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**Site Location:**

# SOLID ROCK COMMUNITY SCHOOL

## 0 KEYSTONE ROAD, TARPON SPRINGS, FL

## PARCEL ID #1 11-27-16-00000-340-0100, 0210, & 0200

# TRANSPORTATION ANALYSIS


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**DECEMBER 21, 2015**

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# I. PROJECT INTRODUCTION

Solid Rock Community School is a proposed private institution for grades K through 12 with 400 students and 32 staff members at full enrollment. The site is currently located within a vacant five (5) lot subdivision with existing 24 ft. wide access into the development from Keystone Road. A copy of the rezoning conceptual plan and location map is included under (**Figure 1 & 2)**.

It is anticipated that the campus hours are from 7 AM to 5 PM daily for staff, before and after care services. Classes start at 8:30 AM with dismissal at 3:00 PM daily. Parents dropping off kids will be directed by on-site signage to parents at designated area on-site. Solid Rock Community School currently has two buses associated with after school recreational activities. Private after school buses that provide services will be treated as traditional vehicles queuing on-site for pick-up and drop-off standard at most public or private institutions.

The purpose of this report is to perform a transportation analysis, which will determine existing/proposed traffic impact conditions, intersection (LOS) analysis, eastbound left-turn lane warrants, on-site storage and queueing circulation analysis.


**FIGURE 1: PROJECT LOCATION**

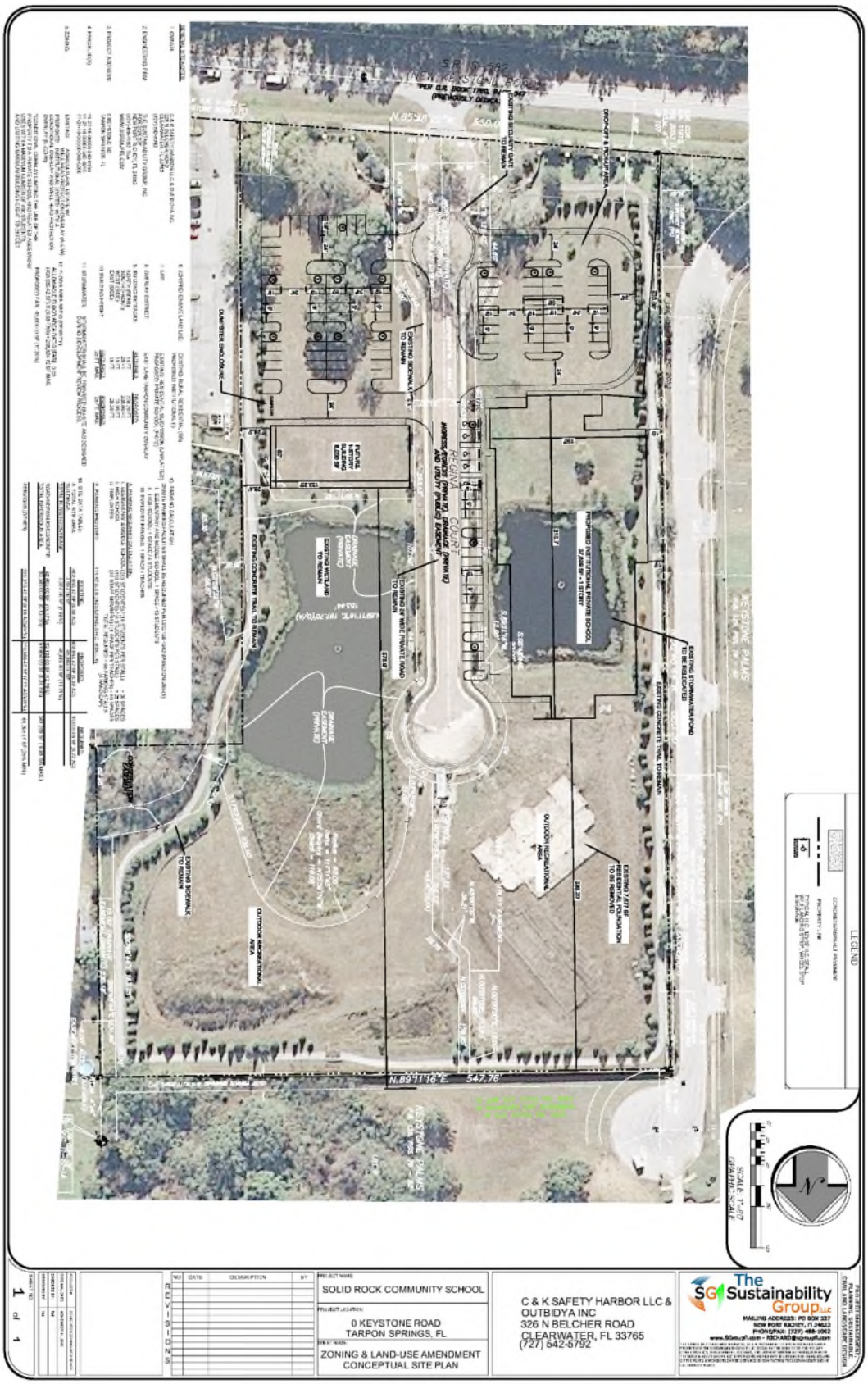



**FIGURE 2: REZONING AND LAND-USE APPLICATION CONCEPTUAL PLAN**

## II. EXISTING BACKGROUND TRAFFIC

Keystone Road is a two (2) lane road located in Pinellas County. Traffic patterns were observed and data collected at the property's entrance along Keystone Road on December 17, 2015 during the times of 7-10 AM and 2-6 PM establishing the AM and PM Peak Hour counts.

| Table 1 - EXISTING AM HOURLY PEAK TRAFFIC | | | | |
|---|---|---|---|---|
| **Existing Roadway** | **2015** | | ***Opening Year 2017** | |
| | Eastbound (EB) Volume | Westbound (WB) Volume | Eastbound (EB) Volume | Westbound (WB) Volume |
| **Keystone Rd** | **610** | **505** | **634** | **525** |

Traffic Volumes shown are from 8:00-9:00 AM to coincide with school start time at 8:30 AM.
*The school is anticipated to open in Spring of 2017. Future year, non-development background traffic was determined by applying an annual growth rate of 2% to the existing traffic volumes for 2 years (covers any construction delays).

| Table 2 - EXISTING PM HOURLY PEAK TRAFFIC | | | | |
|---|---|---|---|---|
| **Existing Roadway** | **2015** | | ***Opening Year 2017** | |
| | Eastbound (EB) Volume | Westbound (WB) Volume | Eastbound (EB) Volume | Westbound (WB) Volume |
| **Keystone Rd** | **418** | **551** | **435** | **573** |

Traffic Volumes shown are from 2:30-3:30 PM to coincide with school dismissal time at 3:00 PM.
*The school is anticipated to open in Spring of 2017. Future year, non-development background traffic was determined by applying an annual growth rate of 2% to the existing traffic volumes for 2 years (covers any construction delays).

**FIGURE 3 - 8-9 AM 2017 PEAK HOURLY BACKGROUND TRAFFIC**

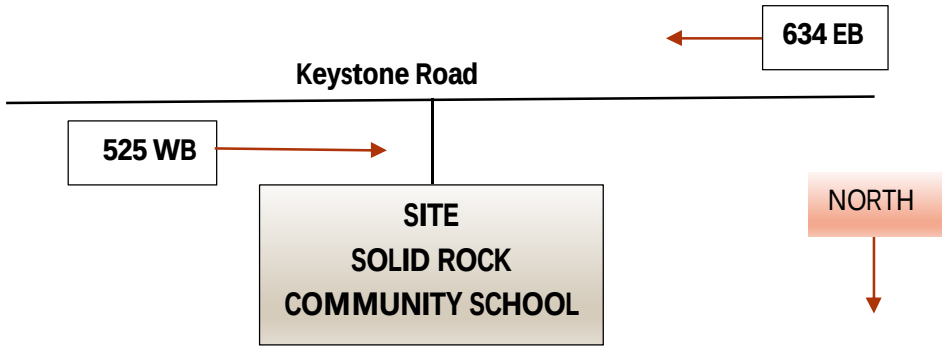
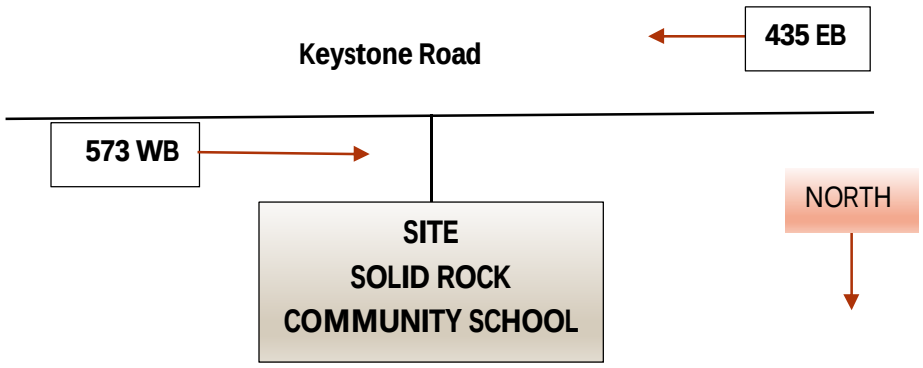



**FIGURE 4 - 2:30-3:30 PM 2017 PEAK HOURLY BACKGROUND TRAFFIC**



| TABLE 4 - TRAFFIC COUNT COLLECTED & PEAK HOURLY TRAFFIC<br>15 MIN INTERVALS W/ PEAK HOUR AM COUNT<br>December 17, 2015 - 7:00-10:00 AM | | | | |
|---|---|---|---|---|
| **Time** | **Eastbound (EB) Lane** | | **Westbound (WB) Lane** | |
| 7:00 – 7:15 AM | 172 | | 95 | |
| 7:15 – 7:30 AM | 183 | | 96 | |
| 7:30 – 7:45 AM | 166 | | 145 | |
| 7:45 – 8:00 AM | 148 | 669 | 116 | 452 |
| 8:00– 8:15 AM | **143** | | **137** | |
| 8:15– 8:30 AM | **186** | | **145** | |
| 8:30– 8:45 AM | **163** | | **116** | |
| 8:45– 9:00 AM | **118** | **610** | **107** | **505** |
| 9:00 – 9:15 AM | 117 | | 85 | |
| 9:15 - 9:30 AM | 135 | | 96 | |
| 9:30 – 9:45 AM | 123 | | 102 | |
| 9:45 – 10:00 AM | 105 | 480 | 73 | 356 |

