# Intersection Analysis Report

## SR 60 Grade Separation over CSX Railroad

**Polk County**
**Financial Project No. 436559-1-52-01**
**Federal Aid No. N/A**

**Prepared For:**

Centennial FDOT 1915 ★ 2015

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**December 2015**

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12/1/15

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## Introduction

The purpose of this report is to review median openings and driveways that are affected by the improvement and present recommendations for access considering the proposed SR 60 grade separation over the CSX railroad, west of Lake Wales, in Polk County Florida.

## Existing Conditions

Currently, SR 60 is a four-lane divided roadway with a posted speed of 65 mph and a 40 foot depressed grass median. This roadway segment is Access Class Three with a minimum spacing of 1320 feet for directional and 2640 feet for full median openings, respectively. Driveway spacing is 660 feet on SR 60 with at least one driveway per property owner. SR 60 intersects CSX railroad at grade crossing 625419-N at roadway milepost 25.544 and railroad milepost SX 834.53, approximately four miles west of Lake Wales. There are existing median openings and driveway access points within the limits of the proposed grade separation which currently provide access to a residence, a utility company and several businesses. Many of these facilities use large trucks in their operations. The existing median openings and turn lanes are as follows:

- Location 1 – Full Median Opening (Station 2370+00)
  - No turn lanes or driveways
- Location 2 – Full Median Opening/Driveway to the Duke Energy Substation (Station 2391+50)
  - No turn lanes (200 feet into eastbound right turn lane for C Baker)
  - 2150 feet east of median opening location 1
- Location 3 – Full Median Opening/Driveway to C Baker (Station 2396+50)
  - 660 foot eastbound right turn lane
  - 250 foot westbound left turn lane
  - 500 feet east of median opening location 2
- Location 4 – Full Median Opening (2405+00)
  - No turn lanes or driveways

    - 850 feet east of median opening location 3
- Location 5 & 6 – Full Median Opening/Driveway to Petersen Properties/Industrial Paper (Station 2419+00)
    - 620 foot eastbound left turn lane, 580 foot eastbound right turn lane
    - 650 foot westbound left turn lane, 500 foot westbound right turn lane
    - 1400 feet east of median opening location 4
- Location 7 – Full Median Opening (Station 2427+00)
    - No turn lanes, driveway on the south side from International Paper
    - 800 feet east of median opening location 5&6

The only median opening that almost meets spacing criteria is median opening location 1, all others are substantially non-compliant.

## Project Improvements

The existing at-grade crossing will be removed and SR 60 will be elevated over the CSX railroad. The improvements will also include new bridges over the Peace Creek Drainage Canal and new bridges west of the CSX railroad crossing over the Kinder Morgan fuel line which doubles as frontage road access.  Frontage roads will be provided in the northwest, southwest and northeast quadrants to restore access to the properties disconnected from grade separating SR 60.

## Adjacent Land Use

There are numerous properties within the project limits that have frontage on SR 60 as shown in Appendix A. These properties consist of a mix of undeveloped agricultural land, commercial businesses and a utility substation. The CSX railroad, which bisects the project, creates four distinct quadrants of property owners. A summary of the properties fronting SR 60 by quadrant with their associated land use and acreage is as follows:

Northwest:

- Jim Venrick – Pasture, three parcels, 83.47 acres total
- Joe Nations – Vacant, commercial, power and fuel line easements, billboard, 2.05 acres
- Duke Energy – Power line, 8.15 acres

Southwest:

- Nora Venrick – Pasture, 182.04 acres
- Robert Stokes – Pasture, narrow strip with fuel line easement, 112.38 acres
- C. Baker – Wholesale distribution terminal, 24.8 acres
- Duke Energy – Electrical Substation, two parcels, 16.43 acres total

Northeast:

- Ann Combee – Vacant, commercial, 0.36 acre
- Bruce Combee – Duplex, 1.17 acres
- Bruce Combee – Vacant, Residential, 1.44 acres
- Peterson Properties – Commercial with Citrus, 45.44 acres

Southeast:

- International Paper – Light manufacturing, 50.94 acres

## Data Collection

Hourly traffic volume data was collected for seven locations consisting of four full median openings without driveways and three full median openings with commercial driveways. The counts collected included left and right turns entering and exiting driveways to SR 60 and U-turns at the median openings. The traffic count data was separated by passenger vehicles and trucks. The count data was collected for eight total hours on July 8, 2015 from 6:00 am to 9:00 am, 11:00 am to 1:00 pm and 3:00 pm to 6:00 pm. The time periods selected for data collection were based on the operating hours of the local businesses. No pedestrians or bicycles were observed during the eight hours counted. The driveway/median opening traffic count data is provided in **Appendix B**.

## Traffic Projections

A growth rate was developed using historical traffic counts on SR 60 to determine the 2040 design year traffic volumes. The computed rate from the FDOT Traffic Data Memorandum was 0.6%, which was rounded up to 1% for purposes of this report. The eight-hour turning movement counts were used to compute the hourly turning movement volumes which were factored using the 1% growth rate for the design year 2040 to evaluate the queue lengths and the need for right turn lanes. The projected 2040 driveway/median traffic turning movements are provided in **Appendix C**.

## Median Opening / Driveway Review

The following is a review and discussion of each of the driveway and median openings that are affected.

The traffic counts collected at the **median opening at Sta. 2370+00** were zero for the entire 8-hour count period.

The traffic count collected at the **Duke Energy Substation Driveway** (Sta. 2391+50 Rt.) was one truck. This trip into the site was a service truck for maintenance. Conversations with Duke Energy indicate that low boy type trucks are used periodically for deliveries to the substation.

The traffic counts collected at the **C&J Driveway** (Sta. 2396+50 Rt.) were nine cars and three trucks. This recycling business had very little activity, but has the potential to service more vehicles when this site is functioning at full capacity.

The traffic counts collected at the **median opening at Sta. 2405+00** were zero for the entire 8-hour count period.

The traffic counts collected at the **International Paper Driveway** (Sta. 2419+00 Rt.) were zero for the entire 8-hour count period. This site is currently unused, but has the potential to service more vehicles when in business. The site includes 70 passenger car parking spaces for employees/visitors and ten truck loading docks which is an indication of the site's potential activity.

The traffic counts collected at the **Petersen Industries Driveway** (Sta. 2419+00 Lt.) were 128 cars and 16 trucks. This was the most active site within the project limits. Most of the traffic originates from and returns to the east towards Lake Wales.

The traffic counts collected at the **median opening at Sta. 2427+00** were zero for the entire 8-hour count period.

Other minor grass driveways exist within the project limits and did not have any vehicle activity.

## Frontage Roads

Access to the existing businesses, utilities, residential owners, and undeveloped properties will be eliminated with the grade separation of SR 60 over the CSX railroad. Frontage roads are proposed to restore access to these properties in three of the four quadrants.

In the southwest quadrant, a two lane frontage road is proposed to provide access to the Duke Energy substation and the C&J recycling business. Large trucks are anticipated to use this frontage with the potential for the C&J site to operate at full capacity, justifying two way, two lane access. This will be accomplished by adding a new frontage terminal and median opening approximately 500 feet east of existing median location 1. The new terminal will connect to existing eastbound SR 60 which will be converted to a two way, two lane roadway for use as the frontage road.

In the northwest quadrant, a new two lane frontage road is proposed to provide access to the property owned by Jim Venrick, Joe Nations, Duke Energy and the Duke Energy and Kinder Morgan utility easements. This frontage road is relatively short and anticipated to require large truck access with large turning radii justifying the two way, two lane access. This frontage road will be connected to the frontage road in the southwest quadrant by new SR 60 bridges that have a dual purpose of providing two way, two lane access and also spanning the Kinder Morgan fuel line. Future development is not expected in this quadrant due to the multiple power line and fuel line easements.

The southeast quadrant is encompassed entirely by the International Paper property. The existing primary driveway is located at median opening location 5&6 and is proposed to remain. A second driveway exists approximately 800 feet east of the primary driveway and connects to a path that leads to the east end of their parking lot. This driveway appears to have been used as a shortcut by employees. All existing access to SR 60 from this parcel will remain.

In the northeast quadrant, Petersen Industries is the primary business property and the driveway to this site is opposite the International Paper driveway at median opening location 5&6. West of the Petersen property are three parcels which consist of vacant residential, duplex, and vacant commercial. The duplex is the only property of the three that currently generates vehicular traffic. The vacant commercial property is adjacent to the CSX railroad and has little potential for development due to its size. It does however have a 27.5 foot connection to a large abutting parcel to the north with common ownership. Of the three quadrants that require a frontage road, this quadrant has the largest potential for future development which led to reviewing three different options:

- One lane frontage road along all parcels
- Combination two lanes through the Peterson property, then one lane to the west
- Full two lane frontage road along all parcels

The total frontage road length is 1750 feet which consists of 1200 feet fronting the Petersen property and 550 feet fronting the remaining three parcels. A one lane frontage road will serve the existing property and will limit the development potential in the future, eliminating the one lane option from consideration. For the combination option, all parcels other than Petersen, are owned by what appears to be family members based on the owners last name, meaning they have the potential to be combined in the future to form a much larger parcel. If this were to happen, extending a two lane frontage to the east end of these parcels would provide adequate access abutting the Petersen property. The full two lane option eliminates all speculation on what future development may occur and provides access under all circumstances. An additional 550 feet of frontage road compared to the combination option is minor. It is recommended to provide a full two lane frontage road to extend to the western most parcel. A new frontage road terminal will be located at the current median opening location 5&6.

The turning movements and return radii for all frontage roads will be designed to accommodate WB-62FL trucks.

