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# Greensburg Vehicle and Pedestrian Study

South Main Street between West Otterman and Pittsburgh Street

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## FINAL RESEARCH REPORT

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# 1. Introduction

The Intelligent Mobility Meter (IMM) is a portable data acquisition and analysis platform for the collection of fine-grained statistics on pedestrian, cyclist and vehicular traffic. This study used the IMM to provide real-world, valuable, traffic data and actionable information to local government entities. This study focuses on the deployment of the IMM in the City of Greensburg to evaluate traffic conditions in front of the courthouse and municipal services complex. In particular focus was placed on a mid-block pedestrian crossing that has been identified as potentially dangerous, as well as the possibility of jaywalking in the area. This study describes the data found and provides recommendations on possible road improvements for increased pedestrian safety.

We performed pedestrian and vehicle counts at the crosswalk on South Main Street between West Otterman and Pittsburgh Street on the days of November 13th, 14th, and 15th of 2018. From our analysis of these counts, we give several possible recommendations to improve the safety of the crossing at the study area, depending on acceptable cost/benefit ratios and budget.

# 2. Existing Conditions

Main Street runs north and south through the heart of Greensburg's Central Business District and gives access to several important town staples such as government buildings, schools, restaurants, and recreational businesses. It is the direct continuation of I-70 East through Pennsylvania. Furthermore, Main Street Bridge provides the most-accessible route for trucks over the Amtrak rail line located to the north of the city center. The bridge adjacent to the west is restricted from thru-trucks' use entirely, and the bridge adjacent to the west is load-limited to 32 tons. The only other passages north for trucks within several miles of the Greensburg city center are single-lane tunnels that may dissuade some truckers. Therefore, Main Street maintains a seemingly high amount of truck traffic for its road category and type of surrounding businesses.

Several bus routes run through the study area, but there are no stops in the vicinity that could affect pedestrian counts. Insofar as minimizing general congestion in the area is a priority, pedestrian safety measures that dissuade bus passage such as raised pedestrian crossings should only be considered if appropriate arrangements can be made with the relevant transit agencies. This fact, in combination with the necessity of Main Street as a passage for trucks generally rules out the use of raised pedestrian crossings. Otherwise, this countermeasure would be a recommendation of choice.

The roadway grade along the study area is negligible. The roadway width at the midblock crossing is about 36 feet in total which then widens to 40 feet at the intersections of both West Otterman and Main and Pittsburgh and Main. Main Street then splits into a left turn only lane and a thru lane. The crosswalk is approximately 40 feet from the lane split at the corner of Main Street and Pittsburgh Street and 70 feet from the split at Main and West

Otterman. Both intersections are signalized and contain a protected left-turn phase and a pedestrian only phase. Right turns at either intersection are prohibited. Parking is prohibited in the entirety of the study area. The speed limit is 25 mph along the entire road section.