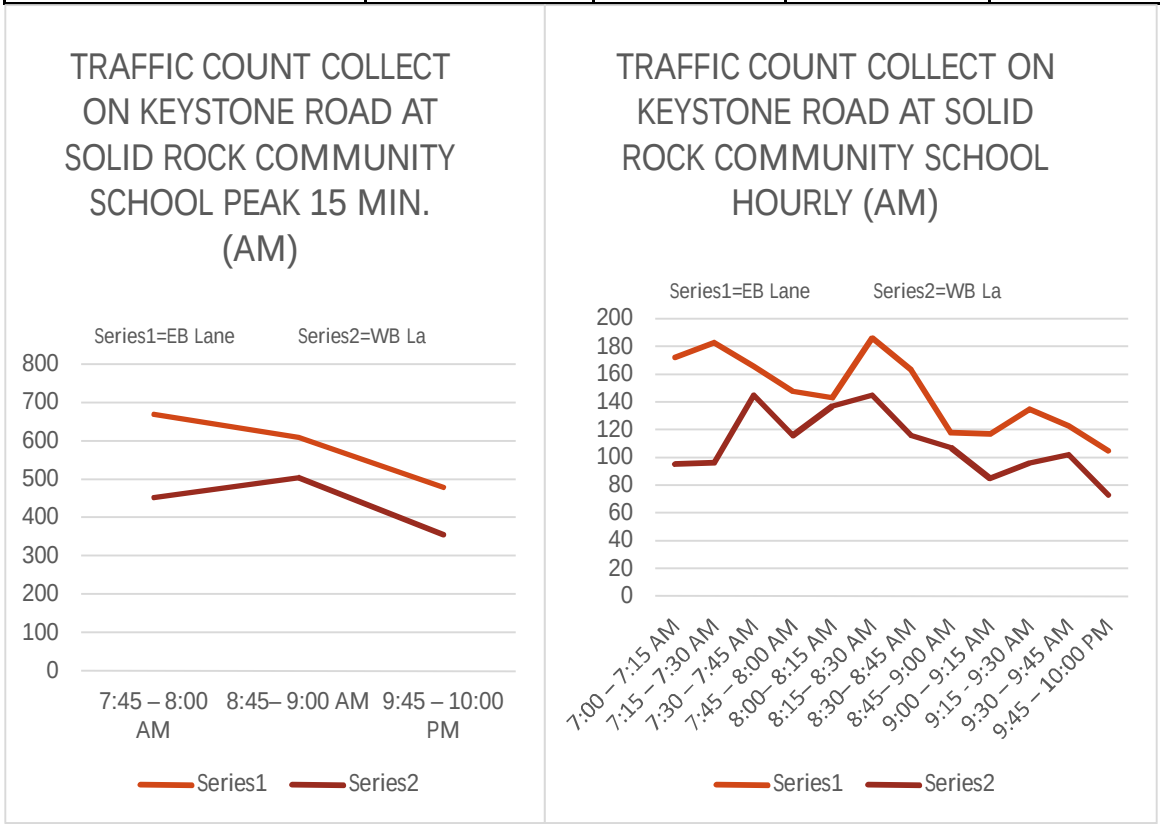
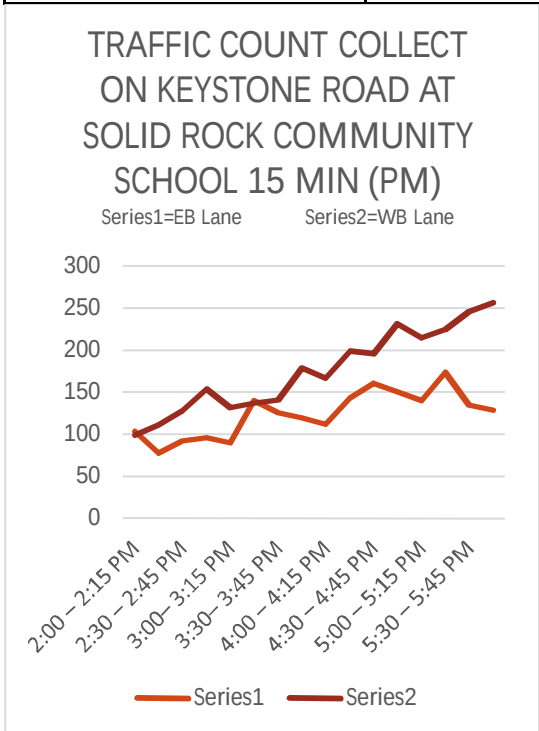



**FIGURE 5: AM HOURLY TRAFFIC DATA COLLECTED**

**TABLE 5 - TRAFFIC COUNT COLLECTED & PEAK HOURLY TRAFFIC**
**15 MIN INTERVALS W/ PEAK HOUR AM COUNT**

December 17, 2015 - 7:00-10:00 AM

| Time | Eastbound (EB) Lane | | Westbound (WB) Lane | |
|---|---|---|---|---|
| 2:00 – 2:15 PM | 104 | | 99 | |
| 2:15 – 2:30 PM | 78 | | 111 | |
| 2:30 – 2:45 PM | **92** | | **128** | |
| 2:45 – 3:00 PM | **96** | 370 | **154** | 492 |
| 3:00– 3:15 PM | **90** | | **132** | |
| 3:15– 3:30 PM | **140** | **418** | **137** | **551** |
| 3:30– 3:45 PM | 126 | | 141 | |
| 3:45– 3:00 PM | 120 | 476 | 179 | 589 |
| 4:00 – 4:15 PM | 112 | | 167 | |
| 4:15 - 4:30 PM | 143 | | 199 | |
| 4:30 – 4:45 PM | 161 | | 196 | |
| 4:45 – 5:00 PM | 151 | 567 | 232 | 794 |
| 5:00 – 5:15 PM | 140 | | 215 | |
| 5:15 – 5:30 PM | 174 | | 225 | |
| 5:30 – 5:45 PM | 135 | | 246 | |
| 5:45 – 6:00 PM | 129 | 578 | 257 | 943 |



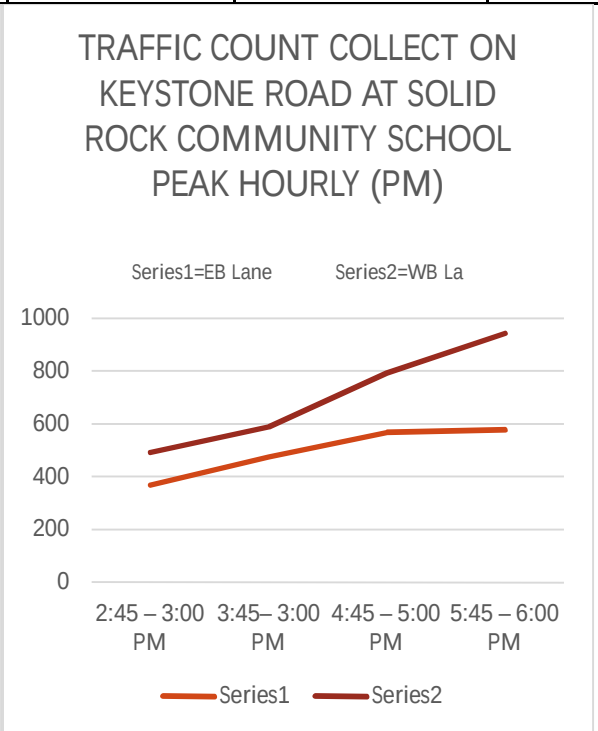




**FIGURE 6: PM HOURLY TRAFFIC DATA COLLECTED**

## III. TRIP GENERATION

Traffic volumes generated by the project were estimated using the appropriate equations published in the Institute of Transportation Engineers' (ITE), Trip Generation Manual (9th Edition). ITE Land Use Code #536 was used for students and staff. Private schools in this land use category primarily serve students attending kindergarten through the 12th grade but may also include those beginning with pre–K classes. These schools may also offer extended care and day care. Students may travel a long distance to get to private schools.

A school typically has three peak periods which may be evaluated. The first is the AM peak period which corresponds to the peak period of adjacent street traffic on Keystone Road 7-9 AM. School starts at 8:30 am and released at 3:00 pm; which adheres with most elementary schools dismissing students between 2 and 4 PM, outside the traditional PM peak period of 4-6 PM. Therefore, there are separate trip generation calculations for the peak hour of the generator, which corresponds with student dismissal, and the peak hour of the adjacent street, which occurs between 4 and 6 PM. The trip generation is lower for the 4-6 PM period as the traffic associated with this timeframe is typically related to staff and extracurricular activities.

The school anticipates only 2 to 3 private buses transporting students to after-school care. There are no traditional public school buses anticipated transporting students to and from school. For the purpose of this analysis, 8 students per private aftercare transport is being assumed with 24 students for private bus and 376 students for parent pickup. Trip Generation is summarized in **Table 6, 7 & 8.** The existing residential subdivision is included crediting the proposed development towards trips generated. Per County staff it is anticipated that the PM Peak period be studied, since the majority of parent's stage right before or after dismissal. With credit given for the existing development, Solid Rock Community school anticipates 197 enter and 123 exit AM Peak Hour trips along with 94 enter and133 exit trips for PM Peak periods per ITE 9$^{th}$ edition.

| TABLE 6 - EXISTING LAND-USE TRIP GENERATION RATE | | | | | |
|---|---|---|---|---|---|
| LAND USE | INDEPENDENT VARIABLE (UNITS) | AM PEAK HOUR TRAFF | | PM PEAK HOUR TRAFF | |
| | | ENTER | EXIT | ENTER | EXIT |
| **210 - Single-Family Detached Housing** | 5 (dwelling units) | 1 | 3 | 3 | 2 |
| *Data Source; ITE Trip Generation Manual, 9th Edition and OTISS, Traffic Impact Study Software | | | | | |

| TABLE 7- PROPOSED LAND-USE TRIP GENERATION RATE | | | | | |
|---|---|---|---|---|---|
| LAND USE | INDEPENDENT VARIABLE (UNITS) | AM PEAK HOUR TRAFF | | PM PEAK HOUR TRAFF | |
| | | ENTER | EXIT | ENTER | EXIT |
| **536 - Private School (K-12)** | 400 (students) | 198 | 126 | 97 | 135 |
| *Data Source; ITE Trip Generation Manual, 9th Edition and OTISS, Traffic Impact Study Software | | | | | |

| TABLE 8- NET NEW TRIPS PROPOSED VS. EXISTING CREDIT | | | | | |
|---|---|---|---|---|---|
| LAND USE | INDEPENDENT VARIABLE (UNITS) | AM PEAK HOUR TRAFF | | PM PEAK HOUR TRAFF | |
| | | ENTER | EXIT | ENTER | EXIT |
| **536 - Private School (K-12)** | 400 (students) | 197 | 123 | 94 | 133 |
| *Data Source; ITE Trip Generation Manual, 9th Edition and OTISS, Traffic Impact Study Software | | | | | |

## IV. TRIP DISTRIBUTION & ROADWAY LEVEL OF SERVICE (LOS) ANALYSIS

The following two figures show the AM and PM proposed site traffic distribution onto Keystone Road and signalized intersection to the west (East Lake Road and Keystone Road). A traffic distribution percentages have been determined based on owner input and engineering judgement (**Figure 7 & 8**).