## Median Openings

Three of the six median openings will be closed due to the addition of the grade separation. The disposition of each of the median openings/driveways is provided below:

- Location 1 – Full Median Opening (Station 2370+00)
  - **Close median opening due to spacing (500 feet) to the new west frontage road terminal median opening, no abutting driveways, and absence of traffic volume**
- Location 1A – New Full Median Opening (Station 2375+00)
  - **New median opening for the west frontage road terminal serving the southwest quadrant**
- Location 2 – Full Median Opening/Driveway to Power Substation (Station 2391+50)
  - **Close median opening due to grade separation**
  - **Provide access via southwest/northwest frontage roads**
- Location 3 – Full Median Opening/Driveway to C Baker (Station 2396+50)
  - **Close median opening due to grade separation**
  - **Provide access via southwest frontage road**
- Location 4 – Full Median Opening (2405+00)
  - **Close median opening due to grade separation**
- Location 5& 6 – Full Median Opening/Driveway to Petersen/Industrial Paper (Station 2419+00)
  - **Maintain existing full median opening**
  - **Provide right and left turn lanes eastbound and westbound**
- Location 7 – Full Median Opening (Station 2427+00)
  - **Close median opening due to spacing (800 feet) to the new east frontage road terminal/median opening location 5&6 and absence of traffic volume**

## Turn Lanes

There are existing right and left turn lanes at the median openings serving the major business driveways. Right and left turn lanes will be provided at both the east and west frontage road terminals to provide full access. From FDOT index 301, we extrapolated the turn lane total deceleration length from 70 mph, which is 515 feet plus queue length. For the right turn lanes, queue length is not included since the right turn movement is a free flow condition.

For the left turn lanes, the queue length for an unsignalized intersection is calculated considering the criteria suggested in the Florida Intersection Design Guide. Section 3.12.2 of this guide states that the storage length may be based on the number of turning vehicles likely to arrive in an average two-minute period within the peak hour. Space for at least two passenger cars should be provided. With over 10% truck traffic, provisions should be made for at least one car and one truck (WB-62FL). Overall turning traffic volumes were low and after projecting these to future 2040 traffic volumes, and rounding up, there is only one car and one truck expected within a two minute peak period. The turn lane queue lengths at the frontage road terminals are calculated as follows:

- Westbound Left turn queue length = 1 car (25’) + 1 truck (75’) = 100’ storage
- Eastbound Left turn queue length = 1 car (25’) + 1 truck (75’) = 100’ storage

This results in the following total turn lane lengths:

- Right turn lanes = 515’ clearance and braking + 0’ queue storage = 515’ total length
- Left turn Lanes = 515’ clearance and braking + 100’ queue storage = 615’ total length

Left turn lanes will be provided on both sides of the frontage road terminal median openings to accommodate U-turns.

The calculated turn lane lengths of 515’ and 615’ specified above are similar to the existing turn lane lengths which range from 500’ to 660’. The new turn lane lengths have been designed to accommodate trucks travelling at a speed of up to 70 mph to safely decelerate within the turn lane and access the new frontage road. Additionally, the frontage road access will be designed with radii to accommodate large trucks, WB-62FL.

## Acceleration Lanes

The SR 60 crossing of the CSX railroad will have a 2400 foot crest vertical curve and 3% approach tangents. The length of the approach tangents are approximately 400 feet west of the CSX railroad and 200 feet east. Acceleration lanes were evaluated to determine if they would be appropriate to assist trucks entering SR 60 from the frontage road terminals. There are two instances where acceleration lanes could be considered. The first would be due to the inability to accelerate to a reasonable operating speed on a grade and the second due to inadequate intersection sight distance. For accelerating to a reasonable operating speed, AASHTO Figure 3-25 was used to determine the speed that trucks will attain traveling uphill on a 3% tangent grade. The distance from the east frontage road terminal to the top of the overpass is 1800 feet and 2570 feet from the west frontage road terminal. In AASHTO **Figure 3-25**, trucks traveling up the 3% tangent grade will attain an approximate speed of 32 mph westbound and 33 mph eastbound.

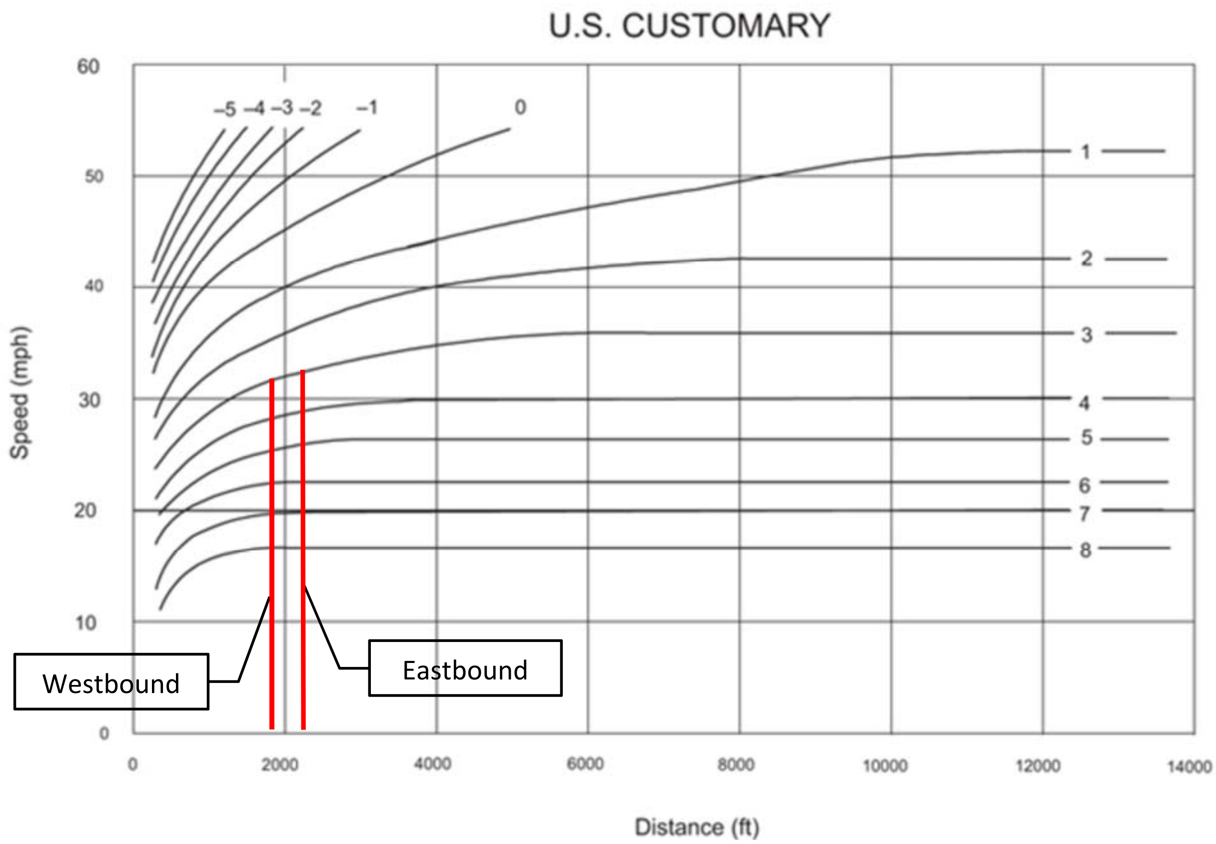



*Figure 3-25 Speed-Distance Curves for Acceleration of a Typical Heavy Truck of 120 kg/kW [200 lb/hp] on Upgrades*

For level terrain (0% grade), the truck speeds are approximately 45 mph after 1800 feet which is only a 12-13 mph difference when compared to a 3% grade. Both of these speeds are lower than the design speed. The 3% tangent grade varies from 200 to 400 feet and then begins to flatten to a 0% grade at the top of the crest vertical curve. Most other references in the AASHTO manual for similar technical areas do not factor criteria either up or down until grades exceed 3%. The traffic volumes are on the low end of the normal range for the 2040 design year. We do not recommend adding acceleration lanes for attaining operating speeds based on the short distance that trucks would be traveling on a 3% grade, the lower traffic volumes, and the minor differences in speeds reached compared to level terrain.

We evaluated intersection sight distance at both frontage road terminals. The worst case is Case B1 from AASHTO Section 9.5, Intersection Sight Distance, which is making a left turn from the minor road (frontage road) onto SR 60. The formula provided to compute intersection sight distance includes variables for design speed and time gap. For Case B1, the time gap variable represents the time for the minor road vehicle to accelerate from a stop and complete a left turn without unduly interfering with major-road traffic operations together with the time to cross the travel lanes and median. The median opening width can accommodate a WB-62FL truck, however it is assumed that the truck would cross the median in one movement to be conservative. The intersection sight distance was computed as 1650 feet as measured from a 14.5 feet offset from the SR 60 edge of pavement to the middle of the inside lane on SR 60. No adjustment to the sight distance lengths are required for grades less than or equal to 3%.

Additionally, the passenger car driver's eye height is 3.5 feet and 7.6 feet for trucks. The only obstruction in the sight triangle is barrier wall that is 2.7 feet high, with an effective height of 2.0 feet to the driver because it is at the edge of the shoulder, leaving a minimum of two feet clear. The computed sight distance length is less than the 1800 feet to the crest vertical curve and, consequently, does not require acceleration lanes. The intersection sight distance calculations are provided in **Appendix D.**

A "trucks entering highway ahead" sign will be added to inform drivers of the potential for truck activity.

## Conclusion

SR 60 is a four-lane divided roadway that includes an at-grade CSX railroad crossing four miles west of Lake Wales. SR 60 will be grade separated over the CSX railroad to eliminate the at-grade railroad crossing. Two way, two lane frontage roads will be provided in the northwest, southwest, and northeast quadrants. All existing median openings will be closed except for the current Petersen Enterprises/International Paper full opening which will become the east frontage road terminal median opening. A new median opening will be added for the west frontage road terminal intersection.