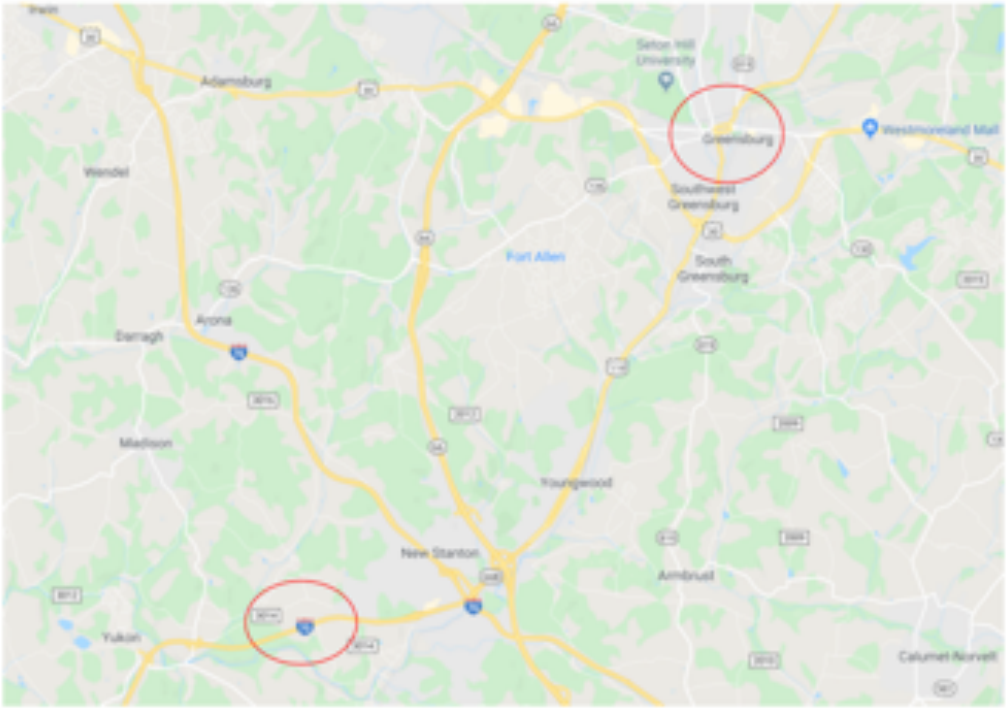


**FIGURE 1.** Study location and in the continuation of I-70

The midblock crossing has the potential to be very well-lit with sets of street lights in front of the crossing from both directions. It is unclear exactly how bright the bulbs used are and if they adequately light the entirety of the 18 feet length of the lane in each direction. Because there is no in-street lighting installed in the crosswalk, it is imperative that the street lamps in front of the mid-block crosswalk on either side be well maintained and the bulbs replaced regularly.

A government services complex containing a courthouse, probation facility, and sheriff and county commissioner's office lies on the west side of Main Street in the study area. The block directly east contains several restaurants, two banks, and two legal establishments. It can be readily observed that a large amount of foot traffic occurs between these two blocks- partly from employees of the complex and partly from visitors to the complex. All individual components of the government service complex open at 8:30 AM and close at 4:00 PM. This generally coincides with observed weekday peak AM and PM traffic volumes.

## 3. Hazards

Both directions of traffic split into two lanes at their respective intersections, only just past the crosswalk, this combined with the fact that the lanes are relatively wide may cause a dangerous interaction. Hazardous conditions can arise where a motorist passing a stopped car to queue into a turn-lane may not spot a pedestrian using the crosswalk due to obscured vision from a preceding vehicle. Many countermeasures that apply specifically to single-lane roads may prove ineffective to protect pedestrians against threats like these associated with multi-lane scenarios.

When event posters are present on the streetlamp in front of the crosswalk from the southbound direction as in the figure below, visibility of the yield sign for large vehicles with a high seating position is greatly reduced.


**FIGURE 2.** Event posters reduce visibility to the 'yield to pedestrians' sign

This negatively affects the probability that large trucks will yield to pedestrians when necessary and could therefore lead to safety hazards. Even without the banner, the crossing marker is partially obscured by the streetlamp's pole.

Compounding factors include the proximity of the crosswalk to both intersections' exits. Motorists attempting to catch a green or yellow light through either intersection are likely to accelerate well beyond the speed limit. This creates problems with pedestrian visibility, reaction time, and stopping distance as all are reduced at higher speeds. In terms of attempting to minimize the negative effects of this hazard from both directions, the crosswalk is well placed at its current location. It sits near the middle of the stretch between the intersections- 160 feet from the intersection of Main and Pittsburgh and 170 from Main and West Otterman: thereby maximizing aggregate reaction time and stopping distance. Unfortunately, these distances still present safety problems associated with speeding vehicles.

Table 1 bellow lists the generally accepted Highway Traffic Safety Association calculations for average light vehicle stopping distances. At 35 mph, a stopping car exiting the intersection from Pittsburgh Street will come only 25 feet from striking a pedestrian at the crosswalk. At 40 mph, a vehicle passing Pittsburgh Street would strike a pedestrian, and a vehicle coming from the opposite direction would come within 10 feet from an accident. A motorist from either direction traveling over 40 mph is expected to hit a crosswalk user. These stopping distances are calculated for an average passenger vehicle in perfect weather and do not take into account the presence of rain, snow, or other inclement sight or roadway conditions. Busses and trucks take even longer to stop at any given speed and therefore present additional dangers. These heavy vehicles made up around 5% of all traffic during the study hours.