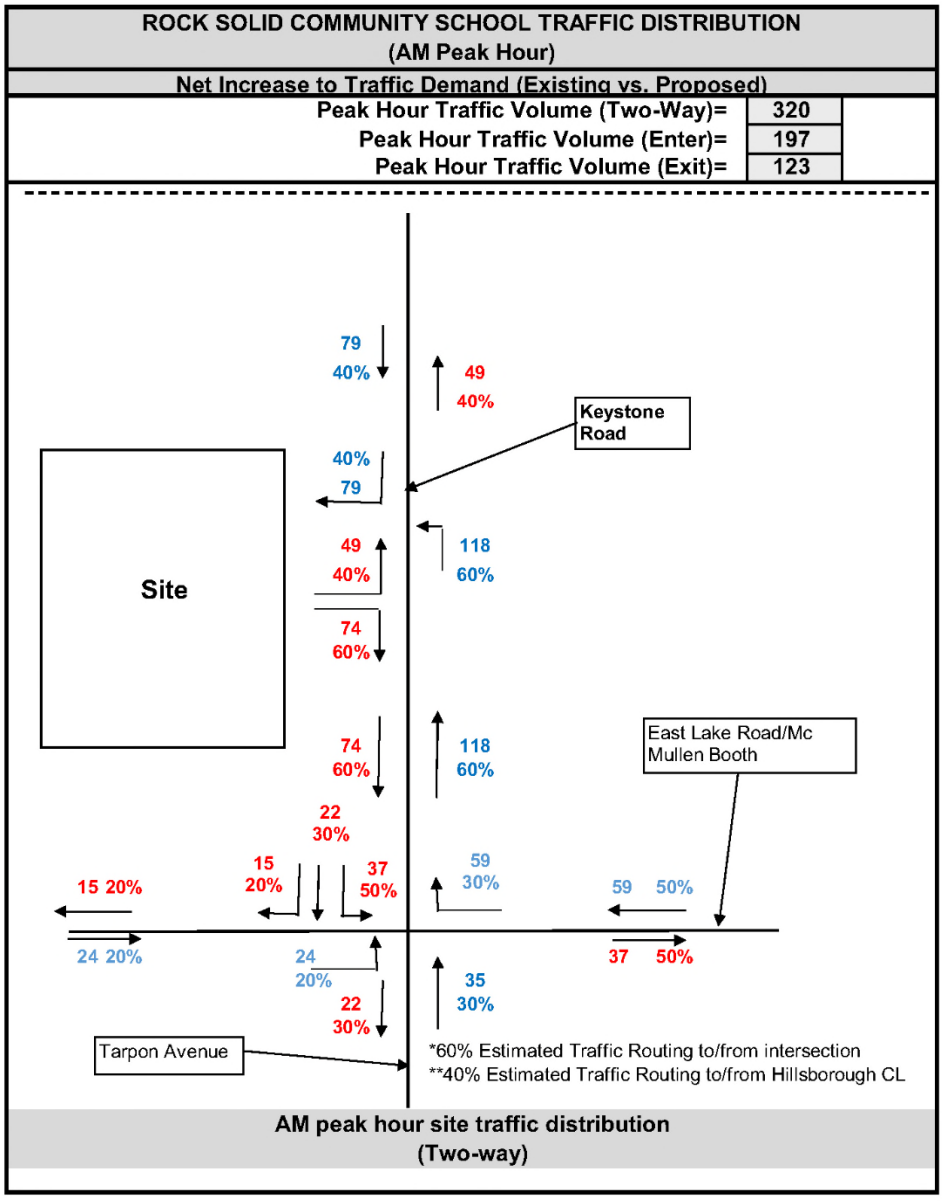



**FIGURE 7 – AM PEAK HOUR TRAFFIC DISTRIBUTION**

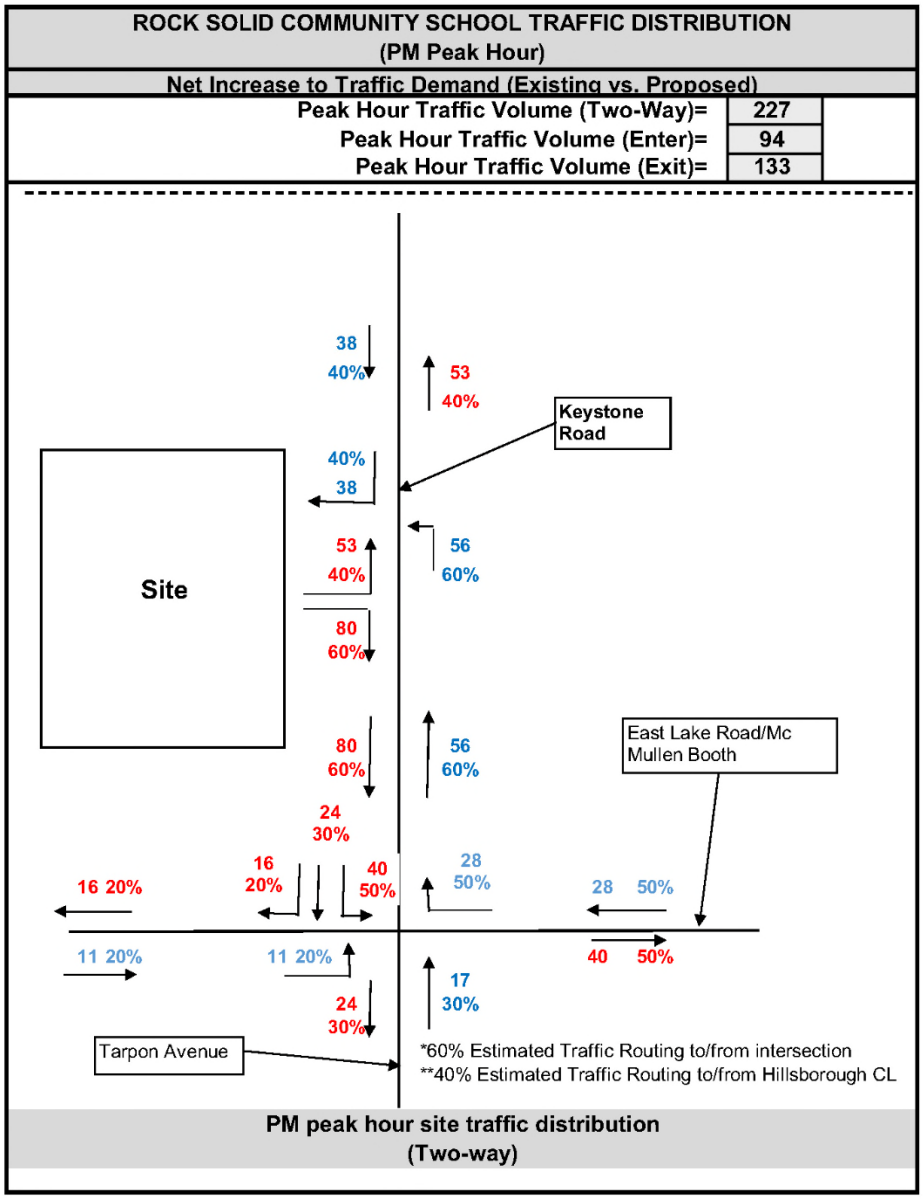



**FIGURE 8 – AM PEAK HOUR TRAFFIC DISTRIBUTION**

**Future Conditions - Keystone Road Level of Service (LOS) Analysis**

The school is anticipated to open in Spring of 2017. Future year, non-development background traffic was determined by applying an annual growth rate of 2% to the existing traffic volumes. Future traffic conditions were estimated by adding project traffic to background traffic volumes. Project traffic was estimated and distributed to the roadway network using the methods previously discussed. **Table 9** lists the LOS for Keystone Road between Hillsborough county line to Woodfield Blvd. This information is from the Pinellas County MPO 2015 Level of Service Report Facility link #802. This report indicates that Keystone Road at the proposed site is currently operating at an acceptable level of service (LOS) C during the PM peak hour direction (WB). **Table 10** illustrates the future LOS with the proposed peak hour site traffic during PM hourly peak period. Based on the analysis Keystone Road is anticipated to operate at or above the adopted Level of Service 'C'. Therefore, no impact mitigation will be required.

**TABLE 9 – EXISTING KEYSTONE ROAD LEVEL OF SERVICE (LOS)**

| Roadway Name | Segment (From/To) | LOS | Length | AADT | WB Peak Hour, Peak Direction Volume | Physical Capacity (LOS C) | Volume to Capacity Ratio |
|---|---|---|---|---|---|---|---|
| **# 802 - KEYSTONE RD** | **(HILLSBOROUGH CL to WOODFIELD BLVD)** | **C** | **2.301 Miles** | **11,722** | **622** | **1,440** | **0.425** |

*Service volume data received from Pinellas County MPO 2015 Level of Service Report Facility #802

**TABLE 10 - SOLID ROCK COMMUNITY SCHOOL - PM PEAK HR. LOS IMPACTS (TRIPS TO SITE)**

| Roadway Name | Segment (From/To) | Peak Hour Traffic Direction | Peak Hour Projected Development Trips Increase (Peak Direction) | WB Peak Hour Peak, Peak Dir. Volume | Total WB Peak Hour Peak, Peak Dir. w/ Site Traffic Volume | WB Peak Hour, Peak Dir. Physical Capacity, Service Volume (LOS C) | WB Peak Hour, Peak Dir. LOS w/ Site Traffic | % Peak Hour Peak Dir. Service Volume Impacted | Volume to Capacity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| **KEYSTONE ROAD** | **SITE TO HILLSBOROUGH CL** | WB | 38 | 622 | 660 | 1440 | C | 2.61% | 0.458 |
| **KEYSTONE ROAD** | **SITE TO EAST LAKE ROAD** | WB | 80 | 622 | 702 | 1440 | C | 5.54% | 0.487 |

*Existing traffic volumes and service volume data received from Pinellas County MPO 2015 Level of Service Report Facility #802

*ITE Land-Use #536 - Private School (K-12)

**KEYSTONE ROAD INTERSECTION LEVEL OF SERVICE (LOS) ANALYSIS**

An intersection analysis has been performed based on 2017 background traffic and proposed eastbound (EB) and westbound (WB) site traffic during the AM and PM peak hours. The analysis was performed using Synchro software, based on the highway Capacity Manual (HCM) criteria for Unsignalized Intersections (**Figures 9, 10, 11, 12**).

FIGURE 9

**Keystone Rd at Solid Rock Driveway AM Peak Hr Intersection Analysis**
**AM Peak Hr Traffic Volumes** **12/21/2015**

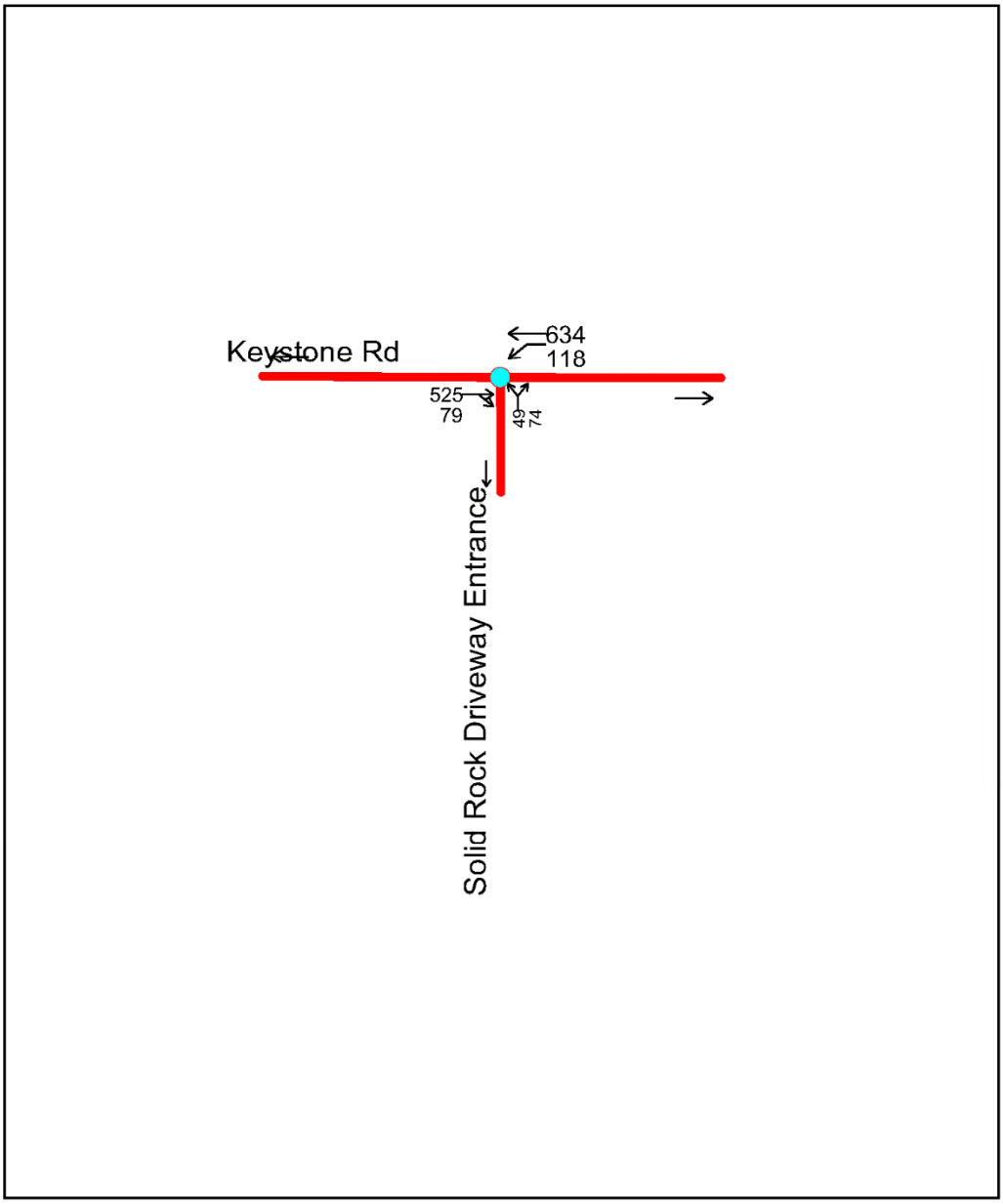



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FIGURE 10

Keystone Rd at Solid Rock Community School Driveway
AM Peak Hr LOS Analysis 12/21/2015

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Sign Control | Free | | | Free | Stop | |
| Grade | 0% | | | 0% | 0% | |
| Volume (veh/h) | 525 | 79 | 118 | 634 | 49 | 74 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 571 | 86 | 128 | 689 | 53 | 80 |
| Pedestrians | | | | | | |
| Lane Width (ft) | | | | | | |
| Walking Speed (ft/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh) | | | | | | |
| Upstream signal (ft) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | | | 657 | | 1559 | 614 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | | | 657 | | 1559 | 614 |
| tC, single (s) | | | 4.1 | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | | | 2.2 | | 3.5 | 3.3 |
| p0 queue free % | | | 86 | | 50 | 84 |
| cM capacity (veh/h) | | | 931 | | 107 | 492 |

| Direction, Lane # | EB 1 | WB 1 | WB 2 | NB 1 |
|---|---|---|---|---|
| Volume Total | 657 | 128 | 689 | 134 |
| Volume Left | 0 | 128 | 0 | 53 |
| Volume Right | 86 | 0 | 0 | 80 |
| cSH | 1700 | 931 | 1700 | 202 |
| Volume to Capacity | 0.39 | 0.14 | 0.41 | 0.66 |
| Queue Length 95th (ft) | 0 | 12 | 0 | 100 |
| Control Delay (s) | 0.0 | 9.5 | 0.0 | 52.3 |
| Lane LOS | | A | | F |
| Approach Delay (s) | 0.0 | 1.5 | | 52.3 |
| Approach LOS | | | | F |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 5.1 | | |
| Intersection Capacity Utilization | 56.2% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |

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Synchro Unsignalized Intersection Report
Based on HCM delay criteria

FIGURE 11

**Keystone Rd at Solid Rock Driveway PM Peak Hr Intersection Analysis**
**PM Peak Hr Traffic Volumes** **12/21/2015**

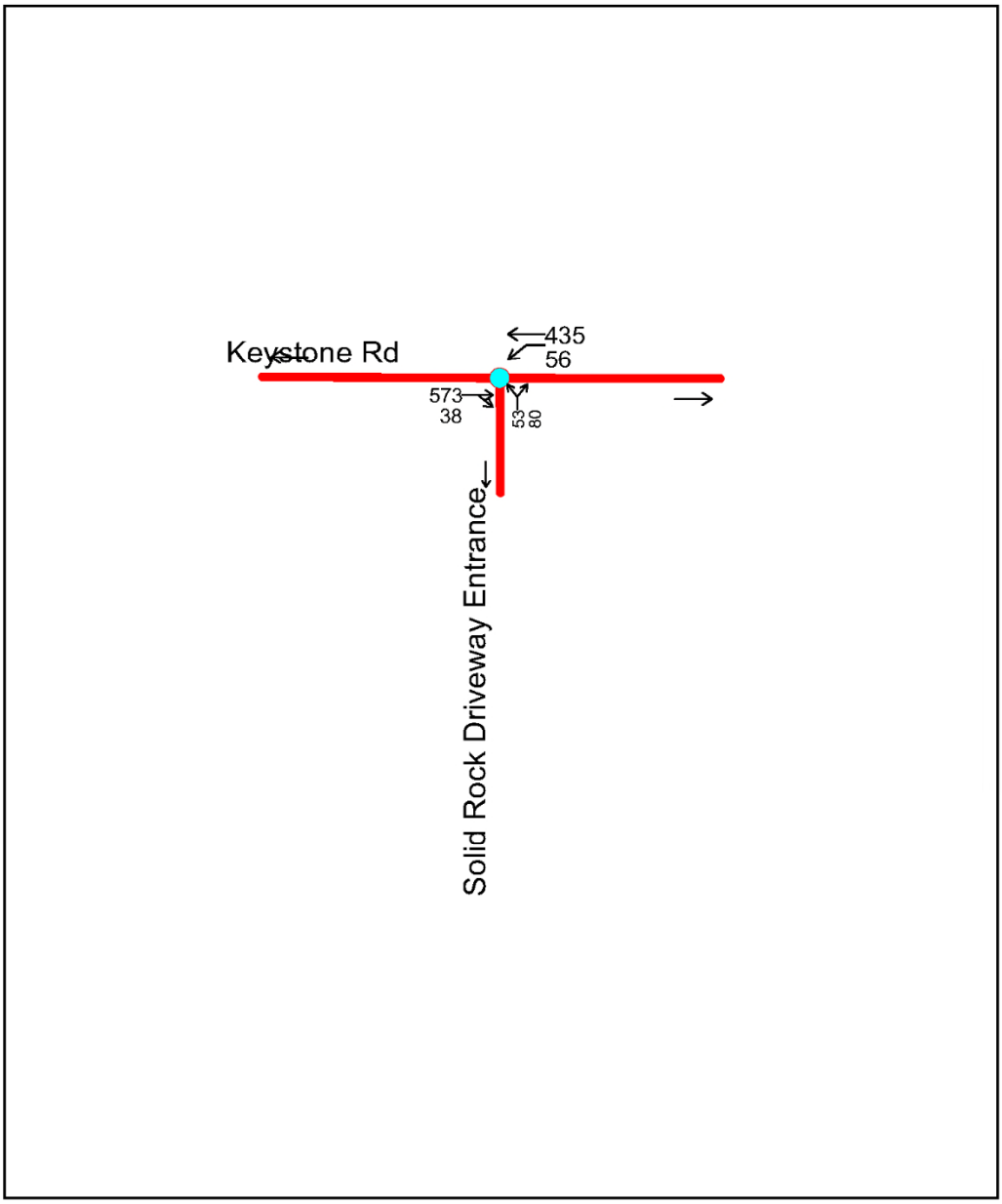


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FIGURE 12

Keystone Rd at Solid Rock Community School Driveway
PM Peak Hr LOS Analysis 12/21/2015

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Sign Control | Free | | | Free | Stop | |
| Grade | 0% | | | 0% | 0% | |
| Volume (veh/h) | 573 | 38 | 56 | 435 | 53 | 80 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 623 | 41 | 61 | 473 | 58 | 87 |
| Pedestrians | | | | | | |
| Lane Width (ft) | | | | | | |
| Walking Speed (ft/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh) | | | | | | |
| Upstream signal (ft) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | | | 664 | | 1238 | 643 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | | | 664 | | 1238 | 643 |
| tC, single (s) | | | 4.1 | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | | | 2.2 | | 3.5 | 3.3 |
| p0 queue free % | | | 93 | | 68 | 82 |
| cM capacity (veh/h) | | | 925 | | 181 | 473 |

| Direction, Lane # | EB 1 | WB 1 | WB 2 | NB 1 |
|---|---|---|---|---|
| Volume Total | 664 | 61 | 473 | 145 |
| Volume Left | 0 | 61 | 0 | 58 |
| Volume Right | 41 | 0 | 0 | 87 |
| cSH | 1700 | 925 | 1700 | 288 |
| Volume to Capacity | 0.39 | 0.07 | 0.28 | 0.50 |
| Queue Length 95th (ft) | 0 | 5 | 0 | 66 |
| Control Delay (s) | 0.0 | 9.2 | 0.0 | 29.4 |
| Lane LOS | | A | | D |
| Approach Delay (s) | 0.0 | 1.0 | | 29.4 |
| Approach LOS | | | | D |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 3.6 | | |
| Intersection Capacity Utilization | 53.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

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Synchro Unsignalized Intersection Report
Based on HCM delay criteria

| TABLE 11 – AM PEAK HOUR INTERSECTION DELAY | | | |
|---|---|---|---|
| **Intersection** | **Existing Traffic Control Type** | **Overall Intersection Delay (Sec/Vehicle)** | **Overall Intersection LOS** |
| Keystone Road at Solid Rock School Entrance | Unsignalized Stop Sign Condition | 5.1 | B |

| TABLE 12 – PM PEAK HOUR INTERSECTION DELAY | | | |
|---|---|---|---|
| **Intersection** | **Existing Traffic Control Type** | **Overall Intersection Delay (Sec/Vehicle)** | **Overall Intersection LOS** |
| Keystone Road at Solid Rock School Entrance | Unsignalized Stop Sign Condition | 3.6 | A |

Overall the intersection operates no worse than a LOS B during the AM peak hour. This is an acceptable level of service for this intersection. There are no obvious delays for Keystone Road's capacity and traffic (**Table 11 & 12**).

## VI. CIRCULATION AND QUEUE ANALYSIS

A queue analysis was performed to determine if on-site storage was adequate or if a staggered dismissal should be considered. The queue analysis was performed for dismissal only, since that is when parents are likely to queue on-site waiting for their child to be released. The Sustainability Group observed Athenian Academy at 2289 North Hercules Avenue, Clearwater, FL as a comparable use. A field study was conducted during a typical school day from start to finish of dismissal time to evaluate the on-site queuing/stacking conditions, bus patterns and other dismissal procedures. Field observations were conducted as well.

At the time of the observations, the observed school's start is at 8:15 AM with a dismissal time of 3:15 PM; the enrollment is approximately 400 students, with bus services provided by two (2) buses for public transportation for approximately 90 students. For the purposes of the analysis, all students not transported by bus were assumed to be "car riders" picked up by a parent or car pool.

The location studied; storage for the vehicles entering the site to pick up children was provided by two (2) queue lines starting at the driveway connection on Hercules Avenue wrapping behind the building and around the northern façade to the parent pick-up and drop-off location. The parent drop-off and pick-up location contains room for (7) stacked vehicles for loading/unlading purposes. Standard procedures included: a child school number tag in each vehicle entering the on-site queue area, which was displayed in the windshield of each vehicle. Staff called out the student number via radio to staff standing

within the drop-off/pick-up location. There was only one pick-up lane being utilized loading seven cars at a time to facilitate a faster dismissal, while keeping the queue stacking area moving. There were two public buses onsite within the front parking area transporting approximately 90 students. Athenian Academy has staff placed through-out the site directing parents to the pick-up car lines and signage stating the "Every Other Car Rule"

The field visit was conducted on Thursday, December 17, 2015, from 7:00 - 8:30 AM for morning drop-off. Afternoon pick-up was observed between 2:00 - 4:00 PM. The peak hourly queue was observed in the afternoon during parent pick-up between 3:00 - 3:15 PM. The field visit observed vehicles started stacking within the queue area around 2:00 pm. The maximum queue was observed was at 3:30 pm, with lines starting to move at 3:15 pm upon release. The line started dissipating quickly with all children picked up by 3:40 PM. The following summarizes the number of vehicles observed in each line at different intervals.

**TABLE 13 - On-site Stacking Observations**
**Athenian Academy Charter School — Hercules Avenue, Pinellas County**

| Time | Number of Cars Stacked within Queue Area (2 Lanes) |
|---|---|
| 2:00-2:15 pm | 2 |
| 2:15-2:30 pm | 8 |
| 2:30-2:45 pm | 16 |
| 2:45-3:00 pm | 36 |
| 3:00-*3:15pm | 54 |
| ****3:15-3:30 pm** | **75** |
| 3:30-3:45 pm | 2 |
| *Student Release<br>**The maximum observed queue was 75 vehicles (total for both lanes). An exhibit indicating the on-site flow pattern and maximum queue and the field observations is attached in Appendix. | |

**TABLE 14 – Observed Site Queue Summary**
**Athenian Academy Charter School — Hercules Avenue, Pinellas County**

| | | Notes |
|---|---|---|
| **Number of Students Enrolled at Time of Study** | 400 Students | 90 Students by Bus & 310 Car Riders |

| | | |
|---|---|---|
| **Maximum Queue Observed** | 75 Vehicles | Total for (2) Queue lanes observed between 3:30 and 3:15 pm |
| **Queue Rate per Pick-up Student** | 0.2419 | Calculation: 75 Vehicles Queued / 310 Car Riders |

Considering that approximately 90 students were provided bus service 310 students were accommodated through the pick-up line (car riders). The maximum queue of 75 vehicles (for the two lanes combined) calculates to a queue ratio of 0.2419 vehicles per car riding student. This ratio was applied to the car-riding students anticipated at the proposed school.

**Proposed Conditions:**

It is anticipated that the campus hours are from 7 AM to 5 PM daily for staff, before and after care services. Classes start at 8:30 AM with dismissal at 3:00 PM daily. Parents dropping off kids will be directed by on-site signage to parents at designated areas on-site. Solid Rock Community School currently has two buses associated with after school recreational activities. Private afterschool buses that provide services will be treated as traditional vehicles queuing on-site for pick-up and drop-off, which is standard at most public or private institutions.

The drop-off/pick up lane is anticipated to accommodate the queuing of vehicles during school dismissal with two circulation lanes throughout the site for queuing (stacking) (**Figure 13**). Upon student registration pamphlets and a campus map will be given to each parent for pick-up and drop-off instructions. School staff will be located throughout the site directing vehicles into pick-up line queueing areas. On-site staff will direct vehicles into designated queueing areas. Every parent will be given a placard to display in the windshield identifying the children they are to picking up. Staff communicates via 2-way radios so that individual children are ready and available when the parent reaches the pick-up point. A number of vehicles are stopped and children are loaded simultaneously, each lane is then dismissed one at a time, after all of the children are in a vehicle. Once all of the lanes have been dismissed, the queue is advanced to minimize conflict between pedestrians, stacking and moving vehicles. Onsite signage will be placed throughout the site letting parents know the pick-up route and every other car rule (Figure 14).