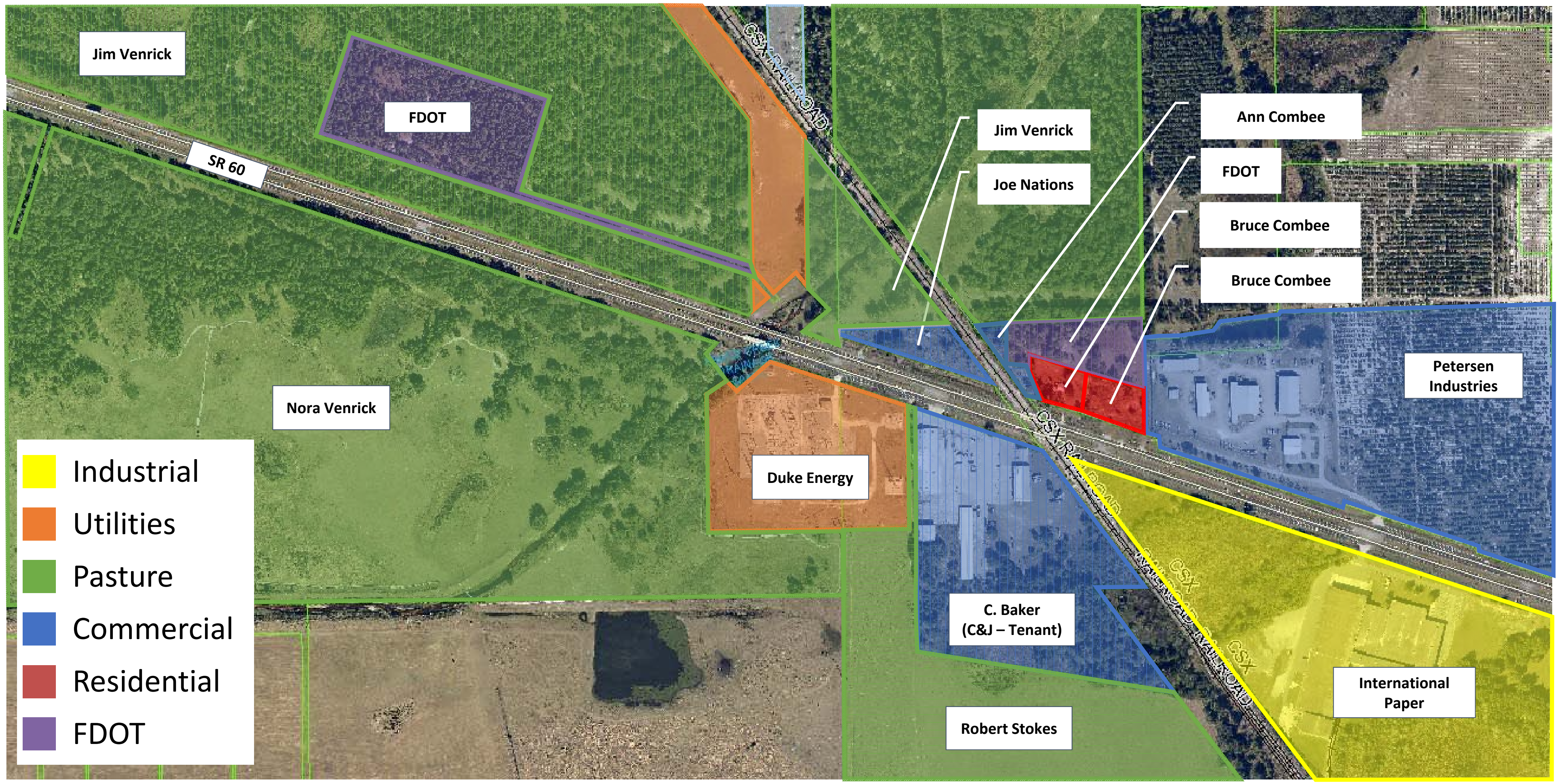
Left and right turn lanes will be provided at both frontage road terminals.

Acceleration lanes were evaluated for two conditions, the inability to accelerate to a reasonable operating speed on a grade and the second due to inadequate intersection sight distance. Neither condition was found to warrant acceleration lanes. A “trucks entering highway ahead” sign will be provided to inform drivers of the potential for truck activity.

The median opening, turn lane, and frontage road concept is provided in **Appendix E**.

# Appendix A
# Adjacent Properties

# Adjacent Properties



# Appendix B
# Traffic Count Data

**SR 60 Intersection Analysis Report**
**Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 1 - Median Opening (Sta. 2370+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period | Movement | | | | | | | | |
| | NBLT | NBRT | SBLT | SBRT | EBLT | EBRT | WBLT | WBRT | Total |
| 6-7 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 7-8 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 8-9 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 11 am-12 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 12-1 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 3-4 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 4-5 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 5-6 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**SR 60 Intersection Analysis Report**

**Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings**

**Date 7/8/15**

| Location 2 - Power Substation Driveway (Sta. 2391+50) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **7-8 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **8-9 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **11 am-12 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **12-1 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **3-4 pm** | 0 | 0 | - | - | - | 0 Cars<br>1 Truck | 0 | - | 0 Cars<br>1 Truck |
| **4-5 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **5-6 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **Total** | 0 | 0 | 0 | 0 | 0 | 0 Cars<br>1 Truck | 0 | 0 | 0 |

## SR 60 Intersection Analysis Report

## Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings

## Date 7/8/15

| Location 3 - Commercial Driveway (Sta. 2396+50) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | 0 | 0 Car<br>1 Truck | - | - | - | 1 Car<br>0 Truck | 0 | - | 1 Car<br>1 Truck |
| **7-8 am** | 0 | 0 | - | - | - | 2 Cars<br>0 Truck | 0 | - | 2 Cars<br>0 Truck |
| **8-9 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **11 am-12 pm** | 1 Car<br>0 Truck | 0 | - | - | - | 1 Car<br>0 Truck | 0 | - | 2 Cars<br>0 Truck |
| **12-1 pm** | 0 | 0 | - | - | - | 0 Car<br>1 Truck | 0 Car<br>1 Truck | - | 0 Cars<br>2 Trucks |
| **3-4 pm** | 2 Cars<br>0 Truck | 0 | - | - | - | 0 | 0 | - | 2 Cars<br>0 Truck |
| **4-5 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **5-6 pm** | 1 Car<br>0 Truck | 0 | - | - | - | 1 Car<br>0 Truck | 0 | - | 2 Cars<br>0 Truck |
| **Total** | 4 Cars<br>0 Truck | 0 Cars<br>1 Truck | 0 | 0 | 0 | 5 Cars<br>1 Truck | 0 Car<br>1 Truck | 0 | 9 Cars<br>3 Trucks |

**SR 60 Intersection Analysis Report**
**Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 4 - Median Opening (Sta. 2405+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period | Movement | | | | | | | | |
| | NBLT | NBRT | SBLT | SBRT | EBLT | EBRT | WBLT | WBRT | Total |
| 6-7 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 7-8 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 8-9 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 11 am-12 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 12-1 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 3-4 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 4-5 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 5-6 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**SR 60 Intersection Analysis Report**
**Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 5 - Commercial Driveway - South Leg (Sta. 2419+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **7-8 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **8-9 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **11 am-12 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **12-1 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **3-4 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **4-5 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **5-6 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **Total** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**SR 60 Intersection Analysis Report**

**Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings**

**Date 7/8/15**

| Location 6 - Commercial Driveway - North Leg (Sta. 2419+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | - | - | 1 Car<br>0 Truck | 0 | 6 Cars<br>0 Truck | - | - | 21 Cars<br>0 Truck | 28 Cars<br>0 Truck |
| **7-8 am** | - | - | 1 Car<br>0 Truck | 0 | 1 Car<br>0 Truck | - | - | 6 Cars<br>0 Truck | 8 Cars<br>0 Truck |
| **8-9 am** | - | - | 1 Car<br>1 Truck | 0 | 1 Car<br>1 Truck | - | - | 4 Cars<br>0 Truck | 6 Cars<br>2 Trucks |
| **11 am-12 pm** | - | - | 11 Cars<br>0 Truck | 1 Car<br>0 Truck | 0 Car<br>1 Truck | - | - | 0 Car<br>1 Truck | 12 Cars<br>2 Trucks |
| **12-1 pm** | - | - | 14 Cars<br>1 Truck | 0 | 1 Car<br>0 Truck | - | - | 15 Cars<br>2 Trucks | 30 Cars<br>3 Trucks |
| **3-4 pm** | - | - | 3 Cars<br>2 Trucks | 1 Car<br>0 Truck | 1 Car<br>1 Truck | - | - | 2 Cars<br>2 Trucks | 7 Cars<br>5 Trucks |
| **4-5 pm** | - | - | 7 Cars<br>2 Trucks | 2 Cars<br>0 Truck | 0 | - | - | 2 Cars<br>2 Trucks | 11 Cars<br>4 Trucks |
| **5-6 pm** | - | - | 24 Cars<br>0 Truck | 2 Cars<br>0 Truck | 0 | - | - | 0 | 26 Cars<br>0 Truck |
| **Total** | 0 | 0 | 62 Cars<br>6 Trucks | 6 Cars<br>0 Truck | 10 Cars<br>3 Trucks | 0 | 0 | 50 Cars<br>7 Trucks | 128 Cars<br>16 Trucks |

**SR 60 Intersection Analysis Report**
**Existing Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 7 - Median Opening (Sta. 2427+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period | Movement | | | | | | | | |
| | NBLT | NBRT | SBLT | SBRT | EBLT | EBRT | WBLT | WBRT | Total |
| 6-7 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 7-8 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 8-9 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 11 am-12 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 12-1 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 3-4 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 4-5 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 5-6 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Appendix C
# Projected Traffic Data

# *Florida Department of Transportation*

RICK SCOTT
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JIM BOXOLD
SECRETARY

## MEMORANDUM

**Date:** September 10, 2015

**To:** Amy Setchell — EXT 2609
Project Management — MS 1-29

**From:** George Martin, GIS Coordinator/Traffic Count Supervisor GM

**Copies:** Kyle Purvis

**Subject:**
**Financial Project No:** 436559-1-32-01
**Roadway ID:** 16110000

**Project Name:** SR 60 over CSX

**County:** Polk
**Type of Work:** Grade Separate SR 60 over CSX
From MP: 24.574 to MP: 26.279

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Per your request, the attached traffic data forecasts are provided for the above roadway. These estimates were taken from trends calculated from traffic counts provided by FDOT.

