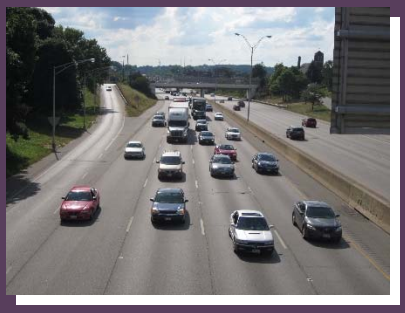
# INTERCHANGE MODIFICATION STUDY

## SUM – 76 – Central Interchange

## PID #101402

City of Akron, Summit County, Ohio



**Prepared For:**

Ohio Department of Transportation
District 4
2088 South Arlington Road
Akron, OH 44306

**Prepared By:**

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**Revised January 2018**

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SUM – 76 – Central Interchange
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AKRON BELTWAY PROJECT

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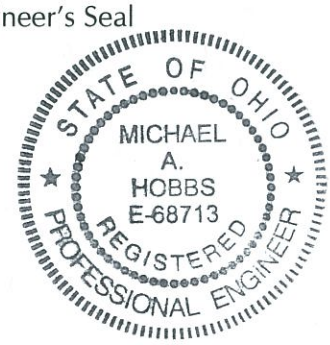
Engineer's Seal

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# I. Executive Summary:

This Interchange Modification Study (IMS) is being prepared at the request of the Ohio Department of Transportation (ODOT). The SUM–76–Central Interchange (PID 101402) project is the first identified project to be derived from the Akron Beltway Planning Study (PID 95831). The central interchange is located in the City of Akron, Summit County, Ohio (see **Figure 1** for a project location map) and is a major systems interchange that allows motorists to access multiple major highways such as: Interstate 77 (I-77), Interstate 76 (I-76), and State Route 8 (SR-8). The central interchange also serves as a major hub for motorists to access the City of Akron and its surrounding cities and suburbs. See **Figure 2** for a map of the study area.

The purpose of this study is to determine if the proposed improvements of the SUM–76–Central Interchange (PID 101402) project will degrade the operation of the central interchange and the adjacent freeways and interchanges surrounding it and if so, what actions are required to address such degradation. The planning study identified the need to replace the left handed exit ramps of I-76 EB to SR-8 NB and I-76 WB to I-77 SB. These ramps are being replaced in advance prior to the finalization of the planning study in order to correct their sub-standard geometrics and poor physical condition. This improvement project will also eliminate the two (2) partial interchanges of Lovers Lane and Inman Street. The safety review from the planning study of the entire Akron Beltway identified the central interchange as the "worst" performing area of the Akron Beltway with 300 crashes occurring between the years of 2009 – 2011. Many of the crashes that have occurred in the central interchange area are due to capacity and congestion issues as well as sub-standard geometrics.

The Opening Year for the proposed central interchange improvement project is 2020 with the Design Year established as 2040. Capacity analysis for all basic freeway segments, ramp merge / diverge junctions, weave segments and intersections were only performed for the Design Year 2040 AM and PM peak hours. The Opening Year was not considered for analysis because the Design Year accounts for the highest amount of traffic that will utilize the central interchange, therefore all improvements will be designed for the Design Year conditions. The 'No-Build' condition represents the existing roadway configuration and operating conditions within the study area. The 'Build' condition incorporates the proposed improvements being recommended as part of this project (shown in **Figure 4)**. The intersection capacity analyses for the Design Year 2040 AM and PM peak hours identifies that the study intersections are anticipated to operate with acceptable Levels-of-Service and minimal delay under both the 'No-Build' and 'Build' traffic conditions.

Based on the information and analysis in this study, the Akron Beltway Team concludes that the SUM–76–Central Interchange (PID 101402) Improvement Project will have no impact on the operation of the central interchange or adjacent interchanges that would require mitigation. Therefore, the recommended roadway improvements and interchange modifications, as detailed in this study, should be pursued.

# II. Introduction and Background:

This Interchange Modification Study (IMS) is being prepared at the request of the Ohio Department of Transportation (ODOT). The SUM–76–Central Interchange (PID 101402) project is the first identified project to be derived from the Akron Beltway Planning Study (PID 95831). The purpose of the Akron Beltway Planning Study is to study and provide preliminary engineering for improvements that will optimize traffic flow throughout the Akron Beltway. The planning study identified the need to replace the left handed exit ramps of I-76 EB to SR-8 NB and I-76 WB to I-77 SB. These ramps are being replaced in advance prior to the finalization of the planning study in order to correct their sub-standard geometrics and poor physical condition. This improvement project will not only address the poor bridge conditions of the two (2) left handed exit ramps but it will also eliminate the two (2) partial interchanges of Lovers Lane and Inman Street. The removal of these partial interchanges will eliminate weave conditions in order to address safety concerns and improve traffic flow. This project will also reconfigure the lane assignments of each left handed ramp to provide dedicated drop lanes as well as two (2) through lanes for I-76 which will address both safety and operation concerns.

This study will evaluate the impact that the proposed SUM–76–Central (PID 101402) project will have on the central interchange and the adjacent freeways and interchanges surrounding it in order to determine if the improvements can be completed without causing degradation. If degradation occurs as a result of the proposed construction project, this study will also identify what measures must be taken in order to restore the 'No-Build' Levels-of-Service.

The central interchange is located in the City of Akron, near the downtown area, and is a major system interchange that services I-76, I-77 and SR-8. The central interchange currently handles approximately 225,000 vehicles per day through the mainline movements and interchange ramps. In addition, adjacent communities surrounding the City of Akron also utilize this interchange. See **Figure 1** for Project Location Map.

A detailed review of the Akron Metropolitan Area Transportation Study (AMATS) Long Range Plan and its Transportation Improvement Plan (TIP) for fiscal years 2016 thru 2019 was conducted. The only project currently listed on the TIP in the vicinity is the SUM – IR 76 Main / Broadway (PID 77269) Major Reconstruction Project. This project will remove the access points of the I-76/77 / Wolf Ledges Parkway / Grant Street interchange while changing the access points and geometry of the I-76/77 / Main Street / Broadway Street interchange. This project will be completed prior to the start of the central interchange project and its final configuration was taken into account when performing the capacity analysis discussed later in this report.

This Interchange Modification Study (IMS) is required for Federal Highway Administration (FHWA) and ODOT approval before any access point modifications to existing freeway interchanges may be made. This study documents any operational deficiencies of the existing interchange based on the Design Year traffic and will assess the impact of the proposed improvements based on future planned development, traffic operations, project cost, and environmental impacts.

## III. Purpose and Need:

The purpose and need for the SUM – 76 – Central Interchange (PID 101402) Project is to address safety concerns of the deficient bridges of the left handed exit ramps from I-76 to I-77 SB and SR-8 NB that were identified from the Akron Beltway Planning Study (PID 95831). The safety review from the planning study of the entire Akron Beltway identified the central interchange as the "worst" performing area of the entire Akron Beltway with 300 crashes occurring between the years of 2009 – 2011. Many of the crashes that have occurred in the central interchange area are due to capacity and congestion issues as well as sub-standard geometrics.

This study will determine if the proposed improvements of the SUM–76–Central Interchange (PID 101402) project will degrade the operation of the central interchange and the adjacent freeways and interchanges surrounding it and if so, what actions are required to address such degradation.

## IV. Study Area:

The central interchange is located in the City of Akron, Summit County, Ohio (see **Figure 1** for a project location map). The central interchange is a major systems interchange that allows motorists to access multiple major highways such as: I-77, I-76 and SR-8. It also serves as a major hub for motorists to access the City of Akron and its surrounding communities. These major highways allow motorists to travel to major cities in Ohio or across state borders. SR-8 from the central interchange extends north where it ultimately intersects Interstate 271, in Macedonia, which enables motorists to access the greater Cleveland area. I-77 extends to the north and south from the central interchange. I-77 originates from the north in Cleveland, Ohio and traverses south through multiple states and terminates in Columbia, South Carolina. I-76 extends to the east and west from the central interchange. I-76 originates from its interchange with Interstate 71 in Seville, Ohio and travels east through Pennsylvania and New Jersey where it ultimately terminates in the City of Bellmawr.

There are four (4) adjacent interchanges surrounding the central interchange. The first interchange is the I-76/77 / Main Street / Broadway Street interchange located to the west of the central interchange. This interchange serves as a major access point for motorists to access downtown Akron as well as The University of Akron. The second interchange is the I-76 / South Arlington Street interchange located to the east and serves as a local access to a primarily residential area. The third interchange is the SR-8 / Carroll Street / Buchtel Avenue interchange located to the north and serves as a main access point for The University of Akron as well as many residences. The fourth and final adjacent interchange is the I-77 / East Archwood Avenue interchange located to the south which serves a primarily residential area.

The study area for this IMS also includes the following four (4) signalized intersections:

- East Archwood Avenue / Burkhardt Avenue
- East Archwood Avenue / Coventry Street
- Lovers Lane / Burkhardt Avenue
- South Arlington Street / I-76 WB Exit Ramp / 2nd Avenue / Martin Avenue

See **Figure 2** for a map of the study area.

# V. Existing Conditions:

### *Current Access Locations:*

Within the study limits of this Interchange Modification Study are six (6) traditional freeway access points; described as follows:

1. Interstate 76/77 / Main Street / Broadway Street interchange
2. Interstate 77 / Lovers Lane Exit Ramp (partial interchange)
3. Interstate 77 / East Archwood Avenue interchange
4. Interstate 76 / South Arlington Street interchange
5. Interstate 76 / Inman Street Exit Ramp (partial interchange)
6. State Route 8 / Carroll Street / Buchtel Avenue interchange

### *Physical Conditions:*

The natural profile of the highways entering / exiting the central interchange are relatively level. The profile of the central interchange itself is comprised of many different levels as highways are crossing over the top and under one another. Further detail on the geometry of the central interchange is provided in the section below. The four (4) interchanges adjacent to the central interchange also maintain a relatively level profile.

### *Existing Roadway Description / Geometry and Traffic Control:*

The functional classification of I-76 and I-77 is Urban Interstate while State Route 8 is classified as an Urban other Freeway and Expressway according to The Ohio Department of Transportation (ODOT). The posted speed limit throughout the study area is 55 miles-per-hour (mph) with the exception of I-76 to the east of the central interchange that has a posted speed limit of 60 mph. These speed limits are to remain after construction is complete.

The interchange itself contains eight (8) system interchange ramps. I-76 comprises the east and west "legs" of the interchange and has two (2) mainline bridges that traverse over the lower levels of the interchange. SR-8 mainline NB and SB (which forms the north "leg" of the interchange) makes up the lowest level of the interchange and has no bridge structures. The I-77 mainline comprises the south "leg" of the interchange as well as overlapping with the I-76 west "leg" of the interchange. Out of the eight (8) systems interchange ramps, all eight (8) have an area of sub-standard geometric conditions. **Table 1** on the following page

contains a description of all eight (8) interchange ramps and shows what sub-standard design element exists on the ramp itself.

| Table 1: Sub-Standard Design Elements on Northeast Interchange Ramps | | |
|---|---|---|
| Ramp Description | Sub-Standard Horizontal Alignment | Sub-Standard Vertical Profile |
| I-77 NB to I-76 WB / I-77 NB (Mainline I-77) | Yes | Yes |
| SR-8 SB to I-76 WB / I-77 NB | Yes | No |
| I-76 EB / I-77 SB to I-77 SB (Mainline I-77) | Yes | Yes |
| I-76 WB to I-77 SB | Yes | Yes |
| I-77 NB to I-76 EB | Yes | Yes |
| SR-8 SB to I-76 EB | Yes | Yes |
| I-76 WB to SR-8 NB | No | Yes |
| I-76 EB to SR-8 NB | Yes | Yes |

As shown in **Table 1**, seven (7) of the eight (8) interchange ramps have sub-standard horizontal alignments, the only ramp that does not is the I-76 WB to SR-8 NB ramp. Additionally, seven (7) of the eight (8) interchange ramps have sub-standard vertical profiles, the only ramp that does not is the SR-8 SB to I-76 WB / I-77 NB ramp. Overall, all eight (8) interchange ramps have an area of sub-standard geometric conditions.

There are four (4) existing signalized intersections that were included in the IMS study area. The four (4) intersections included within the study area are as follows:

East Archwood Avenue / Burkhardt Avenue intersection:

> This intersection is currently signalized using a span wire configuration with signal poles located on the northwest, southwest and southeast corners of the intersection. The intersection consists of three (3) approaches with the following lane configurations: EB East Archwood Avenue – one (1) lane (thru-right), WB East Archwood Avenue – two (2) lanes (left, thru), SB Burkhardt Avenue – two (2) lanes (left, thru-right). A fourth leg to this intersection exists for Burkhardt Avenue and it operates as a one-way southbound road.

East Archwood Avenue / Coventry Street intersection:

> This intersection is currently signalized using a span wire configuration with signal poles located on the northeast and southwest corners of the intersection. The intersection consists of three (3) approaches with the following lane configurations: EB East Archwood Avenue – two (2) lanes (left, thru), WB East Archwood Avenue – one (1) lane (thru-right), NB Coventry Street – one (1) lane (left-thru-right). A fourth leg to this intersection exists for Coventry Street and it operates as a one-way northbound road.

Lovers Lane / Burkhardt Avenue intersection:

This intersection is currently signalized using a span wire configuration with the signal poles located on the northwest and southeast corners of the intersection. The intersection consists of three (3) approaches with the following lane configurations: EB Lovers Lane – one (1) lane (thru-right), WB Lovers Lane – one (1) lane (left-thru), SB Burkhardt Avenue – two (2) lanes (left-thru, right). A fourth leg to this intersection exists for Burkhardt Avenue and it operates as a one-way southbound road.

South Arlington Street / I-76 WB Exit Ramp / 2nd Avenue / Martin Avenue intersection:

This intersection is currently signalized using mast arms with the signal poles located on the northwest, northeast and southeast corner of the intersection. There are two (2) WB approaches with the first being the I-76 WB exit ramp which has no outbound receiving lanes and the second being 2nd Avenue which allows for bi-directional travel. The intersection consists of five (5) approaches with the following lane configurations: EB Martin Avenue – one (1) lane (left-thru-right) with the thru movement corresponding to vehicles destined for 2nd Avenue, I-76 WB Exit Ramp – one (1) lane (left-thru-right), WB 2nd Avenue – one (1) lane (left-thru-right) with the thru movement corresponding to vehicles destined for Martin Avenue, NB South Arlington Street – three (3) lanes (left, thru, thru-right) with the right turn movement corresponding to vehicles destined for 2nd Avenue, and SB South Arlington Street – three (3) lanes (left, thru, thru-right) with the left turn movement corresponding to vehicles destined for 2nd Avenue.

### *Crash History:*

The Akron Beltway Design Team completed a comprehensive safety review of the entire Akron Beltway. As a result of that review, the central interchange was identified as the "worst" performing area of the Akron Beltway. A safety summary memo of the central interchange titled *SUM-76-11.48 (PID 101402) Northeast Interchange Safety Study Summary Memo* dated September 25th, 2015 was prepared by the Akron Beltway Design Team. This memo documented that the area within the central interchange between the two (2) sets of left handed exit ramps (I-76 EB to SR-8 NB and I-76 WB to I-77 SB) was the area which showed the greatest potential for safety improvements.

Crash data was obtained from ODOT's GIS Crash Analysis Tool (GCAT) for the calendar years of 2009 to 2011 for the entire Akron Beltway area. In addition, an Interchange Safety Analysis Tool Enhanced (ISATe) analysis was completed for the entire Akron Beltway. The goal of the ISATe analysis was to evaluate the performance of the entire Akron Beltway as well as to pinpoint areas where safety improvements could be impactful. These crash years 2009 – 2011 were chosen to be utilized for these analyses due to various construction projects that were occurring throughout the study area between 2012 and the present, which could skew the results of the crash statistics. A total of 300 crashes occurred within the study area (Central Interchange) and have been analyzed as part of this detailed review. These crashes include 141 rear-end, 90 fixed object, 66 sideswipe-passing, 2 parked vehicle and 1 overturning crash. 66% of all crashes occurred in daylight and 61% occurred on dry

pavement. 70% of the crashes were property damage only and 29% of the crashes were injury crashes with one (1) fatal crash occurring during these three (3) years.

A fatal crash occurred on June 22nd, 2009 at 11:38 PM on I-76 WB approaching SR-8. The vehicle ran off the left side of the highway, striking the concrete barrier that protects the bridge piers for the SR-8 ramp. The vehicle overturned under the bridge for the ramp from I-76 EB to SR-8 NB.

The large number of rear-end crashes (47%) throughout the study area points to a congestion issue within the study area. Along an uncongested highway, rear-end crashes are less common as traffic should not be slowing down, which is what typically leads to rear-end crashes. An uncongested highway is more likely to have sideswipe-passing crashes, which can be caused by vehicles changing lanes without properly checking the adjacent lane to ensure no vehicles are in the lane.

The fixed object crashes (30%) occurring throughout the study area are mainly occurring on the left handed exit ramps, which are geometrically sub-standard with tight curve radii. When vehicles enter the left handed exit ramps, they are traveling at too high of a speed to successfully negotiate the curve and wind up running off the road and striking a fixed object.

## VI. Analysis Years:

The analysis year utilized for this IMS was determined to be a Design Year of 2040. The Opening Year was not considered for analysis because the Design Year accounts for the highest amount of traffic that will utilize the central interchange, therefore all improvements will be designed for the design year condition. Certified traffic was obtained and used for the analyses. The 'No-Build' condition represents the existing roadway configuration and operating conditions within the study area. The 'Build' condition incorporates the proposed improvements being recommended as part of this project (shown in **Figure 4**). Both the 'No-Build' and 'Build' scenarios assume the completion of the I-77 / I-76 / Main Street / Broadway Street interchange reconstruction (PID 77269).

## VII. Alternatives Considered:

For the purpose of analyzing the existing and proposed conditions for the central interchange, the following two (2) scenarios were evaluated:

*'No-Build':*

The 'No-Build' alternative assumes no changes to the existing roadway configuration or traffic operations at the interchange or surrounding roadway network and is the base condition to which the subsequent alternative is compared. See **Figure 3** for a depiction of the existing traffic conditions.

*'Build':*

The 'Build' alternative incorporates the following proposed improvements:

- Reconstruct the ramp from I-76 WB to I-77 SB on a new alignment
- Reconstruct the ramp from I-76 EB to SR-8 NB on a new alignment.
- Reconstruct the I-76 WB bridge through the central interchange on a new alignment
- Change the alignment of the I-76 WB to SR-8 NB ramp
- Remove the I-77 SB / Lovers Lane exit ramp
- Remove the I-76 WB / Inman Street exit ramp
- Remove the Lafollette Street Bridge over I-77 and build a replacement structure further to the south

From an operations standpoint, the proposed improvements at the central interchange will provide capacity benefits to the I-76 EB and WB mainline movements as well as create even lane utilization for the I-76 / I-77 EB approach into the central interchange. There are currently four (4) travel lanes on I-76 / I-77 EB near the central interchange with the right most lane ending prior to entering the interchange area. This right most lane will no longer terminate prior to the central interchange and will be carried through under the 'Build' conditions. The proposed improvements will create dedicated lanes for all three (3) movements. The left most lane will be a dedicated exit lane for SR-8 NB, the center two (2) lanes will be dedicated lanes to continue on I-76 EB and the right most lane will be a dedicated exit lane for I-77 SB. The proposed improvements will also remove the traffic wishing to enter SR-8 NB from the two (2) lane bridge for I-76 EB mainline by moving the diverge point for the left handed exit ramp further west. This improvement alone will improve the operation of the interchange by reducing the number of vehicles traveling across the I-76 EB mainline bridge.

Similar improvements are also being proposed on the westbound approach to the central interchange. Four (4) westbound lanes approach the interchange area with the left most lane being a dedicated exit ramp to I-77 SB, the center two (2) lanes will be dedicated lanes to continue on I-76 WB and the right most lane will be a dedicated exit lane to SR-8 NB. Additionally, the left handed exit ramp to I-77 SB has been moved further east, prior to the I-76 WB mainline bridge, to reduce the amount of traffic that will be traveling on the two (2) lane bridge which will further improve the operation of the interchange.

Additionally, due to geometric spatial constraints between I-76 EB, SR-8 and the existing Johnston Street Bridge, the most feasible design speed for the I-76 EB to SR-8 NB is 40 mph. The proposed improvements utilize low speed ramp-to-ramp merges near the Johnston Street Bridge due to the merge point between the ramps moving further northward as a result of the design speed increase of the ramp from I-76 WB to SR-8 NB, as noted above. A design exception for shoulder width is also required to avoid impacting the existing Johnston Street Bridge over SR-8.

The final operations improvement to the central interchange area is removing the exit ramp to Lovers Lane from I-77 SB. This partial interchange causes operational issues as it creates a weaving section immediately after the I-76 EB to I-77 SB and I-76 WB to I-77 SB ramps merge together. Vehicles that originated from I-76 WB that wish to exit onto Lovers Lane need to switch lanes in order to access the exit ramp. This weave section is approximately 0.15 miles long, which does not leave a lot of time for traffic to successfully change lanes without significantly slowing down in the left lane of the ramp to wait for a gap in traffic. In the proposed configuration, traffic wishing to access Lovers Lane will travel further south to utilize the East Archwood Avenue exit ramp from I-77 SB. It should be noted that this will still create a weaving area; however the vehicles would now have 0.5 miles to make this lane change if necessary. Similar improvements are being recommended on I-76 WB by removing the exit ramp to Inman Street. In the proposed configuration I-76 WB traffic that would traditionally exit at Inman Street will exit I-76 WB earlier by utilizing the South Arlington Street exit.

The proposed improvements should reduce the amount of lane changing and merging on the approaches to the central interchange, which will reduce the amount of sideswipe-passing crashes that are currently occurring at the interchange. The improved operations will also reduce the amount of slowing and stopping of traffic, which will in turn reduce the amount of rear-end crashes occurring near the interchange as well as reducing emissions within the study area.

See **Figure 4** for a conceptual rendering of the proposed improvements for the study area.

## VIII. Certified Traffic Volumes:

The Opening Year 2020 and Design Year 2040 traffic volumes utilized for this study were developed by the Akron Beltway Team utilizing methodologies previously reviewed and approved by ODOT. The certified traffic request was submitted to the ODOT Office of Statewide Planning and Research on April 28th, 2016 and was approved on September 7th, 2016. See **Appendix A** for the certified traffic plates containing the Opening Year 2020 and Design Year 2040 ADT, AM peak hour and PM peak hour traffic volumes along with the TD and T24 design designations that were utilized in this IMS.

The certified traffic volumes for the Lovers Lane and Inman Street exit ramps were rerouted in order to develop the Design Year 2040 'Build' traffic volumes as these partial interchanges will be eliminated under the 'Build' conditions. The Lovers Lane traffic was rerouted further south to the East Archwood Avenue Exit and the Inman Street traffic was rerouted to exit the highway earlier by utilizing the South Arlington Street Exit. See **Figure 5** for the Design Year 2040 'Build' traffic volumes.

# IX. Traffic Analysis:

### *Methodology:*

Capacity analyses were performed for the AM and PM peak hours for the Design Year 2040 traffic conditions in order to determine the operating conditions experienced by each intersection, freeway segment, ramp merge / diverge junction and weave segment.

The intersection capacity analysis was performed utilizing Highway Capacity Software (HCS) 2010 (Version 6.8) from the McTrans Transportation Research Center and Synchro (Version 8) developed by Trafficware. Analysis results reported by HCS 2010 are based on the Highway Capacity Manual (HCM) 2010 and results reported by Synchro are based on the Highway Capacity Manual (HCM) 2000 calculation outputs.

In addition to using HCS 2010, Synchro was used as a supplemental analysis tool to analyze the intersection capacity of the South Arlington Street / I-76 WB Exit Ramp / 2nd Avenue / Martin Avenue intersection. This intersection is comprised of five (5) approaches and is unable to be properly analyzed with HCS 2010 software. As such, the analysis results for this intersection were reported using the Synchro HCM 2000 outputs as the HCM 2010 does not currently support intersections with more than four (4) approaches.

Capacity analyses for freeway segments, ramp merge / diverge junctions and weave segments were performed utilizing HCS 2010 (Version 6.7). Analysis results reported by HCS 2010 are based on the Highway Capacity Manual (HCM) 2010. Each freeway segment, ramp merge / diverge junction and weave segment was assigned a specific number for purposes of this evaluation. See **Figure 6** for a location key map that identifies the freeway segments, ramp merge / diverge junctions and weave segments of the 'No-Build' conditions and **Figure 7** for a location key map of the 'Build' conditions.

### *Intersection Analysis:*

Intersection capacity analysis was performed for the Design Year 2040 conditions in order to determine the operating conditions experienced by each intersection. The quality of the operating conditions experienced by an intersection is measured in terms of Level-of-Service (LOS), which is determined by the amount of delay experienced by motorists. Levels-of-Service can range from LOS A to LOS F. Level-of-Service ratings of A, B, and C are considered to be in the acceptable range. Level-of-Service D is typically considered acceptable in urban and suburban areas (which this study area has been determined to be within). Levels-of-Service E and F are considered below average with significant levels of delay experienced by vehicles. The thresholds related to average control delay for signalized intersections are shown in **Table 2** on the following page.

| Table 2: Level–of–Service Criteria for Signalized Intersections | |
|---|---|
| Level–of–Service | Delay Threshold – (Sec) |
| A | < 10 |
| B | > 10 - 20 |
| C | > 20 - 35 |
| D | > 35 - 55 |
| E | > 55 - 80 |
| F | > 80 |

**Table 3** below summarizes the Intersection Capacity Analysis and details the Levels-of-Service and delay experienced under the Design Year 2040 'No-Build' and 'Build' conditions for the signalized intersections within the study area. See **Appendix B** for the intersection capacity analysis printouts.