**TABLE 15 – Proposed Site Queue Summary at Full Build for Solid Rock Community School**

| | | Notes |
|---|---|---|
| Proposed Student Enrollment | 400 Students | 400 Student Car Riders |
| Maximum Vehicle Queue Anticipated | 97 Vehicles | 0.2419 vehicles/pick-up student observed at existing site |
| Estimated Stacking Required Based on Current School Site Data (FT.) | 2,425 feet | 25 feet per vehicle |
| **Storage Available** | **2,575 feet**<br>**103 Vehicles** | Total in all lanes. Double Stacking through the parking lot and single stacking down existing road with signage (2,575 LF/25 ft. per vehicle) |
| Based upon this analysis, the proposed site can accommodate approximately 103 vehicles stacked on site through the circulation lanes. It appears that with the proposed one-way circulation, the stacking available on-site may be adequate at full capacity. **Figure 13** shows the proposed circulation patterns for the school. Periodic field observations to observe conditions and make potential adjustments to arrival and dismissal procedures may be recommended to ensure efficient operations. Staff and Pick-up/Drop-off Line Signage will be posted on-site. One-way circulation will be provided only during pick-up hours in the afternoon by staff. | | |

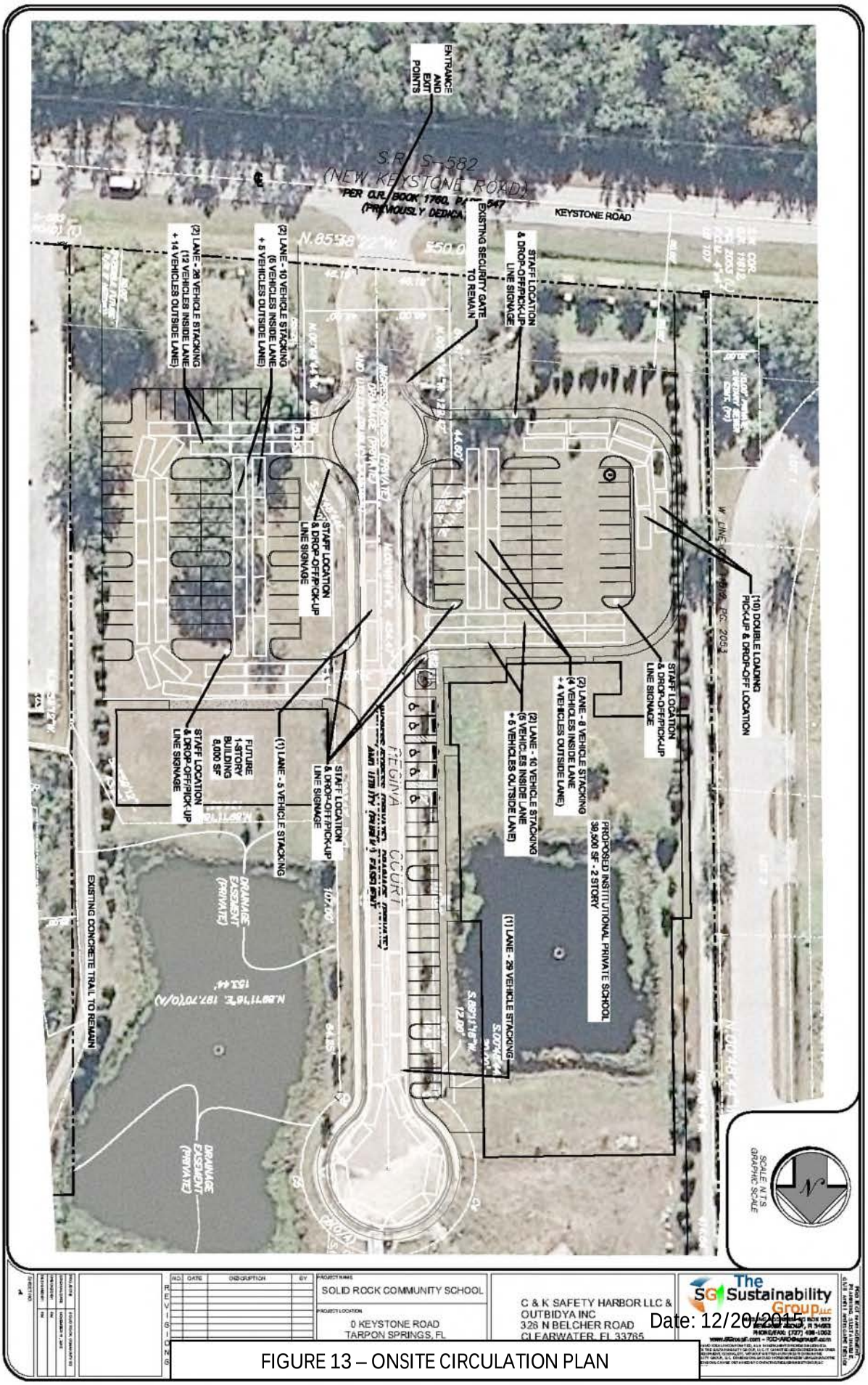



FIGURE 13 – ONSITE CIRCULATION PLAN


**FIGURE 14 – PROPOSED ONSITE SIGNAGE FOR STUDENT DROP OFF/ PICK UP LANES**

## V. EB LEFT TURN AND RIGHT TURN WARRANT ANALYSIS

The proposed school will have access to and from Keystone Road by one (1) 24 ft. wide driveway. A one-way circulation pattern is proposed during the pick-up peak hourly flow, with entry via both the northern and southern driveways and exit via the northern driveway only. Staff will place cones and signage will be installed onsite directing parents to designated queueing areas ensuring the 'every other car' rule and school rules are followed.

A turn lane analysis was performed for the AM and PM Peak Hourly conditions for left turn movement into the site (**Figures 15-19**). The analysis is being provided as required by Pinellas County staff and Transportation Research Board per NCHRP 193 and 745 guidelines.

The result analysis recommends an eastbound left turn lane is provided into the site. This is due to the fact it meets the warrant criteria per NCHRP 193 and 745. This is a result of the high hourly traffic volumes along Keystone Road and high left turn peak hour trips for the proposed private school. We recommend an exclusive left turn lane will be designed per FDOT Index #301 standards and AASHTO Green Book Standards for a 50 MPH design speed, the turn lane length will need to be 290 feet with a maximum queue of 100 feet (NCHRP 745 recommends 50 ft. queue based on site traffic volumes). As a result, a 390 foot turn lane length will be required along with a through-lane taper of 600 feet for a 12 foot offset towards the south per AASHTO Green Book standards. The final left turn lane configuration will be determined during preparation of construction document and staff input during the required Pre-Application meeting.

## Left Turn Lane Warrants

Input Fields

| | | | |
|---|---|---|---|
| Left Turn Volume (vph) | 56 | Speed Limit (mph) | 45 |
| Advancing Volume (vph) | 435 | No. of through lanes | 0 |
| Opposing Volume (vph) | 611 | Percent Heavy Vehicles (decimal percent) | 0.05 |

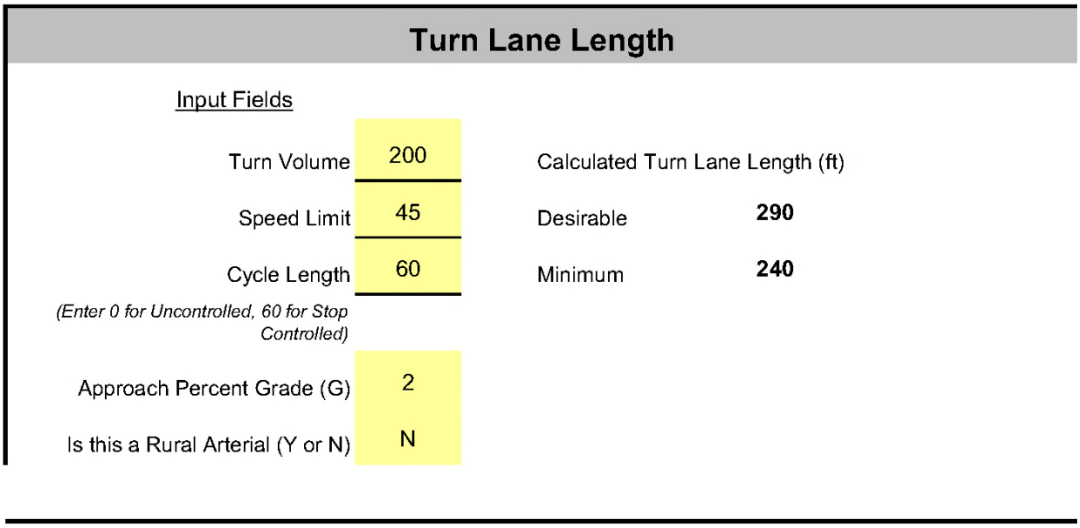

**FIGURE 15 – LEFT TURN LANE ANALYSIS AM PEAK HOUR**

## Left Turn Lane Warrants

Input Fields

| | | | |
|---|---|---|---|
| Left Turn Volume (vph) | 56 | Speed Limit (mph) | 45 |
| Advancing Volume (vph) | 427 | No. of through lanes | 0 |
| Opposing Volume (vph) | 562 | Percent Heavy Vehicles (decimal percent) | 0.05 |


**FIGURE 16 – LEFT TURN LANE ANALYSIS PM PEAK HOUR**



**Turn Lane Length**

Input Fields

| | | | |
|---|---|---|---|
| Turn Volume | 200 | Calculated Turn Lane Length (ft) | |
| Speed Limit | 45 | Desirable | **290** |
| Cycle Length | 60 | Minimum | **240** |
| *(Enter 0 for Uncontrolled, 60 for Stop Controlled)* | | | |
| Approach Percent Grade (G) | 2 | | |
| Is this a Rural Arterial (Y or N) | N | | |

**FIGURE 17 – LEFT TURN LANE PEAK HOUR RECOMMENDED LENGTH**

## Right Turn Lane Warrants

Input Fields

| | | | |
|---|---|---|---|
| Right Turn Volume (vph) | 79 | Speed Limit (mph) | 45 |
| Advancing Volume (vph) | 607 | | |


**FIGURE 18 – RIGHT TURN LANE ANALYSIS AM PEAK HOUR**

## Right Turn Lane Warrants

Input Fields

| | | | |
|---|---|---|---|
| Right Turn Volume (vph) | 56 | Speed Limit (mph) | 45 |
| Advancing Volume (vph) | 427 | | |


**FIGURE 19 – RIGHT TURN LANE ANALYSIS PM PEAK HOUR**

# VI. CONCLUSION

Keystone Road is anticipated to operate at or above the adopted level of service (LOS). The traffic analysis also shows that an eastbound left turn lane is warranted into the project. In addition, the intersection will operate at an acceptable level of service (LOS). The onsite queueing will not cause any traffic backing onto Keystone Road or the right-of-way. Periodic field observations are recommended to determine if adjustments to school procedures are necessary to maintain traffic conditions. School traffic may likely result in congestion for a 15 to 30-minute period during arrival and dismissal times.

Arrival time will coincide with the AM Peak Hour and dismissal will occur outside of the traditional 4-6 PM Peak Hour, this congestion is consistent with delay experienced at other schools. An exclusive eastbound left turn lane with a deceleration lane of 290 feet plus a 100-foot queue area is recommended on Keystone Road per FDOT Index #301 for design speed at 50 MPH. A westbound exclusive right turn lane does not appear to be warranted at this time based upon NCHRP 193 & 745 guidelines. Copies of the warrant analyses are included (Figures 15-19).

