

Appendix B – Safety Countermeasures

Safety Countermeasures

Safety Countermeasure Alternatives

Based on the traffic safety review in the *Baseline Conditions* technical memo, safety countermeasure alternatives were developed for select study area intersections. The following alternatives were prepared to address safety-related needs for locations with the ten highest crash frequencies and based on the critical index ratio. The critical index ratio is the ratio of the observed crash rate to the intersection's critical crash rate. The critical crash rate is a statistical check that identifies intersections with higher-than-expected crash outcomes, and an index rate that exceeds 0.8 was identified as the threshold for "safety needs" in this study. Intersection crash data tables, organized by crash frequencies and crash rates, are provided at the end of this Appendix.

Potential projects for study area intersections are summarized below, based on safety improvement countermeasure assessment. Many of these projects may be short-term treatments, as the study area urbanizes and many of these roads will have significant improvements over the next 20 years which will change safety conditions at the intersections.

Highway 115 & 271st Street Intersection

- Traffic Control Device: **Signal**
- 5-Year Crash Frequency: **31**
- Critical Index Ratio: **1.06**
- Safety Countermeasure Alternatives:
 - Recent improvements at this intersection and along the Highway 115 corridor include construction of a permanent traffic signal, 4-lane corridor, turn lanes, raised median, and roadway lighting.

Cliff Avenue & 271st Street Intersection

- Traffic Control Device: **Signal**
- 5-Year Crash Frequency: **28**
- Critical Index Ratio: **1.03**
- Safety Countermeasure Alternatives:
 - Construct roundabout or install permanent traffic signals with reflective backplates.
 - Install advance warning beacons for traffic signal.
 - Review future requests for redevelopment and changes in access for opportunities to further access management techniques.
 - Continue periodic signal timing updates as traffic patterns evolve.

472nd Avenue & 271st Street Intersection

- Traffic Control Device: **Roundabout**
- 5-Year Crash Frequency: **18**
- Critical Index Ratio: **0.95**
- Safety Countermeasure Alternatives:
 - Consider reviewing speed limits on adjacent roadways and increasing signage size and frequency.
 - Consider increasing approach (entering) deflection or narrowing lanes to decrease approaching and internal roundabout speeds
- Note: Intersection reconstructed to a roundabout in 2018. Crashes increased to seven (7) in 2019 but declined to one (1) in 2020. No crashes after 2016 involved an injury.

Highway 11 & 273rd Street Intersection

- Traffic Control Device: **Two-Way Stop-Control (TWSC)**
- 5-Year Crash Frequency: **18**
- Critical Index Ratio: **1.38**
- Safety Countermeasure Alternatives:
 - Install optimally placed stop bars on stop-controlled approaches, doubled-up (left and right) oversized advance “Stop Ahead” intersection warning and stop signs, and “STOP” road markings.

Highway 115 & 276th Street Intersection

- Traffic Control Device: **Two-Way Stop-Control (TWSC)**
- 5-Year Crash Frequency: **17**
- Critical Index Ratio: **1.82**
- Safety Countermeasure Alternatives:
 - Consider reviewing speed limits on adjacent roadways and increasing intersection warning signage size and frequency.

Cliff Avenue & Willow Street Intersection

- Traffic Control Device: **All-Way Stop-Control (AWSC)**
- 5-Year Crash Frequency: **14**
- Critical Index Ratio: **0.60**
- Safety Countermeasure Alternatives:
 - Intersection being designed for a capacity and safety upgrade anticipated in 2023.

472nd Avenue & 273rd Street Intersection

- Traffic Control Device: **All-Way Stop-Control (AWSC)**
- 5-Year Crash Frequency: **11**
- Critical Index Ratio: **0.55**
- Safety Countermeasure Alternatives:
 - Install doubled-up (left and right) oversized advance “Stop Ahead” intersection warning signs.
 - Consider converting existing doubled-up (left and right) stop signs to larger sizes and/or installing flashing beacons or LED sign border.

Highway 11 & 271st Street Intersection

- Traffic Control Device: **All-Way Stop-Control (AWSC)**
- 5-Year Crash Frequency: **11**
- Critical Index Ratio: **0.69**
- Safety Countermeasure Alternatives:
 - Install doubled-up (left and right) oversized advance “Stop Ahead” intersection warning and stop signs and optimally placed stop bars to the eastbound and westbound approaches.
 - Consider converting existing stop signs to larger sizes and/or installing flashing beacons or LED sign border.