Table 3: Intersection Capacity Analysis Summary – Design Year 2040 'No-Build' vs. 'Build' Conditions

| Intersection / Movement | 'No-Build' Conditions | | | | 'Build' Conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | LOS | Delay (sec) | LOS | Delay (sec) | LOS | Delay (sec) | LOS | Delay (sec) |
| | | | | | | | | |
| **Archwood Avenue / Burkhardt Avenue** | | | | | | | | |
| Eastbound Thru-Right | B | 11.9 | B | 13.8 | B | 12.5 | B | 14.8 |
| *Eastbound Approach* | *B* | *11.9* | *B* | *13.8* | *B* | *12.5* | *B* | *14.8* |
| Westbound Left | B | 14.2 | B | 18.6 | B | 14.8 | B | 19.6 |
| Westbound Thru | B | 10.6 | B | 11.0 | B | 11.1 | B | 11.6 |
| *Westbound Approach* | *B* | *11.3* | *B* | *12.0* | *B* | *11.8* | *B* | *12.7* |
| Southbound Left | B | 11.4 | B | 13.7 | B | 11.5 | B | 13.9 |
| Southbound Thru-Right | B | 12.4 | B | 14.1 | B | 13.2 | B | 15.6 |
| *Southbound Approach* | *B* | *12.0* | *B* | *13.9* | *B* | *12.5* | *B* | *14.8* |
| ***Intersection Total*** | ***B*** | ***11.9*** | ***B*** | ***13.4*** | ***B*** | ***12.4*** | ***B*** | ***14.4*** |
| | | | | | | | | |
| **Archwood Avenue / Coventry Street** | | | | | | | | |
| Eastbound Left | C | 21.7 | C | 29.9 | C | 23.0 | C | 30.4 |
| Eastbound Thru | A | 7.3 | A | 8.5 | A | 8.2 | A | 9.2 |
| *Eastbound Approach* | *B* | *16.4* | *B* | *16.6* | *B* | *15.6* | *B* | *16.6* |
| Westbound Thru-Right | B | 10.6 | B | 10.3 | B | 11.5 | B | 10.4 |
| *Westbound Approach* | *B* | *10.6* | *B* | *10.3* | *B* | *11.5* | *B* | *10.4* |
| Northbound Left-Thru-Right | B | 16.5 | B | 16.7 | B | 15.7 | B | 16.7 |
| *Northbound Approach* | *B* | *16.5* | *B* | *16.7* | *B* | *15.7* | *B* | *16.7* |
| ***Intersection Total*** | ***B*** | ***13.7*** | ***B*** | ***14.2*** | ***B*** | ***13.9*** | ***B*** | ***14.3*** |
| | | | | | | | | |

Table 3: Intersection Capacity Analysis Summary –
Design Year 2040 'No-Build' vs. 'Build' Conditions (Cont.)

| Intersection / Movement | 'No-Build' Conditions | | | | 'Build' Conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | LOS | Delay (sec) | LOS | Delay (sec) | LOS | Delay (sec) | LOS | Delay (sec) |
| | | | | | | | | |
| **Lovers Lane / Burkhardt Avenue** | | | | | | | | |
| Eastbound Thru-Right | B | 11.1 | B | 11.4 | B | 10.3 | B | 11.1 |
| *Eastbound Approach* | *B* | *11.1* | *B* | *11.4* | *B* | *10.3* | *B* | *11.1* |
| Westbound Left-Thru | B | 11.2 | B | 11.1 | B | 10.9 | B | 10.9 |
| *Westbound Approach* | *B* | *11.2* | *B* | *11.1* | *B* | *10.9* | *B* | *10.9* |
| Southbound Left-Thru | B | 11.2 | B | 11.6 | B | 10.8 | B | 11.1 |
| Southbound Right | B | 10.9 | B | 11.0 | B | 10.7 | B | 11.0 |
| *Southbound Approach* | *B* | *11.1* | *B* | *11.4* | *B* | *10.8* | *B* | *11.1* |
| ***Intersection Total*** | ***B*** | ***11.1*** | ***B*** | ***11.3*** | ***B*** | ***10.6*** | ***B*** | ***11.0*** |
| | | | | | | | | |
| **South Arlington Street / I-76 WB Exit Ramp / 2nd Avenue / Martin Avenue** | | | | | | | | |
| Eastbound Left-Thru-Right | B | 13.2 | B | 19.5 | B | 10.7 | B | 16.0 |
| *Eastbound Approach* | *B* | *13.2* | *B* | *19.5* | *B* | *10.7* | *B* | *16.0* |
| I-76 WB Left-Thru-Right | C | 22.1 | C | 29.3 | C | 24.8 | C | 30.0 |
| *I-76 WB Approach* | *C* | *22.1* | *C* | *29.3* | *C* | *24.8* | *C* | *30.0* |
| 2nd Avenue WB Left-Thru-Right | C | 20.9 | C | 21.7 | C | 21.0 | C | 22.4 |
| *2nd Avenue WB Approach* | *C* | *20.9* | *C* | *21.7* | *C* | *21.0* | *C* | *22.4* |
| Northbound Left | B | 14.5 | A | 7.5 | B | 19.4 | B | 10.8 |
| Northbound Thru-Right | B | 14.3 | A | 9.3 | B | 18.3 | B | 13.4 |
| *Northbound Approach* | *B* | *14.3* | *A* | *9.3* | *B* | *18.5* | *B* | *13.4* |
| Southbound Left | B | 12.5 | A | 9.5 | B | 15.4 | B | 14.5 |
| Southbound Thru-Right | B | 13.9 | B | 10.7 | B | 17.2 | B | 16.4 |
| *Southbound Approach* | *B* | *13.8* | *B* | *10.5* | *B* | *17.1* | *B* | *16.2* |
| ***Intersection Total*** | ***B*** | ***15.8*** | ***B*** | ***11.8*** | ***B*** | ***19.4*** | ***B*** | ***17.0*** |
| | | | | | | | | |

As shown in **Table 3**, the analysis of the Design Year 2040 'No-Build' and 'Build' traffic conditions indicates that all four (4) existing signalized intersections within the study area are projected to operate with acceptable Levels-of-Service under the Design Year conditions. The Design Year 2040 'Build' traffic scenario indicates that there will be an increase in overall intersection delay at the Archwood Avenue / Burkhardt Avenue, Archwood Avenue / Coventry Street and South Arlington Street / I-76 WB Exit Ramp / 2nd Avenue / Martin Avenue intersections due to the additional rerouted traffic from the Lovers Lane and Inman Street ramp closures. Although these intersections experience a slight increase in traffic, the Design Year 2040 'Build' traffic scenario indicates that these intersections are anticipated to continue to operate with acceptable Levels-of-Service.

### *Freeway Section Analysis:*

The quality of the operating conditions experienced by a freeway segment is measured in terms of Level-of-Service (LOS) which is determined by the density of traffic on the road. The density of traffic is measured by passenger cars per mile per lane (pc/mi/ln). Levels-of-Service can range from LOS A to LOS F. Level-of-Service ratings of A, B, and C are considered to be in the acceptable range with little to no delay to motorists. Level-of-Service D is typically considered acceptable in urban and suburban areas and is the grade where motorists begin to slow down and experience congestion. Levels-of-Service E and F are considered unacceptable with significant congestion and delay experienced by motorists. **Table 4** below identifies the LOS criteria for freeway segments.

Table 4: Level–of–Service Criteria for Basic Freeway Segments

| Level–of–Service | Density Threshold – (pc/mi/ln) |
|---|---|
| A | 0 - 11 |
| B | > 11 - 18 |
| C | > 18 - 26 |
| D | > 26 - 35 |
| E | > 35 - 45 |
| F | > 45 |

**Table 5** summarizes the HCS Freeway Capacity Analysis and details the Levels-of-Service and density experienced under the Design Year 2040 'No-Build' vs. 'Build' traffic conditions of the basic freeway segments within the study area. With geometric changes being implemented under the 'Build' condition some freeway segments will not be identified by the same identification number between the two (2) conditions. See **Figure 6** for a location key map that identifies the freeway segments, ramp merge / diverge junctions and weave segments of the 'No-Build' conditions and **Figure 7** for a location key map of the 'Build' conditions. These freeway segments include freeway segments F-3, F-6 and F-14. Freeway segment F-3 represents a different freeway segment under each condition while freeway segments F-6 and F-14 are not included under the 'Build' condition, further detail will be provided in the paragraph following **Table 5**. With the exception of the freeway segments detailed above, all other freeways segments will have the same identification number between the 'No-Build' and 'Build' conditions. See **Figure 8** and **Figure 9** for diagrams displaying the Levels-of-Service experienced during the AM and PM peak hours, respectively, under the Design Year 2040 'No-Build' traffic conditions and **Figure 10** and **Figure 11** for diagrams displaying the Levels-of-Service experienced during the AM and PM peak hours, respectively, under the Design Year 2040 'Build' traffic conditions. See **Appendix C** for the HCS Freeway Capacity Analysis printouts.

Table 5: Mainline Freeway Segment Analysis Summary –
Design Year 2040 'No-Build' vs. 'Build' Conditions

| Freeway Segment | 'No-Build' Conditions | | | | 'Build' Conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) |
| | | | | | | | | |
| **I-77 SB / I-76 EB** | | | | | | | | |
| **F-1** (SB Main St On-ramp to NB Main St On-Ramp) | C | 19.5 | D | 28.4 | C | 19.5 | D | 28.4 |
| **F-2** (NB Main St On-Ramp to I-77 SB Off-Ramp) | C | 20.5 | D | 31.1 | C | 20.5 | D | 31.1 |
| **F-3** (NB Main St On-Ramp to I-77 SB Off-Ramp) | D | 27.4 | F | 46.4 | | | | |
| **F-3** (SR-8 NB Off-Ramp to I-77 SB Off-Ramp) | | | | | C | 19.7 | D | 34.4 |
| **F-4** (I-76 EB / I-77 SB Split to I-76 WB On-Ramp) | C | 25.3 | E | 42.5 | C | 25.3 | E | 42.5 |
| **F-5** (I-76 WB On-Ramp to Lovers Ln Off-Ramp) | C | 25.8 | D | 34.0 | C | 25.8 | D | 34.0 |
| **F-6** (Lovers Ln Off-Ramp to SR-8 SB Merge) | C | 23.9 | D | 32.3 | | | | |
| **F-7** (Archwood Ave Off-Ramp to Wilbeth Rd Off-Ramp) | D | 34.9 | F | 171.7 | D | 34.9 | F | 171.7 |
| | | | | | | | | |
| **I-77 NB / I-76 WB** | | | | | | | | |
| **F-8** (Wilbeth Rd On-Ramp to Archwood Ave On-Ramp) | F | 107.9 | E | 40.9 | F | 107.9 | E | 40.9 |
| **F-9** (I-77 NB / SR-8 NB Split to I-77 NB / I-76 EB Split) | D | 28.6 | D | 26.5 | D | 28.6 | D | 26.5 |
| **F-10** (I-77 NB / I-76 EB Split to SR-8 SB Merge) | D | 31.8 | C | 25.6 | D | 31.8 | C | 25.6 |
| **F-11** (SR-8 SB / I-77 NB Merge to I-76 WB) | D | 28.2 | C | 24.5 | D | 28.2 | C | 24.5 |
| **F-12** (SR-8 SB / I-77 NB Merge to Broadway St Off-Ramp) | D | 34.9 | C | 23.3 | D | 34.9 | C | 23.3 |
| **F-13** (Broadway St Off-Ramp to Main St On-Ramp) | C | 20.2 | B | 17.2 | C | 20.2 | B | 17.2 |
| | | | | | | | | |
| **I-76 Eastbound** | | | | | | | | |
| **F-14** (I-77 SB Off-Ramp to SR-8 NB Off-Ramp) | D | 28.5 | F | 48.6 | | | | |
| **F-15** (SR-8 NB Off-Ramp to SR-8 SB / I-77 NB Merge) | B | 15.9 | D | 29.8 | B | 15.9 | D | 29.8 |
| **F-16** (SR-8 SB / I-77 NB Merge to Kelly Ave Off-Ramp) | C | 19.8 | D | 27.2 | C | 19.8 | D | 27.2 |
| **F-17** (SR-8 SB / I-77 NB Merge to Kelly Ave Off-Ramp) | C | 24.2 | D | 34.8 | C | 24.2 | D | 34.8 |
| **F-18** (Kelly Ave Off-Ramp to S. Arlington St On-Ramp) | C | 20.6 | D | 30.9 | C | 20.6 | D | 30.9 |
| | | | | | | | | |

Note: Orange highlighted cells indicate a Level of Service E.
Red highlighted cells indicate a Level of Service F.

Table 5: Mainline Freeway Segment Analysis Summary – Design Year 2040 'No-Build' vs. 'Build' Conditions (Cont.)

| Freeway Segment | 'No-Build' Conditions | | | | 'Build' Conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) |
| | | | | | | | | |
| **I-76 Westbound** | | | | | | | | |
| **F-19** (S. Arlington St. Off-Ramp to Fuller St. On-Ramp) | F | 52.3 | C | 25.1 | F | 50.0 | C | 24.4 |
| **F-20** (Inman St. Off-Ramp to SR-8 NB Off-Ramp) | F | 62.3 | D | 30.3 | E | 35.0 | C | 22.7 |
| **F-21** (SR-8 NB Off-Ramp to I-77 SB Off-Ramp) | F | 159.7 | E | 37.0 | E | 37.2 | C | 24.2 |
| **F-22** (I-77 SB Off-Ramp to SR-8 SB / I-77 NB Merge) | E | 43.6 | C | 21.3 | E | 43.6 | C | 21.3 |
| | | | | | | | | |
| **SR-8 Southbound** | | | | | | | | |
| **F-23** (Buchtel Ave Off-Ramp to Carroll St. On-Ramp) | D | 31.2 | F | 51.6 | D | 31.2 | F | 51.6 |
| **F-24** (Carroll St. On-Ramp to I-76 EB / WB Off-Ramp) | E | 36.0 | F | 89.5 | E | 36.0 | F | 89.5 |
| **F-25** (I-76 EB / WB Off-Ramp to I-77 SB On-Ramp) | D | 31.0 | F | 163.7 | D | 31.0 | F | 163.7 |
| | | | | | | | | |
| **SR-8 Northbound** | | | | | | | | |
| **F-26** (I-76 EB/WB Off-Ramp to SR-8 NB On-Ramp) | F | 260.4 | E | 37.8 | F | 260.4 | E | 37.8 |
| **F-27** (Carroll St. Off-Ramp to Buchtel Ave. On-Ramp) | F | 68.4 | D | 34.3 | F | 68.4 | D | 34.3 |
| | | | | | | | | |
| **Central Interchange Ramps** | | | | | | | | |
| **F-28** (I-76 EB to SR-8 NB) | C | 23.4 | C | 22.6 | C | 23.4 | C | 22.6 |
| **F-29** (SR-8 SB to I-76 EB) | C | 19.7 | C | 18.4 | C | 19.7 | C | 18.4 |
| **F-30** (I-77 NB to I-76 EB) | C | 25.4 | D | 27.5 | C | 25.4 | D | 27.5 |
| **F-31** (SR-8 SB / I-77 NB to I-76 EB) | C | 22.6 | C | 23.0 | C | 22.6 | C | 23.0 |
| **F-32** (I-76 WB to SR-8 NB) | D | 30.3 | C | 18.7 | D | 30.3 | C | 18.7 |
| **F-33** (I-76 WB to I-77 SB) | D | 26.3 | D | 28.2 | D | 26.3 | D | 28.2 |
| **F-34** (SR-8 SB to I-76 EB / WB) | C | 22.2 | C | 20.9 | C | 22.2 | C | 20.9 |
| **F-35** (SR-8 SB to I-76 WB) | C | 24.8 | C | 23.4 | C | 24.8 | C | 23.4 |
| **F-36** (I-76 EB / WB to SR-8 NB) | D | 26.9 | C | 20.7 | D | 26.9 | C | 20.7 |
| | | | | | | | | |

Note: Orange highlighted cells indicate a Level of Service E.
Red highlighted cells indicate a Level of Service F.

As shown in **Table 5** on the previous pages, the results of the mainline freeway analyses indicate that freeway segments F-3, F-4 and F-7, of I-77 SB / I-76 EB, are anticipated to operate at an unacceptable LOS E or worse during the PM peak hour under the Design Year 2040 'No-Build' conditions. These freeway segments experience poor levels-of-service as they have insufficient capacity to contain the combination of traffic from the three (3) major highways (I-76, I-77 and SR-8). It should be noted that, freeway segment F-3 appears to show an improvement from a LOS F to a LOS D from the 'No-Build' condition to the 'Build' condition, however it does not represent the same freeway segment between the two (2) conditions. It should also be noted that, a LOS result is not reported for freeway segment F-6 under the 'Build' condition as freeway segment F-5 will now be carried through to the merge junction with SR-8 SB because there will no longer be a change in traffic volumes with the removal of the Lovers Lane exit ramp.

With no change to the geometrics and no change between the 'No-Build' and 'Build' traffic volumes for the I-77 NB or the I-76 WB / I-77 NB shared use section, the capacity results for freeway segments F-8 to F-13 report the same levels-of-service for both peak hours under the 'No-Build' and 'Build' conditions. As shown in **Table 5**, freeway segment F-8 is anticipated to operate at a LOS F and E during the AM and PM peak hours, respectively, under the Design Year 2040 'No-Build' and 'Build' conditions.

The I-76 EB freeway segment F-14 reports an unacceptable LOS F during the PM peak hour under the Design Year 2040 'No-Build' conditions. It should be noted that, a LOS result is not reported for freeway segment F-14 under the 'Build' condition as it was excluded from the analysis due to the geometric reconfiguration of the I-76 EB / I-77 SB to SR-8 NB exit ramp (F-28). Under the 'Build' condition this ramp movement will occur before the I-77 SB exit ramp (F-4) movement as opposed to after under the 'No-Build' condition.

Freeway segments F-19 and F-20 of I-76 WB report different LOS under each condition due to the removal of the Inman Street exit ramp. Motorists currently utilizing the Inman Street exit ramp were assumed to exit the highway earlier at the South Arlington Street exit ramp. Therefore, the LOS results for F-19 slightly improve from the 'No-Build' to 'Build' condition. Freeway segment F-20 will still represent the same freeway segment and traffic volume for both conditions with the only difference being the number of lanes analyzed. Freeway segment F-20 was analyzed with three (3) lanes under the 'No-Build' condition and four (4) lanes under the 'Build' condition due to the removal of the Inman Street exit ramp. This additional lane will improve the LOS F (62.3 pc/mi/ln) experienced during the AM peak hour under the 'No-Build' condition to a LOS E (35.0+ pc/mi/ln) under the 'Build' condition, a 44% decrease in density. The same condition occurred for freeway segment F-21. F-21 represents the same freeway segment for both conditions but due to the geometric reconfiguration of the I-76 WB to I-77 SB exit ramp (F-33) an additional lane for this segment will be created under the 'Build' condition. Freeway segment F-21 was analyzed with two (2) lanes under the 'No-Build' condition and three (3) lanes under the 'Build' condition. This additional lane will improve the LOS F (159.7 pc/mi/ln) experienced during the AM peak hour under the 'No-Build' condition to a LOS E (37.2 pc/mi/ln) under the 'Build' condition, a 77% decrease in density.

SR-8 SB freeway segments F-23, F-24 & F-25 are anticipated to operate at an unacceptable LOS F during the PM peak hour under both the 'No-Build' and 'Build' conditions while the SR-8 NB freeway segments F-26 & F-27 are anticipated to operate at an unacceptable LOS F during the AM peak hour under both the 'No-Build' and 'Build' conditions. Freeway segments F-24 (AM peak only) and F-26 (PM peak only) are also anticipated to operate at an unacceptable LOS E under both conditions. All the remaining fly-over and connector ramps contained within the central interchange are anticipated to operate with acceptable levels-of-service during the peak hours under both the 'No-Build' and 'Build' conditions.

A majority of the freeway segments report no changes in terms of density from the Design Year 2040 'No-Build' to 'Build' conditions for the following two (2) reasons:

1. The volume of the freeway segment remains constant
2. The capacity provided remains constants (i.e. number of travel lanes)

Although the reported densities from the capacity analysis remain the same across the two (2) analysis conditions, the proposed improvements should reduce the amount of slowing and stopping of traffic, lane changing, and merging on the approaches to the central interchange. Due to the limitations of the HCS software, these conditions are not represented in the analysis results.

***Ramp Junction Analyses:***

Merge and diverge areas of influence are considered separately from the mainline freeway segment analysis. Merge / diverge analyses were performed for all ramp junctions within the study area. **Table 6** below summarizes the levels-of-service criteria for ramp areas of influence.

Table 6: Level–of–Service Criteria for Ramp Areas of Influence

| Level–of–Service | Density Threshold – (pc/mi/ln) |
|---|---|
| A | 0 – 10 |
| B | > 10 – 20 |
| C | > 20 – 28 |
| D | > 28 – 35 |
| E | > 35 |
| F | Demand Exceeds Capacity |

**Table 7** summarizes the Ramp Areas of Influence Levels-of-Service experienced under the Design year 2040 conditions. It should be noted that diverges D-2 and D-6 were analyzed as major diverges. A major diverge occurs when the number of lanes leaving the diverge area is one (1) more than the number entering it. Major diverges follow the same density thresholds when reporting levels-of-service. The following diverge areas of influence have been eliminated under the 'Build' condition due to its new geometric layout: D-1, D-3 and D-5. See **Appendix D** for the HCS Ramp Areas of Influence analyses printouts.

| Table 7: Ramp Areas of Influence Analysis Summary – Design Year 2040 'No-Build' vs. 'Build' Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Ramp Area of Influence** | **'No-Build' Conditions** | | | | **'Build' Conditions** | | | |
| | **AM Peak** | | **PM Peak** | | **AM Peak** | | **PM Peak** | |
| | **LOS** | **Density** (pc/mi/ln) | **LOS** | **Density** (pc/mi/ln) | **LOS** | **Density** (pc/mi/ln) | **LOS** | **Density** (pc/mi/ln) |
| | | | | | | | | |
| D-1 (Lovers Lane Off-Ramp) | C | 27.3 | E | 35.0 | | | | |
| D-2* (Broadway St Off-Ramp) | D | 33.4 | C | 22.4 | D | 33.4 | C | 22.4 |
| D-3 (SR-8 NB Off-Ramp) | C | 26.7 | F | 39.9 | | | | |
| D-4 (Fuller St Off-Ramp) | C | 24.2 | D | 30.9 | C | 24.2 | D | 30.9 |
| D-5 (I-77 SB Off-Ramp) | F | 51.7 | D | 34.3 | | | | |
| D-6* (I-76 EB / WB Off-Ramp) | D | 34.3 | E | 48.7 | D | 34.3 | E | 48.7 |
| | | | | | | | | |
| M-1 (NB Main St On-Ramp) | B | 15.0 | C | 23.7 | B | 15.0 | C | 23.7 |
| M-2 (Carroll St On-Ramp) | D | 29.3 | F | 43.2 | D | 29.3 | F | 43.2 |
| | | | | | | | | |

Note: Red highlighted cells indicate a Level of Service F.
* Major Diverge Area

As shown in **Table 7**, the analyses of the Design Year 2040 traffic conditions shows that under the Design Year 2040 'No-Build' conditions the diverge junction D-1 is anticipated to operate at an unacceptable LOS E during the PM peak hour while the diverge junctions D-3 (PM peak only) and D-5 (AM peak only) are anticipated to operate at an unacceptable LOS F. The Lovers Lane exit ramp will be removed under the 'Build' conditions and therefore the poor operation of diverge junction D-1 will also be eliminated. The diverge junctions D-3 and D-5 will also be eliminated under the 'Build' condition with the geometric reconfiguration of the I-76 left handed exit ramps. The new configuration of these ramps will be a drop lane under the 'Build' condition. The major diverge junction D-6 is anticipated to operate at an unacceptable LOS E during the PM peak hour under both the 'No-Build' and 'Build' conditions due to the poor operation of the freeway segment that precedes it (F-24). The merge junction M-2 is anticipated to operate at an unacceptable LOS F during the PM peak hour under both the 'No-Build' and 'Build' conditions. This poor operation is due to the poor operation of the freeway segment it is merging with (F-23).

### *Weave Segment Analysis:*

Weave segments are considered separately from basic freeway segments and ramp merge and diverge junction analyses. A weave segment is a segment in which two (2) or more separate traffic streams traveling in the same general direction cross paths along a significant length of freeway without the aid of traffic control devices (except for guide signs). Weaving segments are formed when a diverge segment closely follows a merge segment or when a one-lane off-ramp closely follows a one-lane on-ramp and the two (2) are connected by a continuous auxiliary lane. Weave segments follow the same level-of-service criteria as ramp areas of influence, refer to **Table 6** on the previous page.

**Table 8** summarizes the Weave Segment Levels-of-Services experienced under the Design year 2040 conditions. It should be noted that weave segment W-3 is eliminated under the 'Build' condition with the removal of the Inman Street exit ramp. See **Appendix E** for the HCS weave segment analysis printouts.

Table 8: Weave Segment Analysis Summary – Design Year 2040 'No-Build' vs. 'Build' Conditions

| Ramp Area of Influence | 'No-Build' Conditions | | | | 'Build' Conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) |
| | | | | | | | | |
| **I-77 Southbound** | | | | | | | | |
| **W-1** (I-76 / SR-8 SB Merge to Archwood Ave. Off-Ramp) | F | * | F | * | F | * | F | * |
| | | | | | | | | |
| **I-77 Northbound** | | | | | | | | |
| **W-2** (Archwood Ave On-Ramp to I-76 / SR-8 Split) | F | * | F | * | F | * | F | * |
| | | | | | | | | |
| **I-76 Westbound** | | | | | | | | |
| **W-3** (Fuller St On-Ramp to Inman St Off-Ramp) | E | 41.4 | C | 25.8 | | | | |
| | | | | | | | | |
| **SR-8 Northbound** | | | | | | | | |
| **W-4** (I-76 / SR-8 NB Merge to Carroll St. Off-Ramp) | F | * | F | * | F | * | F | * |
| | | | | | | | | |

Note: Orange highlighted cells indicate a Level of Service E.
Red highlighted cells indicate a Level of Service F.
*Results not reported by HCS

As shown on **Table 8**, the analysis of the Design Year 2040 'No-Build' and 'Build' traffic conditions shows that all weave segments are anticipated to operate at an unacceptable Level-of-Service E or worse during the peak hours with the exception of weave segment W-3 during the PM peak hour under the 'No-Build' condition. The weave segment W-3 will no longer exist under the 'Build' conditions with the removal of the Inman Street exit ramp. It should be noted that the weave segments with no reported results are anticipated to operate so poorly that HCS does not calculate a result and the proposed improvements have no impact on these calculations.

### *Storage Length Calculations and Recommendations:*

Storage length calculations were not performed as part of this study as no intersection turn lanes will be affected by the improvements proposed under the SUM–76–Central Interchange (PID 101402) Improvement Project.

Based on the information and analysis in this study, the Akron Beltway Team concludes that the SUM–76–Central Interchange (PID 101402) Improvement Project will have no impact on the operation of the central interchange or adjacent interchanges that would require mitigation.

## X. Cost Estimate:

A cost estimate was developed for the SUM – 76 – Central Interchange (PID 101402) project. The cost includes pavement, roadway, drainage, erosion control, utilities, lighting, traffic control, structures, retaining walls, maintenance of traffic, right-of-way and other miscellaneous items. The current estimated total for the project is $53,000,000 including all design aspects. The attached detailed cost estimate was completed as part of the *SUM-76-11.48 (PID 101402) Northeast Interchange Safety Study Summary Memo* dated September 25th, 2015. See **Appendix F** for the detailed cost estimate.

This project has secured 100% funding from four (4) sources. The largest portion of funding (66% of total project costs) committed to the project is to come from the ODOT Priority System Major Rehabilitation Program (MR) and totals $35,000,000. The Transportation Review Advisory Council (TRAC) has also committed funds totaling $4,000,000 (7.55% of total project costs). An additional $4,000,000 (7.55% of total project costs) was secured through the Highway Safety Program (HSP) after the Akron Beltway Design Team submitted a safety study to the HSP. The remaining $10,000,000 (18.9% of total project costs) will be allocated to the project by ODOT District 4.

## XI. Environmental Summary:

The Akron Beltway Design Team completed an environmental overview of the central interchange and prepared an environmental summary of the known resources in the central interchange project area under the *SUM-76 Central Interchange (PID 101402) Environmental Overview* document dated April 28th, 2016.

Stream information was provided by the Ohio Department of Natural Resources (ODNR) and no streams were found to be within the study area. The Federal Emergency Management Agency (FEMA) also reports that there are no flood plains located within the study area. The northern part of the study area was found to be within the City of Akron – Little Cuyahoga River Basin and the southern part of the study area was found to be within the Portage Lakes – Tuscarawas River Basin, according to the watershed boundaries from the Natural Resources Conservation Service (NRCS).

The Ohio Wetland Inventory (OWI), provided by the ODNR (circa 1970s), suggests the presence of a shallow marsh wetland in the northeast quadrant of the central interchange. The OWI also shows shrub/scrub and shallow marsh wetlands north of Johnston Street and east of SR-8, just outside the study area. The National Wetland Inventory (NWI), provided by the U.S. Fish & Wildlife Service, indicates that there are no NWI wetlands within the study area. A report prepared by ODOT in 2006 identified a small low-quality wetland in the southeast quadrant of the central interchange located outside of the right-of-way at the north end of Merton Avenue.

A literature search of resources of the ODNR Division of Natural Areas and Preserves, U.S. Fish & Wildlife Service and Heritage Data Services for the study area did not reveal the presence of any endangered or threatened species, suitable habitat or other special features within the study area.
According to the Summit County Department of Development database there are no Section 4(f) public parks or recreational lands within the study area. It should be noted that playgrounds or other outdoor areas at Goodrich Middle School may be considered Section 4(f) resources depending upon school policy regarding access by the general public. A search of the United States Department of the Interior National Park Service indicates that no parks paid for by the Land & Water Conservation fund are located in or near the study area. The Ohio Historic Preservation Office (OHPO) database was searched for National Register listings, Ohio historic structures and archaeological sites near or within the study area and none were reported. It should be noted that the database contained records for multiple Ohio historic structures and a National Register determination of eligibility site near the study area and the Ohio historic structures are listed because they were built before 1966.

The only public facilities located near or within the study area are the Summit County Engineer's Office, located in the southwest quadrant of the study area, and the Goodrich Middle School, located in the southeast quadrant of the study area.

There are no landfills, superfund sites or suspect sites listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) or National Priorities List (NPL) databases located within or near the study area. Several Resource Conservation and Recovery Act (RCRA) sites were found outside the study area including: Goodrich Middle School (southeast quadrant), Summit County Engineer's Office (southwest quadrant), Alcon Tool Company (southwest quadrant), Gross Pat Cleaners (southwest quadrant), A&C Welding Inc. (northeast quadrant) and Hoban High School (southeast quadrant).

The U.S. Census Block Groups representing the study area have both minority and low-income populations that exceed 40%. Therefore, the project area should be considered a sensitive environmental justice area. The potential effect on minority and low-income populations resulting from changes in access (ramp and bridge closures) along with residential displacements and neighborhood-oriented business relocations will need to be considered as the project advances.

# XII. Conclusions:

This Interchange Modification Study (IMS) is being prepared at the request of the Ohio Department of Transportation (ODOT). The SUM–76–Central Interchange (PID 101402) project is the first identified project to be derived from the Akron Beltway Planning Study (PID 95831).
The purpose of this study is to determine if the proposed improvements of the SUM–76–Central (PID 101402) project will degrade the operation of the central interchange and the adjacent freeways and interchanges surrounding it and if so, what actions are required to address such degradation.