# APPENDIX A

# TRIP GENERATION & DISTRIBUTION

| EXISTING LAND-USE TRIP GENERATION RATE | | | |
|---|---|---|---|
| **LAND USE** | **INDEPENDENT VARIABLE (UNITS)** | **AM PEAK HOUR TRAFF** | |
| | | **ENTER** | **EXIT** |
| **210 - Single-Family Detached Housing** | 5 (dwelling units) | 1 | 3 |
| *Data Source; ITE Trip Generation Manual, 9th Edition and OTISS, Traffic Impact Study Software | | | |

| PROPOSED LAND-USE TRIP GENERATION RATE | | | |
|---|---|---|---|
| **LAND USE** | **INDEPENDENT VARIABLE (UNITS)** | **AM PEAK HOUR TRAFF** | |
| | | **ENTER** | **EXIT** |
| **536 - Private School (K-12)** | 400 (students) | 198 | 126 |
| *Data Source; ITE Trip Generation Manual, 9th Edition and OTISS, Traffic Impact Study Software | | | |

| NET NEW TRIPS PROPOSED VS. EXISTING CREDIT | | | |
|---|---|---|---|
| **LAND USE** | **INDEPENDENT VARIABLE (UNITS)** | **AM PEAK HOUR TRAFF** | |
| | | **ENTER** | **EXIT** |
| **536 - Private School (K-12)** | 400 (students) | 197 | 123 |
| *Data Source; ITE Trip Generation Manual, 9th Edition and OTISS, Traffic Impact Study Software | | | |

# Private School (K-12)
## (536)

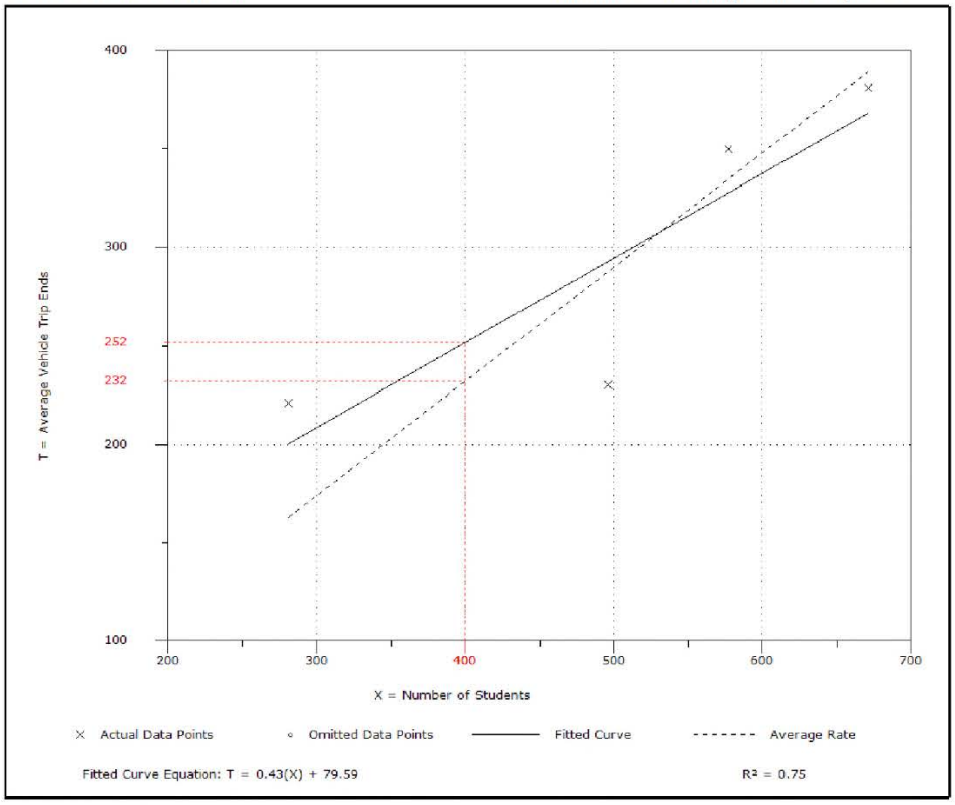
**Average Vehicle Trip Ends vs:** **Students**
**On a:** **Weekday**
**P.M. Peak Hour of Generator**

Number of Studies: 4
Average Number of Students: 506
Directional Distribution: 42% entering, 58% exiting

**Trip Generation per Student**

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.58 | 0.46 - 0.79 | 0.11 |

**Data Plot and Equation** ***Caution - Use Carefully - Small Sample Size***




*Trip Generation*, ITE-TGM 9th Edition

# Private School (K-12)
## (536)

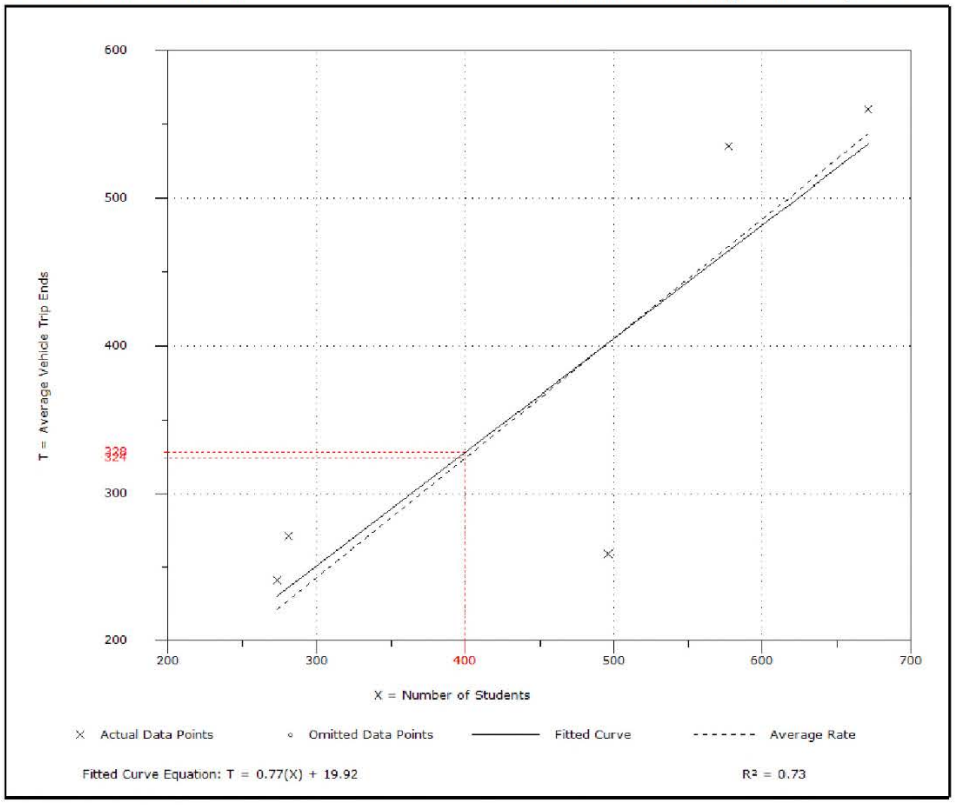
**Average Vehicle Trip Ends vs:** **Students**
**On a:** **Weekday**
**A.M. Peak Hour of Generator**

Number of Studies: 5
Average Number of Students: 460
Directional Distribution: 61% entering, 39% exiting

**Trip Generation per Student**

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.81 | 0.52 - 0.96 | 0.18 |

**Data Plot and Equation** ***Caution - Use Carefully - Small Sample Size***




*Trip Generation*, ITE-TGM 9th Edition

# Single-Family Detached Housing
## (210)

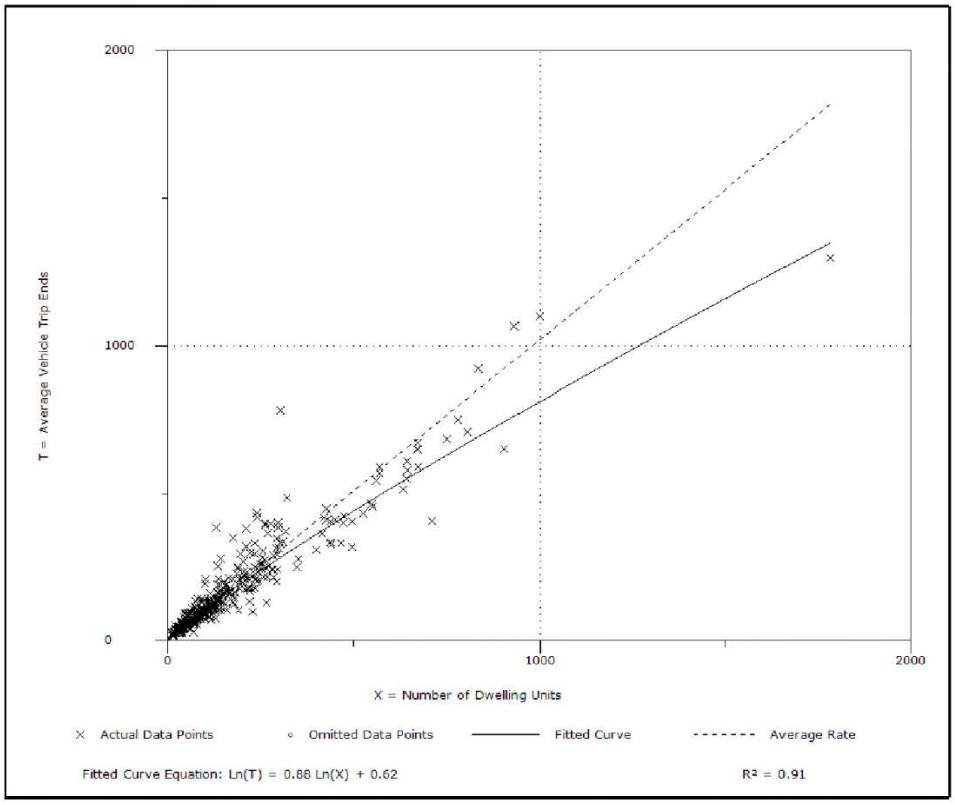
**Average Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Weekday**
**P.M. Peak Hour of Generator**

Number of Studies: 362
Avg. Number of Dwelling Units: 174
Directional Distribution: 64% entering, 36% exiting

**Trip Generation per Dwelling Unit**

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 1.02 | 0.42 - 2.98 | 0.30 |

**Data Plot and Equation**




*Trip Generation*, ITE-TGM 9th Edition

# Single-Family Detached Housing
## (210)

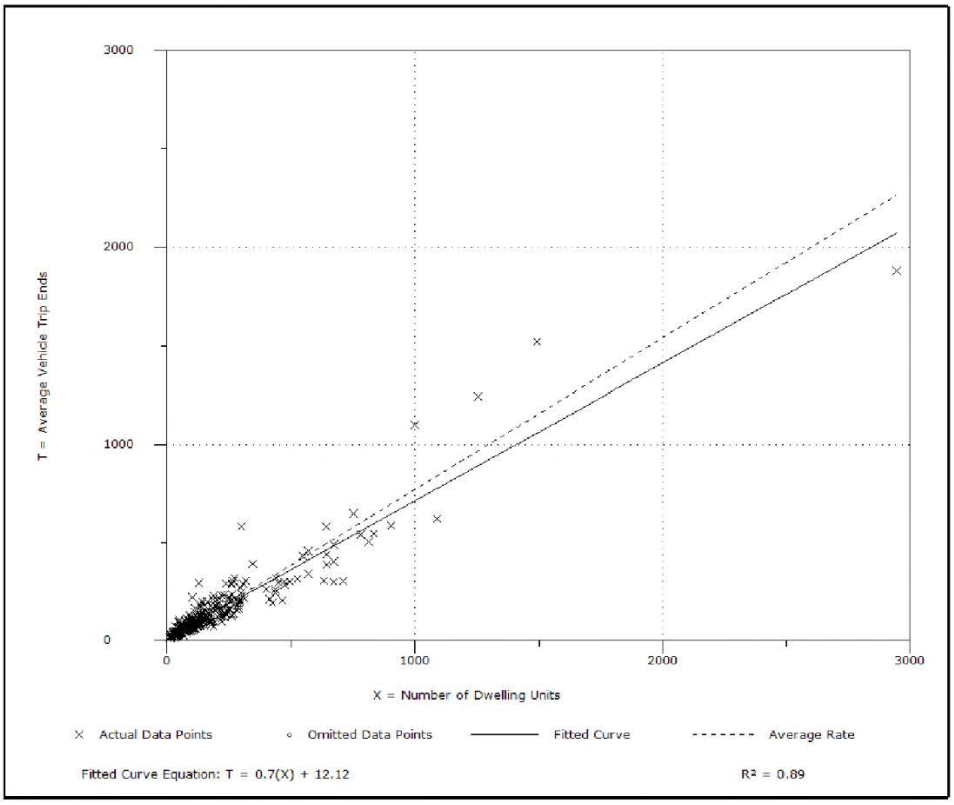
**Average Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Weekday**
**A.M. Peak Hour of Generator**