K = 9.00 %
D = 55.9 %
24 hour T = 21.1%
Design Hour T = 10.55 %
2014 AADT = 23000
Functional Class = URBAN PRIN ART OTHER

The attached 18-KIP Equivalent Single Axle Loading Accumulations are based on the above information, and have been prepared in accordance with the Central Offices memo of December 1, 2000, reflecting the current Equivalency Factors.

As requested, we have included the 24-hour traffic count for site 160023.

Please feel free to contact Kyle Purvis at extension 2216 if you have any questions.

## 18 kip EQUIVALENT SINGLE AXLE LOAD ANALYSIS

*PROJECT TRAFFIC FOR PD&E and DESIGN ANALYSIS INFO / FACTORS*

**FIN #:** 436559-1-32-01
COUNTY: POLK
ROADWAYID: 16110000
PROJECT DESCRIPTION: Grade separate SR 60 over CSX

***LOCATION #:*** 1

***LOCATION DESCRIPTION:*** From MP: 21.318 to MP: 28.696

### *GROWTH RATE FORMULA*

A: Interpolation
B: Enter Growth Rate
C: Enter All AADTs
D: New Facility

If "A" select an interpolation function
If "B" enter rate as decimals (1%=1.01)
If ""C", or "D" continue to next section

Choose A, B, C, or D here: A

Linear Growth Rate X %
Compounded Growth Rate %
Decaying Growth Rate %
(select one)

### *DESIGN INFORMATION*

| | | AADT |
|---|---|---|
| Existing Year | 2015 | 23000 |
| Opening Year | 2020 | N/A |
| Mid-Design Year | 2030 | N/A |
| Design Year | 2040 | 40300 |

Note: AADT values have been rounded to the nearest 100

| | |
|---|---|
| Daily Direction Split (50% or 100%) | 50% |
| Lanes in One Direction | 2 |
| **T24 values** | |
| Existing to Opening Year | 21.10% |
| Opening to Mid-Year | 21.10% |
| Mid-Year to Design-Year | 21.10% |

### *2000 EQUIVALENCY FACTORS |u(1)|*

(selected with an X)

| | FLEXIBLE PAVEMENT SN = 5/THICK | | RIGID PAVEMENT SN = 12/THICK | |
|---|---|---|---|---|
| RURAL FREEWAY: | 1.050 | | 1.600 | |
| URBAN FREEWAY: | 0.900 | | 1.270 | |
| RURAL HIGHWAY: | 0.960 | | 1.350 | |
| URBAN HIGHWAY: | 0.890 | X | 1.220 | |
| OTHER (Enter Factor and X): | | | | |

(1) Equivalency Factors are based on Updated Pavement Damage Factors Memorandum, dated December 1, 2000.

Lane Factors developed by Copes equation

I have reviewed the 18 kip Equivalent Single Axle Loads (ESAL's) to be used for pavement design on this project. I hereby attest that these have been developed in accordance with the FDOT Project Traffic Forecasting Procedure using historical traffic data and other available information.

Prepared by: Kyle Purvis — Traffic Count Analyst — FDOT
Name — Title — Org. Unit or Firm
Kyle Purvis (signature) — 9-10-15
Signature — Date

George Martin, GIS Coordinator/Traffic Count Supervisor — FDOT
Reviewed by: Name — Title — Org. Unit or Firm
George C. Martin (signature) — 9-10-15
Signature — Date

# 18 kip EQUIVALENT SINGLE AXLE LOAD ANALYSIS - LOCATION 1

*PROJECT TRAFFIC FOR PD&E and DESIGN ANALYSIS INFO / FACTORS*

**YEARS:** *2015 to 2040*

**SECTION #:** 16110000 **COUNTY:** POLK **FIN #:** 436559-1-32-01

FLEXIBLE PAVEMENT URBAN HIGHWAY 0.890

SN=5/THICK Grade separate SR 60 over CSX A

| YEAR | AADT | ESAL (1000S) | ACCUM (1000s) | D | T | LF | EF |
|---|---|---|---|---|---|---|---|
| 2015 | 23000 | 627 | 0 | 0.5 | 21.10% | 0.795 | 0.890 |
| 2016 | 23600 | 642 | 0 | 0.5 | 21.10% | 0.793 | 0.890 |
| 2017 | 24300 | 659 | 0 | 0.5 | 21.10% | 0.790 | 0.890 |
| 2018 | 25000 | 675 | 0 | 0.5 | 21.10% | 0.788 | 0.890 |
| 2019 | 25700 | 692 | 0 | 0.5 | 21.10% | 0.786 | 0.890 |
| 2020 | 26400 | 709 | 709 | 0.5 | 21.10% | 0.783 | 0.890 |
| 2021 | 27100 | 726 | 1435 | 0.5 | 21.10% | 0.781 | 0.890 |
| 2022 | 27800 | 743 | 2178 | 0.5 | 21.10% | 0.779 | 0.890 |
| 2023 | 28500 | 759 | 2937 | 0.5 | 21.10% | 0.777 | 0.890 |
| 2024 | 29200 | 776 | 3713 | 0.5 | 21.10% | 0.775 | 0.890 |
| 2025 | 29900 | 793 | 4506 | 0.5 | 21.10% | 0.773 | 0.890 |
| 2026 | 30600 | 809 | 5315 | 0.5 | 21.10% | 0.771 | 0.890 |
| 2027 | 31300 | 826 | 6141 | 0.5 | 21.10% | 0.769 | 0.890 |
| 2028 | 31900 | 840 | 6981 | 0.5 | 21.10% | 0.768 | 0.890 |
| 2029 | 32600 | 856 | 7837 | 0.5 | 21.10% | 0.766 | 0.890 |
| 2030 | 33300 | 873 | 8710 | 0.5 | 21.10% | 0.764 | 0.890 |
| 2031 | 34000 | 889 | 9599 | 0.5 | 21.10% | 0.762 | 0.890 |
| 2032 | 34700 | 905 | 10504 | 0.5 | 21.10% | 0.761 | 0.890 |
| 2033 | 35400 | 921 | 11425 | 0.5 | 21.10% | 0.759 | 0.890 |
| 2034 | 36100 | 938 | 12363 | 0.5 | 21.10% | 0.757 | 0.890 |
| 2035 | 36800 | 954 | 13317 | 0.5 | 21.10% | 0.756 | 0.890 |
| 2036 | 37500 | 970 | 14287 | 0.5 | 21.10% | 0.754 | 0.890 |
| 2037 | 38200 | 986 | 15273 | 0.5 | 21.10% | 0.753 | 0.890 |
| 2038 | 38900 | 1002 | 16275 | 0.5 | 21.10% | 0.751 | 0.890 |
| 2039 | 39600 | 1018 | 17293 | 0.5 | 21.10% | 0.750 | 0.890 |
| 2040 | 40300 | 1034 | 18327 | 0.5 | 21.10% | 0.748 | 0.890 |

Opening to Mid-Design Year ESAL Accumulation (1000s): 8001

Opening to Design Year ESAL Accumulation (1000s): 17618

I have reviewed the 18 kip Equivalent Single Axle Loads (ESAL's) to be used for pavement design on this project. I hereby attest that these have been developed in accordance with the FDOT Project Traffic Forecasting Procedure using historical traffic data and other available information.

Prepared by: Kyle Purvis — Traffic Count Analyst — FDOT

Name — Title — Org. Unit or Firm

Kyle Purvis 9-10-15

Signature — Date

George Martin, GIS Coordinator/Traffic Count Supervisor — FDOT

Reviewed by: Name — Title — Org. Unit or Firm

George A. Martin 9-10-15

Signature — Date

**SR 60 Intersection Analysis Report**
**2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 1 - Median Opening (Sta. 2370+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period | Movement | | | | | | | | |
| | NBLT | NBRT | SBLT | SBRT | EBLT | EBRT | WBLT | WBRT | Total |
| 6-7 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 7-8 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 8-9 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 11 am-12 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 12-1 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 3-4 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 4-5 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 5-6 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**SR 60 Intersection Analysis Report**

**2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings**

**Date 7/8/15**

| Location 2 - Power Substation Driveway (Sta. 2391+50) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **7-8 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **8-9 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **11 am-12 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **12-1 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **3-4 pm** | 0 | 0 | - | - | - | 0 Cars<br>1 Truck | 0 | - | 0 Cars<br>1 Truck |
| **4-5 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **5-6 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **Total** | 0 | 0 | 0 | 0 | 0 | 0 Cars<br>1 Truck | 0 | 0 | 0 |