The planning study identified the need to replace the left handed exit ramps of I-76 EB to SR-8 NB and I-76 WB to I-77 SB. These ramps are being replaced in advance prior to the finalization of the planning study in order to correct their sub-standard geometrics and poor physical condition. This improvement project will also eliminate the two (2) partial interchanges of Lovers Lane and Inman Street.

The safety review from the planning study identified the central interchange as the "worst" performing area of the Akron Beltway with 300 crashes occurring between the years of 2009 – 2011. Many of the crashes that have occurred in the central interchange area are due to capacity and congestion issues as well as sub-standard geometrics of all eight (8) interchange ramps.

The Opening Year for the proposed central interchange improvement project is 2020 with the Design Year established as 2040. Capacity analysis for all basic freeway segments, ramp merge / diverge junctions, weave segments and intersections were only performed for the Design Year 2040 AM and PM peak hours. The intersection capacity analyses for the Design Year 2040 AM and PM peak hours identified that the study intersections are anticipated to operate with acceptable Levels-of-Service and minimal delay under both the 'No-Build' and 'Build' traffic conditions. The capacity analysis also identified many freeway segments, ramp merge / diverge junctions and weave segments within the study area that operate with unacceptable levels-of-service under both the Design Year 2040 'No-Build' and 'Build' traffic conditions.

Based on the information and analysis in this study, the Akron Beltway Team concludes that the SUM–76–Central Interchange (PID 101402) Improvement Project will have no impact on the operation of the central interchange or adjacent interchanges that would require mitigation.

The SUM–76–Central Interchange (PID 101402) Improvement Project should be pursued while incorporating the recommended roadway improvements and modifications detailed in this study. Each individual improvement will contribute to the overall function of the central interchange and allow it to continue to provide for the current needs and future demands expected by the traveling public.

# XIII. Recommendations:

From the Akron Beltway Planning Study (PID 95831) it was recommended that the left handed exit ramps of I-76 EB to SR-8 NB and I-76 WB to I-77 SB be reconstructed in order to correct their sub-standard geometrics and poor physical condition. The planning study also recommended the elimination of the two (2) partial interchanges of Lovers Lane and Inman Street. The elimination of these partial interchanges will eliminate weave conditions and improve traffic flow. Reconfiguring the lane assignments of each left handed ramp to provide dedicated drop lanes for the ramps as wells as two (2) through lanes for I-76 will address both safety and operation concerns. The SUM–76–Central Interchange (PID 101402) project includes the following improvements:

- Reconstruct the ramp from I-76 WB to I-77 SB on a new alignment
- Reconstruct the ramp from I-76 EB to SR-8 NB on a new alignment.
- Reconstruct the I-76 WB bridge through the central interchange on a new alignment
- Change the alignment of the I-76 WB to SR-8 NB ramp
- Remove the I-77 SB / Lovers Lane exit ramp
- Remove the I-76 WB / Inman Street exit ramp
- Remove the Lafollette Street Bridge over I-77 and build a replacement structure further to the south

The proposed improvements identified within this Interchange Modification Study will correct sub-standard geometrics of the I-76 left handed exit ramps, improve traffic flow by creating dedicated drop lanes for said exit ramps and remove two (2) partial interchanges which will eliminate two (2) weaving segments from the central interchange. All of the improvements detailed above will contribute to improving the overall operation of the central interchange as well as improving safety. None of the improvements will degrade the operation of the central interchange or the adjacent freeways and interchanges surrounding it.

# FIGURES

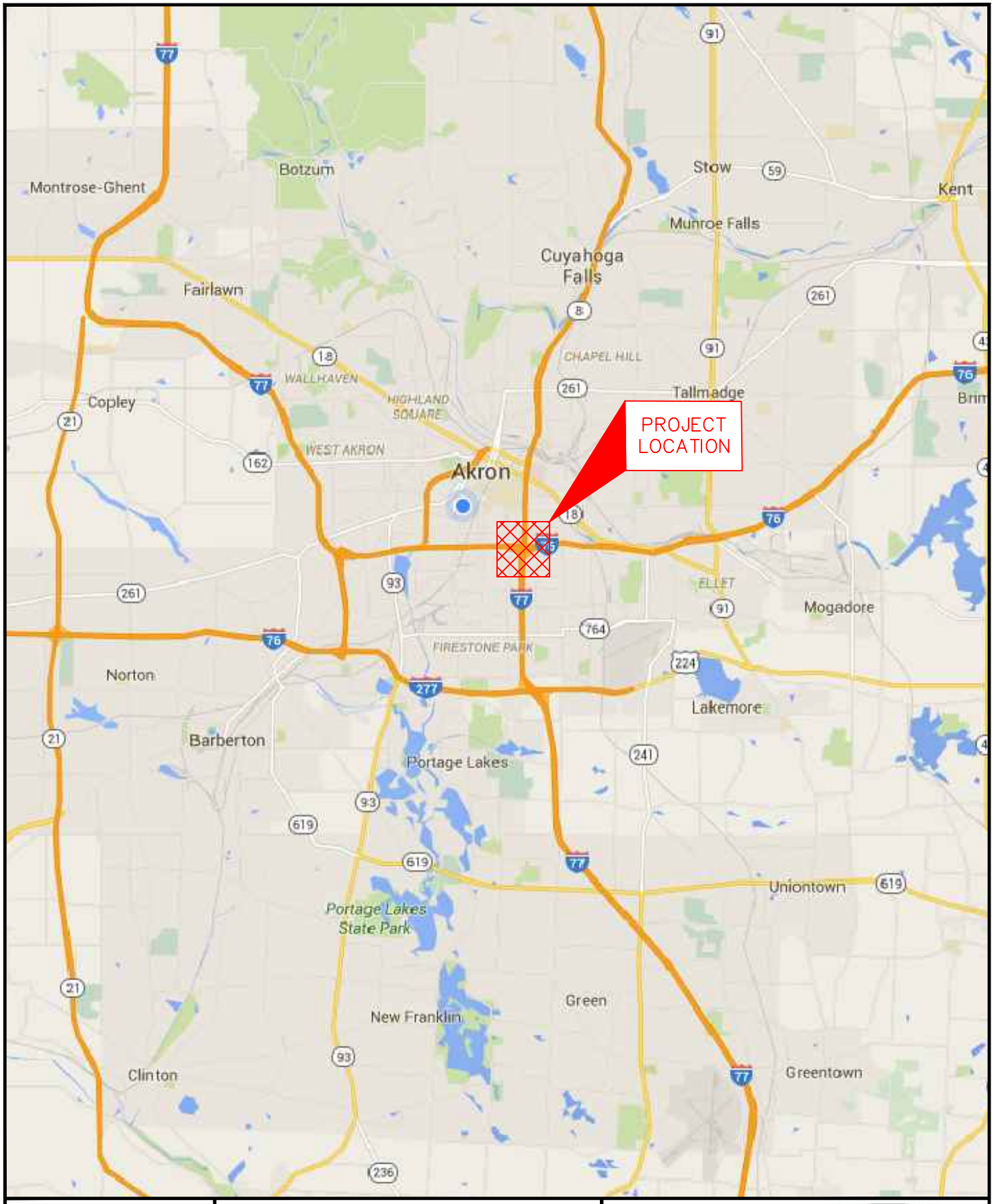



FIGURE 1

PROJECT LOCATION MAP

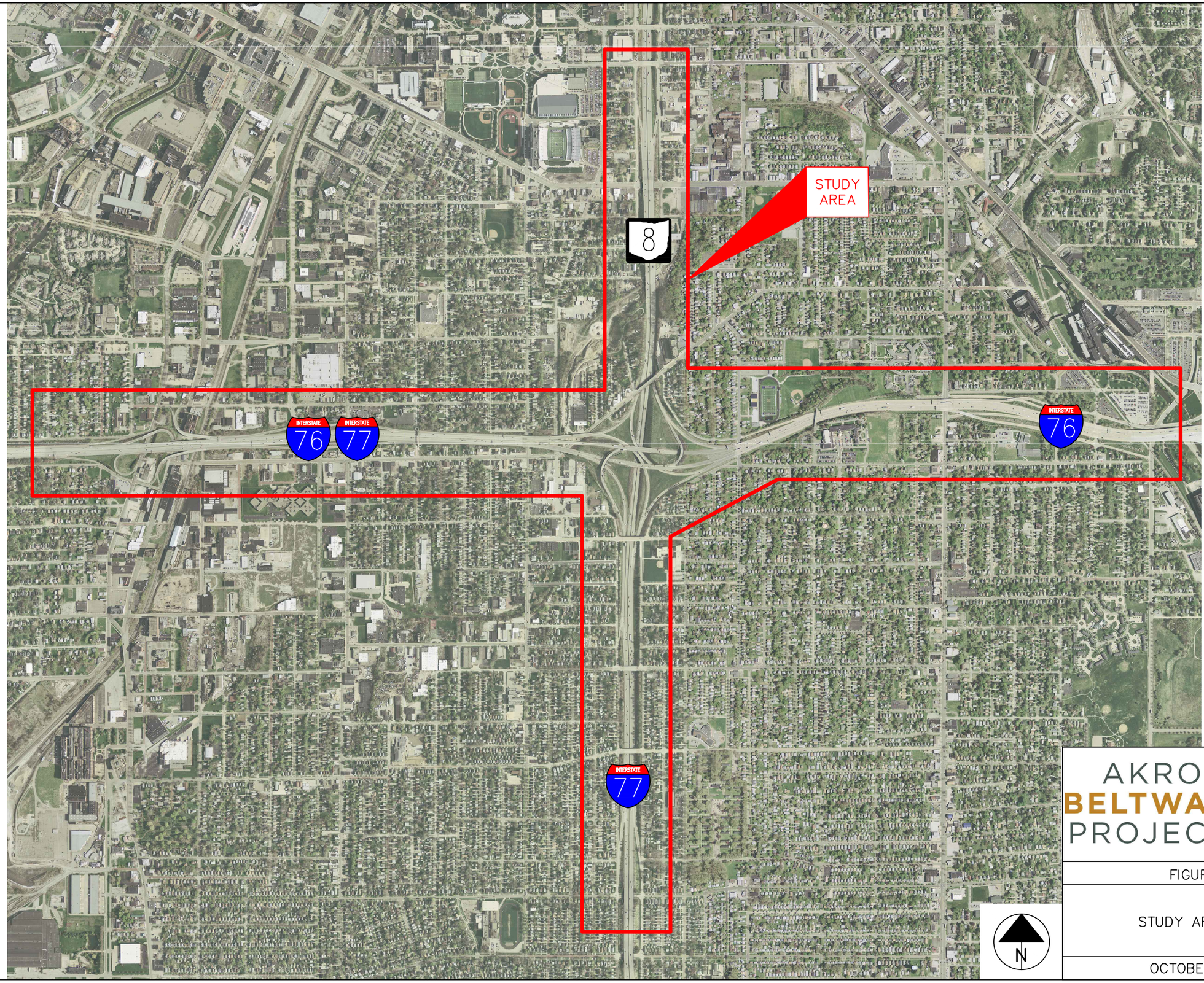
OCTOBER 2016

N

N.T.S.

AKRON BELTWAY PROJECT

CAD FILE: O:\2013\2013350\SUM\95831\TRAFFIC\INTERCHANGE MODIFICATION STUDY\FIGURES\FIGURE 1_PROJECT LOCATION MAP.DWG
DATE: 10/7/2016 TIME: 3:17:07 PM
TECHNICIAN: BFERRELL



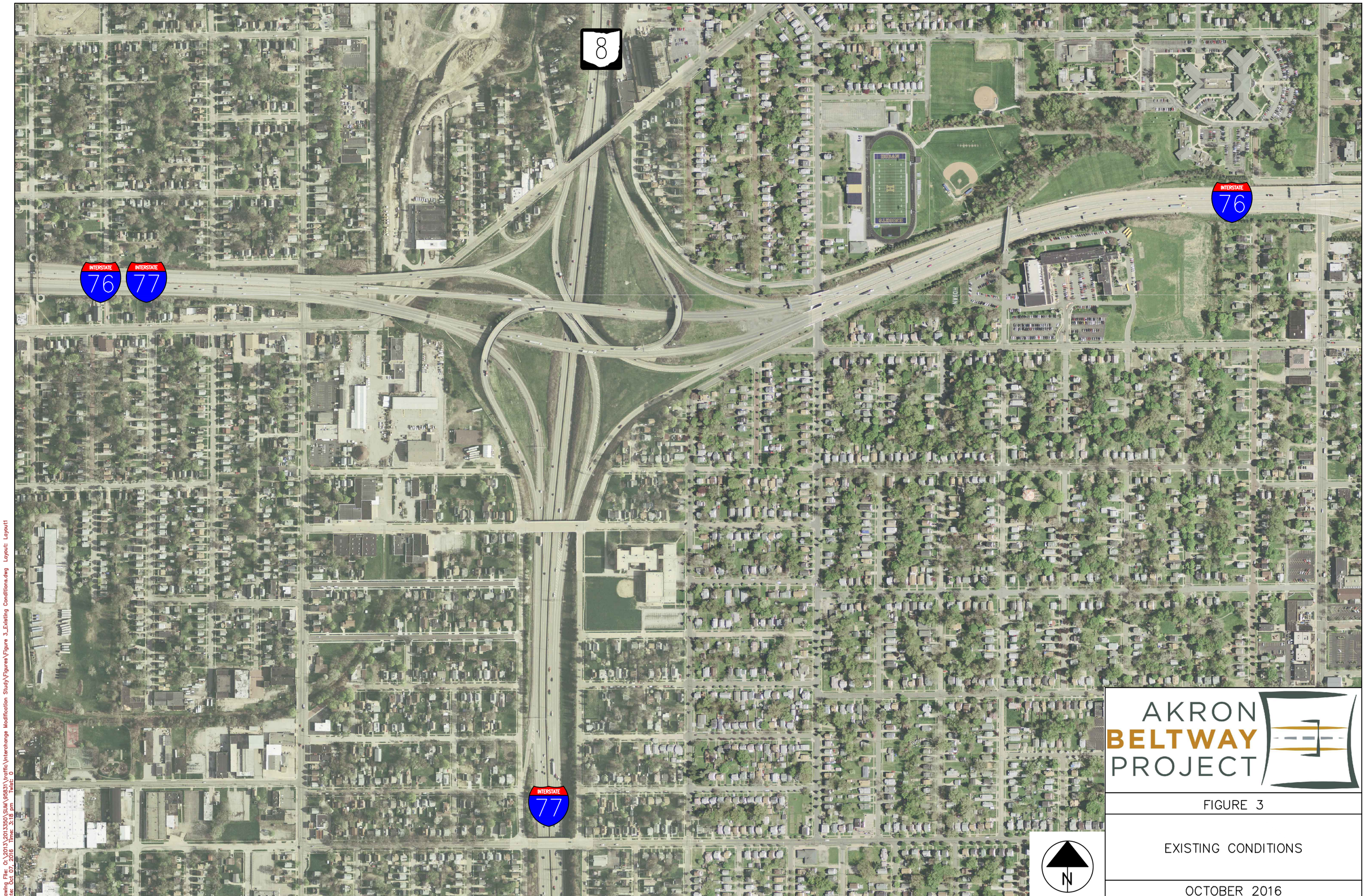

AKRON BELTWAY PROJECT

FIGURE 2

STUDY AREA MAP

OCTOBER 2016

Drawing File: G:\2013\2013350\SUM\95831\Traffic\Interchange Modification Study\Figures\Figure 2_Study Area Map.dwg Layout: Layout1
Date: Oct 07, 2016 Time: 3:18 pm Twist: 0
Technician: bferrell




AKRON BELTWAY PROJECT

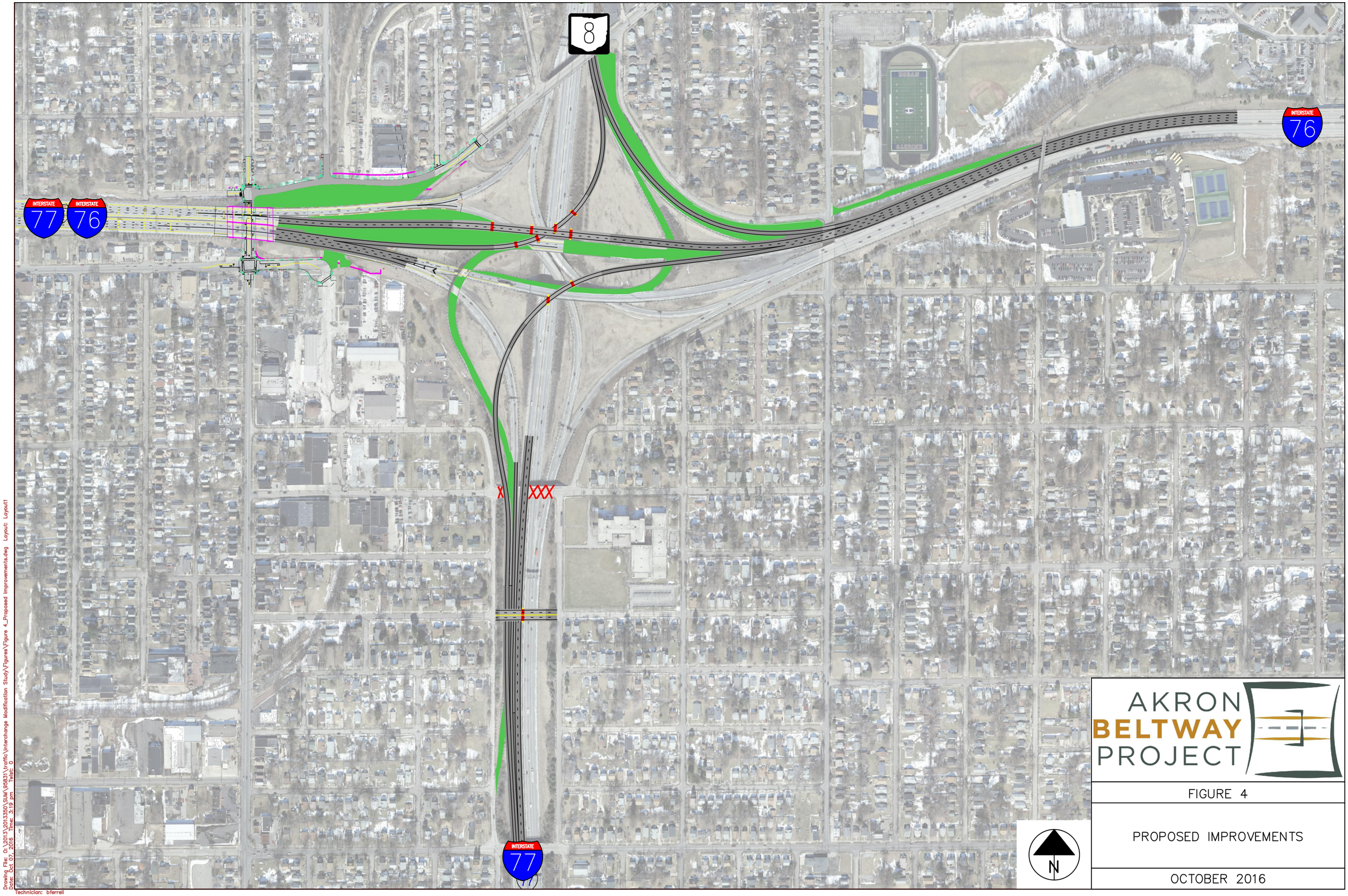
FIGURE 3

EXISTING CONDITIONS

OCTOBER 2016

N

Drawing File: O:\2013\20133501\SUM\95831\traffic\Interchange Modification Study\Figures\Figure 3_Existing Conditions.dwg Layout: Layout1
Date: Oct 07, 2016 Time: 3:18 pm Twist: 0
Technician: bferrell




AKRON BELTWAY PROJECT

FIGURE 4

PROPOSED IMPROVEMENTS

OCTOBER 2016

N

Drawing File: O:\2013\2013350\SUM\95831\Traffic\Interchange Modification Study\Figures\Figure 4_Proposed Improvements.dwg Layout: Layout1
Date: Oct 07, 2016 Time: 3:19 pm Twist: 0
Technician: bferrell

(6,410) 4,600
7,060 (5,070)
CARROLL STREET
(1,050) 650
1,210 (620)
8
(7,460) 5,250
8,270 (5,690)
DETAIL 'A'
INMAN STREET
6,710 (4,380)
INTERSTATE 76
3,780 (5,190)
S. ARLINGTON STREET
5
4
410 (550)
6,300 (3,830)
340 (220)
2ND AVENUE
6,640 (4,050)
3,410 (4,980)
200 (250)
3,210 (4,730)
570 (460)
FULLER STREET
(3,300) 3,870
(730) 550
(4,030) 4,420
(5,170) 4,450
(850) 1,140
(4,320) 3,310
(1,210) 490
(5,530) 3,800
(500) 180
S. MAIN STREET
S. BROADWAY STREET
2,860 (1,210)
6,730 (4,510)
INTERSTATE 77
INTERSTATE 76
3,980 (6,030)
BURKHARDT AVENUE
(3,370) 2,560
LOVERS LANE
3
(8,760) 5,610
8,450 (6,280)
INTERSTATE 77
(600) 470
680 (500)
E. ARCHWOOD AVENUE
1
2
(8,160) 5,140
7,770 (5,780)
(2,070) 2,200
2,670 (2,050)
(1,160) 1,230
1,160 (1,120)
(2,450) 2,830
(2,060) 3,900
1,510 (930)
5,200 (3,450)
(4,910) 2,820
(1,980) 1,260
2,220 (2,260)
1,560 (2,930)
970 (910)
(1,390) 1,300
1,250 (1,350)
(5,390) 3,050
1,600 (1,290)
5,600 (3,640)
(3,370) 2,560
2,850 (2,640)
INMAN STREET

LEGEND

## – AM PEAK
(##) – PM PEAK

N

N.T.S.

AKRON BELTWAY PROJECT

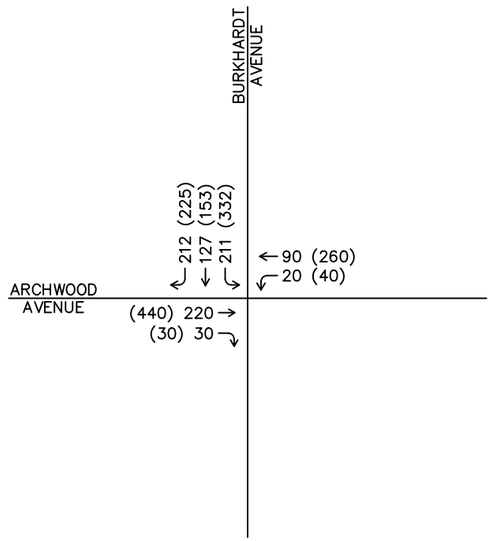
FIGURE 5

DESIGN YEAR 2040
'BUILD' TRAFFIC VOLUMES
SHEET 1 OF 2

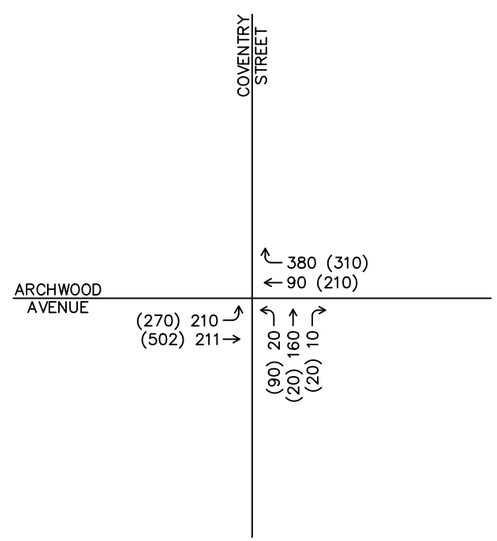
OCTOBER 2016

Drawing File: Q:\2013\2013350\SUM\95831\traffic\Interchange Modification Study\Figures\Figure 5_'Build' Volumes.dwg Layout: Highway 'Build' Volumes
Date: Oct 07, 2016 Time: 3:13 pm Twist: -1.57079633
Technician: bferrell

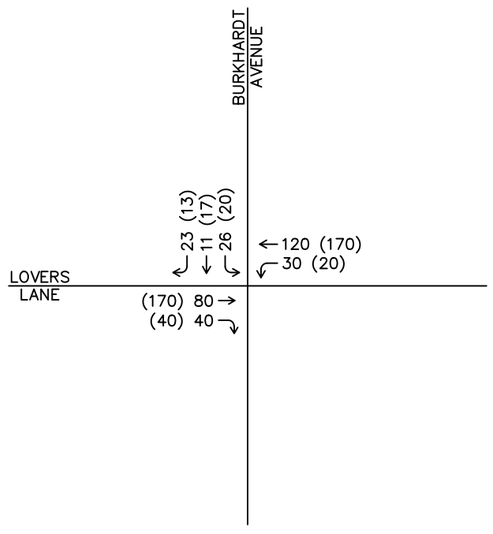
## 1 ARCHWOOD AVENUE / BURKHARDT AVENUE



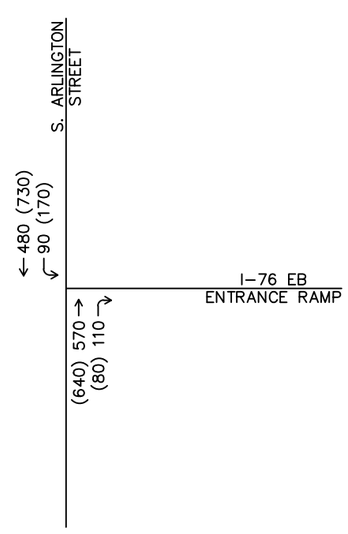

## 2 ARCHWOOD AVENUE / COVENTRY STREET



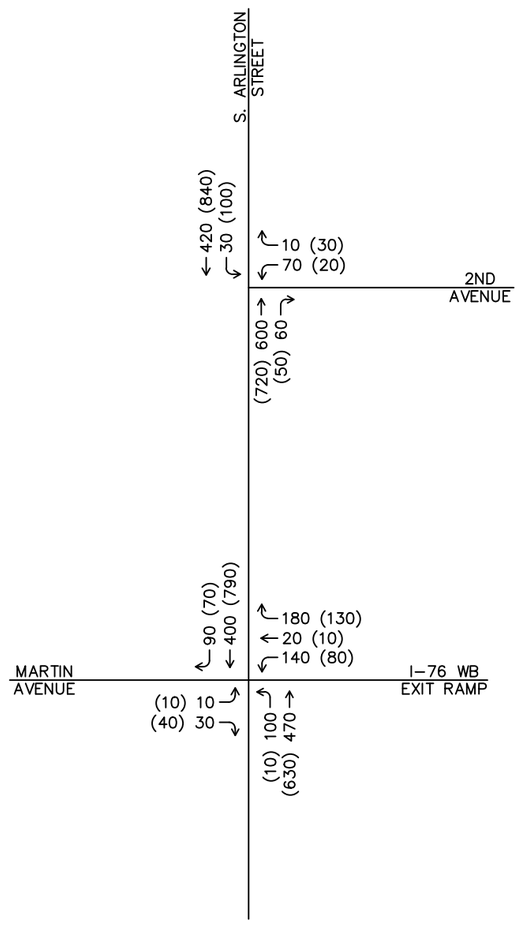

## 3 LOVERS LANE / BURKHARDT AVENUE




## 4 SOUTH ARLINGTON STREET / I-76 EB ENTRANCE RAMP




## 5 SOUTH ARLINGTON STREET / I-76 WB EXIT RAMP / MARTIN AVENUE / 2ND AVENUE




LEGEND

## – AM PEAK HOUR
(##) – PM PEAK HOUR

N

N.T.S.