Highway 115 & 272nd Street Intersection

- Traffic Control Device: **Two-Way Stop-Control (TWSC)**
- 5-Year Crash Frequency: **10**
- Critical Index Ratio: **0.45**
- Safety Countermeasure Alternatives:
 - Recent improvements at this intersection and along the Highway 115 corridor include construction of a 4-lane corridor, turn lanes, raised median, and roadway lighting.
 - Review traffic signal warrants as volumes increase.

Tallgrass Avenue & 271st Street Intersection

- Traffic Control Device: **Two-Way Stop-Control (TWSC)**
- 5-Year Crash Frequency: **9**
- Critical Index Ratio: **0.67**
- Safety Countermeasure Alternatives:
 - No identified safety trends.
 - Intersection planned for reconstruction as part of future South Veterans Parkway project.

481st Avenue & 276th Street Intersection

- Traffic Control Device: **Two-Way Stop-Control (TWSC)**
- 5-Year Crash Frequency: **8**
- Critical Index Ratio: **1.32**
- Safety Countermeasure Alternatives:
 - Intersection has recent additions of flashing beacons and rumble strips. Monitor if these changes mitigation issues. If additional changes are warranted consider reviewing speed limits on adjacent eastbound and westbound road segments and converting existing stop signs to a larger size.

Table 1: Harrisburg Intersection Crash Frequency Rankings – Injury Severity and Manner of Collision (2016 – 2020)

| Int. No. | Intersection | Traffic Control Device | Total Crashes | Injury Severity | | | Manner of Collision | | | | |
|----------------|--|------------------------|---------------|-----------------|-----------|------------|---------------------|-----------|----------|-----------|-----------|
| | | | | Fatal | Injury | PDO | Single Vehicle | Rear-end | Head-on | Angle | Sideswipe |
| 1 | Hwy 115 & 271 st St | Signal | 31 | 0 | 10 | 21 | 3 | 12 | 1 | 15 | 0 |
| 2 | Cliff Ave & 271 st St | Signal | 28 | 0 | 10 | 18 | 2 | 14 | 0 | 11 | 1 |
| 3 | 472 nd Ave & 271 st St | Roundabout | 18 | 0 | 1 | 17 | 6 | 8 | 0 | 3 | 1 |
| 4 | Hwy 11 & 273 rd St | TWSC | 18 | 0 | 10 | 8 | 6 | 1 | 0 | 10 | 1 |
| 5 | Hwy 115 & 276 th St | TWSC | 17 | 1 | 10 | 6 | 2 | 0 | 0 | 14 | 1 |
| 6 | Cliff Ave & Willow St | AWSC | 14 | 0 | 1 | 13 | 0 | 3 | 0 | 11 | 0 |
| 7 | 472 nd Ave & 273 rd St | AWSC | 11 | 0 | 1 | 10 | 1 | 2 | 0 | 8 | 0 |
| 8 | Hwy 11 & 271 st St | AWSC | 11 | 0 | 2 | 9 | 1 | 4 | 0 | 5 | 1 |
| 9 | Hwy 115 & 272 nd St | TWSC | 10 | 0 | 2 | 8 | 3 | 1 | 0 | 5 | 1 |
| 10 | Tallgrass Ave & 271 st St | TWSC | 9 | 0 | 2 | 7 | 2 | 2 | 0 | 3 | 2 |
| Totals: | | | 167 | 1 | 49 | 117 | 26 | 47 | 1 | 85 | 8 |

Table 3: Harrisburg Intersection Crash Frequency Rankings – Light Condition and Road Surface Condition (2016 – 2020)