Number of Studies: 343
Avg. Number of Dwelling Units: 180
Directional Distribution: 26% entering, 74% exiting

**Trip Generation per Dwelling Unit**

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.77 | 0.33 - 2.27 | 0.26 |

**Data Plot and Equation**



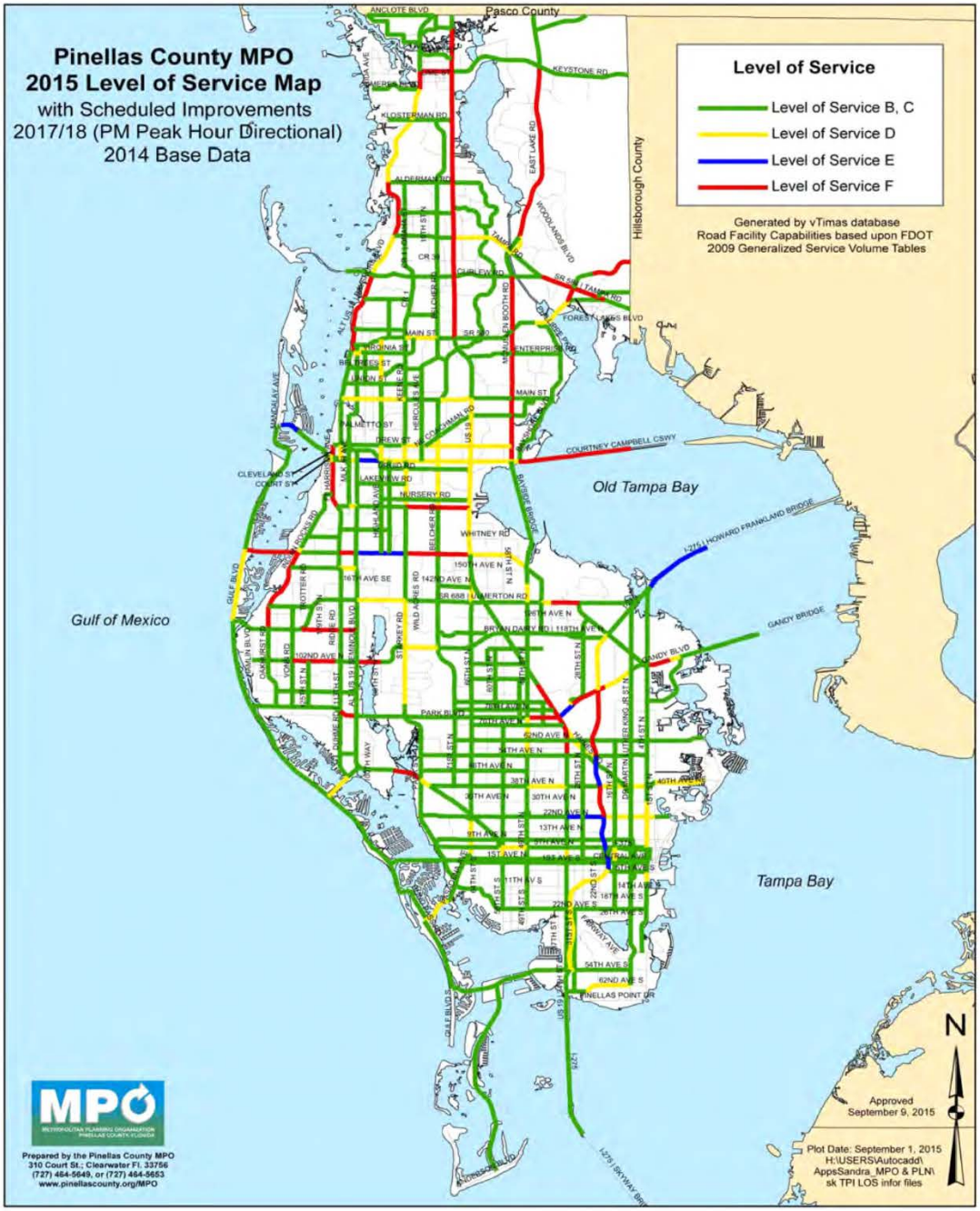

*Trip Generation*, ITE-TGM 9th Edition

# APPENDIX B TRAFFIC COLLECTED COUNTS & ROADWAY DATA

| TRAFFIC COUNT COLLECT ON KEYSTONE ROAD AT SOLID ROCK COMMUNITY SCHOOL<br>December 17, 2015 - 7:00-10:00 AM | | |
|---|---|---|
| **Time** | **Eastbound (EB) Lane** | **Westbound (WB) Lane** |
| 7:00 – 7:15 AM | 172 | 95 |
| 7:15 – 7:30 AM | 183 | 96 |
| 7:30 – 7:45 AM | 166 | 145 |
| 7:45 – 8:00 AM | 148 | 116 |
| 8:00– 8:15 AM | **143** | **137** |
| 8:15– 8:30 AM | **186** | **145** |
| 8:30– 8:45 AM | **163** | **116** |
| 8:45– 9:00 AM | **118** | **107** |
| 9:00 – 9:15 AM | 117 | 85 |
| 9:15 - 9:30 AM | 135 | 96 |
| 9:30 – 9:45 AM | 123 | 102 |
| 9:45 – 10:00 AM | 105 | 73 |

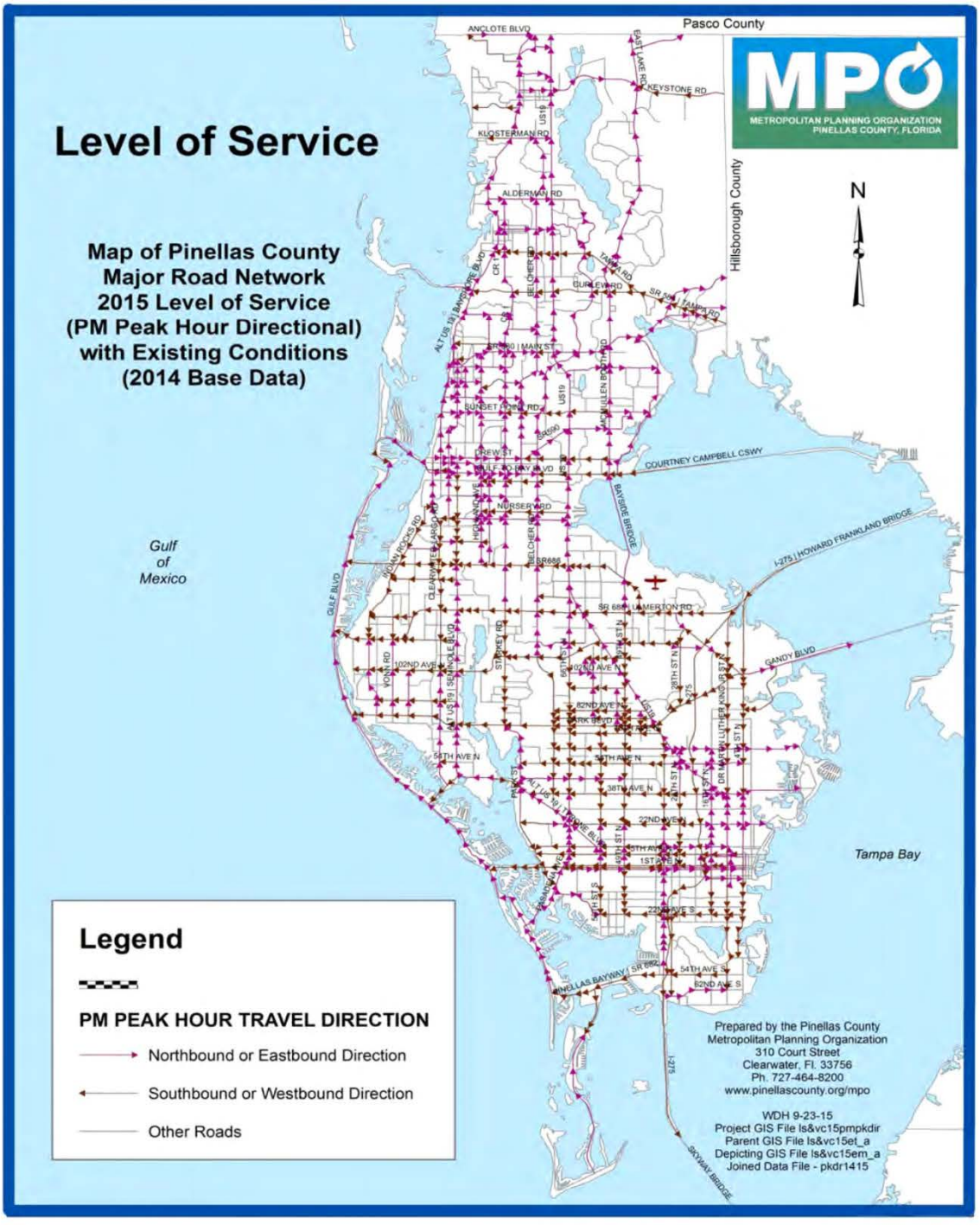
| TRAFFIC COUNT COLLECT ON KEYSTONE ROAD AT SOLID ROCK COMMUNITY SCHOOL<br>December 17, 2015 - 7:00-10:00 AM | | |
|---|---|---|
| **Time** | **Eastbound (EB) Lane** | **Westbound (WB) Lane** |
| 2:00 – 2:15 PM | 104 | 99 |
| 2:15 – 2:30 PM | 78 | 111 |
| 2:30 – 2:45 PM | **92** | **128** |
| 2:45 – 3:00 PM | **96** | **154** |
| 3:00– 3:15 PM | **90** | **132** |
| 3:15– 3:30 PM | **140** | **137** |
| 3:30– 3:45 PM | 126 | 141 |
| 3:45– 3:00 PM | 120 | 179 |
| 4:00 – 4:15 PM | 112 | 167 |
| 4:15 - 4:30 PM | 143 | 199 |
| 4:30 – 4:45 PM | 161 | 196 |
| 4:45 – 5:00 PM | 151 | 232 |
| 5:00 – 5:15 PM | 140 | 215 |
| 5:15 – 5:30 PM | 174 | 225 |
| 5:30 – 5:45 PM | 135 | 246 |
| 5:45 – 6:00 PM | 129 | 257 |