**TABLE 1.** Generally accepted HTSA light vehicle stopping distances

| MPH | Ft./Sec. | Braking Deceleration Distance | Perception Reaction Time | Total Stopping Distance |
|---|---|---|---|---|
| 25 | 36 | 30 | 55 | 85 |
| 30 | 44 | 43 | 66 | 109 |
| 35 | 51.3 | 59 | 77 | 136 |
| 40 | 58.7 | 76 | 88 | 164 |
| 45 | 66 | 97 | 99 | 196 |

This leads us to our next concern. About 25% of pedestrians we counted crossing the street did so by jaywalking, and as we were only able to count jaywalkers in the area south of the crosswalk, the total percentage of jaywalkers is likely 40% or more. As crossing at the designated crossing location effectively maximizes stopping distance for motorists approaching from both sides, crossing at any other location increases general dangers associated with reduced vehicle stopping time.

Given these concerns, we can break down the main goal of increasing the safety of pedestrians at the study area into three actionable sub goals:

(1.) Maximize driver awareness of pedestrians at the midblock street crossing

(2.) Incentivize pedestrians to use the designated crosswalk

(3.) Reduce the speed at which vehicles approach the crosswalk

Any countermeasure that effectively accomplishes any of these three objectives will increase the safety of pedestrians and motorists in the study area alike.

## 4. Findings

The study involved both a traffic and pedestrian count on Main Street over three days during the hours of 5 – 8 AM and 1 - 4 PM. The counts occurred on Tuesday, Wednesday, and Thursday of the month of November. The peak hours of vehicular traffic are 8am for the morning segment and 4pm for the afternoon study hours. The largest pedestrian volumes occur at 8am and 1pm. The Southbound and Northbound directions see roughly equal vehicular traffic, and close to 5% of this traffic is composed of busses and trucks. The hourly average traffic counts are summarized below.

**TABLE 2.** Observed average counts per hour

| | Averages by Hour | | | | |
|---|---|---|---|---|---|
| | Pedestrians | | 2 Way Traffic | | |
| HOUR | Jaywalk | Crosswalk | Cars | Busses | Trucks |
| 5:00:00 AM | 0 | 0 | 161 | 8 | 2 |
| 6:00:00 AM | 0 | 0 | 314 | 12 | 15 |
| 7:00:00 AM | 0 | 2 | 679 | 8 | 21 |
| 8:00:00 AM | 7 | 19 | 686 | 11 | 29 |
| 1:00:00 PM | 12 | 19 | 611 | 2 | 26 |
| 2:00:00 PM | 2 | 14 | 684 | 22 | 24 |
| 3:00:00 PM | 4 | 12 | 768 | 11 | 19 |
| 4:00:00 PM | 2 | 10 | 866 | 5 | 18 |

Generally, the counts observed are consistent with normal central business district traffic. Estimated average daily traffic from these counts comes to somewhere between 7,000 and 10,500 vehicles per day. Our recommendations take this spread into account and are appropriate for any value therein.

## 5. Recommendations and Cost-Benefit Analysis

The following countermeasures have been selected based on criteria from the U.S. Department of Transportation's PEDSAFE pedestrian safety countermeasure implementation guide. The countermeasures provided have been studied across multiple different locations and scenarios and have been proven to be effective in conditions similar to that of our study area.

### 5.1 Advance Yield Markings

The current signage in the study area could be improved markedly by the addition of two new signs and road markings constituting an advance yield area (see Figure 3). Studies performed by the DOT indicated that advance yield signs and stop markings placed 20-50 feet from the crossing location are a relatively inexpensive and effective means of improving the safety of pedestrians at uncontrolled crossing locations.