AKRON BELTWAY PROJECT

FIGURE 5

DESIGN YEAR 2040
'BUILD' TRAFFIC VOLUMES
SHEET 2 OF 2

OCTOBER 2016

Drawing File: O:\2013\2013350\SUM\95831\traffic\Interchange Modification Study\Figures\Figure 5_'Build' Volumes.dwg Layout: Intersection 'Build' Volumes
Date: Oct 13, 2016 Time: 10:42 am Tablet: -1.57079633
Technician: bferrell

LEGEND

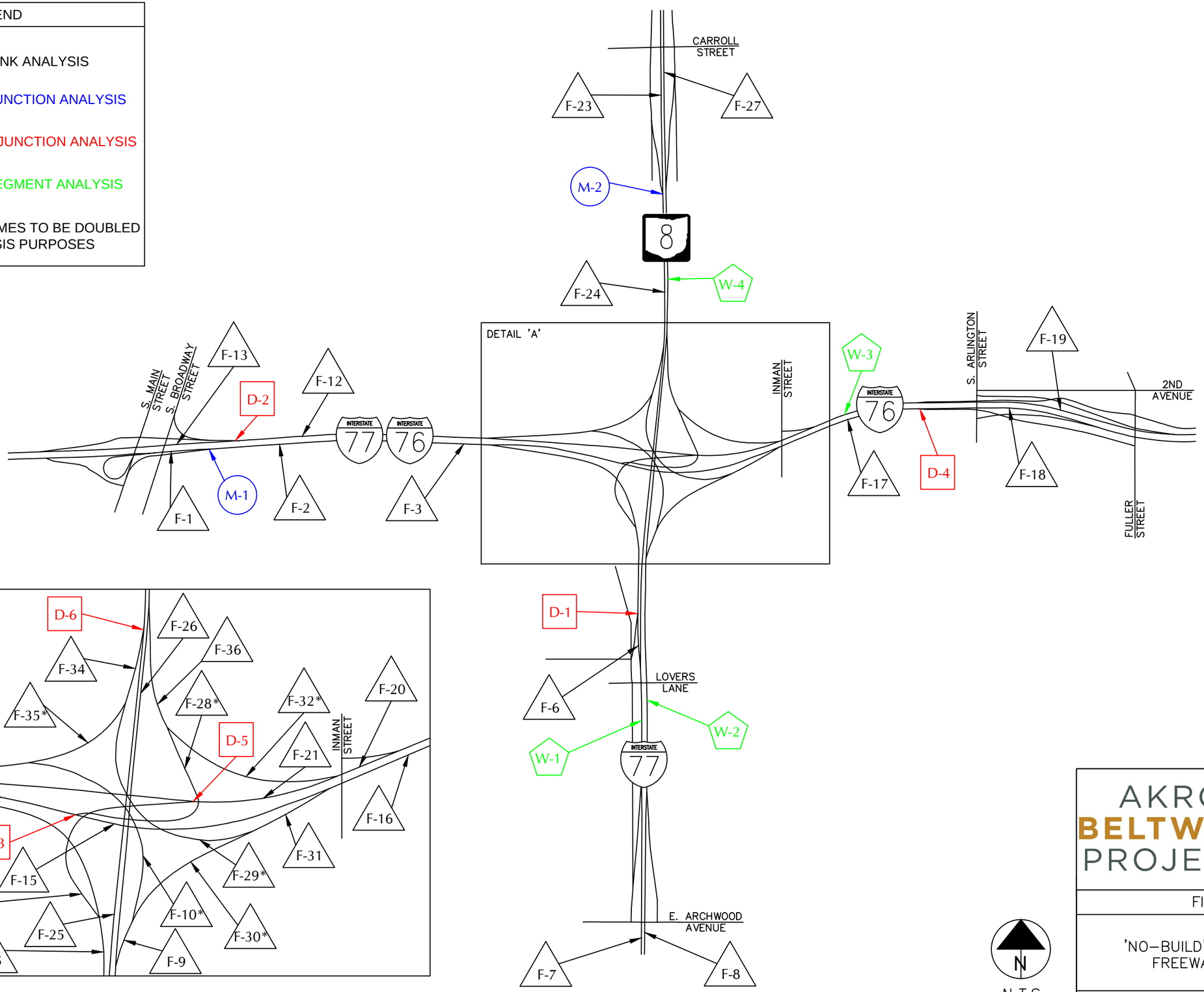
F-# FREEWAY LINK ANALYSIS

M-# MERGING JUNCTION ANALYSIS

D-# DIVERGING JUNCTION ANALYSIS

W-# WEAVING SEGMENT ANALYSIS

* RAMP VOLUMES TO BE DOUBLED FOR ANALYSIS PURPOSES

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AKRON BELTWAY PROJECT

FIGURE 6

'NO-BUILD' HCS ANALYSIS
FREEWAY KEY MAP

OCTOBER 2016

Drawing File: O:\2013\2013350\SUM\95831\Traffic\Interchange Modification Study\Figures\Figure 6_'No-Build' Freeway Key Map.dwg Layout: 'No-Build' Key Map
Date: Oct 07, 2016 Time: 3:20 pm Twist: -1.57079633
Technician: bferrell

LEGEND

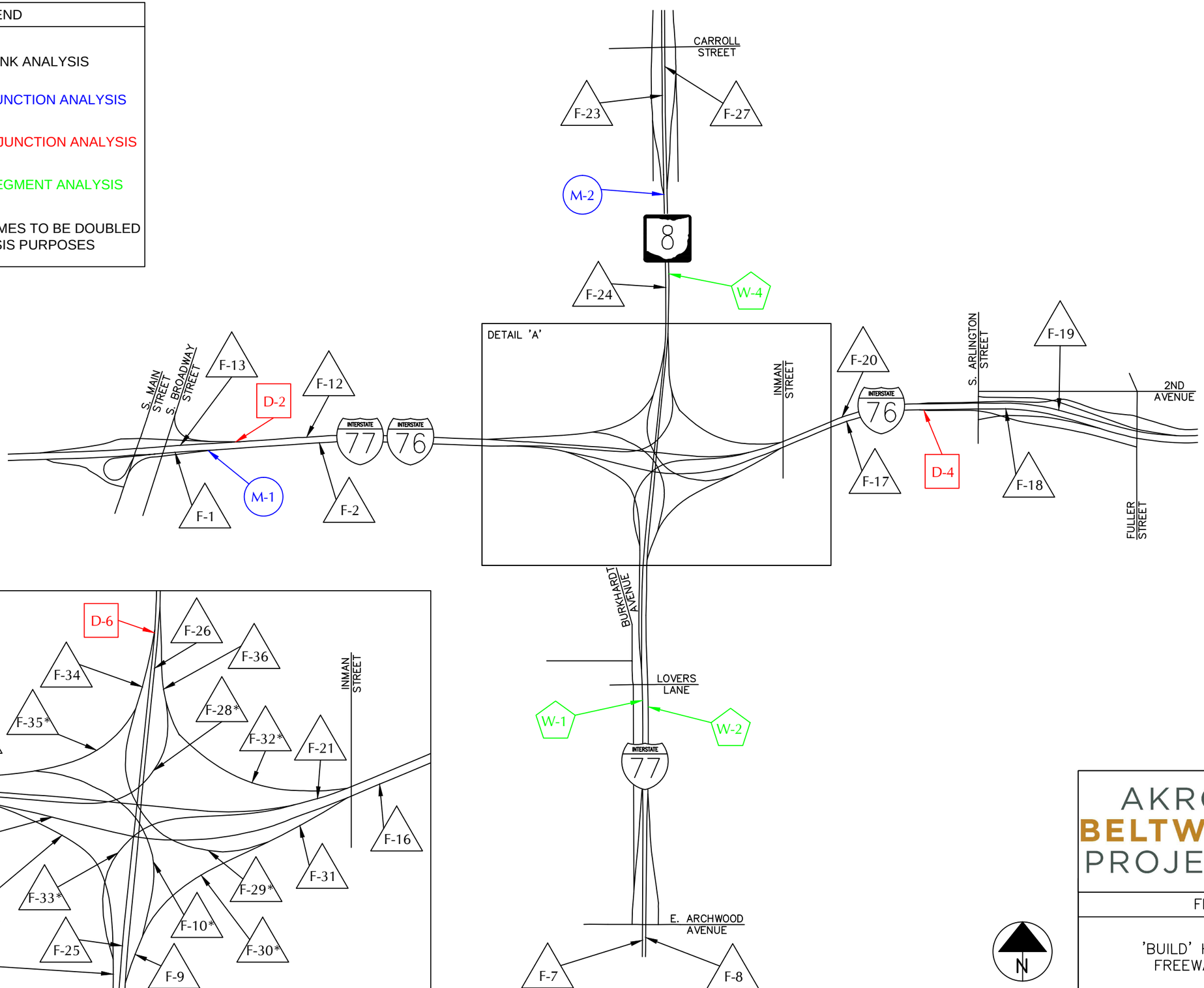
F-# FREEWAY LINK ANALYSIS

M-# MERGING JUNCTION ANALYSIS

D-# DIVERGING JUNCTION ANALYSIS

W-# WEAVING SEGMENT ANALYSIS

* RAMP VOLUMES TO BE DOUBLED FOR ANALYSIS PURPOSES

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AKRON BELTWAY PROJECT

FIGURE 7

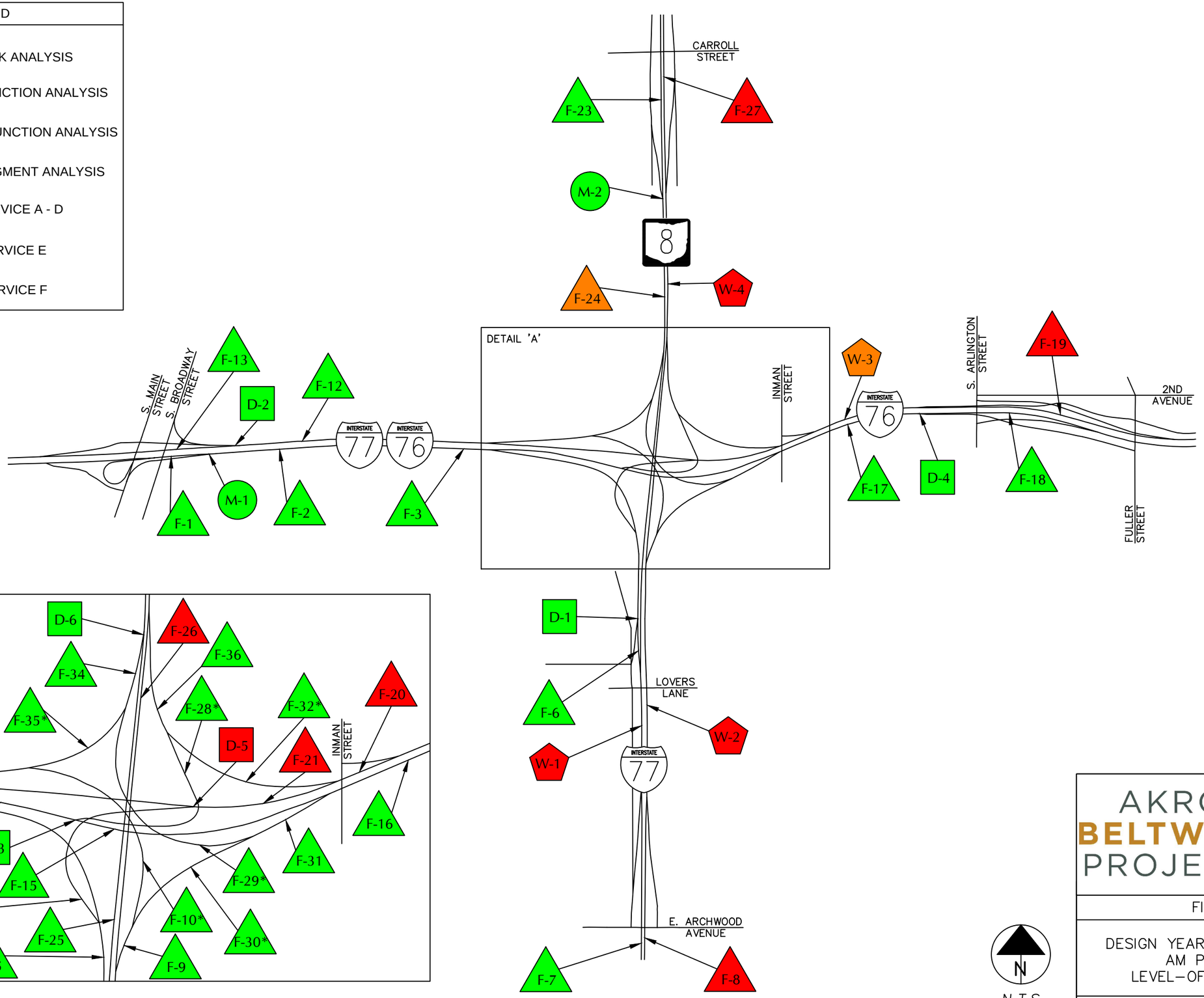
'BUILD' HCS ANALYSIS
FREEWAY KEY MAP

OCTOBER 2016

Drawing File: Q:\2013\2013350\SUM\95831\traffic\Interchange Modification Study\Figures\Figure 7_'Build' Freeway Key Map.dwg Layout: 'Build' Key Map
Date: Oct 07, 2016 Time: 3:20 pm Twist: -1.5707963
Technician: bferrell

LEGEND

- F-# FREEWAY LINK ANALYSIS
- M-# MERGING JUNCTION ANALYSIS
- D-# DIVERGING JUNCTION ANALYSIS
- W-# WEAVING SEGMENT ANALYSIS
- LEVEL-OF-SERVICE A - D
- LEVEL-OF-SERVICE E
- LEVEL-OF-SERVICE F




N

N.T.S.

AKRON BELTWAY PROJECT

FIGURE 8

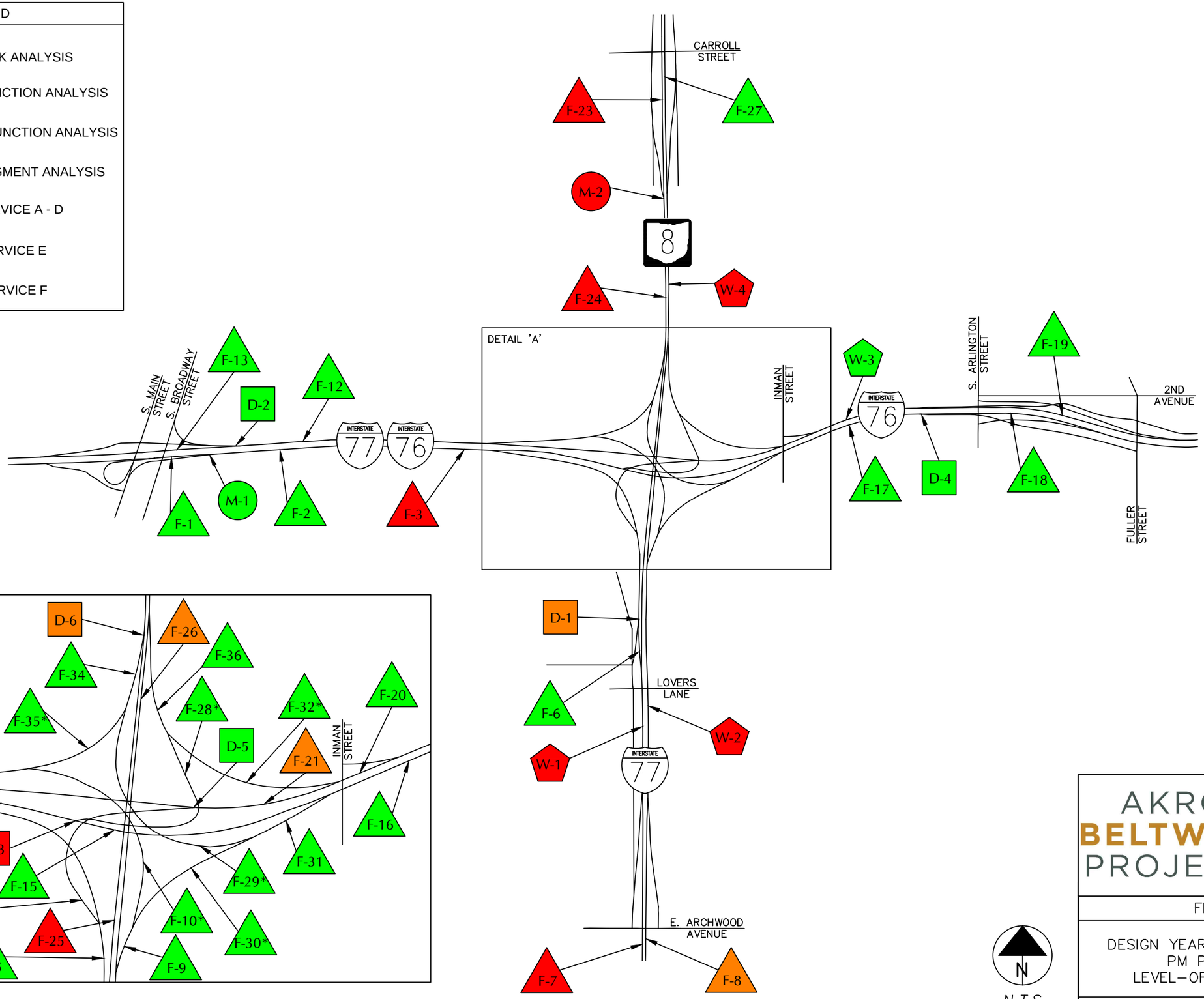
DESIGN YEAR 2040 'NO-BUILD'
AM PEAK HOUR
LEVEL-OF-SERVICE MAP

OCTOBER 2016

Drawing File: Q:\2013\2013350\SUM\95831\Traffic\Interchange Modification Study\Figures\Figures 8 & 9_Design Year 'No-Build' LOS Map.dwg Layout: AM 'No-Build' LOS Map
Date: Oct 10, 2016 Time: 8:40 am Twist: -1.57079633
Technician: bferrell

LEGEND

- F-# FREEWAY LINK ANALYSIS
- M-# MERGING JUNCTION ANALYSIS
- D-# DIVERGING JUNCTION ANALYSIS
- W-# WEAVING SEGMENT ANALYSIS
- LEVEL-OF-SERVICE A - D
- LEVEL-OF-SERVICE E
- LEVEL-OF-SERVICE F

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N.T.S.

AKRON BELTWAY PROJECT

FIGURE 9

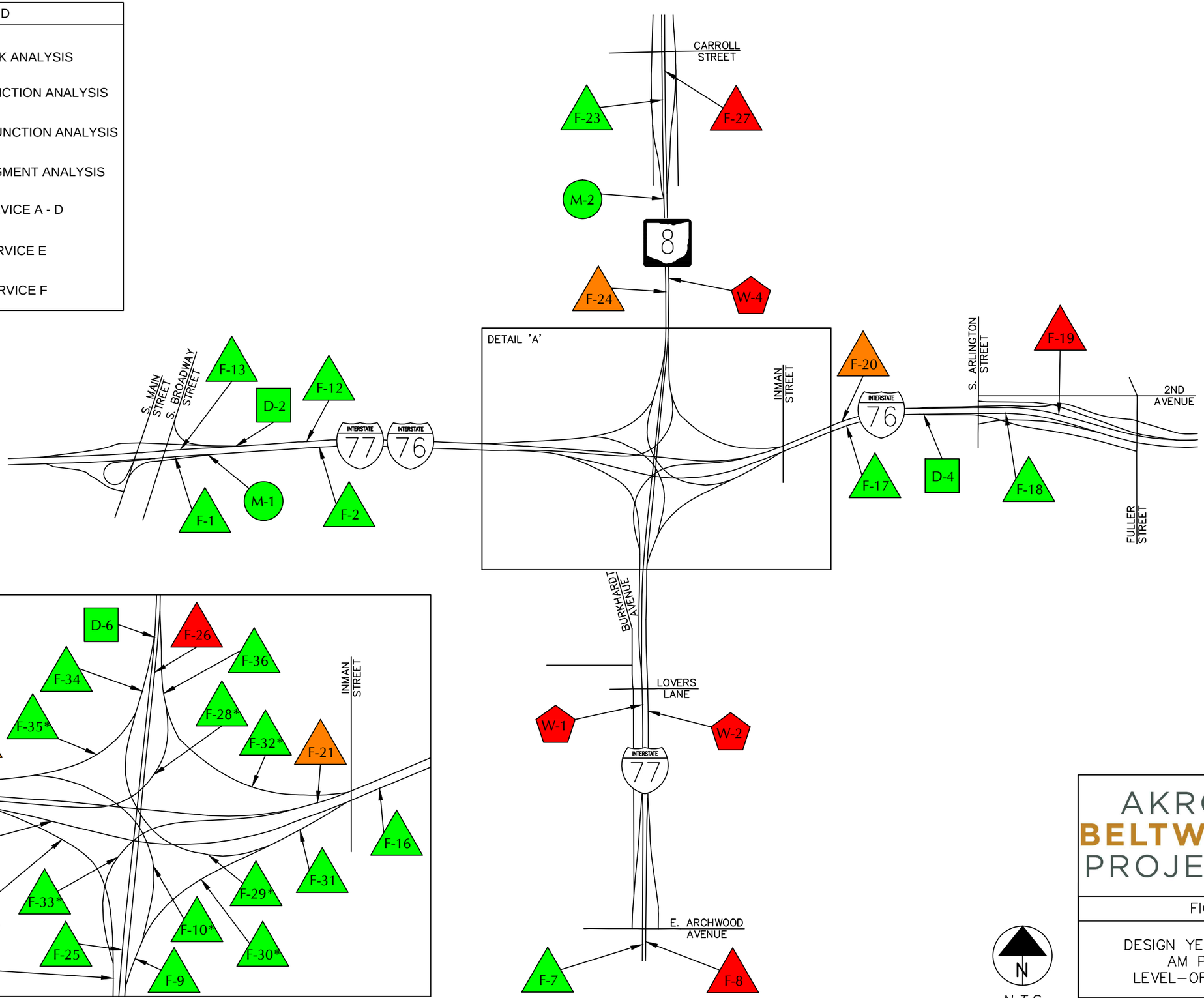
DESIGN YEAR 2040 'NO-BUILD'
PM PEAK HOUR
LEVEL-OF-SERVICE MAP

OCTOBER 2016 (REV. 12/05/16)

Drawing File: Q:\2013\2013350\SUM\95831\Traffic\Interchange Modification Study\Figures\Figures 8 & 9_Design Year 'No-Build' LOS Map.dwg Layout: PM 'No-Build' LOS Map
Date: Dec 01, 2016 Time: 1:16 pm Twist: -1.57079633
Technician: bferrell

LEGEND

- F-# FREEWAY LINK ANALYSIS
- M-# MERGING JUNCTION ANALYSIS
- D-# DIVERGING JUNCTION ANALYSIS
- W-# WEAVING SEGMENT ANALYSIS
- LEVEL-OF-SERVICE A - D
- LEVEL-OF-SERVICE E
- LEVEL-OF-SERVICE F




N

N.T.S.

AKRON BELTWAY PROJECT

FIGURE 10

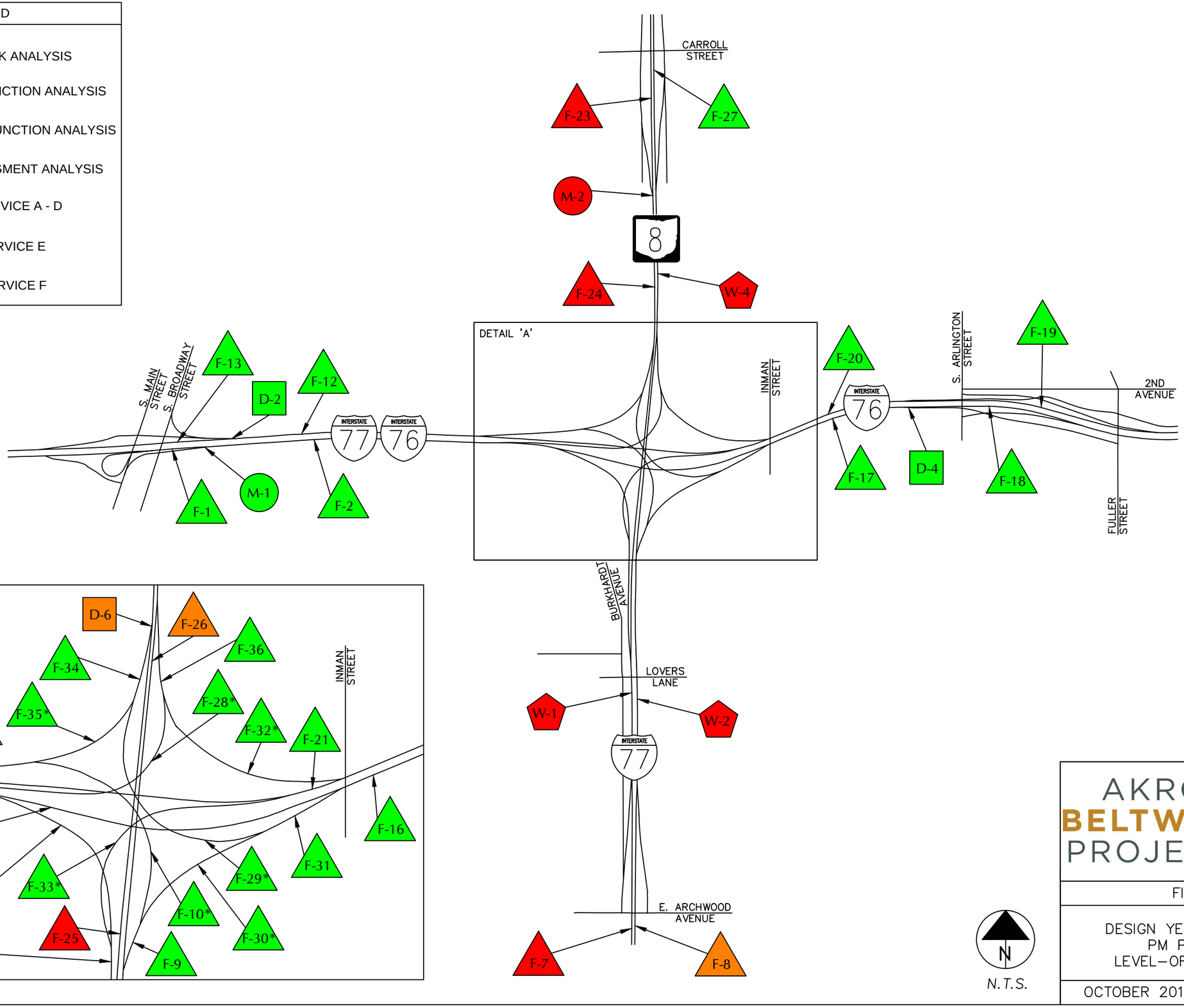
DESIGN YEAR 2040 'BUILD'
AM PEAK HOUR
LEVEL-OF-SERVICE MAP

OCTOBER 2016

Drawing File: Q:\2013\2013350\SUM_95831\traffic\Interchange Modification Study\Figures\Figures 10 & 11_Design Year 'Build' LOS Map.dwg Layout: AM 'Build' LOS Map
Date: Oct 10, 2016 Time: 8:41 am Twist: -1.57079633
Technician: bferrell

LEGEND

- F-# FREEWAY LINK ANALYSIS
- M-# MERGING JUNCTION ANALYSIS
- D-# DIVERGING JUNCTION ANALYSIS
- W-# WEAVING SEGMENT ANALYSIS
- LEVEL-OF-SERVICE A - D
- LEVEL-OF-SERVICE E
- LEVEL-OF-SERVICE F




N

N.T.S.

AKRON BELTWAY PROJECT

FIGURE 11

DESIGN YEAR 2040 'BUILD'
PM PEAK HOUR
LEVEL-OF-SERVICE MAP

OCTOBER 2016 (REV. 12/05/16)

Drawing File: Q:\2013\2013350\SUM_95831\traffic\Interchange Modification Study\Figures\Figures 10 & 11_Design Year 'Build' LOS Map.dwg Layout: PM 'Build' LOS Map
Date: Dec 01, 2016 Time: 1:17 pm Twist: -1.57079633
Technician: bferrell

# APPENDIX A
# CERTIFIED TRAFFIC PLATES

# INTER-OFFICE COMMUNICATION

**TO:** **Lorie Feudner, District 4**

**FROM:** Bryan Raderstorf, Office of Statewide Planning and Research

**SUBJECT:** **SUM-76-11.56**

**DATE:** September 7, 2016

In reply to a request dated April 28, 2016, the Office of Statewide Planning and Research has reviewed the 2020/2040 traffic for the subject study and the volumes that were provided are reasonable.

The forecasts shown on the attached pages are certified for use in the subject project.

If you have any questions, please contact me at (614) 752-5736.

(54,900) 49,820
53,940 (59,740)
CARROLL STREET
(10,850) 10,340
9,290 (9,810)
8
(65,750) 60,160
63,230 (69,550)
DETAIL 'A'
INMAN STREET
S. ARLINGTON STREET
52,370 (53,710)
INTERSTATE 76
47,320 (48,850)
5,680 (5,680)
46,690 (48,030)
1,400 (1,490)
2ND AVENUE
48,090 (49,520)
43,880 (45,530)
2,290 (2,420)
41,590 (43,110)
5,730 (5,740)
FULLER STREET
(46,950) 46,460
(10,220) 10,210
(57,170) 56,670
(58,710) 56,090
(9,830) 9,810
(48,880) 46,280
(7,550) 7,540
(56,430) 53,820
(6,170) 6,160
S. MAIN STREET
S. BROADWAY STREET
14,450 (14,460)
60,910 (61,410)
INTERSTATE 77
INTERSTATE 76
59,980 (62,600)
BURKHARDT AVENUE
(1,760) 1,750
(38,280) 34,640
MORGAN AVENUE
LOVERS LANE
(76,360) 67,140
68,780 (76,840)
INTERSTATE 77
(4,980) 4,970
6,770 (6,770)
E. ARCHWOOD AVENUE
(71,380) 62,170
62,010 (70,070)

DETAIL 'A'

(27,670) 27,660
(16,700) 16,700
(36,420) 36,170
(24,990) 24,740
(38,200) 38,180
(24,400) 21,800
(15,640) 14,590
(38,080) 32,500
(40,040) 36,390
(970) 940
27,670 (27,690)
(52,740) 51,430
15,570 (15,580)
12,100 (12,110)
39,330 (40,630)
24,710 (26,230)
22,610 (22,620)
10,960 (10,970)
13,750 (15,260)
19,470 (19,720)
35,560 (41,860)
33,220 (34,980)

LEGEND

## – YEAR 2020
(##) – YEAR 2040

N

N.T.S.

