1 of 1 Goto Record go

Location ID	82000102	**MPO ID**	
Type	SPOT	**HPMS ID**	
On NHS	Yes	**On HPMS**	
LRS ID	82SR093001	**LRS Loc Pt.**	5.961
SF Group	Urban Principal Arterial	**Route Type**	
AF Group	Region 1 Urban Other Principal Arterial	**Route**	
GF Group	Sullivan	**Active**	Yes
Class Dist Grp	Region 1 Urban Other Principal Arterial	**Category**	CC
Seas Clss Grp			
WIM Group			
QC Group	Default		
Fnct'l Class	Other Principal Arterial	**Milepost**	
Located On	SR093		
Loc On Alias	SULLIVAN GARDENS PKWY.		
	S OF KINGSPORT		

More Detail

STATION DATA

Directions: 2-WAY NB SB

AADT

	Year	AADT	DHV-30	K %	D %	PA	BC	Src
	2023	13,614[12]		10	59	12,919 (95%)	695 (5%)	
	2022	12,822[7]		10	59	12,193 (95%)	629 (5%)	
	2021	13,034	1,345	10	59	12,292 (94%)	742 (6%)	
	2020	12,057	1,246	10	56	10,995 (91%)	1,062 (9%)	
	2019	12,898		11	56			

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Travel Demand Model

	Model Year	Model AADT	AM PHV	AM PPV	MD PHV	MD PPV	PM PHV	PM PPV	NT PHV	NT PPV

Stopping Sight Distance

Stopping sight distances exceeding those shown in the table below should be used as basis for design wherever practical.

In computing and measuring stopping sight distances, the height of the driverõs eye is estimated to be 3.5 feet and the height of the object to be seen by the driver is 2 feet, equivalent to the taillight height of a passenger car. The ñK Valuesò shown are a coefficient by which the algebraic difference in grade may be multiplied to determine the length in feet of the vertical curve that will provide minimum sight distance. Crest vertical curves shall meet or exceed AASHTO design criteria for Stopping Sight Distance, not the "k" Values. Sag vertical curves shall meet or exceed the AASHTO design criteria for headlight sight distance and "k" Values.

Height of Eye 3.5’											**Height of Object 2’**
Design Speed (mph) **	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
MIN. SIGHT DISTANCE (FT.)	155	200	250	305	360	425	495	570	645	730	820
MINIMUM K VALUE FOR:											
CREST VERTICAL CURVES	12	19	29	44	61	84	114	151	193	247	312
SAG VERTICAL CURVES	26	37	49	64	79	96	115	136	157	181	206

Source: 2011 AASHTO Green Book, Chapter 3, Section 3.2.2[*], page 3-4

TABLE 2-5 STOPPING SIGHT DISTANCE

When a highway is on a grade, the sight distances in the table below shall be used.

Design Speed (mph) **	**Stopping Sight Distance on Grades**					
	Downgrades			**Upgrades**		
	3%	**6%**	**9%**	**3%**	**6%**	**9%**
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561
70	771	825	891	690	658	631
75	866	927	1003	772	736	704

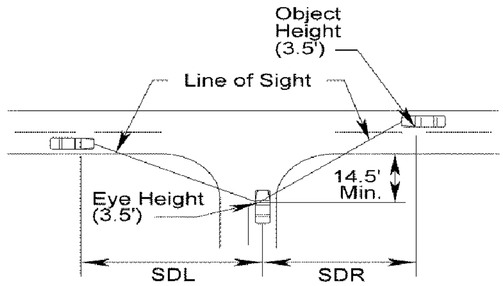
TABLE 2-6 STOPPING SIGHT DISTANCE ON GRADES

(See 2011 AASHTO Green Book, Chapter 3, Section 3.2.2, page 3-5)

[*] Rev. 1/14

Intersection Sight Distance

The following table shows intersection sight distance requirements for various speeds along major roads:



SDR = Sight Distance Right (For a vehicle making a left turn)
SDL = Sight Distance Left (For a vehicle making a right or left turn)