**SR 60 Intersection Analysis Report**
**2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 3 - Commercial Driveway (Sta. 2396+50) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | 0 | 0 Car<br>1 Truck | - | - | - | 1 Car<br>0 Truck | 0 | - | 1 Car<br>1 Truck |
| **7-8 am** | 0 | 0 | - | - | - | 2 Cars<br>0 Truck | 0 | - | 2 Cars<br>0 Truck |
| **8-9 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **11 am-12 pm** | 1 Car<br>0 Truck | 0 | - | - | - | 1 Car<br>0 Truck | 0 | - | 2 Cars<br>0 Truck |
| **12-1 pm** | 0 | 0 | - | - | - | 0 Car<br>1 Truck | 0 Car<br>1 Truck | - | 0 Cars<br>2 Trucks |
| **3-4 pm** | 3 Cars<br>0 Truck | 0 | - | - | - | 0 | 0 | - | 3 Cars<br>0 Truck |
| **4-5 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **5-6 pm** | 1 Car<br>0 Truck | 0 | - | - | - | 1 Car<br>0 Truck | 0 | - | 2 Cars<br>0 Truck |
| **Total** | 5 Cars<br>0 Truck | 0 Cars<br>1 Truck | 0 | 0 | 0 | 5 Cars<br>1 Truck | 0 Car<br>1 Truck | 0 | 10 Cars<br>3 Trucks |

**SR 60 Intersection Analysis Report**
**2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 4 - Median Opening (Sta. 2405+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period | Movement | | | | | | | | |
| | NBLT | NBRT | SBLT | SBRT | EBLT | EBRT | WBLT | WBRT | Total |
| 6-7 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 7-8 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 8-9 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 11 am-12 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 12-1 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 3-4 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 4-5 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 5-6 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## SR 60 Intersection Analysis Report
## 2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings
## Date 7/8/15

| Location 5 - Commercial Driveway - South Leg (Sta. 2419+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **7-8 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **8-9 am** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **11 am-12 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **12-1 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **3-4 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **4-5 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **5-6 pm** | 0 | 0 | - | - | - | 0 | 0 | - | 0 |
| **Total** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**SR 60 Intersection Analysis Report**

**2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings**

**Date 7/8/15**

| Location 6 - Commercial Driveway - North Leg (Sta. 2419+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time Period** | **Movement** | | | | | | | | |
| | **NBLT** | **NBRT** | **SBLT** | **SBRT** | **EBLT** | **EBRT** | **WBLT** | **WBRT** | **Total** |
| **6-7 am** | - | - | 1 Car<br>0 Truck | 0 | 8 Cars<br>0 Truck | - | - | 27 Cars<br>0 Truck | 36 Cars<br>0 Truck |
| **7-8 am** | - | - | 1 Car<br>0 Truck | 0 | 1 Car<br>0 Truck | - | - | 8 Cars<br>0 Truck | 10 Cars<br>0 Truck |
| **8-9 am** | - | - | 1 Car<br>1 Truck | 0 | 1 Car<br>1 Truck | - | - | 5 Cars<br>0 Truck | 7 Cars<br>2 Trucks |
| **11 am-12 pm** | - | - | 14 Cars<br>0 Truck | 1 Car<br>0 Truck | 0 Car<br>1 Truck | - | - | 0 Car<br>1 Truck | 15 Cars<br>2 Trucks |
| **12-1 pm** | - | - | 18 Cars<br>1 Truck | 0 | 1 Car<br>0 Truck | - | - | 19 Cars<br>3 Trucks | 38 Cars<br>4 Trucks |
| **3-4 pm** | - | - | 4 Cars<br>3 Trucks | 1 Car<br>0 Truck | 1 Car<br>1 Truck | - | - | 3 Cars<br>3 Trucks | 9 Cars<br>7 Trucks |
| **4-5 pm** | - | - | 9 Cars<br>3 Trucks | 3 Cars<br>0 Truck | 0 | - | - | 3 Cars<br>3 Trucks | 15 Cars<br>6 Trucks |
| **5-6 pm** | - | - | 31 Cars<br>0 Truck | 3 Cars<br>0 Truck | 0 | - | - | 0 | 34 Cars<br>0 Truck |
| **Total** | 0 | 0 | 79 Cars<br>8 Trucks | 8 Cars<br>0 Truck | 12 Cars<br>3 Trucks | 0 | 0 | 65 Cars<br>10 Trucks | 164 Cars<br>21 Trucks |

**SR 60 Intersection Analysis Report**
**2040 Projected Hourly Turning Movement Traffic Counts - Driveways and Median Openings**
**Date 7/8/15**

| Location 7 - Median Opening (Sta. 2427+00) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period | Movement | | | | | | | | |
| | NBLT | NBRT | SBLT | SBRT | EBLT | EBRT | WBLT | WBRT | Total |
| 6-7 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 7-8 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 8-9 am | - | - | - | - | 0 | - | 0 | - | 0 |
| 11 am-12 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 12-1 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 3-4 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 4-5 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| 5-6 pm | - | - | - | - | 0 | - | 0 | - | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Appendix D
# Intersection Sight Distance

Faller, Davis and Associates, Inc.

SUBJECT: Intersection sight distance

COMP. BY: KM
CK. BY: JS
DATE: 9/1/15
SHEET NO.: 1 of 2
JOB NO.: 417-01

CASE B1 - LEFT TURN LANE from Minor Road is worst CASE for determining intersection sight distance - Longest crossing time / distance.

FORMULA 9-1

ISD = 1.47 $V_{MAJOR}$ $t_g$

ISD = intersection sight distance

$V_{MAJOR}$ = 70 mph Design speed

$t_g$ = time gap

Use combination truck for determining $t_g$

TABLE 9-5 for combination truck (WB62FL Low range of Combo)

$t_g$ = 11.5 s + Additional crossing time

$t_g$ = 11.5 + 0.7s( 1 × 2 (crossing two inside Lanes) + (40/12 median)

= 11.5 + 0.7s (2 + 3.33)

$t_g$ = 15.23 sec. Say 16

ISD = 1.47 × 70 × 16 = 1646'

Sight Triangle from High point of EB SR 60 VC To EXIT from North side of East Frontage Road terminal = 1646' min.

grades 3% or Less do not Affect sight distance

Max. grade = 3%

Faller, Davis and Associates, Inc.

SUBJECT: Intersection Sight distance

COMP. BY: KM
CK. BY: VS
DATE: 9/1/15
SHEET NO.: 2 of 2
JOB NO.: 417.00

- Median barrier review for sight distance
  in AASHTO section 9.5.2: Use 3.5' for drivers eye
  and 3.5' for obstruction height.

  Truck drivers eye is 7.6'

  Barrier wall height may vary from 2.67' to 3.17'
  Both are below 3.5'
  Visibility of vehicles approaching on EB SR60 are
  elevated due to profile.

- $WB_1$, $WB_2$, $WB_3$, and $WB_4$ are the effective vehicle wheelbases, or distances between axle groups, starting at the front and working towards the back of each unit.
- S is the distance from the rear effective axle to the hitch point or point of articulation.
- T is the distance from the hitch point or point of articulation measured back to the center of the next axle or the center of the tandem axle assembly.

**Table 2-1b Design Vehicle Dimensions (U.S. Customary Units)**

| Design Vehicle Type | Symbol | Dimensions (ft) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Overall | | | Overhang | | | | | | | | |
| | | Height | Width | Length | Front | Rear | $WB_1$ | $WB_2$ | S | T | $WB_3$ | $WB_4$ | Typical Kingpin to Center of Rear Tandem Axle |
| Passenger Car | P | 4.3 | 7.0 | 19.0 | 3.0 | 5.0 | 11.0 | — | — | — | — | — | — |
| Single-Unit Truck | SU-30 | 11.0–13.5 | 8.0 | 30.0 | 4.0 | 6.0 | 20.0 | — | — | — | — | — | — |
| Single-Unit Truck (three-axle) | SU-40 | 11.0–13.5 | 8.0 | 39.5 | 4.0 | 10.5 | 25.0 | — | — | — | — | — | — |
| **Buses** | | | | | | | | | | | | | |
| Intercity Bus (Motor Coaches) | BUS-40 | 12.0 | 8.5 | 40.5 | 6.3 | 9.0[a] | 25.3 | — | — | — | — | — | — |
| | BUS-45 | 12.0 | 8.5 | 45.5 | 6.2 | 9.0[a] | 28.5 | — | — | — | — | — | — |
| City Transit Bus | CITY-BUS | 10.5 | 8.5 | 40.0 | 7.0 | 8.0 | 25.0 | — | — | — | — | — | — |
| Conventional School Bus (65 pass.) | S-BUS 36 | 10.5 | 8.0 | 35.8 | 2.5 | 12.0 | 21.3 | — | — | — | — | — | — |
| Large School Bus (84 pass.) | S-BUS 40 | 10.5 | 8.0 | 40.0 | 7.0 | 13.0 | 20.0 | — | — | — | — | — | — |
| Articulated Bus | A-BUS | 11.0 | 8.5 | 60.0 | 8.6 | 10.0 | 22.0 | 19.4 | 6.2[b] | 13.2[b] | — | — | — |
| **Combination Trucks** | | | | | | | | | | | | | |
| Intermediate Semitrailer | WB-40 | 13.5 | 8.0 | 45.5 | 3.0 | 4.5[a] | 12.5 | 25.5 | — | — | — | — | 25.5 |
| Interstate Semitrailer | WB-62** | 13.5 | 8.5 | 69.0 | 4.0 | 4.5[a] | 19.5 | 41.0 | — | — | — | — | 41.0 |
| Interstate Semitrailer | WB-67** | 13.5 | 8.5 | 73.5 | 4.0 | 4.5[a] | 19.5 | 45.5 | — | — | — | — | 45.5 |
| "Double-Bottom" Semitrailer/Trailer | WB-67D | 13.5 | 8.5 | 72.3 | 2.3 | 3.0 | 11.0 | 23.0 | 3.0[c] | 7.0[c] | 22.5 | — | 23.0 |
| Rocky Mountain Double-Semitrailer/Trailer | WB-92D | 13.5 | 8.5 | 97.3 | 2.3 | 3.0 | 17.5 | 40.0 | 4.5 | 7.0 | 22.5 | — | 40.5 |
| Triple-Semitrailer/Trailers | WB-100T | 13.5 | 8.5 | 104.8 | 2.3 | 3.0 | 11.0 | 22.5 | 3.0[d] | 7.0[d] | 22.5 | 22.5 | 23.0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turnpike Double-Semitrailer/Trailer | WB-109D* | 13.5 | 8.5 | 114.0 | 2.3 | 4.5[a] | 12.2 | 40.0 | 4.5[e] | 10.0[e] | 40.0 | — | 40.5 |
| **Recreational Vehicles** | | | | | | | | | | | | | |
| Motor Home | MH | 12.0 | 8.0 | 30.0 | 4.0 | 6.0 | 20.0 | — | — | — | — | — | — |
| Car and Camper Trailer | P/T | 10.0 | 8.0 | 48.7 | 3.0 | 12.0 | 11.0 | — | 5.0 | 17.7 | — | — | — |
| Car and Boat Trailer | P/B | — | 8.0 | 42.0 | 3.0 | 8.0 | 11.0 | — | 5.0 | 15.0 | — | — | — |
| Motor Home and Boat Trailer | MH/B | 12.0 | 8.0 | 53.0 | 4.0 | 8.0 | 20.0 | — | 6.0 | 15.0 | — | — | — |