AKRON BELTWAY PROJECT

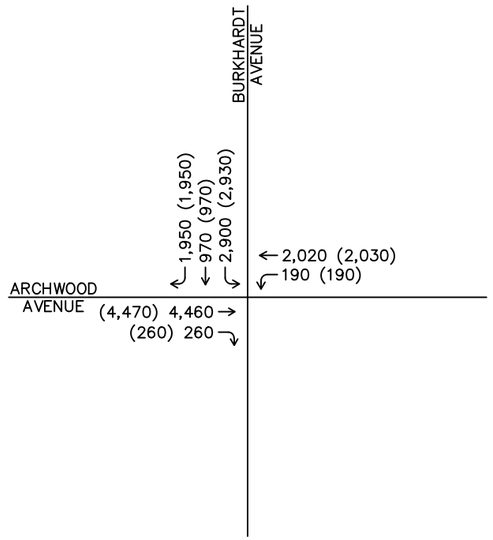
PLATE 1

YEAR 2020 / YEAR 2040
ADT
SHEET 1 OF 2

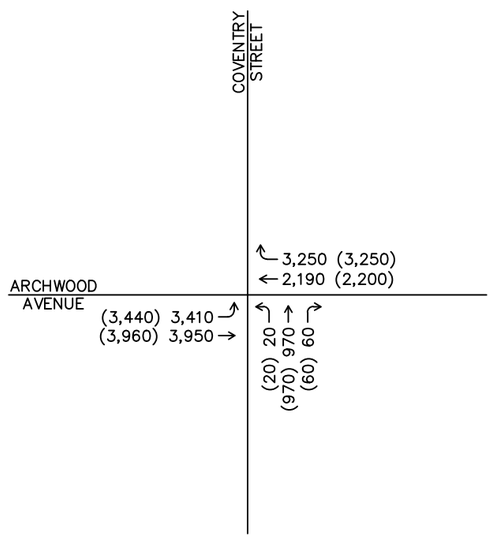
APRIL 2016 (REV. AUGUST 2016)

Drawing File: Q:\2013\2013350\SUM\95833\traffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 1-1
Date: Aug 29, 2016 Time: 2:23 pm Twist: -1.57079633
Technician: cdeibel

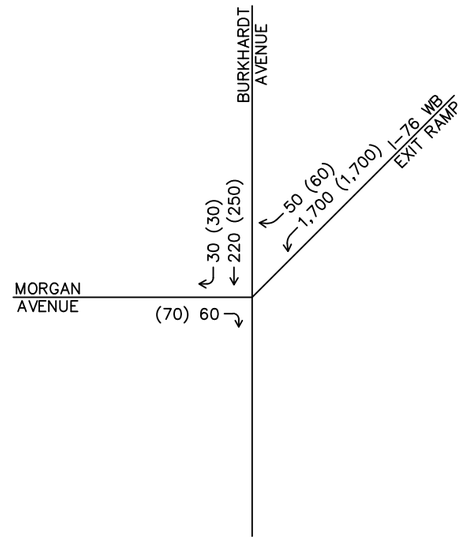
## 1 ARCHWOOD AVENUE / BURKHARDT AVENUE



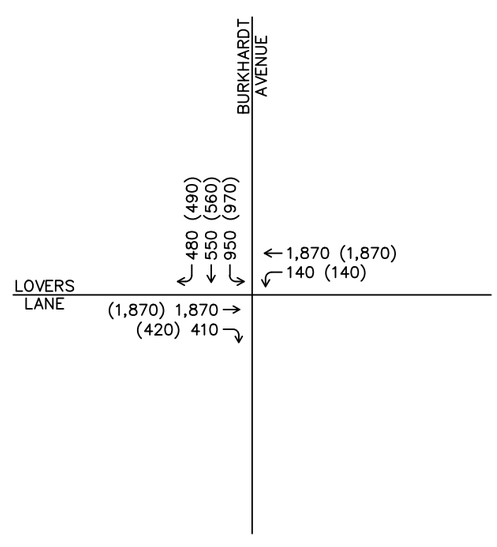

## 2 ARCHWOOD AVENUE / COVENTRY STREET



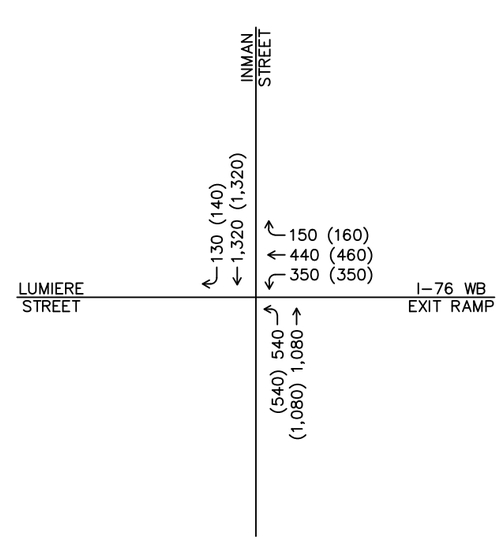

## 3 I-77 SB EXIT RAMP / BURKHARDT AVENUE / MORGAN AVENUE



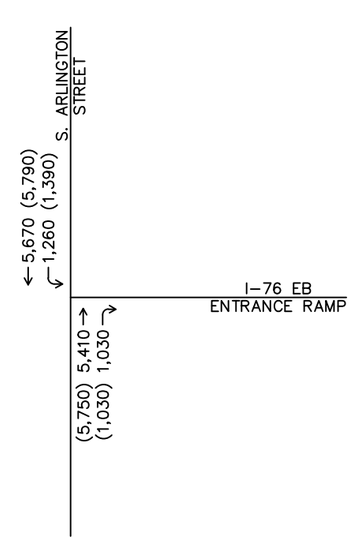

## 4 LOVERS LANE / BURKHARDT AVENUE



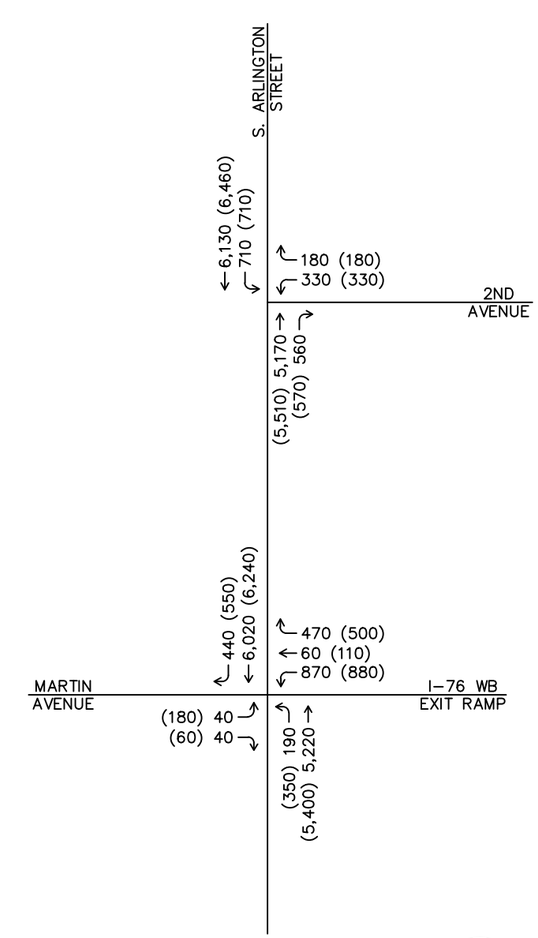

## 5 I-76 WB EXIT RAMP / INMAN STREET / LUMIERE STREET




## 6 SOUTH ARLINGTON STREET / I-76 EB ENTRANCE RAMP




## 7 SOUTH ARLINGTON STREET / I-76 WB EXIT RAMP / MARTIN AVENUE / 2ND AVENUE




LEGEND

## – YEAR 2020
(##) – YEAR 2040

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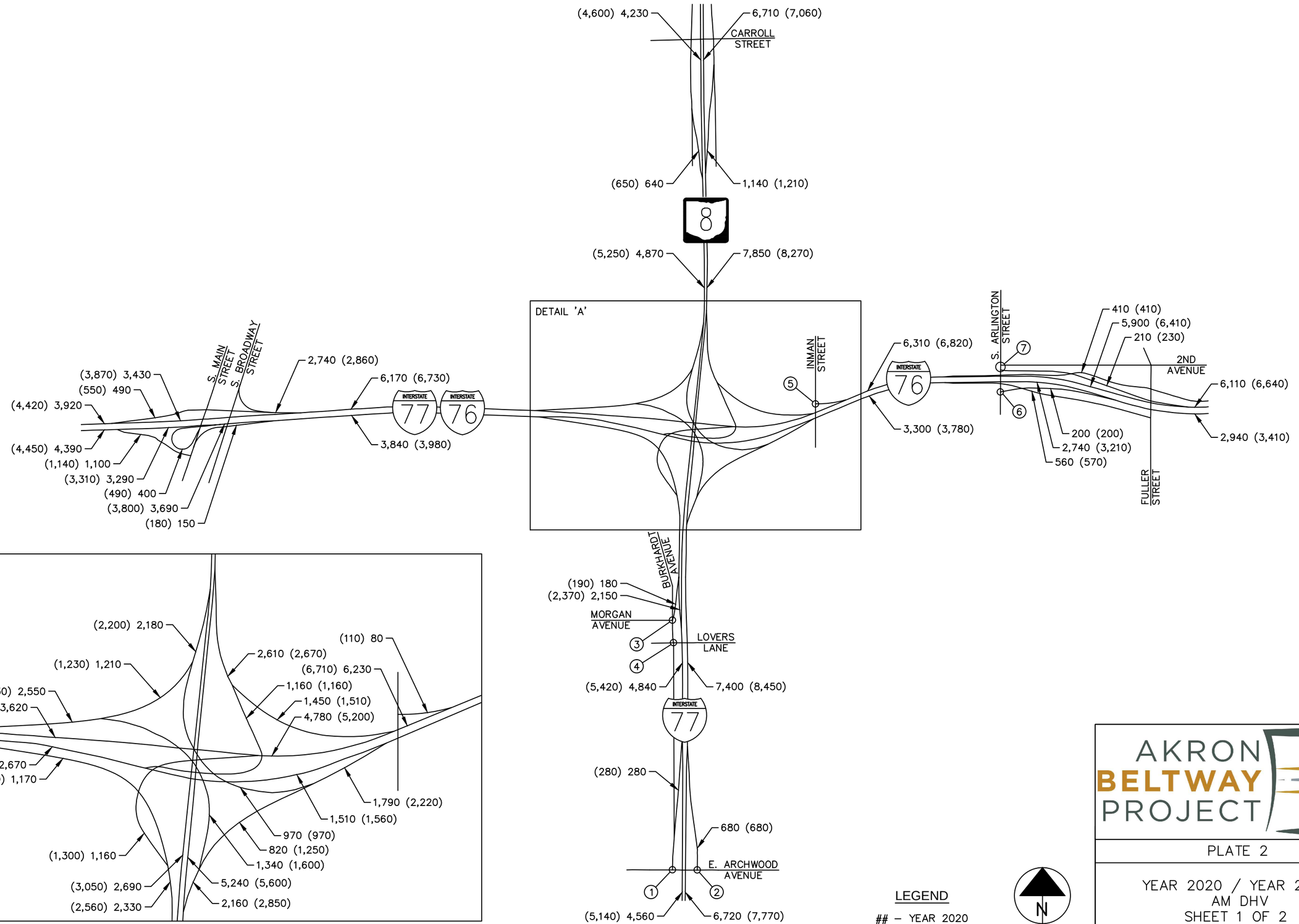
AKRON BELTWAY PROJECT

PLATE 1

YEAR 2020 / YEAR 2040
ADT
SHEET 2 OF 2

APRIL 2016 (REV. JULY 2016)

Drawing File: O:\2013\2013350\SUM\95831\traffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 1-2
Date: Aug 29, 2016 Time: 2:23 pm Tablet: -1.57079633
Technician: cdeibel




LEGEND

## – YEAR 2020
(##) – YEAR 2040

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N.T.S.

AKRON BELTWAY PROJECT

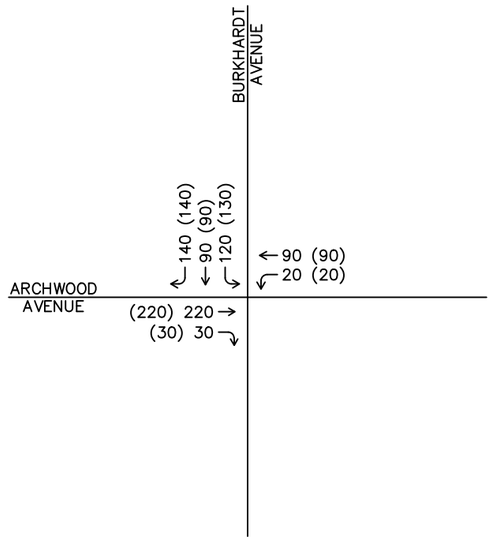
PLATE 2

YEAR 2020 / YEAR 2040
AM DHV
SHEET 1 OF 2

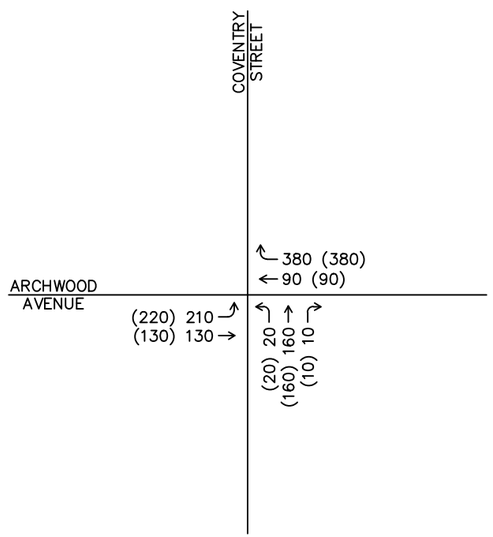
APRIL 2016 (REV. AUGUST 2016)

Drawing File: Q:\2013\2013350\SUM\95833\Vraffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 2-1
Date: Aug 29, 2016 Time: 2:23 pm Twist: -1.57079633
Technician: cdeibel

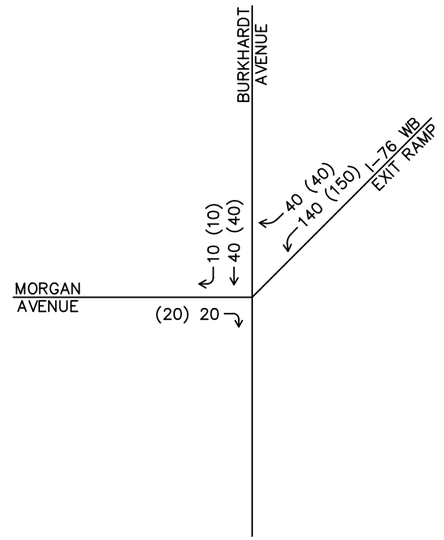
## 1 ARCHWOOD AVENUE / BURKHARDT AVENUE



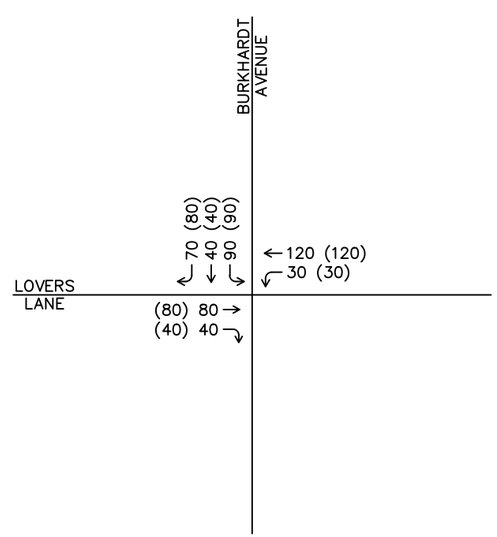

## 2 ARCHWOOD AVENUE / COVENTRY STREET



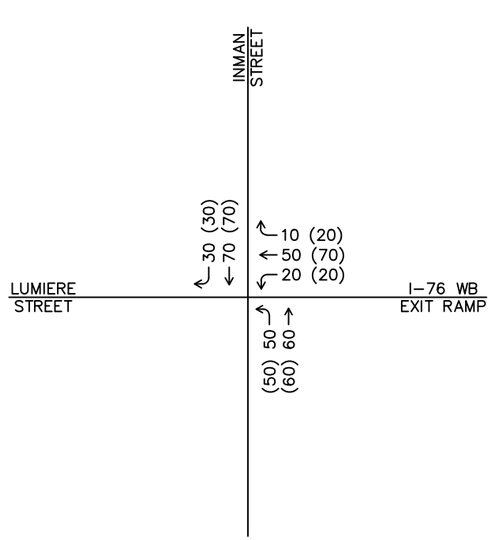

## 3 I-77 SB EXIT RAMP / BURKHARDT AVENUE / MORGAN AVENUE



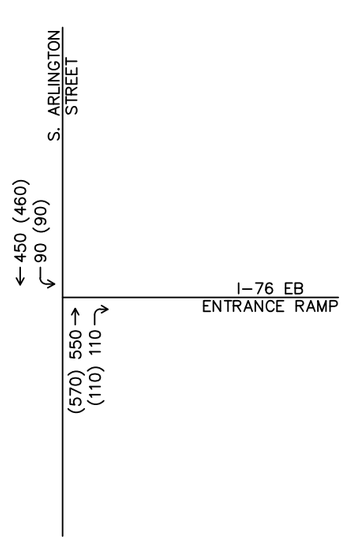

## 4 LOVERS LANE / BURKHARDT AVENUE



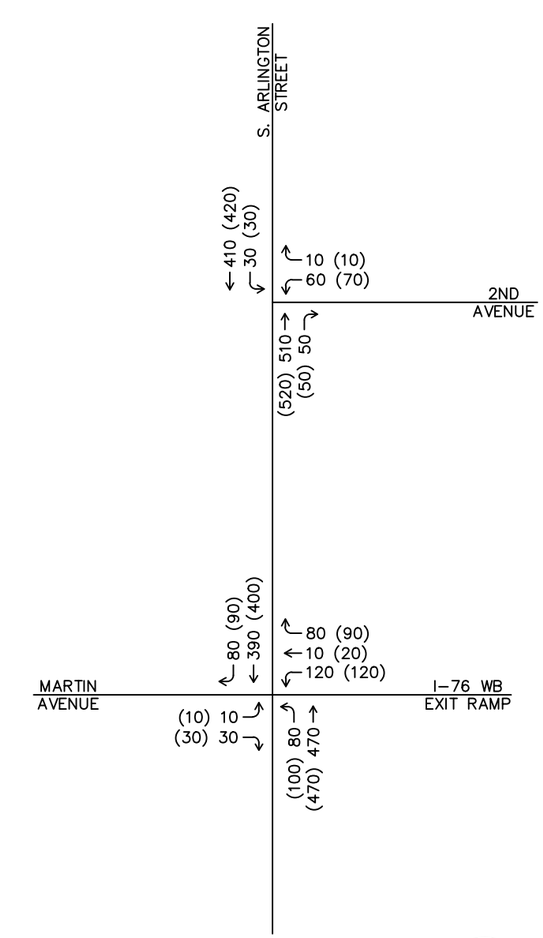

## 5 I-76 WB EXIT RAMP / INMAN STREET / LUMIERE STREET




## 6 SOUTH ARLINGTON STREET / I-76 EB ENTRANCE RAMP




## 7 SOUTH ARLINGTON STREET / I-76 WB EXIT RAMP / MARTIN AVENUE / 2ND AVENUE




LEGEND

## – YEAR 2020
(##) – YEAR 2040

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N.T.S.

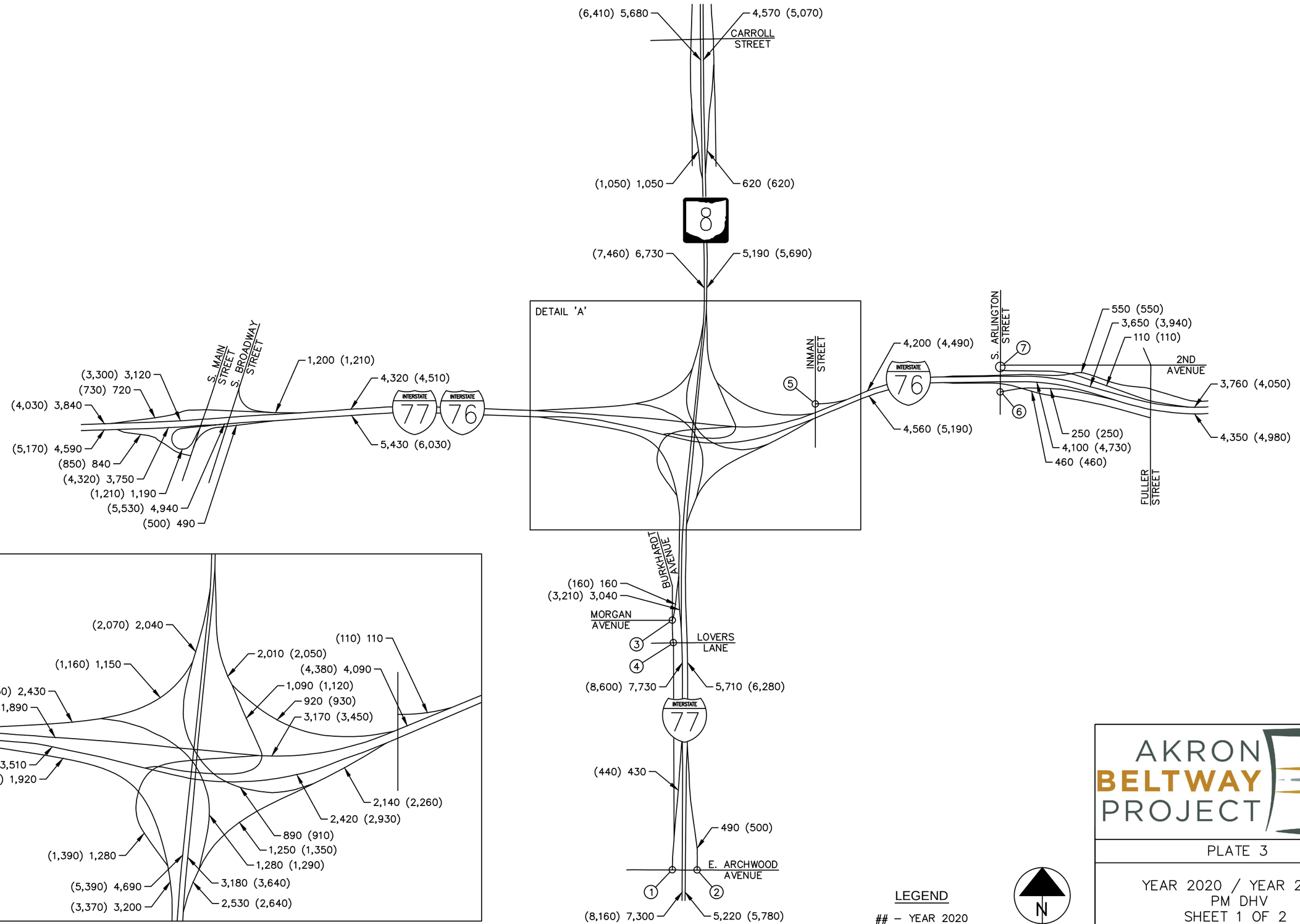
AKRON BELTWAY PROJECT

PLATE 2

YEAR 2020 / YEAR 2040
AM DHV
SHEET 2 OF 2

APRIL 2016 (REV. AUGUST 2016)

Drawing File: O:\2013\2013350\SUM\95831\Traffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 2-2
Date: Aug 29, 2016 Time: 2:24 pm Twist: -1.57079633
Technician: cdeibel




LEGEND

## – YEAR 2020
(##) – YEAR 2040

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N.T.S.

AKRON BELTWAY PROJECT

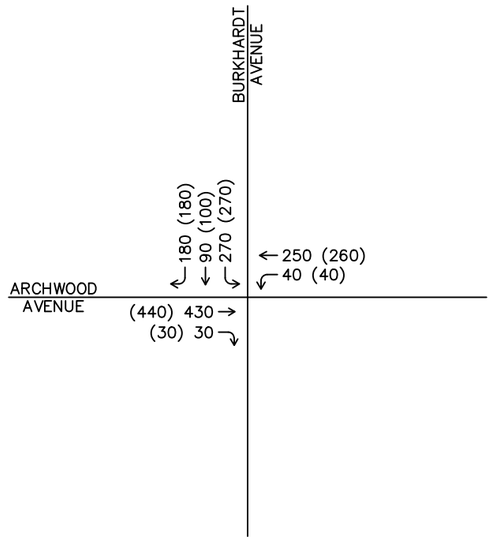
PLATE 3

YEAR 2020 / YEAR 2040
PM DHV
SHEET 1 OF 2

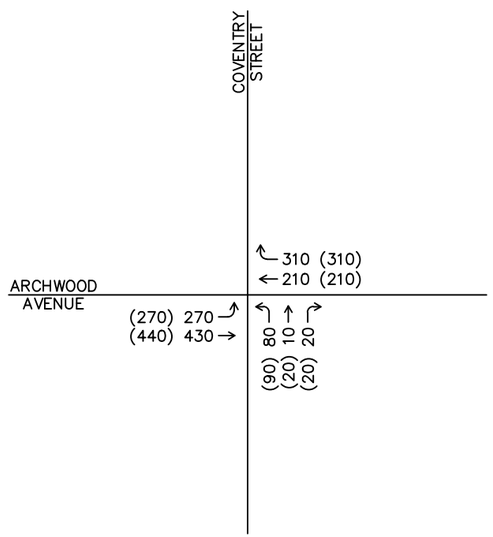
APRIL 2016 (REV. AUGUST 2016)

Drawing File: Q:\2013\2013350\SUM\95833\traffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 3-1
Date: Aug 29, 2016 Time: 2:24 pm Twist: -1.57079633
Technician: cdeibel

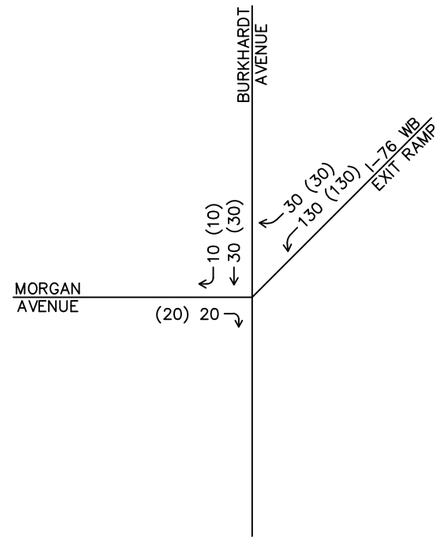
## (1) ARCHWOOD AVENUE / BURKHARDT AVENUE