Height of Eye 3.5'											**Height of Object 3.5'**
Design Speed (mph)**		**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**
SDL=SDR: 2 Lane Major Road		225	280	335	390	445	500	555	610	665	720	775
SDR: 4 Lane Major Road (Undivided) or 3 Lane		250	315	375	440	500	565	625	690	750	815	875
SDL: 4 Lane Major Road (Undivided) or 3 Lane		240	295	355	415	475	530	590	650	710	765	825
SDR: 4 Lane Major Road (Divided ï 18ôMedian)		275	340	410	480	545	615	680	750	820	885	955
SDL: 4 Lane Major Road (Divided ï 18ôMedian)		240	295	355	415	475	530	590	650	710	765	825
SDR: 5 Lane Major Road (continuous two-way turn-lane)	**In Feet**	265	335	400	465	530	600	665	730	800	860	930
SDL: 5 Lane Major Road (continuous two-way turn-lane)		250	315	375	440	500	565	625	690	750	815	875
SDR: 6 Lane Major Road (Divided ï 18ôMedian)		290	360	430	505	575	645	720	790	860	935	1005
SDL: 6 Lane Major Road (Divided ï 18ôMedian)		250	315	375	440	500	565	625	690	750	815	875
SDL: (Where left turns are physically restricted)		210	260	310	365	415	465	515	566	620	670	725

TABLE 2-7 INTERSECTION SIGHT DISTANCE

Source: AASHTO Green Book, Chapter 9, Section 9.5.3, page 9-37 thru 9-52, * Table 9-5 thru 9-14

**For all tables, use design speed if available, if not use legal speed.

* Rev. 1/14

Warrants for Left Turn Storage Lanes on Two-Lane Highways

Advancing volume and opposing volumes (VPH), speed and percent left turns are used to determine whether a left turn storage lane is warranted on two-lane highways.

The warrants in table below are taken from the 2011 AASHTO Green Book, Chapter 9, Section 9.7.3, Page 9-132, Table 9-23. They were derived from Highway Research Report No. 211, Figures 2 through 19, for required storage length determinations.

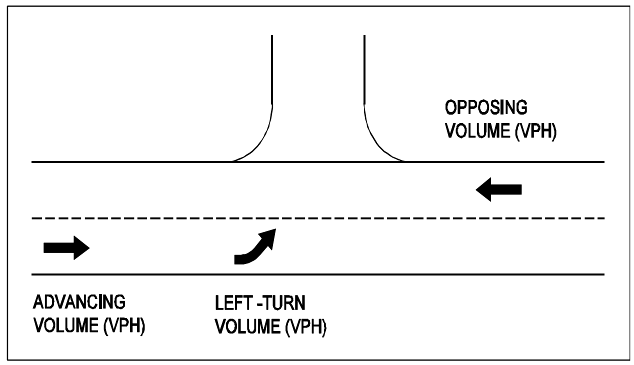
WARRANTS FOR LEFT TURN LANES ON TWO-LANE HIGHWAYS

VPH OPPOSING VOLUME	ADVANCING VOLUME			
	5% LEFT TURNS	10% LEFT TURNS	20% LEFT TURNS	30% LEFT TURNS
	40-MPH DESIGN SPEED*			
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	515	390	340
	50-MPH DESIGN SPEED*			
800	280	210	165	135
600	350	280	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
	60-MPH DESIGN SPEED*			
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

TABLE 3-1

Source: Adapted from 2011 AASHTO Green Book, Chapter 9, Section 9.7.3, Page 9-132, Table 9-23

* USE DESIGN SPEED IF AVAILABLE, IF NOT USE LEGAL SPEED LIMIT.*



Example:

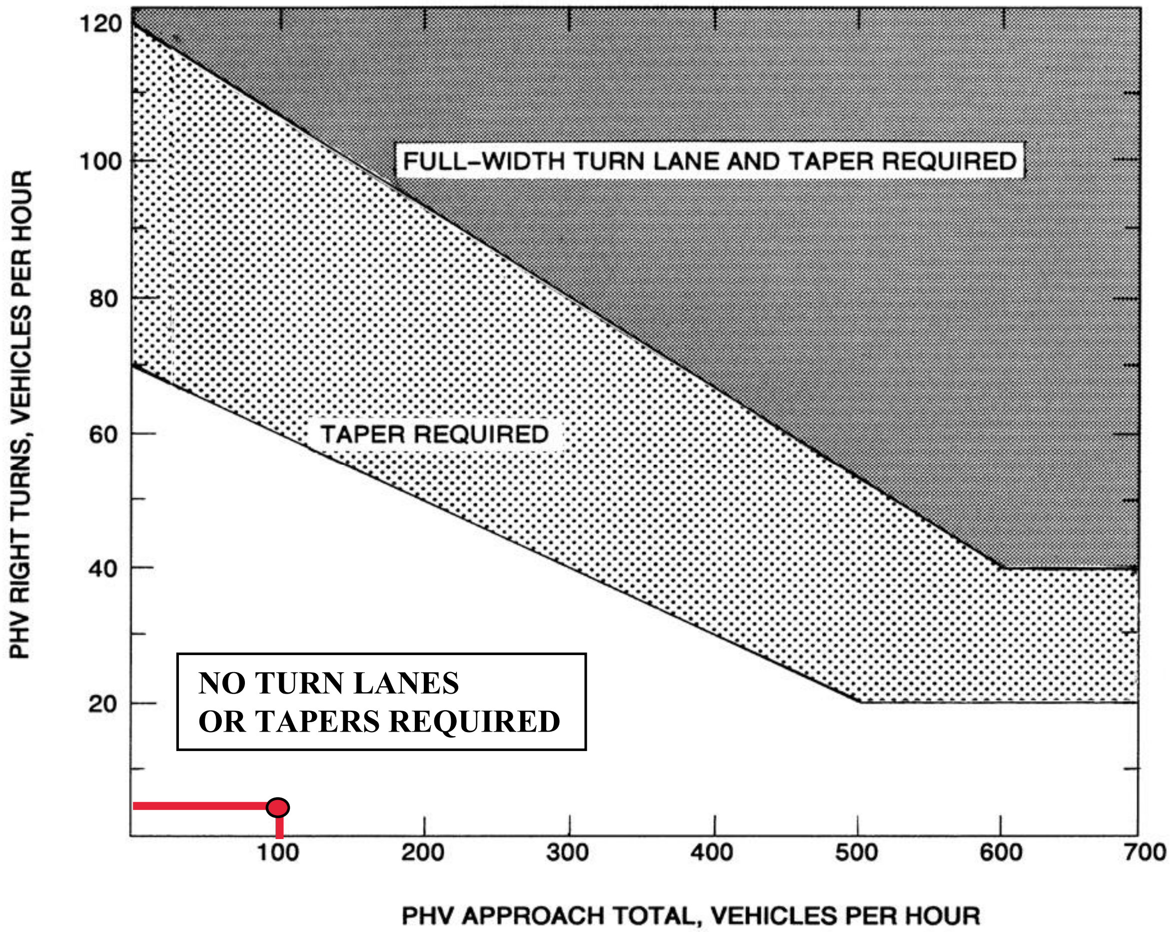
Two-lane highway with 40-MPH operating speed

Opposing Volume (VPH) - 600
Advancing Volume (VPH) - 440
Left-Turn Volume (VPH) - 44 or 10% of Advancing Volume

With opposing volume (VPH) of 600 and 10% of advancing volume (VPH) making left turns, and advancing volume (VPH) of 305 or more will warrant a left-turn lane.

When the Average Running Speed on an existing facility is available, the corresponding Design Speed may be obtained from Appendix A, Section A-1.

* Rev. 7/14



Appropriate Radius required at all Intersections and Entrances (Commercial or Private).