* Design vehicle with 48.0-ft trailer as adopted in 1982 Surface Transportation Assistance Act (STAA).

** Design vehicle with 53.0-ft trailer as grandfathered in with 1982 Surface Transportation Assistance Act (STAA).

[a] This is the length of the overhang from the back axle of the tandem axle assembly.

[b] Combined dimension is 19.4 ft and articulating section is 4.0 ft wide.

[c] Combined dimension is typically 10.0 ft.

[d] Combined dimension is typically 10.0 ft.

[e] Combined dimension is typically 12.5 ft.

- $WB_1$, $WB_2$, $WB_3$, and $WB_4$ are the effective vehicle wheelbases, or distances between axle groups, starting at the front and working towards the back of each unit.
- S is the distance from the rear effective axle to the hitch point or point of articulation.
- T is the distance from the hitch point or point of articulation measured back to the left of the next axle or the left of the tandem axle assembly.

Depending on expected usage, a large school bus (84 passengers) or a conventional school bus (65 passengers) may be used for the design of intersections of highways with low-volume county highways and township/local roads under 400 ADT. The school bus may also be appropriate for the design of some subdivision street intersections.

The WB-20 [WB 67] truck should generally be the minimum size design vehicle considered for intersections of freeway ramp terminals with arterial crossroads and for other intersections on state highways and industrialized streets that carry high volumes of traffic or that provide local access for large trucks, or both. In many cases, operators of WB-20 [WB-67] and larger vehicles pull the rear axles of the vehicle forward to maintain a kingpin-to-rear-axle distance of 12.5 m [41 ft], which makes the truck more maneuverable and is required by law in many jurisdictions. Where this practice is prevalent, the WB-19 [WB-62] may be used in design for turning maneuvers, but the WB-20 [WB-67] should be used in design situations where the overall length of the vehicle is considered, such as for sight distance at railroad-highway grade crossings.

Recent research has developed several design vehicles larger than those presented here, with overall lengths up to 39.41 m [129.3 ft]. These larger design vehicles are not generally needed for design to accommodate the current truck fleet. However, if needed to address conditions at specific sites, their dimensions and turning performance can be found in NCHRP Report 505 (*24*).

### 2.1.2 Minimum Turning Paths of Design Vehicles

Table 2-2 presents the minimum turning radii and Figures 2-1 through 2-9 and 2-13 through 2-23 present the minimum turning paths for 20 typical design vehicles. The principal dimensions affecting design are the minimum centerline turning radius (CTR), the out-to-out track width, the wheelbase, and the path of the inner rear tire. Effects of driver characteristics (such as the speed at which the driver makes a turn) and of the slip angles of wheels are minimized by assuming that the speed of the vehicle for the minimum turning radius is less than 15 km/h [10 mph].

The boundaries of the turning paths of each design vehicle for its sharpest turns are established by the outer trace of the front overhang and the path of the inner rear wheel. This sharpest turn assumes that the outer front wheel follows the circular arc defining the minimum centerline turning radius as determined by the vehicle steering mechanism. The minimum radii of the outside

The distances shown in Table 9-3 are generally less than the corresponding values of stopping sight distance for the same design speed. This relationship is illustrated in Figure 9-16. Where a clear sight triangle has legs that correspond to the stopping sight distances on their respective approaches, an even greater margin of efficient operation is provided. However, since field observations show that motorists slow down to some extent on approaches to uncontrolled intersections, the provision of a clear sight triangle with legs equal to the full stopping sight distance is not essential.

Where the grade along an intersection approach exceeds 3 percent, the leg of the clear sight triangle along that approach should be adjusted by multiplying the appropriate sight distance from Table 9-3 by the appropriate adjustment factor from Table 9-4.

**Table 9-4 Adjustment Factors for Sight Distance Based on Approach Grade**

| **Metric** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Design Speed (mph)** | | | | | | | | | | | | | |
| **Approach Grade (%)** | **20** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **110** | **120** | **130** | **—** | **—** |
| −6 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | — | — |
| −5 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | — | — |
| −4 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | — | — |
| −3 to +3 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | — | — |
| +4 | 1.0 | 1.0 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | — | — |
| +5 | 1.0 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | — | — |
| +6 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | — | — |

| **U.S. Customary** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Design Speed (mph)** | | | | | | | | | | | | | |
| **Approach Grade (%)** | **15** | **20** | **25** | **30** | **35** | **40** | **45** | **50** | **55** | **60** | **65** | **70** | **75** | **80** |
| −6 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| −5 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 |
| −4 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| −3 to +3 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| +4 | 1.0 | 1.0 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| +5 | 1.0 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| +6 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |

Note: Based on ratio of stopping sight distance on specified approach grade to stopping sight distance on level terrain.

If the sight distances given in Table 9-3, as adjusted for grades, cannot be provided, consideration should be given to installing regulatory speed signing to reduce speeds or installing stop signs on one or more approaches.

No departure sight triangle like that shown in Figure 9-15B is needed at an uncontrolled intersection because such intersections typically have very low traffic volumes. If a motorist needs to stop at an uncontrolled intersection because of the presence of a conflicting vehicle on an intersecting approach, it is very unlikely another potentially conflicting vehicle will be encountered as the first vehicle departs the intersection.

## Case B—Intersections with Stop Control on the Minor Road

Departure sight triangles for intersections with stop control on the minor road should be considered for three situations:

- Case B1—Left turns from the minor road;

- Case B2—Right turns from the minor road; and
- Case B3—Crossing the major road from a minor-road approach.

Intersection sight distance criteria for stop-controlled intersections are longer than stopping sight distance to allow the intersection to operate smoothly. Minor-road vehicle operators can wait until they can proceed safely without forcing a major-road vehicle to stop.

## Case B1—Left Turn from the Minor Road (Worst Case)

Departure sight triangles for traffic approaching from either the right or the left, like those shown in Figure 9-15B, should be provided for left turns from the minor road onto the major road for all stop-controlled approaches. The length of the leg of the departure sight triangle along the major road in both directions, shown as distance b in Figure 9-15B, is the recommended intersection sight distance for Case B1.

The vertex (decision point) of the departure sight triangle on the minor road should be 4.4 m [14.5 ft] from the edge of the major-road traveled way. This represents the typical position of the minor-road driver's eye when a vehicle is stopped relatively close to the major road. Field observations of vehicle stopping positions found that, where needed, drivers will stop with the front of their vehicle 2.0 m [6.5 ft] or less from the edge of the major-road traveled way. Measurements of passenger cars indicate that the distance from the front of the vehicle to the driver's eye for the current U.S. passenger car population is nearly always 2.4 m [8 ft] or less (*12*). Where practical, it is desirable to increase the distance from the edge of the major-road traveled way to the vertex of the clear sight triangle from 4.4 m to 5.4 m [14.5 to 18 ft]. This increase allows 3.0 m [10 ft] from the edge of the major-road traveled way to the front of the stopped vehicle, providing a larger sight triangle. The length of the sight triangle along the minor road (distance *a* in Figure 9-15B) is the sum of the distance from the major road plus $^1/_2$ lane width for vehicles approaching from the left, or $1^1/_2$ lane widths for vehicles approaching from the right.

Field observations of the gaps in major-road traffic actually accepted by drivers turning onto the major road have shown that the values in Table 9-5 provide sufficient time for the minor-road vehicle to accelerate from a stop and complete a left turn without unduly interfering with major-road traffic operations. The time gap acceptance time does not vary with approach speed on the major road. Studies have indicated that a constant value of time gap, independent of approach speed, can be used as a basis for intersection sight distance determinations. Observations have also shown that major-road drivers will reduce their speed to some extent when minor-road vehicles turn onto the major road. Where the time gap acceptance values in Table 9-5 are used to determine the length of the leg of the departure sight triangle, most major-road drivers should not need to reduce speed to less than 70 percent of their initial speed (*12*).

The intersection sight distance in both directions should be equal to the distance traveled at the design speed of the major road during a period of time equal to the time gap. In applying Table 9-5, it can usually be assumed that the minor-road vehicle is a passenger car. However, where substantial volumes of heavy vehicles enter the major road, such as from a ramp terminal, the use of tabulated values for single-unit or combination trucks should be considered.