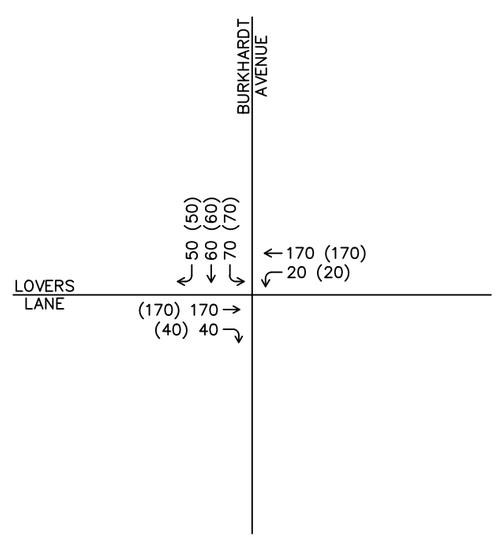

## (2) ARCHWOOD AVENUE / COVENTRY STREET



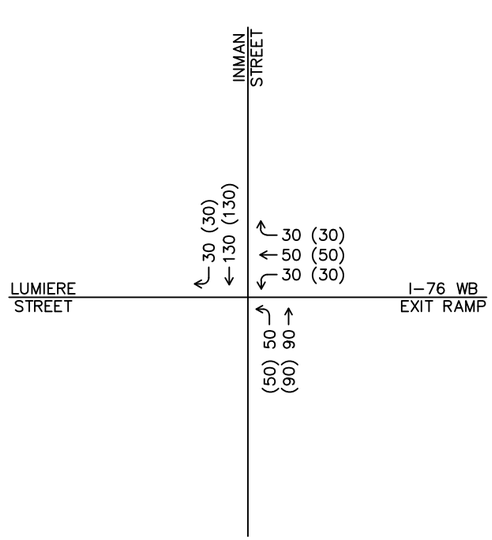

## (3) I-77 SB EXIT RAMP / BURKHARDT AVENUE / MORGAN AVENUE



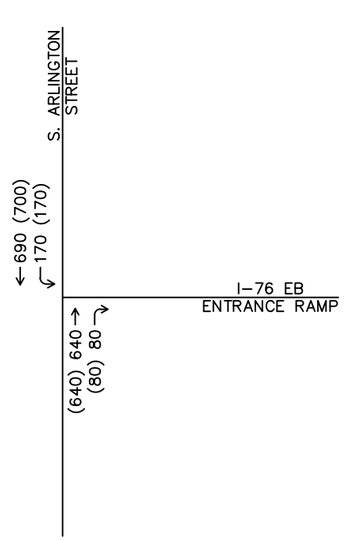

## (4) LOVERS LANE / BURKHARDT AVENUE



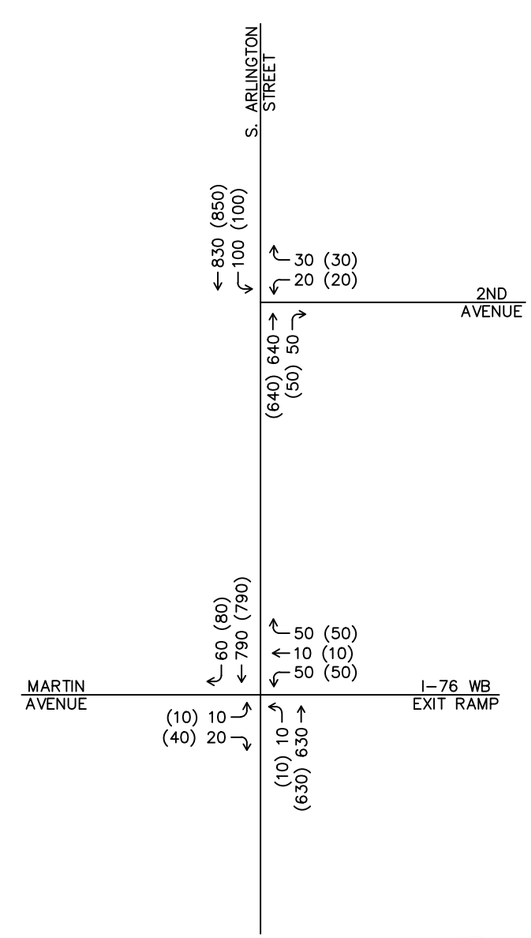

## (5) I-76 WB EXIT RAMP / INMAN STREET / LUMIERE STREET




## (6) SOUTH ARLINGTON STREET / I-76 EB ENTRANCE RAMP




## (7) SOUTH ARLINGTON STREET / I-76 WB EXIT RAMP / MARTIN AVENUE / 2ND AVENUE




LEGEND

## – YEAR 2020
(##) – YEAR 2040

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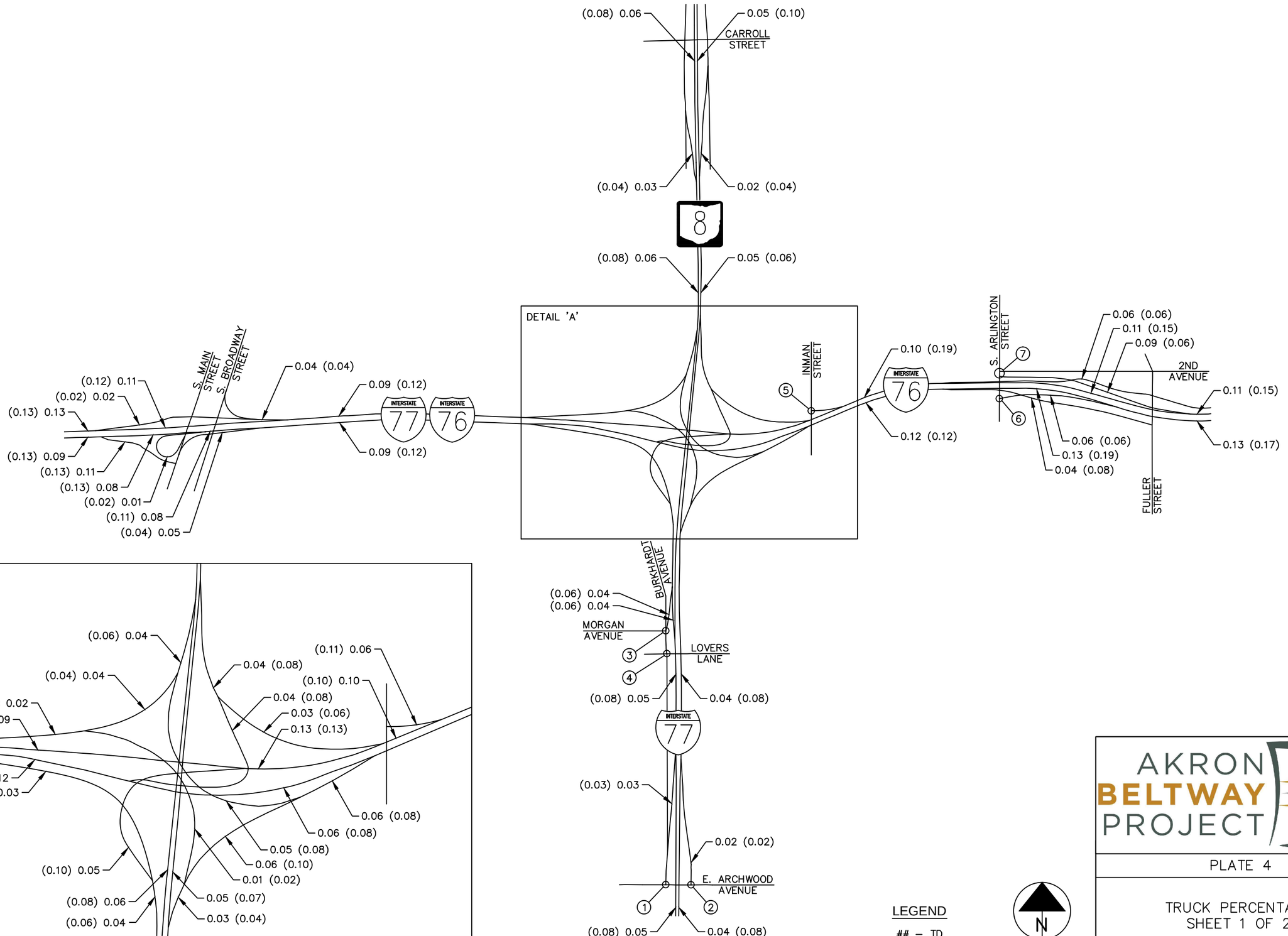
AKRON BELTWAY PROJECT

PLATE 3

YEAR 2020 / YEAR 2040
PM DHV
SHEET 2 OF 2

APRIL 2016 (REV. AUGUST 2016)

Drawing File: O:\2013\2013350\SUM\95831\Traffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 3-2
Date: Aug 29, 2016 Time: 2:24 pm Twist: -1.5707963
Technician: cdeibel




LEGEND

## – TD
(##) – T24

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AKRON BELTWAY PROJECT

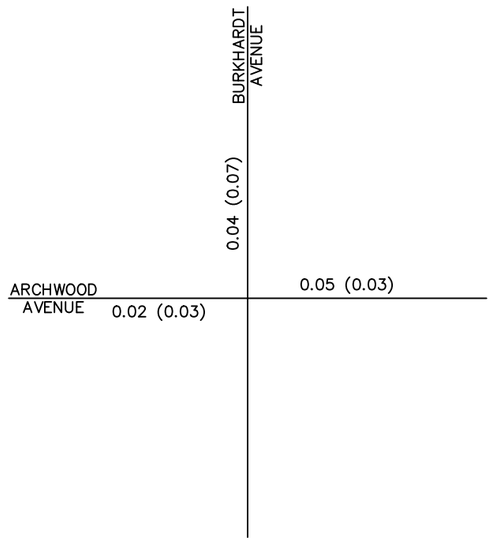
PLATE 4

TRUCK PERCENTAGES
SHEET 1 OF 2

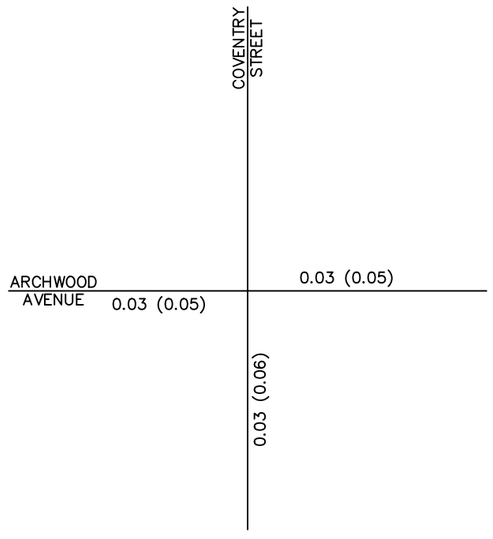
APRIL 2016

Drawing File: Q:\2013\2013350\SUM\95831\Vcraffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 4-1
Date: Apr 22, 2016 Time: 10:34 am Twist: -1.57079633
Technician: ddombrosky

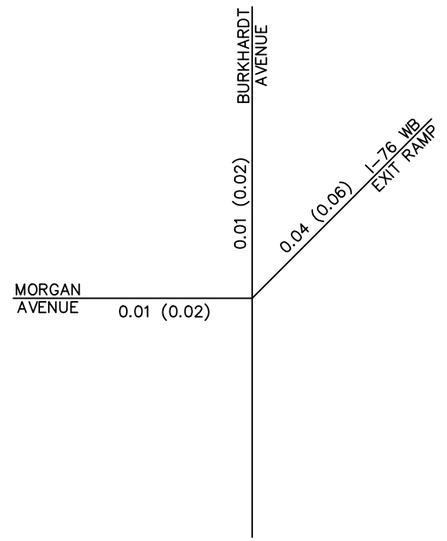
## 1 ARCHWOOD AVENUE / BURKHARDT AVENUE



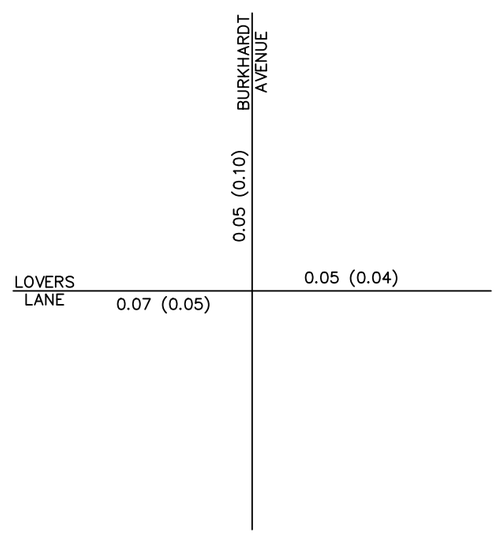

## 2 ARCHWOOD AVENUE / COVENTRY STREET



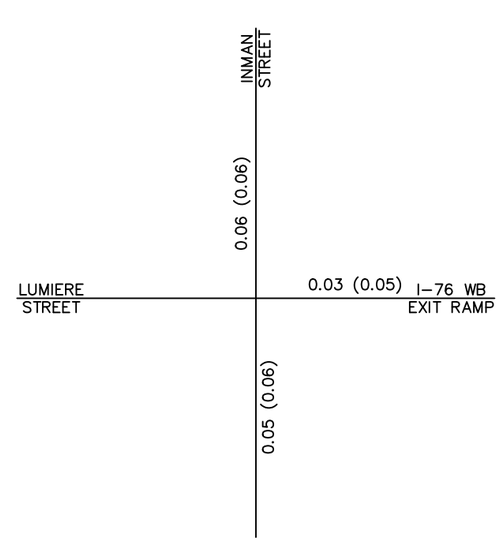

## 3 I-77 SB EXIT RAMP / BURKHARDT AVENUE / MORGAN AVENUE



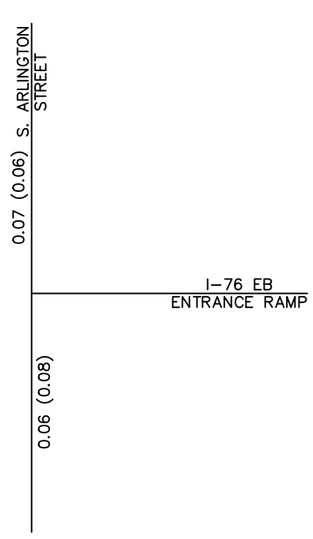

## 4 LOVERS LANE / BURKHARDT AVENUE



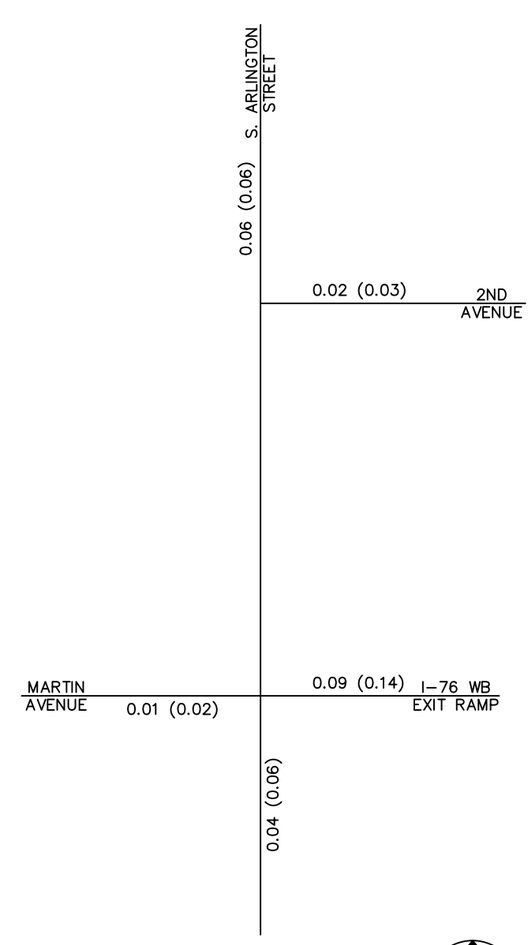

## 5 I-76 WB EXIT RAMP / INMAN STREET / LUMIERE STREET




## 6 SOUTH ARLINGTON STREET / I-76 EB ENTRANCE RAMP




## 7 SOUTH ARLINGTON STREET / I-76 WB EXIT RAMP / MARTIN AVENUE / 2ND AVENUE




LEGEND

## – TD
(##) – T24

N

N.T.S.

AKRON BELTWAY PROJECT

PLATE 4

TRUCK PERCENTAGES
SHEET 2 OF 2

APRIL 2016

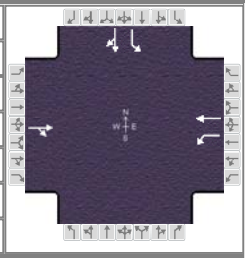
Drawing File: O:\2013\2013350\SUM\95831\traffic\Certified Traffic Requests\Central Interchange\Figures\Volume Plates.dwg Layout: Plate 4-2
Date: Apr 22, 2016 Time: 10:25 am Tablet: -1.570796633
Technician: ddombrosky

# APPENDIX B
# INTERSECTION CAPACITY ANALYSIS

# DESIGN YEAR 2040 'NO-BUILD' CONDITIONS

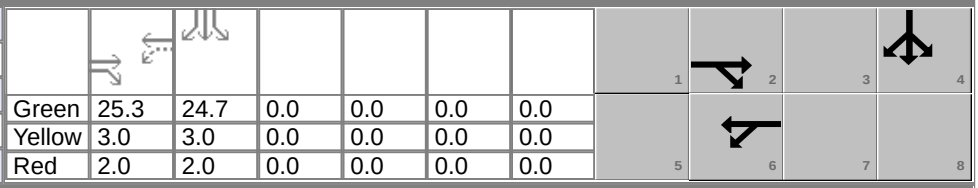
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 1. Archwood & Burkhardt_2040 'No-Build' AM.xus | | |
| Project Description | Design Year 2040 'No-Build' AM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 220 | 30 | 20 | 90 | | | | | 130 | 90 | 140 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Green | 25.3 | 24.7 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

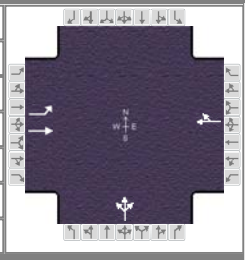
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 6.0 | | | | 10.0 |
| Phase Duration, s | | 30.3 | | 30.3 | | | | 29.7 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 8.1 | | 8.9 | | | | 8.3 |
| Green Extension Time ( $g_e$ ), s | | 0.7 | | 0.7 | | | | 0.8 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.00 | | 0.00 | | | | 0.00 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 272 | | 22 | 98 | | | | | 141 | 250 | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1823 | | 1071 | 1810 | | | | | 1740 | 1647 | |
| Queue Service Time ( $g_s$ ), s | | 6.1 | | 0.8 | 2.0 | | | | | 3.1 | 6.3 | |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 6.1 | | 6.9 | 2.0 | | | | | 3.1 | 6.3 | |
| Green Ratio ( *g/C* ) | | 0.42 | | 0.42 | 0.42 | | | | | 0.41 | 0.41 | |
| Capacity ( *c* ), veh/h | | 769 | | 463 | 763 | | | | | 716 | 678 | |
| Volume-to-Capacity Ratio ( *X* ) | | 0.353 | | 0.047 | 0.128 | | | | | 0.197 | 0.369 | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 52.6 | | 4.6 | 17.3 | | | | | 27.7 | 53.4 | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 2.1 | | 0.2 | 0.7 | | | | | 1.1 | 2.1 | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | 0.00 | 0.00 | | | | | 0.00 | 0.00 | |
| Uniform Delay ( $d_1$ ), s/veh | | 11.8 | | 14.1 | 10.6 | | | | | 11.3 | 12.2 | |
| Incremental Delay ( $d_2$ ), s/veh | | 0.1 | | 0.0 | 0.0 | | | | | 0.0 | 0.1 | |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | 0.0 | 0.0 | | | | | 0.0 | 0.0 | |
| Control Delay ( *d* ), s/veh | | 11.9 | | 14.2 | 10.6 | | | | | 11.4 | 12.4 | |
| Level of Service (LOS) | | B | | B | B | | | | | B | B | |
| Approach Delay, s/veh / LOS | 11.9 | B | | 11.3 | B | | 0.0 | | | 12.0 | B | |
| Intersection Delay, s/veh / LOS | 11.9 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Coventry Street | File Name | 2. Archwood & Coventry_2040 'No-Build' AM.xus | | |
| Project Description | Design Year 2040 'No-Build' AM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 220 | 130 | | | 90 | 380 | 20 | 160 | 10 | | | |

| Signal Information | | | | | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 | | | | | | | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 31.7 | 18.3 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |
| Uncoordinated | Yes | Simult. Gap E/W | On | Yellow | 3.0 | 3.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 2.0 | 2.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |

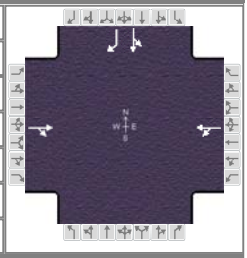
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | 8 | | |
| Case Number | | 6.0 | | 8.0 | | 12.0 | | |
| Phase Duration, s | | 36.7 | | 36.7 | | 23.3 | | |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | 5.0 | | |
| Max Allow Headway ( *MAH* ), s | | 3.6 | | 3.6 | | 3.2 | | |
| Queue Clearance Time ( $g_s$ ), s | | 30.7 | | 15.1 | | 7.3 | | |
| Green Extension Time ( $g_e$ ), s | | 0.4 | | 2.4 | | 0.3 | | |
| Phase Call Probability | | 1.00 | | 1.00 | | 1.00 | | |
| Max Out Probability | | 1.00 | | 0.02 | | 0.00 | | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 5 | 2 | | | 6 | 16 | 3 | 8 | 18 | | | |
| Adjusted Flow Rate ( *v* ), veh/h | 239 | 141 | | | 511 | | | 207 | | | | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 877 | 1845 | | | 1610 | | | 1818 | | | | |
| Queue Service Time ( $g_s$ ), s | 15.5 | 2.3 | | | 13.1 | | | 5.3 | | | | |
| Cycle Queue Clearance Time ( $g_c$ ), s | 28.7 | 2.3 | | | 13.1 | | | 5.3 | | | | |
| Green Ratio ( *g/C* ) | 0.53 | 0.53 | | | 0.53 | | | 0.30 | | | | |
| Capacity ( *c* ), veh/h | 391 | 975 | | | 851 | | | 554 | | | | |
| Volume-to-Capacity Ratio ( *X* ) | 0.611 | 0.145 | | | 0.600 | | | 0.372 | | | | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | 76.4 | 18.9 | | | 94 | | | 53.8 | | | | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | 3.0 | 0.7 | | | 3.8 | | | 2.1 | | | | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | 0.00 | 0.00 | | | 0.00 | | | 0.00 | | | | |
| Uniform Delay ( $d_1$ ), s/veh | 19.7 | 7.2 | | | 9.8 | | | 16.3 | | | | |
| Incremental Delay ( $d_2$ ), s/veh | 2.0 | 0.0 | | | 0.8 | | | 0.2 | | | | |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | | 0.0 | | | 0.0 | | | | |
| Control Delay ( *d* ), s/veh | 21.7 | 7.3 | | | 10.6 | | | 16.5 | | | | |
| Level of Service (LOS) | C | A | | | B | | | B | | | | |
| Approach Delay, s/veh / LOS | 16.4 | B | | 10.6 | B | | 16.5 | B | | 0.0 | | |
| Intersection Delay, s/veh / LOS | 13.7 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

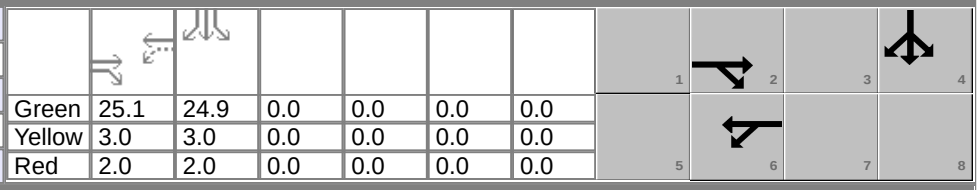
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | Lovers Lane | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 3. Lovers Lane & Burkhardt_2040 'No-Build' AM.xus | | |
| Project Description | Design Year 2040 'No-Build' AM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 80 | 40 | 30 | 120 | | | | | 90 | 40 | 80 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Green | 25.1 | 24.9 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 8.0 | | | | 11.0 |
| Phase Duration, s | | 30.1 | | 30.1 | | | | 29.9 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 4.9 | | 5.5 | | | | 5.1 |
| Green Extension Time ( $g_e$ ), s | | 0.5 | | 0.5 | | | | 0.4 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.00 | | 0.00 | | | | 0.00 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 130 | | | 163 | | | | | | 141 | 87 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1675 | | | 1697 | | | | | | 1749 | 1533 |
| Queue Service Time ( $g_s$ ), s | | 2.9 | | | 0.0 | | | | | | 3.1 | 2.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 2.9 | | | 3.5 | | | | | | 3.1 | 2.1 |
| Green Ratio ( *g/C* ) | | 0.42 | | | 0.42 | | | | | | 0.42 | 0.42 |
| Capacity ( *c* ), veh/h | | 701 | | | 782 | | | | | | 726 | 636 |
| Volume-to-Capacity Ratio ( *X* ) | | 0.186 | | | 0.208 | | | | | | 0.195 | 0.137 |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 24.8 | | | 29.7 | | | | | | 27.5 | 17.4 |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 0.9 | | | 1.2 | | | | | | 1.1 | 0.7 |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | | 0.00 | | | | | | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | | 11.0 | | | 11.2 | | | | | | 11.2 | 10.9 |
| Incremental Delay ( $d_2$ ), s/veh | | 0.0 | | | 0.0 | | | | | | 0.0 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | | 0.0 | | | | | | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | | 11.1 | | | 11.2 | | | | | | 11.2 | 10.9 |
| Level of Service (LOS) | | B | | | B | | | | | | B | B |
| Approach Delay, s/veh / LOS | 11.1 | B | | 11.2 | B | | 0.0 | | | 11.1 | B | |
| Intersection Delay, s/veh / LOS | 11.1 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL2 | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 10 | 0 | 30 | 120 | 20 | 90 | 100 | 420 | 50 | 30 | 380 | 40 |
| Future Volume (vph) | 10 | 0 | 30 | 120 | 20 | 90 | 100 | 420 | 50 | 30 | 380 | 40 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| Total Lost time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | 1.00 | | | 1.00 | | 1.00 | 0.95 | | 1.00 | 0.95 | |
| Frt | | 0.90 | | | 0.95 | | 1.00 | 0.98 | | 1.00 | 0.99 | |
| Flt Protected | | 0.99 | | | 0.97 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 1582 | | | 1524 | | 1644 | 3236 | | 1613 | 3181 | |
| Flt Permitted | | 0.90 | | | 0.81 | | 0.48 | 1.00 | | 0.43 | 1.00 | |
| Satd. Flow (perm) | | 1448 | | | 1272 | | 831 | 3236 | | 736 | 3181 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 11 | 0 | 33 | 130 | 22 | 98 | 109 | 457 | 54 | 33 | 413 | 43 |
| RTOR Reduction (vph) | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 |
| Lane Group Flow (vph) | 0 | 12 | 0 | 0 | 250 | 0 | 109 | 511 | 0 | 33 | 444 | 0 |
| Heavy Vehicles (%) | 1% | 1% | 1% | 9% | 9% | 9% | 4% | 4% | 4% | 6% | 6% | 6% |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | | 14.4 | | | 14.4 | | 16.4 | 16.4 | | 16.4 | 16.4 | |
| Effective Green, g (s) | | 14.4 | | | 14.4 | | 16.4 | 16.4 | | 16.4 | 16.4 | |
| Actuated g/C Ratio | | 0.28 | | | 0.28 | | 0.32 | 0.32 | | 0.32 | 0.32 | |
| Clearance Time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | 409 | | | 359 | | 267 | 1042 | | 237 | 1024 | |
| v/s Ratio Prot | | | | | | | | c0.16 | | | 0.14 | |
| v/s Ratio Perm | | 0.01 | | | c0.20 | | 0.13 | | | 0.04 | | |
| v/c Ratio | | 0.03 | | | 0.70 | | 0.41 | 0.49 | | 0.14 | 0.43 | |
| Uniform Delay, d1 | | 13.2 | | | 16.3 | | 13.5 | 13.9 | | 12.2 | 13.6 | |
| Progression Factor | | 1.00 | | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 0.0 | | | 5.8 | | 1.0 | 0.4 | | 0.3 | 0.3 | |
| Delay (s) | | 13.2 | | | 22.1 | | 14.5 | 14.3 | | 12.5 | 13.9 | |
| Level of Service | | B | | | C | | B | B | | B | B | |
| Approach Delay (s) | | 13.2 | | | 22.1 | | | 14.3 | | | 13.8 | |
| Approach LOS | | B | | | C | | | B | | | B | |