| Int. No. | Intersection | Traffic Control Device | Total Crashes | Daylight | Light Condition | | | Road Surface Condition | | | |
|----------------|--|------------------------|---------------|------------|--------------------|----------------|------------|------------------------|-----------|-----------|-------------------|
| | | | | | Dark – Not Lighted | Dark – Lighted | Dawn/ Dusk | Dry | Wet | Snow | Slush/ Ice/ Frost |
| 1 | Hwy 115 & 271 st St | Signal | 31 | 18 | 6 | 6 | 1 | 22 | 3 | 2 | 3 |
| 2 | Cliff Ave & 271 st St | Signal | 28 | 20 | 2 | 3 | 3 | 24 | 3 | 1 | 0 |
| 3 | 472 nd Ave & 271 st St | Roundabout | 18 | 14 | 2 | 1 | 1 | 12 | 1 | 4 | 1 |
| 4 | Hwy 11 & 273 rd St | TWSC | 18 | 7 | 11 | 0 | 0 | 15 | 2 | 0 | 1 |
| 5 | Hwy 115 & 276 th St | TWSC | 17 | 13 | 4 | 0 | 0 | 15 | 1 | 1 | 0 |
| 6 | Cliff Ave & Willow St | AWSC | 14 | 8 | 1 | 3 | 1 | 11 | 3 | 0 | 0 |
| 7 | 472 nd Ave & 273 rd St | AWSC | 11 | 8 | 2 | 0 | 1 | 6 | 0 | 3 | 2 |
| 8 | Hwy 11 & 271 st St | AWSC | 11 | 9 | 2 | 0 | 0 | 9 | 1 | 1 | 0 |
| 9 | Hwy 115 & 272 nd St | TWSC | 10 | 5 | 3 | 2 | 0 | 8 | 0 | 1 | 1 |
| 10 | Tallgrass Ave & 271 st St | TWSC | 9 | 7 | 2 | 0 | 0 | 5 | 1 | 0 | 3 |
| Totals: | | | 167 | 109 | 35 | 15 | 7 | 127 | 15 | 13 | 11 |

Table 4: Harrisburg Intersection Crashes Frequency by Year (2016 – 2020)

| Int. No. | Intersection | Traffic Control Device | Total Crashes | 2016 | 2017 | 2018 | 2019 | 2020 |
|----------------|--------------------------|------------------------|---------------|-----------|-----------|-----------|-----------|-----------|
| 1 | Hwy 115 & 271st St | Signal | 31 | 4 | 7 | 10 | 5 | 5 |
| 2 | Cliff Ave & 271st St | Signal | 28 | 8 | 6 | 3 | 9 | 2 |
| 3 | 472nd Ave & 271st St | Roundabout | 18 | 4 | 2 | 4 | 7 | 1 |
| 4 | Hwy 11 & 273rd St | TWSC | 18 | 1 | 2 | 5 | 6 | 4 |
| 5 | Hwy 115 & 276th St | TWSC | 17 | 6 | 3 | 2 | 2 | 4 |
| 6 | Cliff Ave & Willow St | AWSC | 14 | 4 | 0 | 4 | 3 | 3 |
| 7 | 472nd Ave & 273rd St | AWSC | 11 | 5 | 2 | 1 | 3 | 0 |
| 8 | Hwy 11 & 271st St | AWSC | 11 | 0 | 0 | 8 | 1 | 2 |
| 9 | Hwy 115 & 272nd St | TWSC | 10 | 2 | 2 | 3 | 1 | 2 |
| 10 | Tallgrass Ave & 271st St | TWSC | 9 | 0 | 3 | 1 | 2 | 3 |
| Totals: | | | 167 | 34 | 27 | 41 | 39 | 26 |

Table 5: Harrisburg Intersection Crash Rates (2016 – 2020)

| Int. No. | Intersection | Total Crashes | Daily Entering Vehicles | Million Entering Vehicles | Crash Rate | Critical Crash Rate | Ratio |
|----------|--|---|-------------------------|---------------------------|------------|---------------------|-------------|
| 1 | Hwy 115 & 276 th St | 17 | 3,000 | 5.40 | 3.15 | 1.73 | 1.82 |
| 2 | 481 st Ave & 276 th St | 8 | 1,600 | 2.96 | 2.70 | 2.04 | 1.32 |
| 3 | Hwy 11 & 273 rd St | 18 | 4,600 | 8.35 | 2.16 | 1.56 | 1.38 |
| 4 | Hwy 115 & 271 st St | 31 | 11,600 | 21.13 | 1.47 | 1.38 | 1.06 |
| 5 | Cliff Ave & 271 st St | 28 | 10,600 | 19.32 | 1.45 | 1.40 | 1.03 |
| 6 | 472 nd Ave & 271 st St | 18 | 7,300 | 13.25 | 1.36 | 1.42 | 0.95 |
| 7 | Tallgrass Ave & 271 st St | 9 | 4,800 | 8.67 | 1.04 | 1.55 | 0.67 |
| 8 | Hwy 11 & 271 st St | 11 | 5,900 | 10.84 | 1.02 | 1.48 | 0.69 |
| 9 | Hwy 11 & 276 th St | 7 | 3,800 | 6.97 | 1.00 | 1.62 | 0.62 |
| 10 | 476 th Ave & 271 st St | 8 | 4,700 | 8.66 | 0.92 | 1.55 | 0.60 |
| | | <i>HSM weighted average crash rate for study area signalized intersections = 1.00</i> | | | | | |
| | | <i>HSM weighted average crash rate for study area unsignalized intersections = 0.95</i> | | | | | |

Intersections with a crash rate exceeding the critical crash rate (ratio > 0.8) noted in **Red Bold**.