Table 9-5 includes appropriate adjustments to the gap times for the number of lanes on the major road and for the approach grade of the minor road. The adjustment for the grade of the minor-road approach is needed only if the rear wheels of the design vehicle would be on an upgrade that exceeds 3 percent when the vehicle is at the stop line of the minor-road approach.

**Table 9-5 Time Gap for Case B1, Left Turn from Stop**

| Design Vehicle | Time Gap ($t_g$)(s) at Design Speed of Major Road |
|---|---|
| Passenger car 19.0' | 7.5 |
| Single-unit truck 39.5' | 9.5 |
| Combination truck 45.5' - 114' | WB 62 FL 69' 11.5 Lower range of combo. |

Note: Time gaps are for a stopped vehicle to turn left onto a two-lane highway with no median and with grades of 3 percent or less. The table values should be adjusted as follows:

For multilane highways—For left turns onto two-way highways with more than two lanes, add 0.5 s for passenger cars or 0.7 s for trucks for each additional lane, from the left, in excess of one, to be crossed by the turning vehicle.

For minor road approach grades—If the approach grade is an upgrade that exceeds 3 percent, add 0.2 s for each percent grade for left turns.

The intersection sight distance along the major road (distance *b* in Figure 9-15B) is determined by:

| Metric | U.S. Customary | |
|---|---|---|
| $ISD = 0.278\ V_{major}\ t_g$ | $ISD = 1.47\ V_{major}\ t_g$ | (9-1) |
| where: | where: | |
| $ISD$ = intersection sight distance (length of the leg of sight triangle along the major road) (m) | $ISD$ = intersection sight distance (length of the leg of sight triangle along the major road) (ft) | |
| $V_{major}$ = design speed of major road (km/h) | $V_{major}$ = design speed of major road (mph) | |
| $t_g$ = time gap for minor road vehicle to enter the major road (s) | $t_g$ = time gap for minor road vehicle to enter the major road (s) | |

For example, a passenger car turning left onto a two-lane major road should be provided sight distance equivalent to a time gap of 7.5 s in major-road traffic. If the design speed of the major road is 100 km/h [60 mph], this corresponds to a sight distance of 0.278(100)(7.5) = 208.5 or 210 m [1.47(60)(7.5) = 661.5 or 665 ft], rounded for design.

A passenger car turning left onto a four-lane undivided roadway will need to cross two near lanes, rather than one. This increases the recommended gap in major-road traffic from 7.5 to 8.0 s. The corresponding value of sight distance for this example would be 223 m [706 ft]. If the minor-road approach to such an intersection is located on a 4 percent upgrade, then the time gap selected for intersection sight distance design for left turns should be increased from 8.0 to 8.8 s, equivalent to an increase of 0.2 s for each percent grade.

The design values for intersection sight distance for passenger cars are shown in Table 9-6. Figure 9-17 includes design values, based on the time gaps for the design vehicles included in Table 9-5.

No adjustment of the recommended sight distance values for the major-road grade is generally needed because both the major- and minor-road vehicle will be on the same grade when departing from the intersection. However, if the minor-road design vehicle is a heavy truck and the intersection is located near a sag vertical curve with grades over 3 percent, then an adjustment to extend the recommended sight distance based on the major-road grade should be considered.

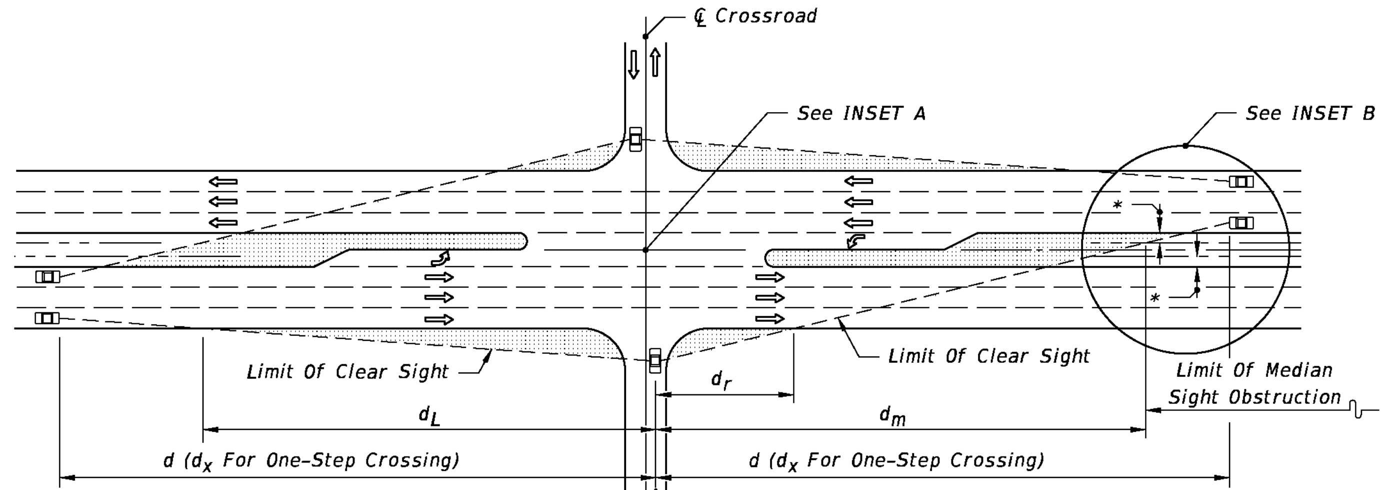
**Table 9-6 Design Intersection Sight Distance—Case B1, Left Turn from Stop**

| Metric | | | | U.S. Customary | | | |
|---|---|---|---|---|---|---|---|
| Design Speed (km/h) | Stopping Sight Distance (m) | Intersection Sight Distance for Passenger Cars: Calculated (m) | Intersection Sight Distance for Passenger Cars: Design (m) | Design Speed (mph) | Stopping Sight Distance (ft) | Intersection Sight Distance for Passenger Cars: Calculated (ft) | Intersection Sight Distance for Passenger Cars: Design (ft) |
| 20 | 20 | 41.7 | 45 | 15 | 80 | 165.4 | 170 |
| 30 | 35 | 62.6 | 65 | 20 | 115 | 220.5 | 225 |
| 40 | 50 | 83.4 | 85 | 25 | 155 | 275.6 | 280 |
| 50 | 65 | 104.3 | 105 | 30 | 200 | 330.8 | 335 |
| 60 | 85 | 125.1 | 130 | 35 | 250 | 385.9 | 390 |
| 70 | 105 | 146.0 | 150 | 40 | 305 | 441.0 | 445 |
| 80 | 130 | 166.8 | 170 | 45 | 360 | 496.1 | 500 |
| 90 | 160 | 187.7 | 190 | 50 | 425 | 551.3 | 555 |
| 100 | 185 | 208.5 | 210 | 55 | 495 | 606.4 | 610 |
| 110 | 220 | 229.4 | 230 | 60 | 570 | 661.5 | 665 |
| 120 | 250 | 250.2 | 255 | 65 | 645 | 716.6 | 720 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 130 | 285 | 271.1 | 275 | 70 | 730 | 771.8 | 775 |
| — | — | — | — | 75 | 820 | 826.9 | 830 |
| — | — | — | — | 80 | 910 | 882.0 | 885 |

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Sight distance design for left turns at divided-highway intersections should consider multiple design vehicles and median width. If the design vehicle used to determine sight distance for a divided-highway intersection is larger than a passenger car, then sight distance for left turns will need to be checked for that selected design vehicle and for smaller design vehicles as well. If the divided-highway median is wide enough to store the design vehicle with a clearance to the through lanes of approximately 1 m [3 ft] at both ends of the vehicle, no separate analysis for the departure sight triangle for left turns is needed on the minor-road approach for the near roadway to the left. In most cases, the departure sight triangle for right turns (Case B2) will provide sufficient sight distance for a passenger car to cross the near roadway to reach the median. Possible exceptions are addressed in the discussion of Case B3.




* 6' For Restricted Conditions
CZ For Nonrestricted Conditions
See Index No. 700

PLAN

PICTORIAL

## LEGEND

Areas Free Of Sight Obstructions

| MEDIAN 22' OR LESS | | | | |
|---|---|---|---|---|
| Design Speed | $d_x$ | $d_L$ | $d_r$ | $d_m$ |
| 30 | 415 | 295 | 80 | 355 |
| 35 | 485 | 345 | 90 | 415 |
| 40 | 555 | 395 | 105 | 470 |
| 45 | 625 | 445 | 115 | 530 |
| 50 | 690 | 490 | 130 | 585 |
| 55 | 760 | 540 | 140 | 645 |
| 60 | 830 | 590 | 155 | 705 |
| 65 | 900 | 640 | 170 | 765 |

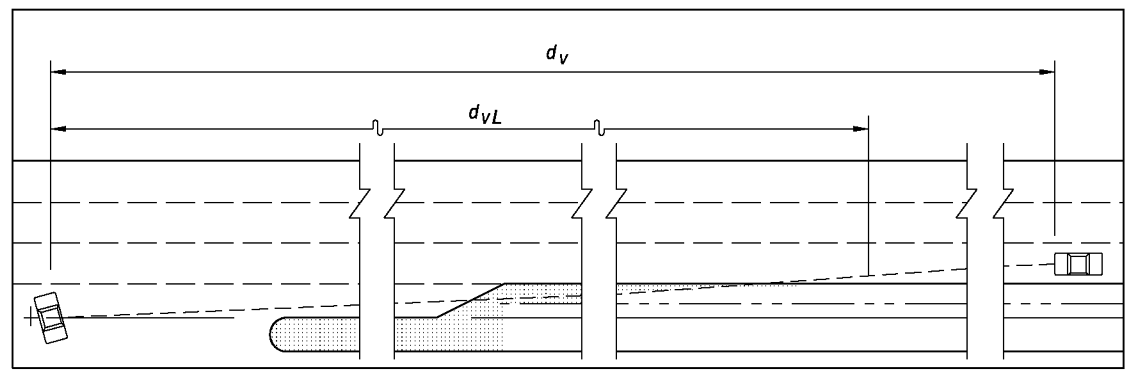
| 25'-64' MEDIAN | | | | |
|---|---|---|---|---|
| Design Speed | d | $d_L$ | $d_v$ | $d_{vL}$ |
| 30 | 375 | 265 | 330 | 240 |
| 35 | 440 | 315 | 385 | 280 |
| 40 | 500 | 355 | 445 | 320 |
| 45 | 565 | 400 | 500 | 360 |
| 50 | 625 | 445 | 555 | 400 |
| 55 | 690 | 490 | 610 | 440 |
| 60 | 750 | 530 | 665 | 480 |
| 65 | 815 | 580 | 720 | 520 |