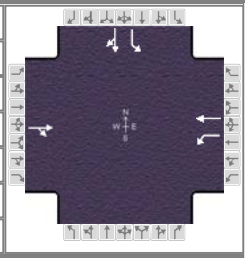
| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 15.8 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.51 | | |
| Actuated Cycle Length (s) | 50.9 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 67.9% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | SWL | SWR | SWR2 |
|---|---|---|---|
| Lane Configurations | | | |
| Traffic Volume (vph) | 20 | 50 | 10 |
| Future Volume (vph) | 20 | 50 | 10 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 |
| Total Lost time (s) | 5.0 | | |
| Lane Util. Factor | 1.00 | | |
| Frt | 0.90 | | |
| Flt Protected | 0.99 | | |
| Satd. Flow (prot) | 1567 | | |
| Flt Permitted | 0.99 | | |
| Satd. Flow (perm) | 1567 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 22 | 54 | 11 |
| RTOR Reduction (vph) | 78 | 0 | 0 |
| Lane Group Flow (vph) | 9 | 0 | 0 |
| Heavy Vehicles (%) | 2% | 2% | 2% |
| Turn Type | Prot | | |
| Protected Phases | 10 | | |
| Permitted Phases | | | |
| Actuated Green, G (s) | 5.1 | | |
| Effective Green, g (s) | 5.1 | | |
| Actuated g/C Ratio | 0.10 | | |
| Clearance Time (s) | 5.0 | | |
| Vehicle Extension (s) | 3.0 | | |
| Lane Grp Cap (vph) | 157 | | |
| v/s Ratio Prot | c0.01 | | |
| v/s Ratio Perm | | | |
| v/c Ratio | 0.06 | | |
| Uniform Delay, d1 | 20.7 | | |
| Progression Factor | 1.00 | | |
| Incremental Delay, d2 | 0.1 | | |
| Delay (s) | 20.9 | | |
| Level of Service | C | | |
| Approach Delay (s) | 20.9 | | |
| Approach LOS | C | | |

| Intersection Summary |
|---|

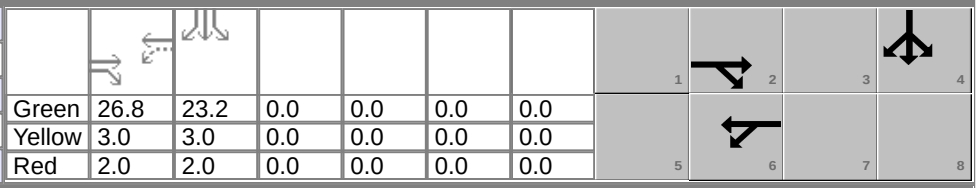
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 5. Archwood & Burkhardt_2040 'No-Build' PM.xus | | |
| Project Description | Design Year 2040 'No-Build' PM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 440 | 30 | 40 | 260 | | | | | 270 | 100 | 180 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Green | 26.8 | 23.2 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

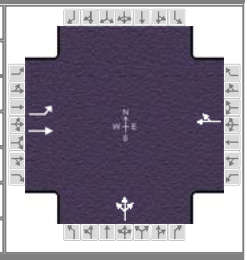
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 6.0 | | | | 10.0 |
| Phase Duration, s | | 31.8 | | 31.8 | | | | 28.2 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 14.7 | | 17.2 | | | | 10.4 |
| Green Extension Time ( $g_e$ ), s | | 1.5 | | 1.4 | | | | 1.2 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.03 | | 0.08 | | | | 0.01 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 511 | | 43 | 283 | | | | | 293 | 304 | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1842 | | 860 | 1810 | | | | | 1740 | 1637 | |
| Queue Service Time ( $g_s$ ), s | | 12.7 | | 2.4 | 6.1 | | | | | 7.5 | 8.4 | |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 12.7 | | 15.2 | 6.1 | | | | | 7.5 | 8.4 | |
| Green Ratio ( *g/C* ) | | 0.45 | | 0.45 | 0.45 | | | | | 0.39 | 0.39 | |
| Capacity ( *c* ), veh/h | | 823 | | 321 | 808 | | | | | 673 | 633 | |
| Volume-to-Capacity Ratio ( *X* ) | | 0.621 | | 0.135 | 0.350 | | | | | 0.436 | 0.481 | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 114 | | 11.2 | 52.4 | | | | | 67.6 | 71.7 | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 4.6 | | 0.4 | 2.1 | | | | | 2.7 | 2.9 | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | 0.00 | 0.00 | | | | | 0.00 | 0.00 | |
| Uniform Delay ( $d_1$ ), s/veh | | 12.7 | | 18.5 | 10.9 | | | | | 13.6 | 13.9 | |
| Incremental Delay ( $d_2$ ), s/veh | | 1.1 | | 0.1 | 0.1 | | | | | 0.2 | 0.2 | |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | 0.0 | 0.0 | | | | | 0.0 | 0.0 | |
| Control Delay ( *d* ), s/veh | | 13.8 | | 18.6 | 11.0 | | | | | 13.7 | 14.1 | |
| Level of Service (LOS) | | B | | B | B | | | | | B | B | |
| Approach Delay, s/veh / LOS | 13.8 | B | | 12.0 | B | | 0.0 | | | 13.9 | B | |
| Intersection Delay, s/veh / LOS | 13.4 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Coventry Street | File Name | 6. Archwood & Coventry_2040 'No-Build' PM.xus | | |
| Project Description | Design Year 2040 'No-Build' PM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 270 | 440 | | | 210 | 310 | 90 | 20 | 20 | | | |

| Signal Information | | | | | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 | | | | | | | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 32.8 | 17.2 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |
| Uncoordinated | Yes | Simult. Gap E/W | On | Yellow | 3.0 | 3.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 2.0 | 2.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |

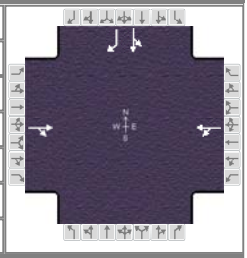
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | 8 | | |
| Case Number | | 6.0 | | 8.0 | | 12.0 | | |
| Phase Duration, s | | 37.8 | | 37.8 | | 22.2 | | |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | 5.0 | | |
| Max Allow Headway ( *MAH* ), s | | 3.5 | | 3.5 | | 3.3 | | |
| Queue Clearance Time ( $g_s$ ), s | | 34.8 | | 16.0 | | 5.8 | | |
| Green Extension Time ( $g_e$ ), s | | 0.0 | | 3.6 | | 0.2 | | |
| Phase Call Probability | | 1.00 | | 1.00 | | 1.00 | | |
| Max Out Probability | | 1.00 | | 0.08 | | 0.00 | | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 5 | 2 | | | 6 | 16 | 3 | 8 | 18 | | | |
| Adjusted Flow Rate ( *v* ), veh/h | 293 | 478 | | | 565 | | | 141 | | | | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 834 | 1845 | | | 1666 | | | 1736 | | | | |
| Queue Service Time ( $g_s$ ), s | 18.8 | 9.5 | | | 14.0 | | | 3.8 | | | | |
| Cycle Queue Clearance Time ( $g_c$ ), s | 32.8 | 9.5 | | | 14.0 | | | 3.8 | | | | |
| Green Ratio ( *g/C* ) | 0.55 | 0.55 | | | 0.55 | | | 0.29 | | | | |
| Capacity ( *c* ), veh/h | 382 | 1008 | | | 911 | | | 498 | | | | |
| Volume-to-Capacity Ratio ( *X* ) | 0.769 | 0.474 | | | 0.621 | | | 0.284 | | | | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | 119.1 | 74.4 | | | 101.1 | | | 36.8 | | | | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | 4.7 | 2.9 | | | 4.0 | | | 1.4 | | | | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | 0.00 | 0.00 | | | 0.00 | | | 0.00 | | | | |
| Uniform Delay ( $d_1$ ), s/veh | 21.6 | 8.3 | | | 9.3 | | | 16.6 | | | | |
| Incremental Delay ( $d_2$ ), s/veh | 8.3 | 0.1 | | | 1.0 | | | 0.1 | | | | |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | | 0.0 | | | 0.0 | | | | |
| Control Delay ( *d* ), s/veh | 29.9 | 8.5 | | | 10.3 | | | 16.7 | | | | |
| Level of Service (LOS) | C | A | | | B | | | B | | | | |
| Approach Delay, s/veh / LOS | 16.6 | B | | 10.3 | B | | 16.7 | B | | 0.0 | | |
| Intersection Delay, s/veh / LOS | 14.2 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

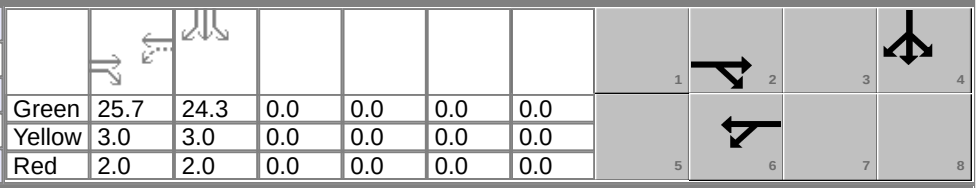
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | Lovers Lane | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 7. Lovers Lane & Burkhardt_2040 'No-Build' PM.xus | | |
| Project Description | Design Year 2040 'No-Build' PM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 170 | 40 | 20 | 170 | | | | | 70 | 60 | 50 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Green | 25.7 | 24.3 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 8.0 | | | | 11.0 |
| Phase Duration, s | | 30.7 | | 30.7 | | | | 29.3 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 7.3 | | 6.4 | | | | 5.1 |
| Green Extension Time ( $g_e$ ), s | | 0.8 | | 0.8 | | | | 0.4 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.00 | | 0.00 | | | | 0.00 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 228 | | | 207 | | | | | | 141 | 54 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1717 | | | 1754 | | | | | | 1762 | 1533 |
| Queue Service Time ( $g_s$ ), s | | 5.3 | | | 0.0 | | | | | | 3.1 | 1.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 5.3 | | | 4.4 | | | | | | 3.1 | 1.3 |
| Green Ratio ( *g/C* ) | | 0.43 | | | 0.43 | | | | | | 0.40 | 0.40 |
| Capacity ( *c* ), veh/h | | 735 | | | 818 | | | | | | 714 | 621 |
| Volume-to-Capacity Ratio ( *X* ) | | 0.310 | | | 0.253 | | | | | | 0.198 | 0.088 |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 45.2 | | | 37.8 | | | | | | 28 | 10.9 |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 1.7 | | | 1.5 | | | | | | 1.1 | 0.4 |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | | 0.00 | | | | | | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | | 11.3 | | | 11.1 | | | | | | 11.5 | 11.0 |
| Incremental Delay ( $d_2$ ), s/veh | | 0.1 | | | 0.1 | | | | | | 0.0 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | | 0.0 | | | | | | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | | 11.4 | | | 11.1 | | | | | | 11.6 | 11.0 |
| Level of Service (LOS) | | B | | | B | | | | | | B | B |
| Approach Delay, s/veh / LOS | 11.4 | B | | 11.1 | B | | 0.0 | | | 11.4 | B | |
| Intersection Delay, s/veh / LOS | 11.3 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL2 | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 10 | 0 | 40 | 50 | 10 | 50 | 10 | 580 | 50 | 100 | 770 | 70 |
| Future Volume (vph) | 10 | 0 | 40 | 50 | 10 | 50 | 10 | 580 | 50 | 100 | 770 | 70 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| Total Lost time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | 1.00 | | | 1.00 | | 1.00 | 0.95 | | 1.00 | 0.95 | |
| Frt | | 0.89 | | | 0.94 | | 1.00 | 0.99 | | 1.00 | 0.99 | |
| Flt Protected | | 0.99 | | | 0.98 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 1575 | | | 1516 | | 1644 | 3250 | | 1613 | 3186 | |
| Flt Permitted | | 0.93 | | | 0.83 | | 0.25 | 1.00 | | 0.36 | 1.00 | |
| Satd. Flow (perm) | | 1478 | | | 1284 | | 433 | 3250 | | 615 | 3186 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 11 | 0 | 43 | 54 | 11 | 54 | 11 | 630 | 54 | 109 | 837 | 76 |
| RTOR Reduction (vph) | 0 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 |
| Lane Group Flow (vph) | 0 | 8 | 0 | 0 | 119 | 0 | 11 | 684 | 0 | 109 | 903 | 0 |
| Heavy Vehicles (%) | 1% | 1% | 1% | 9% | 9% | 9% | 4% | 4% | 4% | 6% | 6% | 6% |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | | 7.5 | | | 7.5 | | 25.1 | 25.1 | | 25.1 | 25.1 | |
| Effective Green, g (s) | | 7.5 | | | 7.5 | | 25.1 | 25.1 | | 25.1 | 25.1 | |
| Actuated g/C Ratio | | 0.14 | | | 0.14 | | 0.48 | 0.48 | | 0.48 | 0.48 | |
| Clearance Time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | 210 | | | 183 | | 206 | 1550 | | 293 | 1520 | |
| v/s Ratio Prot | | | | | | | | 0.21 | | | c0.28 | |
| v/s Ratio Perm | | 0.01 | | | c0.09 | | 0.03 | | | 0.18 | | |
| v/c Ratio | | 0.04 | | | 0.65 | | 0.05 | 0.44 | | 0.37 | 0.59 | |
| Uniform Delay, d1 | | 19.4 | | | 21.3 | | 7.4 | 9.1 | | 8.7 | 10.0 | |
| Progression Factor | | 1.00 | | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 0.1 | | | 8.0 | | 0.1 | 0.2 | | 0.8 | 0.6 | |
| Delay (s) | | 19.5 | | | 29.3 | | 7.5 | 9.3 | | 9.5 | 10.7 | |
| Level of Service | | B | | | C | | A | A | | A | B | |
| Approach Delay (s) | | 19.5 | | | 29.3 | | | 9.3 | | | 10.5 | |
| Approach LOS | | B | | | C | | | A | | | B | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 11.8 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.53 | | |
| Actuated Cycle Length (s) | 52.6 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 71.5% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

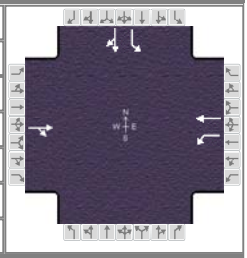
| Movement | SWL | SWR | SWR2 |
|---|---|---|---|
| Lane Configurations | | | |
| Traffic Volume (vph) | 10 | 10 | 30 |
| Future Volume (vph) | 10 | 10 | 30 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 |
| Total Lost time (s) | 5.0 | | |
| Lane Util. Factor | 1.00 | | |
| Frt | 0.89 | | |
| Flt Protected | 0.99 | | |
| Satd. Flow (prot) | 1559 | | |
| Flt Permitted | 0.99 | | |
| Satd. Flow (perm) | 1559 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 11 | 11 | 33 |
| RTOR Reduction (vph) | 50 | 0 | 0 |
| Lane Group Flow (vph) | 5 | 0 | 0 |
| Heavy Vehicles (%) | 2% | 2% | 2% |
| Turn Type | Prot | | |
| Protected Phases | 10 | | |
| Permitted Phases | | | |
| Actuated Green, G (s) | 5.0 | | |
| Effective Green, g (s) | 5.0 | | |
| Actuated g/C Ratio | 0.10 | | |
| Clearance Time (s) | 5.0 | | |
| Vehicle Extension (s) | 3.0 | | |
| Lane Grp Cap (vph) | 148 | | |
| v/s Ratio Prot | c0.00 | | |
| v/s Ratio Perm | | | |
| v/c Ratio | 0.04 | | |
| Uniform Delay, d1 | 21.6 | | |
| Progression Factor | 1.00 | | |
| Incremental Delay, d2 | 0.1 | | |
| Delay (s) | 21.7 | | |
| Level of Service | C | | |
| Approach Delay (s) | 21.7 | | |
| Approach LOS | C | | |

| Intersection Summary |
|---|

# DESIGN YEAR 2040 'BUILD' CONDITIONS

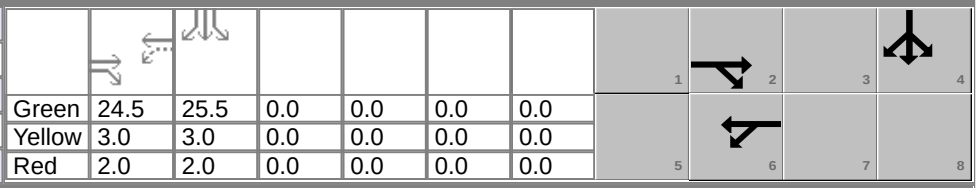
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 1. Archwood & Burkhardt_2040 'Build' AM.xus | | |
| Project Description | Design Year 2040 'Build' AM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 220 | 30 | 20 | 90 | | | | | 211 | 127 | 212 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green | 24.5 | 25.5 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |

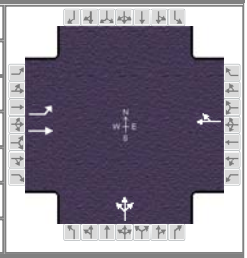
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 6.0 | | | | 10.0 |
| Phase Duration, s | | 29.5 | | 29.5 | | | | 30.5 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 8.2 | | 9.1 | | | | 12.0 |
| Green Extension Time ( $g_e$ ), s | | 0.7 | | 0.7 | | | | 1.2 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.00 | | 0.00 | | | | 0.01 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 272 | | 22 | 98 | | | | | 229 | 368 | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1823 | | 1071 | 1810 | | | | | 1740 | 1642 | |
| Queue Service Time ( $g_s$ ), s | | 6.2 | | 0.9 | 2.0 | | | | | 5.2 | 10.0 | |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 6.2 | | 7.1 | 2.0 | | | | | 5.2 | 10.0 | |
| Green Ratio ( *g/C* ) | | 0.41 | | 0.41 | 0.41 | | | | | 0.42 | 0.42 | |
| Capacity ( *c* ), veh/h | | 745 | | 446 | 739 | | | | | 739 | 698 | |
| Volume-to-Capacity Ratio ( *X* ) | | 0.365 | | 0.049 | 0.132 | | | | | 0.310 | 0.528 | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 54.4 | | 4.8 | 17.8 | | | | | 46 | 84 | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 2.2 | | 0.2 | 0.7 | | | | | 1.8 | 3.4 | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | 0.00 | 0.00 | | | | | 0.00 | 0.00 | |
| Uniform Delay ( $d_1$ ), s/veh | | 12.3 | | 14.8 | 11.1 | | | | | 11.4 | 12.8 | |
| Incremental Delay ( $d_2$ ), s/veh | | 0.1 | | 0.0 | 0.0 | | | | | 0.1 | 0.4 | |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | 0.0 | 0.0 | | | | | 0.0 | 0.0 | |
| Control Delay ( *d* ), s/veh | | 12.5 | | 14.8 | 11.1 | | | | | 11.5 | 13.2 | |
| Level of Service (LOS) | | B | | B | B | | | | | B | B | |
| Approach Delay, s/veh / LOS | 12.5 | B | | 11.8 | B | | 0.0 | | | 12.5 | B | |
| Intersection Delay, s/veh / LOS | 12.4 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Coventry Street | File Name | 2. Archwood & Coventry_2040 'Build' AM.xus | | |
| Project Description | Design Year 2040 'Build' AM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 210 | 211 | | | 90 | 380 | 20 | 160 | 10 | | | |

| Signal Information | | | | | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 | | | | | | | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 30.7 | 19.3 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |
| Uncoordinated | Yes | Simult. Gap E/W | On | Yellow | 3.0 | 3.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 2.0 | 2.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | | | |

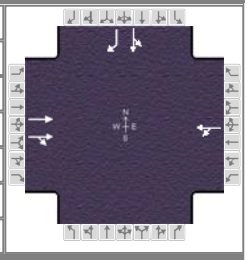
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | 8 | | |
| Case Number | | 6.0 | | 8.0 | | 12.0 | | |
| Phase Duration, s | | 35.7 | | 35.7 | | 24.3 | | |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | 5.0 | | |
| Max Allow Headway ( *MAH* ), s | | 3.5 | | 3.5 | | 3.2 | | |
| Queue Clearance Time ( $g_s$ ), s | | 30.7 | | 15.6 | | 7.2 | | |
| Green Extension Time ( $g_e$ ), s | | 0.0 | | 2.5 | | 0.3 | | |
| Phase Call Probability | | 1.00 | | 1.00 | | 1.00 | | |
| Max Out Probability | | 1.00 | | 0.04 | | 0.00 | | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 5 | 2 | | | 6 | 16 | 3 | 8 | 18 | | | |
| Adjusted Flow Rate ( *v* ), veh/h | 228 | 229 | | | 511 | | | 207 | | | | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 877 | 1845 | | | 1610 | | | 1818 | | | | |
| Queue Service Time ( $g_s$ ), s | 15.1 | 4.2 | | | 13.6 | | | 5.2 | | | | |
| Cycle Queue Clearance Time ( $g_c$ ), s | 28.7 | 4.2 | | | 13.6 | | | 5.2 | | | | |
| Green Ratio ( *g/C* ) | 0.51 | 0.51 | | | 0.51 | | | 0.32 | | | | |
| Capacity ( *c* ), veh/h | 370 | 944 | | | 824 | | | 585 | | | | |
| Volume-to-Capacity Ratio ( *X* ) | 0.617 | 0.243 | | | 0.620 | | | 0.353 | | | | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | 75.7 | 34.1 | | | 100.5 | | | 52 | | | | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | 3.0 | 1.3 | | | 4.0 | | | 2.0 | | | | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | 0.00 | 0.00 | | | 0.00 | | | 0.00 | | | | |
| Uniform Delay ( $d_1$ ), s/veh | 20.7 | 8.2 | | | 10.5 | | | 15.6 | | | | |
| Incremental Delay ( $d_2$ ), s/veh | 2.3 | 0.0 | | | 1.1 | | | 0.1 | | | | |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | | 0.0 | | | 0.0 | | | | |
| Control Delay ( *d* ), s/veh | 23.0 | 8.2 | | | 11.5 | | | 15.7 | | | | |
| Level of Service (LOS) | C | A | | | B | | | B | | | | |
| Approach Delay, s/veh / LOS | 15.6 | B | | 11.5 | B | | 15.7 | B | | 0.0 | | |
| Intersection Delay, s/veh / LOS | 13.9 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

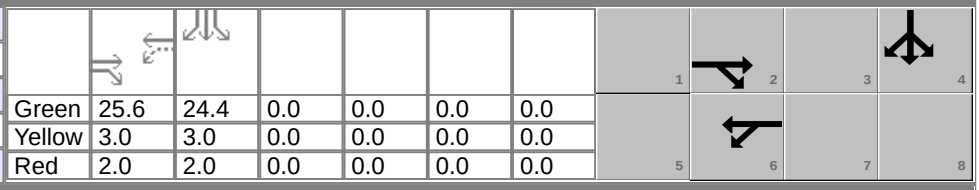
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | Lovers Lane | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 3. Lovers Lane & Burkhardt_2040 'Build' AM.xus | | |
| Project Description | Design Year 2040 'Build' AM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 80 | 40 | 30 | 120 | | | | | 26 | 11 | 23 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |



| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 1 | 2 | 3 | 4 | |
| Green | 25.6 | 24.4 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 6 | 7 | 8 | | |

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 8.0 | | | | 11.0 |
| Phase Duration, s | | 30.6 | | 30.6 | | | | 29.4 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 3.5 | | 5.4 | | | | 2.8 |
| Green Extension Time ( $g_e$ ), s | | 0.5 | | 0.5 | | | | 0.1 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.00 | | 0.00 | | | | 0.00 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 66 | 64 | | 163 | | | | | | 40 | 25 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1776 | 1583 | | 1697 | | | | | | 1748 | 1533 |
| Queue Service Time ( $g_s$ ), s | | 1.3 | 1.5 | | 0.0 | | | | | | 0.8 | 0.6 |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 1.3 | 1.5 | | 3.4 | | | | | | 0.8 | 0.6 |
| Green Ratio ( *g/C* ) | | 0.43 | 0.43 | | 0.43 | | | | | | 0.41 | 0.41 |
| Capacity ( *c* ), veh/h | | 758 | 675 | | 796 | | | | | | 711 | 624 |
| Volume-to-Capacity Ratio ( *X* ) | | 0.087 | 0.095 | | 0.205 | | | | | | 0.057 | 0.040 |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 11.8 | 11.5 | | 29 | | | | | | 7.5 | 4.9 |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 0.4 | 0.4 | | 1.2 | | | | | | 0.3 | 0.2 |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | 0.00 | | 0.00 | | | | | | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | | 10.2 | 10.3 | | 10.8 | | | | | | 10.8 | 10.7 |
| Incremental Delay ( $d_2$ ), s/veh | | 0.0 | 0.0 | | 0.0 | | | | | | 0.0 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | 0.0 | | 0.0 | | | | | | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | | 10.3 | 10.3 | | 10.9 | | | | | | 10.8 | 10.7 |
| Level of Service (LOS) | | B | B | | B | | | | | | B | B |
| Approach Delay, s/veh / LOS | 10.3 | B | | 10.9 | B | | 0.0 | | | 10.8 | B | |
| Intersection Delay, s/veh / LOS | 10.6 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL2 | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 10 | 0 | 30 | 140 | 20 | 180 | 100 | 420 | 50 | 30 | 380 | 40 |
| Future Volume (vph) | 10 | 0 | 30 | 140 | 20 | 180 | 100 | 420 | 50 | 30 | 380 | 40 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| Total Lost time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | 1.00 | | | 1.00 | | 1.00 | 0.95 | | 1.00 | 0.95 | |
| Frt | | 0.90 | | | 0.93 | | 1.00 | 0.98 | | 1.00 | 0.99 | |
| Flt Protected | | 0.99 | | | 0.98 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 1582 | | | 1502 | | 1644 | 3236 | | 1613 | 3181 | |
| Flt Permitted | | 0.90 | | | 0.85 | | 0.46 | 1.00 | | 0.40 | 1.00 | |
| Satd. Flow (perm) | | 1435 | | | 1298 | | 792 | 3236 | | 686 | 3181 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 11 | 0 | 33 | 152 | 22 | 196 | 109 | 457 | 54 | 33 | 413 | 43 |
| RTOR Reduction (vph) | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 |
| Lane Group Flow (vph) | 0 | 16 | 0 | 0 | 370 | 0 | 109 | 511 | 0 | 33 | 443 | 0 |
| Heavy Vehicles (%) | 1% | 1% | 1% | 9% | 9% | 9% | 4% | 4% | 4% | 6% | 6% | 6% |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | | 18.0 | | | 18.0 | | 12.9 | 12.9 | | 12.9 | 12.9 | |
| Effective Green, g (s) | | 18.0 | | | 18.0 | | 12.9 | 12.9 | | 12.9 | 12.9 | |
| Actuated g/C Ratio | | 0.35 | | | 0.35 | | 0.25 | 0.25 | | 0.25 | 0.25 | |
| Clearance Time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | 508 | | | 459 | | 201 | 821 | | 174 | 807 | |
| v/s Ratio Prot | | | | | | | | c0.16 | | | 0.14 | |
| v/s Ratio Perm | | 0.01 | | | c0.29 | | 0.14 | | | 0.05 | | |
| v/c Ratio | | 0.03 | | | 0.81 | | 0.54 | 0.62 | | 0.19 | 0.55 | |
| Uniform Delay, d1 | | 10.7 | | | 14.8 | | 16.4 | 16.8 | | 14.9 | 16.4 | |
| Progression Factor | | 1.00 | | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 0.0 | | | 10.0 | | 3.0 | 1.5 | | 0.5 | 0.8 | |
| Delay (s) | | 10.7 | | | 24.8 | | 19.4 | 18.3 | | 15.4 | 17.2 | |
| Level of Service | | B | | | C | | B | B | | B | B | |
| Approach Delay (s) | | 10.7 | | | 24.8 | | | 18.5 | | | 17.1 | |
| Approach LOS | | B | | | C | | | B | | | B | |

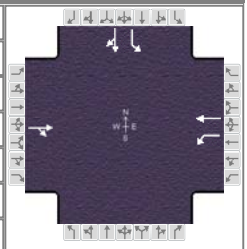
| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 19.4 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.64 | | |
| Actuated Cycle Length (s) | 50.8 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 74.9% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | SWL | SWR | SWR2 |
|---|---|---|---|
| Lane Configurations | | | |
| Traffic Volume (vph) | 20 | 50 | 10 |
| Future Volume (vph) | 20 | 50 | 10 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 |
| Total Lost time (s) | 5.0 | | |
| Lane Util. Factor | 1.00 | | |
| Frt | 0.90 | | |
| Flt Protected | 0.99 | | |
| Satd. Flow (prot) | 1567 | | |
| Flt Permitted | 0.99 | | |
| Satd. Flow (perm) | 1567 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 22 | 54 | 11 |
| RTOR Reduction (vph) | 79 | 0 | 0 |
| Lane Group Flow (vph) | 8 | 0 | 0 |
| Heavy Vehicles (%) | 2% | 2% | 2% |
| Turn Type | Prot | | |
| Protected Phases | 10 | | |
| Permitted Phases | | | |
| Actuated Green, G (s) | 4.9 | | |
| Effective Green, g (s) | 4.9 | | |
| Actuated g/C Ratio | 0.10 | | |
| Clearance Time (s) | 5.0 | | |
| Vehicle Extension (s) | 3.0 | | |
| Lane Grp Cap (vph) | 151 | | |
| v/s Ratio Prot | c0.01 | | |
| v/s Ratio Perm | | | |
| v/c Ratio | 0.06 | | |
| Uniform Delay, d1 | 20.8 | | |
| Progression Factor | 1.00 | | |
| Incremental Delay, d2 | 0.2 | | |
| Delay (s) | 21.0 | | |
| Level of Service | C | | |
| Approach Delay (s) | 21.0 | | |
| Approach LOS | C | | |

| Intersection Summary |
|---|

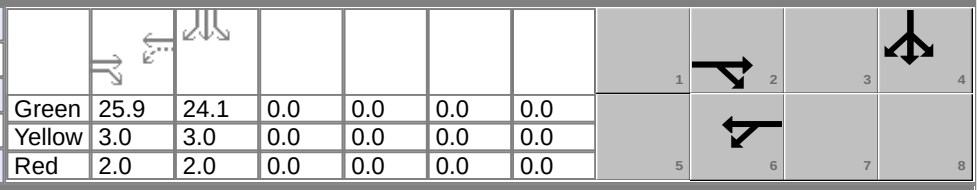
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 5. Archwood & Burkhardt_2040 'Build' PM.xus | | |
| Project Description | Design Year 2040 'Build' PM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 440 | 30 | 40 | 260 | | | | | 332 | 153 | 225 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Green | 25.9 | 24.1 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