## Pinellas County Metropolitan Planning Organization

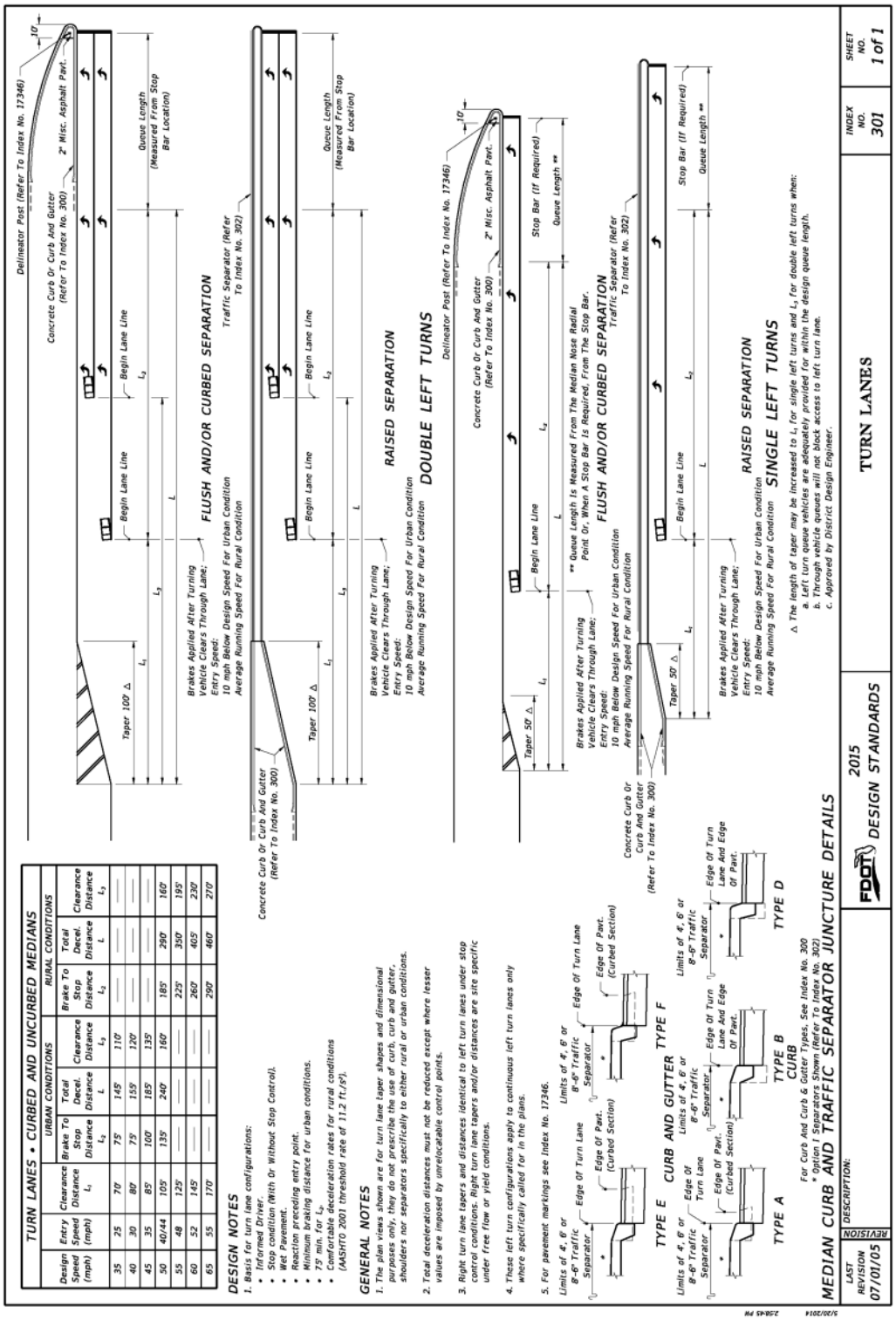


| Facility | Juris | Plan Area | Fac Type | Road Type | LOS Std | Length (mi) | Signals Per Mile | LOS Meth | AADT | Volume | Physical Capacity | V:Cap Ratio | Def Flag | Fac LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 770 - I-275: (54TH AVE N -to- 38TH AVE N) | SR | 11 | F | 8F | D | .948 | .00 | T | 155,500 | 7,954 | 8,400 | .947 | 2 | E |
| 771 - I-275: (PINELLAS SHORELINE -to- 4TH ST N) | SR | 11 | F | 8F | D | 2.220 | .00 | T | 152,000 | 7,775 | 8,400 | .926 | 2 | E |
| 772 - I-275: (38TH AVE N -to- 22ND AVE N) | SR | 11 | F | 6F | D | 1.027 | .00 | T | 153,500 | 7,852 | 6,200 | 1.266 | 2 | F |
| 773 - I-275: (4TH ST N -to- SR 686 \| ROOSEVELT BLVD) | SR | 11 | F | 8F | D | 2.040 | .00 | T | 107,260 | 5,486 | 8,400 | .653 | 0 | C |
| 774 - I-275: (I-375 -to- I-175) | SR | 11 | F | 6F | D | .441 | .00 | T | 118,000 | 6,036 | 6,200 | .974 | 2 | E |
| 775 - I-275: (22ND AVE N -to- I-375) | SR | 11 | F | 8F | D | 1.322 | .00 | T | 151,500 | 7,749 | 8,400 | .922 | 2 | E |
| 778 - I-375: (I-275 -to- 7TH ST N) | SR | 11 | F | 6F | D | 2.333 | .00 | T | 30,500 | 1,560 | 6,200 | .252 | 0 | B |
| 779 - INDIAN ROCKS RD: (BELLEVIEW BLVD -to- MEHLENBACHER RD) | BL | 07 | SA | 2U | D | 1.550 | .65 | T | 9,303 | 486 | 792 | .614 | 0 | C |
| 780 - INDIAN ROCKS RD: (MEHLENBACHER RD -to- SUNSET BLVD) | CR | 07 | NA | 2D | D | .432 | .00 | T | 9,303 | 486 | 1,512 | .321 | 0 | C |
| 781 - INDIAN ROCKS RD: (SUNSET BLVD -to- W BAY DR) | CR | 07 | SA | 4D | D | .142 | 7.04 | T | 13,128 | 686 | 1,530 | .448 | 0 | D |
| 782 - INDIAN ROCKS RD: (W BAY DR -to- WALSINGHAM RD) | CR | 07 | SA | 2U | D | 2.793 | 1.07 | T | 16,954 | 886 | 792 | 1.119 | 2 | F |
| 795 - KEENE RD: (E BAY DR -to- BELLEAIR RD) | CR | 07 | SA | 4D | D | 1.526 | 1.31 | T | 29,466 | 1,540 | 1,764 | .873 | 0 | C |
| 796 - KEENE RD: (BELLEAIR RD -to- DRUID RD) | CR | 06 | SA | 4D | D | 1.255 | 2.39 | T | 29,466 | 1,540 | 1,683 | .915 | 1 | D |
| 797 - KEENE RD: (DRUID RD -to- GULF-TO-BAY BLVD) | CR | 06 | SA | 6D | D | .252 | 3.97 | T | 29,466 | 1,540 | 2,547 | .605 | 0 | C |
| 798 - KEENE RD: (GULF-TO-BAY BLVD -to- DREW ST) | CR | 06 | SA | 6D | D | .393 | 5.09 | T | 28,822 | 1,506 | 2,313 | .651 | 0 | D |
| 799 - KEENE RD: (DREW ST -to- SUNSET POINT RD) | CR | 06 | SA | 4D | D | 1.518 | .66 | T | 26,048 | 1,361 | 1,764 | .772 | 0 | B |
| 800 - KEENE RD: (SUNSET POINT RD -to- SR 580) | CR | 04 | SA | 4D | D | 2.032 | 1.97 | T | 24,440 | 1,277 | 1,764 | .724 | 0 | B |
| 801 - KEYSTONE RD: (US 19 -to- EAST LAKE RD) | CR | 01 | SA | 4D | D | 2.995 | .67 | T | 25,698 | 1,343 | 1,764 | .761 | 0 | B |
| 802 - KEYSTONE RD: (HILLSBOROUGH CL -to- WOODFIELD BLVD) | CR | 02 | NA | 2U | D | 2.301 | .00 | T | 11,722 | 612 | 1,440 | .425 | 0 | C |
| 803 - KEYSTONE RD: (WOODFIELD BLVD -to- EAST LAKE RD) | CR | 02 | SA | 2U | D | .543 | 1.84 | T | 12,981 | 678 | 792 | .856 | 0 | C |
| 806 - KLOSTERMAN RD: (ALT US 19 -to- US 19) | CR | 01 | SA | 4D | D | 1.275 | 1.57 | T | 16,961 | 886 | 1,764 | .502 | 0 | B |
| 807 - KLOSTERMAN RD: (ALT US 19 -to- CARLTON RD) | CR | 01 | NA | 2U | D | .745 | .00 | T | 10,748 | 562 | 1,440 | .390 | 0 | C |
| 811 - LAKE AVE: (EAST BAY DR -to- BELLEAIR RD) | CR | 07 | SC | 2U | D | 1.534 | .65 | T | 3,379 | 177 | 572 | .309 | 0 | B |
| 812 - LAKE AVE: (BELLEAIR RD -to- GULF-TO-BAY BLVD) | CR | 06 | SC | 2U | D | 1.508 | 1.99 | T | 3,379 | 177 | 572 | .309 | 0 | B |
| 817 - LAKE ST GEORGE DR: (HIGHLANDS BLVD -to- TAMPA RD) | CR | 03 | NMC | 2U | D | .381 | .00 | T | 4,974 | 260 | 1,440 | .181 | 0 | B |
| 818 - LAKE ST GEORGE DR: (TAMPA RD -to- COUNTRYSIDE BLVD) | CR | 03 | SMC | 2U | D | 1.192 | .84 | T | 4,974 | 260 | 572 | .455 | 0 | B |
| 823 - LAKEVIEW RD: (MISSOURI AVE -to- KEENE RD) | CR | 06 | SA | 2U | D | 1.533 | 1.96 | T | 8,489 | 444 | 792 | .561 | 0 | B |
| 837 - LIVE OAK ST: (ALT 19 -to- US19) | CR | 01 | SC | 2U | D | 1.061 | .94 | T | 2,580 | 134 | 572 | .234 | 0 | B |
| 846 - MAIN ST: (BROADWAY AVE -to- SKINNER BLVD) | DN | 04 | SC | 2U | D | .600 | 5.00 | T | 3,661 | 191 | 514 | .372 | 0 | D |
| 847 - MAIN ST: (MCMULLEN BOOTH RD -to- BAYSHORE DR) | CR | 05 | NA | 2U | D | 1.274 | .00 | T | 8,753 | 457 | 1,440 | .317 | 0 | C |
| 859 - MCMULLEN BOOTH RD: (GULF-TO-BAY BLVD -to- SUNSET PT RD \| MAIN ST) | CR | 06 | SA | 6D | D | 2.267 | 1.76 | T | 66,577 | 3,479 | 2,646 | 1.315 | 2 | F |
| 860 - MCMULLEN BOOTH RD: (SUNSET PT RD \| MAIN ST -to- SR 580) | CR | 05 | SA | 6D | D | 2.233 | 1.79 | T | 66,577 | 3,479 | 2,646 | 1.315 | 2 | F |
| 861 - MCMULLEN BOOTH RD: (SR 580 -to- CURLEW RD) | CR | 05 | SA | 6D | D | 1.768 | 1.70 | T | 57,035 | 2,980 | 2,646 | 1.126 | 2 | F |
| 862 - MCMULLEN BOOTH RD: (CURLEW RD -to- SOUTH SPLIT) | CR | 03 | NA | 6D | D | .546 | .00 | T | 47,984 | 2,507 | 5,650 | .444 | 0 | B |
| 867 - MEHLENBACHER \| 8TH AVE NW: (CLWTR-LARGO RD -to- INDIAN ROCKS RD) | CR | 07 | SC | 2U | D | 1.009 | .99 | T | 4,670 | 244 | 572 | .427 | 0 | B |
| 868 - MEMORIAL CSWY: (CLEARWATER BEACH ROUNDABOUT -to- ISLAND WAY) | SR | 06 | SA | 4D | D | .447 | 2.24 | T | 34,500 | 1,803 | 1,870 | .964 | 2 | E |
| 869 - MEMORIAL CSWY: (CHESTNUT ST CONNECTION -to- MEMORIAL CSWY \| WB/EB SPLIT) | SR | 06 | NA | 2O | D | .185 | .00 | H | 14,500 | 758 | 3,400 | .240 | 0 | B |
| 870 - MEMORIAL CSWY: (ISLAND WAY -to- MEMORIAL CSWY \| WB/EB SPLIT) | SR | 06 | NA | 4D | D | 1.118 | .00 | T | 34,500 | 1,803 | 3,760 | .480 | 0 | C |
| 871 - MEMORIAL CSWY: (MEMORIAL CSWY \| WB/EB SPLIT -to- COURT ST CONNECTION) | SR | 06 | NA | 2O | D | .162 | .00 | H | 16,000 | 836 | 3,400 | .270 | 0 | B |
| 873 - MERES BLVD: (ALT 19 -to- FLORIDA AVE) | CR | 01 | NMC | 2U | D | 1.808 | .00 | T | 7,687 | 402 | 1,440 | .279 | 0 | C |
| 875 - MICHIGAN BLVD: (CR 1 -to- ALT 19) | DN | 04 | SMC | 2U | D | 1.537 | 1.30 | T | 4,852 | 243 | 572 | .425 | 0 | B |
| 877 - MILWAUKEE AVE: (VIRGINIA ST -to- UNION ST) | DN | 04 | SMC | 2U | D | 1.020 | 1.96 | T | 4,804 | 241 | 572 | .421 | 0 | B |
| 879 - MISSOURI AVE: (COURT ST -to- CLEVELAND ST) | CL | 06 | SA | 4D | D | .328 | 3.05 | T | 12,033 | 629 | 1,683 | .374 | 0 | C |
| 883 - MLK JR AVE: (BELLEAIR RD -to- DREW ST) | CL | 06 | SC | 2U | D | 2.015 | 2.98 | T | 5,847 | 306 | 559 | .547 | 0 | C |

## Pinellas County Metropolitan Planning Organization



# APPENDIX C
# DESIGN REQUIREMENTS



# APPENDIX D
# REFERENCES

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