PASSENGER VEHICLE (P)

| MEDIAN 35' OR LESS | | | | |
|---|---|---|---|---|
| Design Speed | $d_x$ | $d_L$ | $d_r$ | $d_m$ |
| 30 | 570 | 405 | 90 | 495 |
| 35 | 665 | 470 | 105 | 580 |
| 40 | 760 | 540 | 120 | 660 |
| 45 | 855 | 605 | 135 | 745 |
| 50 | 955 | 675 | 155 | 830 |
| 55 | 1050 | 745 | 170 | 915 |
| 60 | 1145 | 810 | 185 | 995 |
| 65 | 1240 | 880 | 200 | 1080 |

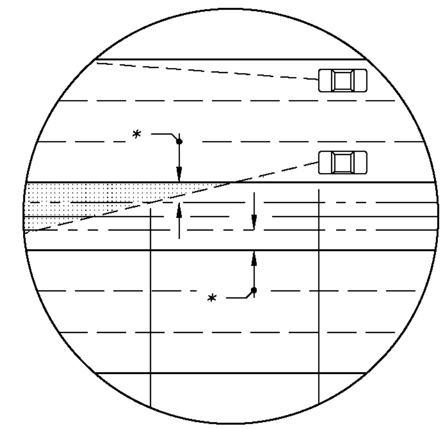
| 40'-64' MEDIAN | | | | |
|---|---|---|---|---|
| Design Speed | d | $d_L$ | $d_v$ | $d_{vL}$ |
| 30 | 480 | 340 | 420 | 330 |
| 35 | 560 | 400 | 490 | 385 |
| 40 | 640 | 455 | 560 | 440 |
| 45 | 720 | 510 | 630 | 490 |
| 50 | 805 | 570 | 700 | 545 |
| 55 | 885 | 625 | 770 | 600 |
| 60 | 965 | 685 | 840 | 665 |
| 65 | 1045 | 740 | 910 | 710 |

SINGLE-UNIT TRUCK (SU)




Where The Median Is Sufficiently Wide For The Design Vehicle To Pause In The Median (Vehicle Length Plus 6' Min.) The Clear Line Of Sight To The Right ($d_v$) Is Measured From The Vehicle Pause Location, i.e., Not From The Cross Road Stop Position; Distances $d_r$ & $d_m$ Do Not Apply.

INSET A




INSET B

| MEDIAN 30' OR LESS | | | | |
|---|---|---|---|---|
| Design Speed | $d_x$ | $d_L$ | $d_r$ | $d_m$ |
| 30 | 650 | 460 | 110 | 560 |
| 35 | 755 | 535 | 130 | 655 |
| 40 | 865 | 615 | 145 | 745 |
| 45 | 970 | 690 | 165 | 835 |
| 50 | 1080 | 765 | 185 | 930 |
| 55 | 1185 | 840 | 200 | 1025 |
| 60 | 1290 | 915 | 220 | 1115 |
| 65 | 1400 | 990 | 235 | 1210 |

| 35'-50' MEDIAN | | | | |
|---|---|---|---|---|
| Design Speed | $d_x$ | $d_L$ | $d_r$ | $d_m$ |
| 30 | 700 | 495 | 95 | 625 |
| 35 | 815 | 580 | 115 | 725 |
| 40 | 930 | 660 | 130 | 825 |
| 45 | 1045 | 740 | 145 | 930 |
| 50 | 1165 | 825 | 160 | 1035 |
| 55 | 1280 | 905 | 175 | 1140 |
| 60 | 1395 | 990 | 190 | 1240 |
| 65 | 1510 | 1070 | 210 | 1340 |

| 64' MEDIAN | | | | |
|---|---|---|---|---|
| Design Speed | d | $d_L$ | $d_v$ | $d_{vL}$ |
| 30 | 570 | 405 | 510 | 435 |
| 35 | 665 | 470 | 590 | 500 |
| 40 | 760 | 540 | 680 | 575 |
| 45 | 855 | 605 | 760 | 645 |
| 50 | 950 | 675 | 845 | 720 |
| 55 | 1045 | 740 | 930 | 790 |
| 60 | 1140 | 805 | 1015 | 865 |
| 65 | 1235 | 875 | 1100 | 935 |

INTERMEDIATE SEMI-TRAILERS (WB-40 & WB-50)

## NOTES FOR 6-LANE DIVIDED ROADWAY

1. See Sheet 2 for origin of clear sight line on the minor road.
2. Values shown in the tables are the governing (controlling) sight distances calculated based on 'AASHTO Case B - Intersection with Stop Control on the Minor Road.'

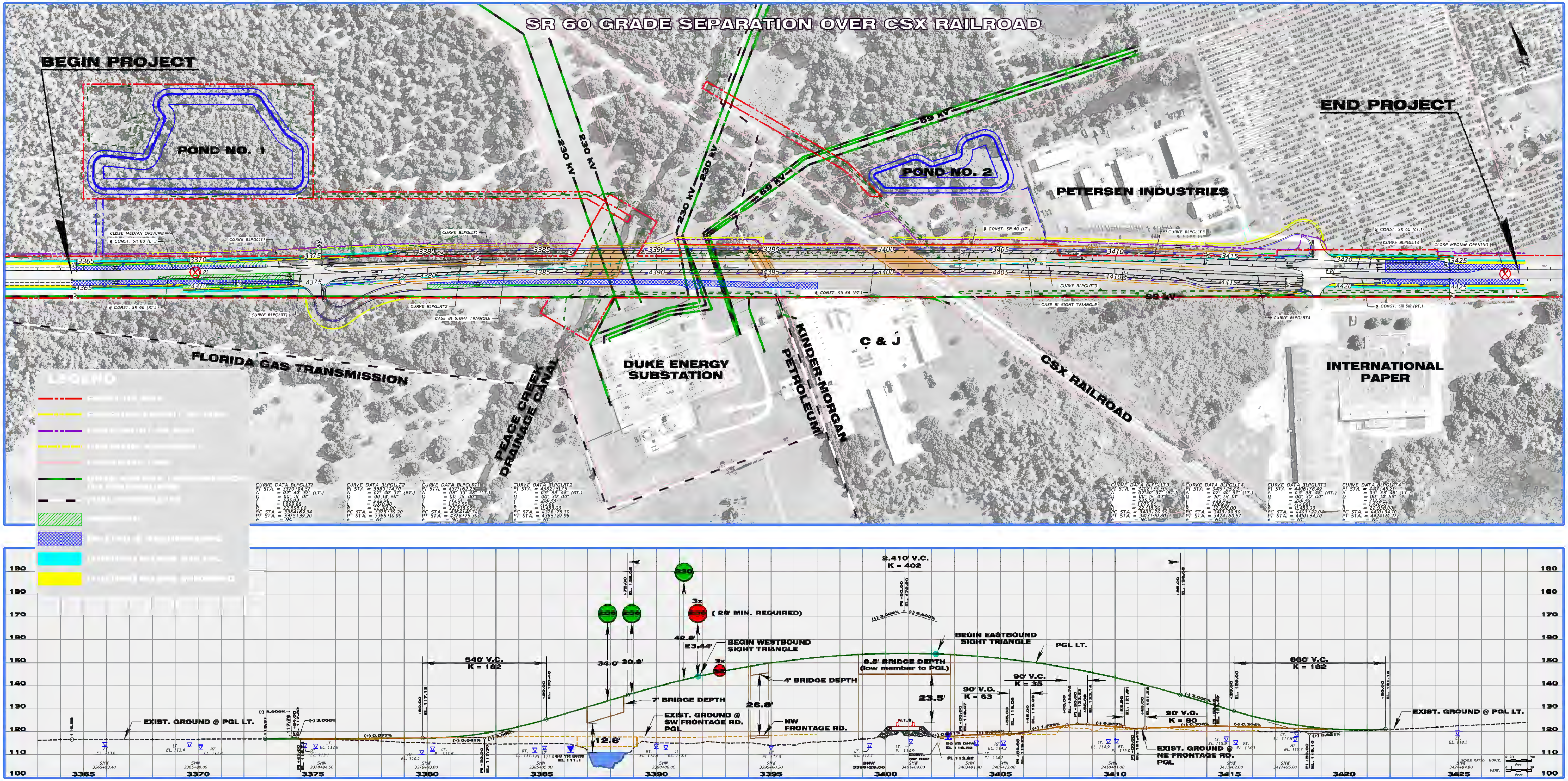
## SIGHT DISTANCES (d), ($d_V$) & ($d_X$) AND RELATED DISTANCES ($d_L$, $d_r$, $d_m$ & $d_{vL}$) (FEET)

## 6 LANE DIVIDED

# Appendix E
# Recommended Access Design

# RECOMMENDED ACCESS DESIGN

## 15% LINE AND GRADE



**RECOMMENDED ACCESS DESIGN**

**PROPERTY OWNERS**