Table 6: Harrisburg Intersection Crash Rate Rankings – Injury Severity and Manner of Collision (2016 – 2020)

| Int. No. | Intersection | Traffic Control Device | Total Crashes | Injury Severity | | | Manner of Collision | | | | |
|----------------|--|------------------------|---------------|-----------------|-----------|------------|---------------------|-----------|----------|-----------|-----------|
| | | | | Fatal | Injury | PDO | Single Vehicle | Rear-end | Head-on | Angle | Sideswipe |
| 1 | Hwy 115 & 276 th St | TWSC | 17 | 1 | 10 | 6 | 2 | 0 | 0 | 14 | 1 |
| 2 | 481 st Ave & 276 th St | TWSC | 8 | 0 | 2 | 6 | 1 | 2 | 0 | 5 | 0 |
| 3 | Hwy 11 & 273 rd St | TWSC | 18 | 0 | 10 | 8 | 6 | 1 | 0 | 10 | 1 |
| 4 | Hwy 115 & 271 st St | Signal | 31 | 0 | 10 | 21 | 3 | 12 | 1 | 15 | 0 |
| 5 | Cliff Ave & 271 st St | Signal | 28 | 0 | 10 | 18 | 2 | 14 | 0 | 11 | 1 |
| 6 | 472 nd Ave & 271 st St | Roundabout | 18 | 0 | 1 | 17 | 6 | 8 | 0 | 3 | 1 |
| 7 | Tallgrass Ave & 271 st St | TWSC | 9 | 0 | 2 | 7 | 2 | 2 | 0 | 3 | 2 |
| 8 | Hwy 11 & 271 st St | AWSC | 11 | 0 | 2 | 9 | 1 | 4 | 0 | 5 | 1 |
| 9 | Hwy 11 & 276 th St | TWSC | 7 | 0 | 2 | 5 | 6 | 0 | 0 | 1 | 0 |
| 10 | 476 th Ave & 271 st St | TWSC | 8 | 1 | 2 | 5 | 1 | 1 | 0 | 6 | 0 |
| Totals: | | | 155 | 2 | 51 | 102 | 30 | 44 | 1 | 73 | 7 |

Table 7: Harrisburg Intersection Crash Rate Rankings – Light Condition and Road Surface Condition (2016 – 2020)

| Int. No. | Intersection | Traffic Control Device | Total Crashes | Daylight | Light Condition | | | Road Surface Condition | | | |
|----------------|--|------------------------|---------------|------------|--------------------|----------------|------------|------------------------|-----------|-----------|-------------------|
| | | | | | Dark – Not Lighted | Dark – Lighted | Dawn/ Dusk | Dry | Wet | Snow | Slush/ Ice/ Frost |
| 1 | Hwy 115 & 276 th St | TWSC | 17 | 13 | 4 | 0 | 0 | 15 | 1 | 1 | 0 |
| 2 | 481 st Ave & 276 th St | TWSC | 8 | 6 | 2 | 0 | 0 | 7 | 1 | 0 | 0 |
| 3 | Hwy 11 & 273 rd St | TWSC | 18 | 7 | 11 | 0 | 0 | 15 | 2 | 0 | 1 |
| 4 | Hwy 115 & 271 st St | Signal | 31 | 18 | 6 | 6 | 1 | 22 | 3 | 2 | 3 |
| 5 | Cliff Ave & 271 st St | Signal | 28 | 20 | 2 | 3 | 3 | 24 | 3 | 1 | 0 |
| 6 | 472 nd Ave & 271 st St | Roundabout | 18 | 14 | 2 | 1 | 1 | 12 | 1 | 4 | 1 |
| 7 | Tallgrass Ave & 271 st St | TWSC | 9 | 7 | 2 | 0 | 0 | 5 | 1 | 0 | 3 |
| 8 | Hwy 11 & 271 st St | AWSC | 11 | 9 | 2 | 0 | 0 | 9 | 1 | 1 | 0 |
| 9 | Hwy 11 & 276 th St | TWSC | 7 | 3 | 1 | 0 | 3 | 7 | 0 | 0 | 0 |
| 10 | 476 th Ave & 271 st St | TWSC | 8 | 3 | 4 | 0 | 1 | 6 | 0 | 1 | 1 |
| Totals: | | | 155 | 100 | 36 | 10 | 9 | 122 | 13 | 10 | 9 |