**FIGURE 3.** Example of recommended advance yield markings.

Furthermore, because both ends of the road split from one lane into two, vehicles passing other traffic to queue into the left-turn lane may not be able to effectively spot a crossing pedestrian. Advanced yield markings greatly reduce the potential for problems associated with this type of interaction by signaling to any passing cars that a pedestrian is crossing and giving more time to the crosser to react to a vehicle that doesn't stop as shown in Figure 4.

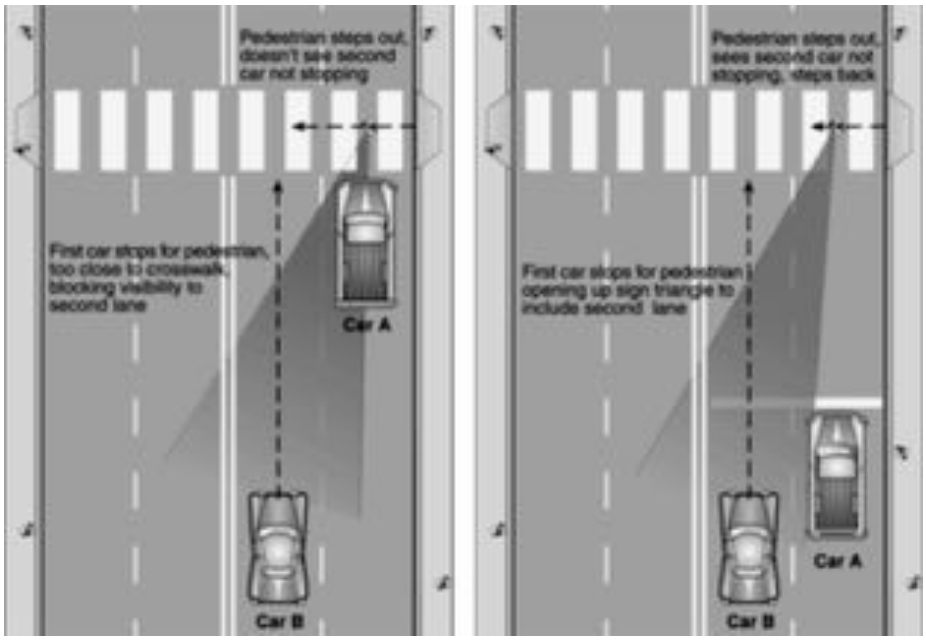


**FIGURE 4.** Illustration of improved visibility due to the usage of advanced yield markings.

Advanced yield markings placed 20 – 50 feet in front of a crosswalk in either direction as shown in the figure below have been observed to reduce the probability of pedestrian and vehicle conflicts by as much as 25%. And given the current visibility problem, it is highly likely that the installation of advanced yield markings will increase the percentage of motor vehicles that yield to pedestrians in general.


**FIGURE 5.** Another example of the usage of advanced yield markings to improve safety.

This measure is also quite cost-effective. The cost of each yield sign and line painting combination is $620. This makes the total price of installing this countermeasure approximately $1240, making this the most effective measure in terms of cost-benefit. In addition, this countermeasure can be used effectively with any other recommendation mentioned henceforth.

## 5.2 Rectangular Rapid Flash Beacon (RRFB)

Rectangular Rapid Flash Beacons are a relatively new, yet incredibly effective, means of increasing vehicle yielding, crosswalk utilization, and general crosswalk visibility (see Figure 6). RRFBs are installed below existing crosswalk signs and are either actuated automatically by passive radio-wave pedestrian detectors or by nearby buttons mounted on existing light-poles or other infrastructure. The two lights activate in an irregular pattern that is extremely effective in capturing the attention of passing motorists and ensuring they yield to pedestrians.