LEGEND

PHV - Peak Hour Volume (also Design Hourly Volume equivalent)

Adjustment for Right Turns

For posted speeds at or under 45 mph, PHV right turns > 40, and PHV total < 300.
Adjusted right turns = PHV Right Turns - 20
If PHV is not known use formula: PHV = ADT x K x D

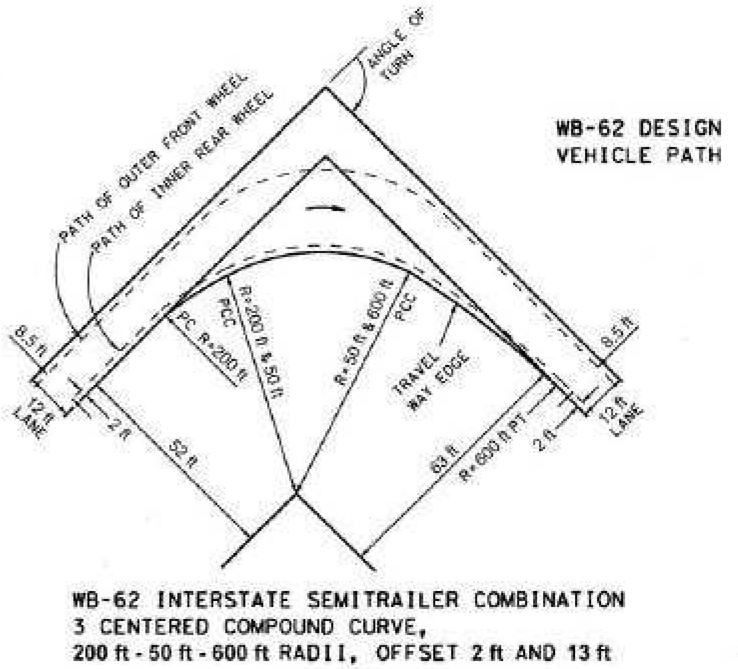
K = the percent of AADT occurring in the peak hour
D = the percent of traffic in the peak direction of flow

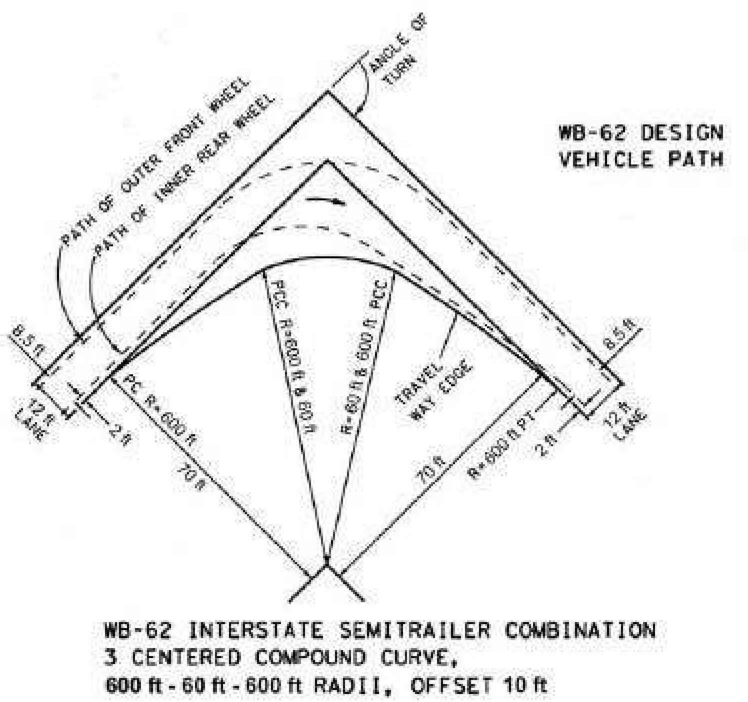
Note: An average of 11% for K x D will suffice.

When right turn facilities are warranted, see Figure 3-1 for design criteria.*

FIGURE 3-26 WARRANTS FOR RIGHT TURN TREATMENT (2-LANE HIGHWAY)

* Rev. 1/15





US Customary

Exhibit 9-26. Minimum Edge-of-Traveled-Way Designs (WB-19 [WB-62] Design Vehicle Path) (Continued)