**FIGURE 5.** Two examples of RRFB deployments.

Studies by U.S. DOT's PEDSAFE concluded that their installation can cut the occurrences of pedestrian crashes by half. They can also greatly increase motorist yielding. A study by Texas A&M's Transport Institute observed motorist yielding rates as high as 98% at locations outfitted with RRFBs. RRFBs tend to collaborate with other countermeasures as well. In one study done on a previously uncontrolled crosswalk location, the installation of

an RRFB alone reduced vehicle-pedestrian conflicts by 67% and the addition of advanced yield markings further reduced conflicts from baseline by 23%. Additionally, RRFBs are particularly effective in low-light scenarios where pedestrian visibility is a concern. Although the crosswalk area is relatively well-lit, RRFBs further catch the attention of motorists during the most hazardous sight-conditions like rain and snow.

The price of acquisition and installation for RRFBs is relatively high. The total cost to outfit the crosswalk with this system would average around $45,000. Further installation pricing details from PEDSAFE are outlined below.

**TABLE 2.** Expected unit costs of an RRFB installation.

| Description | Median | Average | Min. Low | Max. High | Cost Unit |
|---|---|---|---|---|---|
| RRFB | $14,160 | $22,250 | $4,520 | $52,310 | Each |

## 5.3 In-Pavement and Overhead Lighting

Current lighting conditions are relatively good, but further improvements can still be made. Lighting of pedestrians crossing the crosswalk appears to be adequate, but perception of the crosswalk location and compliance to yielding laws are still of concern. Installing in-street LED lighting along the crosswalk distinctly illuminates the crosswalk area and signals to drivers the legitimacy of the location (see Figure 6). Combined with advance yield markings, the system would maximally convey the location and necessity of yielding at the crossing.

**FIGURE 6.** Example of in-pavement lighting.

Because of the large width of the road at the crossing location, additional lighting may be necessary to fully illuminate pedestrians near the middle of the crossing. In-pavement lighting would solve this problem while still maintaining the uniform look of the streetlamps along Main Street. The other option to address this concern would be to install an overhanging light on either side of the crosswalk as shown in Figure 7.

**FIGURE 7.** Example of overhead lighting.

This option tends to be cheaper than in-pavement lighting, but it is slightly less effective at illumination across the entire width of the crosswalk. Also, it may not make financial sense to install an entirely different type of streetlamp where they already exist. PEDSAFE pricing estimates obtained from past projects are detailed below.

**TABLE 2.** Expected costs of proposed lighting solutions.

| Infrastructure | Description | Median | Average | Min. Low | Max. High | Cost Unit |
|---|---|---|---|---|---|---|
| Lighting | In-pavement Lighting | $18,250 | $17,620 | $6,480 | $40,000 | Total |
| Lighting | Streetlight | $3,602 | $4,882 | $310 | $13,895 | Each |

## 5.4 Non-Countermeasure Recommendations

General upkeep and modification of a few key components may be enough to make a noticeable improvement on pedestrian safety, crosswalk utilization, and motorist compliance in the study area. First, banners should not be hung on the streetlamps directly in front of the line of sight of the crosswalk sign. This type of banner placement obscures visibility of the crossing sign and limits awareness of the crossing location for motorists unfamiliar with the area. Also, in its current condition, the paint outline of the midblock crosswalk is relatively faded in color and chipped off intermittently along its length (See Figure 8). Repainting the outline of the crosswalk with a fresh white coat will improve visibility in overcast and dark conditions for minimal cost. This may itself cause a large improvement in crosswalk utilization and motorist yielding.

**FIGURE 8.** Crosswalk paint at the time of the data collection was chipped and faded.

## 6. Conclusions

Given the observed existing crosswalk conditions and the collected data, it does not appear that the crosswalk is extremely dangerous for pedestrians, although a number of measures could be put into effect that should have a significant improvement on safety. As discussed above, the volume of buses and trucks in the area precludes the use of raised pedestrian crossings. However, if alternative routes could be found for this type of traffic, then such countermeasures should be considered. Otherwise, in the short term, we recommend implementation of advance yield markings as well as the non-countermeasure recommendations listed. If there is budget availability, the other recommendations (especially RRFBs) should be considered for additional safety. It is important to note that none of the recommendations are mutually exclusive, so all could be implemented for maximizing safety.