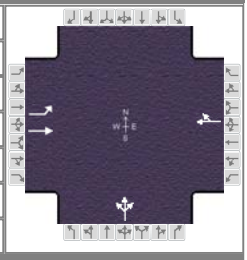
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 6.0 | | | | 10.0 |
| Phase Duration, s | | 30.9 | | 30.9 | | | | 29.1 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 15.1 | | 17.6 | | | | 13.9 |
| Green Extension Time ( $g_e$ ), s | | 1.5 | | 1.3 | | | | 1.5 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.05 | | 0.13 | | | | 0.07 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 511 | | 43 | 283 | | | | | 361 | 411 | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1842 | | 860 | 1810 | | | | | 1740 | 1650 | |
| Queue Service Time ( $g_s$ ), s | | 13.1 | | 2.5 | 6.3 | | | | | 9.4 | 11.9 | |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 13.1 | | 15.6 | 6.3 | | | | | 9.4 | 11.9 | |
| Green Ratio ( *g/C* ) | | 0.43 | | 0.43 | 0.43 | | | | | 0.40 | 0.40 | |
| Capacity ( *c* ), veh/h | | 795 | | 304 | 781 | | | | | 699 | 663 | |
| Volume-to-Capacity Ratio ( *X* ) | | 0.643 | | 0.143 | 0.362 | | | | | 0.516 | 0.620 | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 120.5 | | 11.6 | 54.8 | | | | | 84.4 | 105.9 | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 4.8 | | 0.5 | 2.2 | | | | | 3.4 | 4.2 | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | 0.00 | 0.00 | | | | | 0.00 | 0.00 | |
| Uniform Delay ( $d_1$ ), s/veh | | 13.4 | | 19.5 | 11.5 | | | | | 13.6 | 14.3 | |
| Incremental Delay ( $d_2$ ), s/veh | | 1.4 | | 0.1 | 0.1 | | | | | 0.3 | 1.3 | |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | 0.0 | 0.0 | | | | | 0.0 | 0.0 | |
| Control Delay ( *d* ), s/veh | | 14.8 | | 19.6 | 11.6 | | | | | 13.9 | 15.6 | |
| Level of Service (LOS) | | B | | B | B | | | | | B | B | |
| Approach Delay, s/veh / LOS | 14.8 | B | | 12.7 | B | | 0.0 | | | 14.8 | B | |
| Intersection Delay, s/veh / LOS | 14.4 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | Archwood Avenue | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Coventry Street | File Name | 6. Archwood & Coventry_2040 'Build' PM.xus | | |
| Project Description | Design Year 2040 'Build' PM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 270 | 502 | | | 210 | 310 | 90 | 20 | 20 | | | |

| Signal Information | | | | | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 | | L | T | R | L | T | R | L | T | R | L | T | R |
| Offset, s | 0 | Reference Point | End | Green | 32.7 | 17.3 | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | |
| Uncoordinated | Yes | Simult. Gap E/W | On | Yellow | 3.0 | 3.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 2.0 | 2.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | |

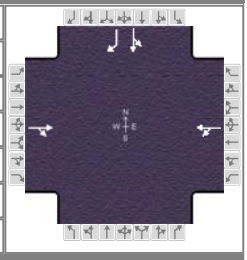
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | 8 | | |
| Case Number | | 6.0 | | 8.0 | | 12.0 | | |
| Phase Duration, s | | 37.7 | | 37.7 | | 22.3 | | |
| Change Period, ( *Y+R c* ), s | | 5.0 | | 5.0 | | 5.0 | | |
| Max Allow Headway ( *MAH* ), s | | 3.5 | | 3.5 | | 3.3 | | |
| Queue Clearance Time ( *g s* ), s | | 34.7 | | 16.0 | | 5.8 | | |
| Green Extension Time ( *g e* ), s | | 0.0 | | 3.8 | | 0.2 | | |
| Phase Call Probability | | 1.00 | | 1.00 | | 1.00 | | |
| Max Out Probability | | 1.00 | | 0.10 | | 0.00 | | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 5 | 2 | | | 6 | 16 | 3 | 8 | 18 | | | |
| Adjusted Flow Rate ( *v* ), veh/h | 293 | 546 | | | 565 | | | 141 | | | | |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 834 | 1845 | | | 1666 | | | 1736 | | | | |
| Queue Service Time ( *g s* ), s | 18.7 | 11.5 | | | 14.0 | | | 3.8 | | | | |
| Cycle Queue Clearance Time ( *g c* ), s | 32.7 | 11.5 | | | 14.0 | | | 3.8 | | | | |
| Green Ratio ( *g/C* ) | 0.55 | 0.55 | | | 0.55 | | | 0.29 | | | | |
| Capacity ( *c* ), veh/h | 380 | 1005 | | | 908 | | | 501 | | | | |
| Volume-to-Capacity Ratio ( *X* ) | 0.773 | 0.543 | | | 0.623 | | | 0.282 | | | | |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | 120.4 | 91.7 | | | 102.4 | | | 36.6 | | | | |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | 4.7 | 3.6 | | | 4.1 | | | 1.4 | | | | |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | 0.00 | 0.00 | | | 0.00 | | | 0.00 | | | | |
| Uniform Delay ( *d 1* ), s/veh | 21.7 | 8.8 | | | 9.4 | | | 16.5 | | | | |
| Incremental Delay ( *d 2* ), s/veh | 8.7 | 0.3 | | | 1.0 | | | 0.1 | | | | |
| Initial Queue Delay ( *d 3* ), s/veh | 0.0 | 0.0 | | | 0.0 | | | 0.0 | | | | |
| Control Delay ( *d* ), s/veh | 30.4 | 9.2 | | | 10.4 | | | 16.7 | | | | |
| Level of Service (LOS) | C | A | | | B | | | B | | | | |
| Approach Delay, s/veh / LOS | 16.6 | B | | 10.4 | B | | 16.7 | B | | 0.0 | | |
| Intersection Delay, s/veh / LOS | 14.3 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

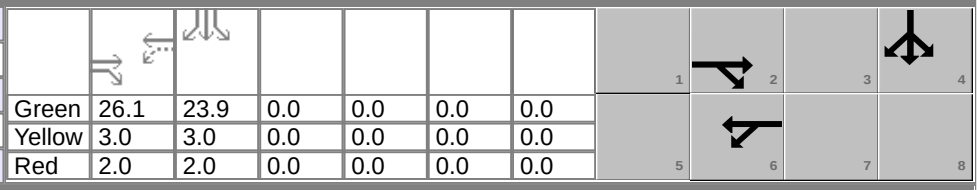
# HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GPD Group | | | Duration, h | 0.25 |
| Analyst | Brett M. Ferrell | Analysis Date | Jun 8, 2016 | Area Type | Other |
| Jurisdiction | City of Akron | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | Lovers Lane | Analysis Year | 2040 | Analysis Period | 1> 7:00 |
| Intersection | Burkhardt Avenue | File Name | 7. Lovers Lane & Burkhardt_2040 'Build' PM.xus | | |
| Project Description | Design Year 2040 'Build' PM Peak Hour | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | | 170 | 40 | 20 | 170 | | | | | 20 | 17 | 13 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 60.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | Yes | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Green | 26.1 | 23.9 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Yellow | 3.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Red | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 2 | | 6 | | | | 4 |
| Case Number | | 8.0 | | 8.0 | | | | 11.0 |
| Phase Duration, s | | 31.1 | | 31.1 | | | | 28.9 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | | | | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.1 | | 3.1 | | | | 3.3 |
| Queue Clearance Time ( $g_s$ ), s | | 7.2 | | 6.4 | | | | 2.8 |
| Green Extension Time ( $g_e$ ), s | | 0.8 | | 0.8 | | | | 0.1 |
| Phase Call Probability | | 1.00 | | 1.00 | | | | 1.00 |
| Max Out Probability | | 0.00 | | 0.00 | | | | 0.00 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | | 2 | 12 | 1 | 6 | | | | | 7 | 4 | 14 |
| Adjusted Flow Rate ( *v* ), veh/h | | 228 | | | 207 | | | | | | 40 | 14 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | | 1717 | | | 1754 | | | | | | 1762 | 1533 |
| Queue Service Time ( $g_s$ ), s | | 5.2 | | | 0.0 | | | | | | 0.8 | 0.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | | 5.2 | | | 4.4 | | | | | | 0.8 | 0.3 |
| Green Ratio ( *g/C* ) | | 0.44 | | | 0.44 | | | | | | 0.40 | 0.40 |
| Capacity ( *c* ), veh/h | | 747 | | | 829 | | | | | | 702 | 611 |
| Volume-to-Capacity Ratio ( *X* ) | | 0.306 | | | 0.249 | | | | | | 0.057 | 0.023 |
| Back of Queue ( *Q* ), ft/ln ( 50 th percentile) | | 44.2 | | | 37 | | | | | | 7.7 | 2.8 |
| Back of Queue ( *Q* ), veh/ln ( 50 th percentile) | | 1.7 | | | 1.5 | | | | | | 0.3 | 0.1 |
| Queue Storage Ratio ( *RQ* ) ( 50 th percentile) | | 0.00 | | | 0.00 | | | | | | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | | 11.0 | | | 10.8 | | | | | | 11.1 | 11.0 |
| Incremental Delay ( $d_2$ ), s/veh | | 0.1 | | | 0.1 | | | | | | 0.0 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | | 0.0 | | | 0.0 | | | | | | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | | 11.1 | | | 10.9 | | | | | | 11.1 | 11.0 |
| Level of Service (LOS) | | B | | | B | | | | | | B | B |
| Approach Delay, s/veh / LOS | 11.1 | B | | 10.9 | B | | 0.0 | | | 11.1 | B | |
| Intersection Delay, s/veh / LOS | 11.0 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | | | | | | | | |
| Bicycle LOS Score / LOS | | | | | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL2 | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 10 | 0 | 40 | 80 | 10 | 130 | 10 | 580 | 50 | 100 | 770 | 70 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| Total Lost time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | 1.00 | | | 1.00 | | 1.00 | 0.95 | | 1.00 | 0.95 | |
| Frt | | 0.89 | | | 0.92 | | 1.00 | 0.99 | | 1.00 | 0.99 | |
| Flt Protected | | 0.99 | | | 0.98 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 1575 | | | 1493 | | 1644 | 3250 | | 1613 | 3186 | |
| Flt Permitted | | 0.92 | | | 0.86 | | 0.21 | 1.00 | | 0.33 | 1.00 | |
| Satd. Flow (perm) | | 1456 | | | 1303 | | 358 | 3250 | | 560 | 3186 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 11 | 0 | 43 | 87 | 11 | 141 | 11 | 630 | 54 | 109 | 837 | 76 |
| RTOR Reduction (vph) | 0 | 41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 |
| Lane Group Flow (vph) | 0 | 13 | 0 | 0 | 239 | 0 | 11 | 684 | 0 | 109 | 903 | 0 |
| Heavy Vehicles (%) | 1% | 1% | 1% | 9% | 9% | 9% | 4% | 4% | 4% | 6% | 6% | 6% |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | | 13.1 | | | 13.1 | | 21.2 | 21.2 | | 21.2 | 21.2 | |
| Effective Green, g (s) | | 13.1 | | | 13.1 | | 21.2 | 21.2 | | 21.2 | 21.2 | |
| Actuated g/C Ratio | | 0.24 | | | 0.24 | | 0.39 | 0.39 | | 0.39 | 0.39 | |
| Clearance Time (s) | | 5.0 | | | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | 349 | | | 312 | | 139 | 1261 | | 217 | 1237 | |
| v/s Ratio Prot | | | | | | | | 0.21 | | | c0.28 | |
| v/s Ratio Perm | | 0.01 | | | c0.18 | | 0.03 | | | 0.19 | | |
| v/c Ratio | | 0.04 | | | 0.77 | | 0.08 | 0.54 | | 0.50 | 0.73 | |
| Uniform Delay, d1 | | 15.9 | | | 19.3 | | 10.5 | 12.9 | | 12.7 | 14.3 | |
| Progression Factor | | 1.00 | | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 0.0 | | | 10.7 | | 0.2 | 0.5 | | 1.8 | 2.2 | |
| Delay (s) | | 16.0 | | | 30.0 | | 10.8 | 13.4 | | 14.5 | 16.4 | |
| Level of Service | | B | | | C | | B | B | | B | B | |
| Approach Delay (s) | | 16.0 | | | 30.0 | | | 13.4 | | | 16.2 | |
| Approach LOS | | B | | | C | | | B | | | B | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 17.0 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.65 | | |
| Actuated Cycle Length (s) | 54.6 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 78.5% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

| Movement | SWL | SWR | SWR2 |
|---|---|---|---|
| Lane Configurations | | | |
| Volume (vph) | 10 | 10 | 30 |
| Ideal Flow (vphpl) | 1800 | 1800 | 1800 |
| Total Lost time (s) | 5.0 | | |
| Lane Util. Factor | 1.00 | | |
| Frt | 0.89 | | |
| Flt Protected | 0.99 | | |
| Satd. Flow (prot) | 1559 | | |
| Flt Permitted | 0.99 | | |
| Satd. Flow (perm) | 1559 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 11 | 11 | 33 |
| RTOR Reduction (vph) | 50 | 0 | 0 |
| Lane Group Flow (vph) | 5 | 0 | 0 |
| Heavy Vehicles (%) | 2% | 2% | 2% |
| Turn Type | Prot | | |
| Protected Phases | 10 | | |
| Permitted Phases | | | |
| Actuated Green, G (s) | 5.3 | | |
| Effective Green, g (s) | 5.3 | | |
| Actuated g/C Ratio | 0.10 | | |
| Clearance Time (s) | 5.0 | | |
| Vehicle Extension (s) | 3.0 | | |
| Lane Grp Cap (vph) | 151 | | |
| v/s Ratio Prot | c0.00 | | |
| v/s Ratio Perm | | | |
| v/c Ratio | 0.04 | | |
| Uniform Delay, d1 | 22.3 | | |
| Progression Factor | 1.00 | | |
| Incremental Delay, d2 | 0.1 | | |
| Delay (s) | 22.4 | | |
| Level of Service | C | | |
| Approach Delay (s) | 22.4 | | |
| Approach LOS | C | | |

| Intersection Summary |
|---|

# APPENDIX C
# HCS FREEWAY CAPACITY ANALYSIS

# DESIGN YEAR 2040 'NO-BUILD' CONDITIONS

AM PEAK HOUR

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound/I-76 Eastbound* |
| From/To | *F-1* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3800* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *8* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.962* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1074* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *19.5* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound/I-76 Eastbound* |
| From/To | *F-2* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3980* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1130* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *20.5* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound/I-76 Eastbound* |
| From/To | *F-3* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3980* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1507* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *27.4* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-4* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2520* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *3* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.985* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1390* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *25.3* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-5* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2560* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1419* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *25.8* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-6* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2370* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1314* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *23.9* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-7* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5140* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1909* | pc/h/ln |
| S | *54.7* | mph |
| D = $v_p$ / S | *34.9* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound* |
| From/To | *F-8* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *7770* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2872* | pc/h/ln |
| S | *26.6* | mph |
| D = $v_p$ / S | *107.9* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound* |
| From/To | *F-9* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2850* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *3* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.985* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1572* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *28.6* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 NB / I-76 WB Ramp* |
| From/To | *F-10* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3200* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *1* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.995* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1748* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *31.8* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 10-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 NB / I-76 WB Ramp* |
| From/To | *F-11* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2830* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *2* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.990* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1553* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *28.2* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound/I-76 Westbound* |
| From/To | *F-12* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6730* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1911* | pc/h/ln |
| S | *54.7* | mph |
| D = $v_p$ / S | *34.9* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound/I-76 Westbound* |
| From/To | *F-13* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3870* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *11* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.948* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1109* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *20.2* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-14* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2720* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1567* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *28.5* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-15* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *1560* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *873* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *15.9* | pc/mi/ln |
| LOS | *B* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-16* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3780* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1089* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *19.8* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-17* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3780* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1452* | pc/h/ln |
| S | *60.0* | mph |
| D = $v_p$ / S | *24.2* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-18* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3210* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *13* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.939* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1239* | pc/h/ln |
| S | *60.0* | mph |
| D = $v_p$ / S | *20.6* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-19* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6410* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *11* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.948* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2450* | pc/h/ln |
| S | *46.9* | mph |
| D = $v_p$ / S | *52.3* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-20* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6710* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2553* | pc/h/ln |
| S | *41.0* | mph |
| D = $v_p$ / S | *62.3* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-21* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5200* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *13* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.939* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *3010* | pc/h/ln |
| S | *18.9* | mph |
| D = $v_p$ / S | *159.7* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-22* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3900* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2215* | pc/h/ln |
| S | *50.7* | mph |
| D = $v_p$ / S | *43.6* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Southbound* |
| From/To | *F-23* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4600* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1717* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *31.2* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Southbound* |
| From/To | *F-24* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5250* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1959* | pc/h/ln |
| S | *54.4* | mph |
| D = $v_p$ / S | *36.0* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SR-8 Southbound* |
| From/To | *F-25* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3050* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1707* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *31.0* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Northbound* |
| From/To | *F-26* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5600* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *3120* | pc/h/ln |
| S | *12.0* | mph |
| D = $v_p$ / S | *260.4* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Northbound* |
| From/To | *F-27* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *7060* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2622* | pc/h/ln |
| S | *38.3* | mph |
| D = $v_p$ / S | *68.4* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SR-8 Northbound Ramp* |
| From/To | *F-28* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2320* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1286* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *23.4* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound Ramp* |
| From/To | *F-29* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *1940* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1081* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *19.7* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-30* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2500* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1399* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *25.4* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound Ramp* |
| From/To | *F-31* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2220* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1243* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *22.6* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 10-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SR-8 Northbound Ramp* |
| From/To | *F-32* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3020* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *3* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.985* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1666* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *30.3* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 10-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-33* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2600* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1448* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *26.3* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound/Westbound Ramp* |
| From/To | *F-34* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2200* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1220* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *22.2* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 NB / I-76 WB Ramp* |
| From/To | *F-35* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2460* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1364* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *24.8* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Northbound Ramp* |
| From/To | *F-36* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2670* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1480* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *26.9* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

PM PEAK HOUR

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound/I-76 Eastbound* |
| From/To | *F-1* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5530* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *8* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.962* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1563* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *28.4* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound/I-76 Eastbound* |
| From/To | *F-2* |
| Jurisdiction | *'No-Build* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6030* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1712* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *31.1* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound/I-76 Eastbound* |
| From/To | *F-3* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6030* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2283* | pc/h/ln |
| S | *49.2* | mph |
| D = $v_p$ / S | *46.4* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-4* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3960* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *3* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.985* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2184* | pc/h/ln |
| S | *51.4* | mph |
| D = $v_p$ / S | *42.5* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-5* |
| Jurisdiction | *'No-Build* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3370* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1868* | pc/h/ln |
| S | *54.9* | mph |
| D = $v_p$ / S | *34.0* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-6* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3210* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1779* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *32.3* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-7* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *8160* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *3030* | pc/h/ln |
| S | *17.6* | mph |
| D = $v_p$ / S | *171.7* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound* |
| From/To | *F-8* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5780* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2136* | pc/h/ln |
| S | *52.2* | mph |
| D = $v_p$ / S | *40.9* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound* |
| From/To | *F-9* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2640* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *3* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.985* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1456* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *26.5* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 10-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *Brett Ferrell* | Highway/Direction of Travel | *I-77 NB / I-76 WB Ramp* |
| Agency or Company | *GPD Group* | From/To | *F-10* |
| Date Performed | *06/01/16* | Jurisdiction | *'No-Build'* |
| Analysis Time Period | *PM Peak Hour* | Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2580* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *1* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.995* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1409* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *25.6* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *Brett Ferrell* | Highway/Direction of Travel | *I-77 NB / I-76 WB Ramp* |
| Agency or Company | *GPD Group* | From/To | *F-11* |
| Date Performed | *06/01/16* | Jurisdiction | *'No-Build'* |
| Analysis Time Period | *PM Peak Hour* | Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2450* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *2* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.990* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1345* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *24.5* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound/I-76 Westbound* |
| From/To | *F-12* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4510* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1281* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *23.3* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Northbound/I-76 Westbound* |
| From/To | *F-13* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3300* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *11* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.948* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *946* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *17.2* | pc/mi/ln |
| LOS | *B* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-14* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4050* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2333* | pc/h/ln |
| S | *48.0* | mph |
| D = $v_p$ / S | *48.6* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-15* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2930* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1640* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *29.8* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-16* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5190* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1495* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *27.2* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-17* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5190* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1993* | pc/h/ln |
| S | *57.2* | mph |
| D = $v_p$ / S | *34.8* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-18* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4730* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *13* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.939* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1825* | pc/h/ln |
| S | *59.1* | mph |
| D = $v_p$ / S | *30.9* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-19* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3940* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *11* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.948* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1506* | pc/h/ln |
| S | *60.0* | mph |
| D = $v_p$ / S | *25.1* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 10-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-20* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4380* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1666* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *30.3* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-21* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3450* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *13* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.939* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1997* | pc/h/ln |
| S | *54.0* | mph |
| D = $v_p$ / S | *37.0* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-22* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2060* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *9* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.957* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1170* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *21.3* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Southbound* |
| From/To | *F-23* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6410* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2392* | pc/h/ln |
| S | *46.3* | mph |
| D = $v_p$ / S | *51.6* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *Brett Ferrell* | Highway/Direction of Travel | *State Route 8 Southbound* |
| Agency or Company | *GPD Group* | From/To | *F-24* |
| Date Performed | *06/01/16* | Jurisdiction | *'No-Build'* |
| Analysis Time Period | *PM Peak Hour* | Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *7460* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

| Speed Inputs | | | Calc Speed Adj and FFS | | |
|---|---|---|---|---|---|
| Lane Width | | ft | | | |
| Rt-Side Lat. Clearance | | ft | $f_{LW}$ | | mph |
| Number of Lanes, N | *3* | | $f_{LC}$ | | mph |
| Total Ramp Density, TRD | | ramps/mi | TRD Adjustment | | mph |
| FFS (measured) | *55.0* | mph | FFS | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph | | | |

| LOS and Performance Measures | | | Design (N) | |
|---|---|---|---|---|
| Operational (LOS) | | | Design (N) | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2784* | pc/h/ln | Design LOS | |
| S | *31.1* | mph | $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| D = $v_p$ / S | *89.5* | pc/mi/ln | S | mph |
| LOS | *F* | | D = $v_p$ / S | pc/mi/ln |
| | | | Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SR-8 Southbound* |
| From/To | *F-25* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5390* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *3017* | pc/h/ln |
| S | *18.4* | mph |
| D = $v_p$ / S | *163.7* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Northbound* |
| From/To | *F-26* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3640* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2028* | pc/h/ln |
| S | *53.7* | mph |
| D = $v_p$ / S | *37.8* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Northbound* |
| From/To | *F-27* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5070* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1883* | pc/h/ln |
| S | *54.8* | mph |
| D = $v_p$ / S | *34.3* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 10-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SR-8 Northbound Ramp* |
| From/To | *F-28* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2240* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1242* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *22.6* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound Ramp* |
| From/To | *F-29* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *1820* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1014* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *18.4* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-30* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2700* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1511* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *27.5* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound Ramp* |
| From/To | *F-31* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2260* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *6* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.971* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1265* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *23.0* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *SR-8 Northbound Ramp* |
| From/To | *F-32* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *1860* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *3* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.985* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1026* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *18.7* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-77 Southbound* |
| From/To | *F-33* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2780* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *5* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.976* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1549* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *28.2* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound/Westbound Ramp* |
| From/To | *F-34* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2070* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1147* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *20.9* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | *Brett Ferrell* | Highway/Direction of Travel | *I-77 NB / I-76 WB Ramp* |
| Agency or Company | *GPD Group* | From/To | *F-35* |
| Date Performed | *06/01/16* | Jurisdiction | *'No-Build'* |
| Analysis Time Period | *PM Peak Hour* | Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2320* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1286* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *23.4* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |



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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *State Route 8 Northbound Ramp* |
| From/To | *F-36* |
| Jurisdiction | *'No-Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2050* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *4* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.980* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *2* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1136* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *20.7* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# DESIGN YEAR 2040 'BUILD' CONDITIONS

AM PEAK HOUR

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-3* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *2820* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1083* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *19.7* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-19* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6300* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *11* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.948* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2408* | pc/h/ln |
| S | *48.1* | mph |
| D = $v_p$ / S | *50.0* | pc/mi/ln |
| LOS | *F* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-20* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *6710* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1915* | pc/h/ln |
| S | *54.7* | mph |
| D = $v_p$ / S | *35.0* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | | |
|---|---|---|
| Design LOS | | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | | pc/h/ln |
| S | | mph |
| D = $v_p$ / S | | pc/mi/ln |
| Required Number of Lanes, N | | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *AM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-21* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *5200* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *13* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.939* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *2007* | pc/h/ln |
| S | *53.9* | mph |
| D = $v_p$ / S | *37.2* | pc/mi/ln |
| LOS | *E* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

PM PEAK HOUR

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Eastbound* |
| From/To | *F-3* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4910* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *12* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.943* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1886* | pc/h/ln |
| S | *54.8* | mph |
| D = $v_p$ / S | *34.4* | pc/mi/ln |
| LOS | *D* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-19* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3830* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *11* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.948* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *60.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *60.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1464* | pc/h/ln |
| S | *60.0* | mph |
| D = $v_p$ / S | *24.4* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-20* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *4380* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *10* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.952* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *4* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1250* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *22.7* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

| | |
|---|---|
| Analyst | *Brett Ferrell* |
| Agency or Company | *GPD Group* |
| Date Performed | *06/01/16* |
| Analysis Time Period | *PM Peak Hour* |

## Site Information

| | |
|---|---|
| Highway/Direction of Travel | *I-76 Westbound* |
| From/To | *F-21* |
| Jurisdiction | *'Build'* |
| Analysis Year | *2040* |

Project Description *SUM-76-Central Interchange (PID 101402)*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

## Flow Inputs

| | | | | |
|---|---|---|---|---|
| Volume, V | *3450* | veh/h | Peak-Hour Factor, PHF | *0.92* |
| AADT | | veh/day | %Trucks and Buses, $P_T$ | *13* |
| Peak-Hr Prop. of AADT, K | | | %RVs, $P_R$ | *0* |
| Peak-Hr Direction Prop, D | | | General Terrain: | *Level* |
| DDHV = AADT x K x D | | veh/h | Grade % Length Up/Down % | *mi* |

## Calculate Flow Adjustments

| | | | |
|---|---|---|---|
| $f_p$ | *1.00* | $E_R$ | *1.2* |
| $E_T$ | *1.5* | $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ | *0.939* |

## Speed Inputs

| | | |
|---|---|---|
| Lane Width | | ft |
| Rt-Side Lat. Clearance | | ft |
| Number of Lanes, N | *3* | |
| Total Ramp Density, TRD | | ramps/mi |
| FFS (measured) | *55.0* | mph |
| Base free-flow Speed, BFFS | | mph |

## Calc Speed Adj and FFS

| | | |
|---|---|---|
| $f_{LW}$ | | mph |
| $f_{LC}$ | | mph |
| TRD Adjustment | | mph |
| FFS | *55.0* | mph |

## LOS and Performance Measures

Operational (LOS)

| | | |
|---|---|---|
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | *1331* | pc/h/ln |
| S | *55.0* | mph |
| D = $v_p$ / S | *24.2* | pc/mi/ln |
| LOS | *C* | |

## Design (N)

Design (N)

| | |
|---|---|
| Design LOS | |
| $v_p$ = (V or DDHV) / (PHF x N x $f_{HV}$ x $f_p$) | pc/h/ln |
| S | mph |
| D = $v_p$ / S | pc/mi/ln |
| Required Number of Lanes, N | |

## Glossary

| | |
|---|---|
| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| $v_p$ - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

## Factor Location

| | |
|---|---|
| $E_R$ - Exhibits 11-10, 11-12 | $f_{LW}$ - Exhibit 11-8 |
| $E_T$ - Exhibits 11-10, 11-11, 11-13 | $f_{LC}$ - Exhibit 11-9 |
| $f_p$ - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3 | |

# APPENDIX D
# HCS RAMP JUNCTION ANALYSES

# DIVERGE JUNCTION ANALYSIS

# DESIGN YEAR 2040 'NO-BUILD' CONDITIONS

AM PEAK HOUR

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-77 Southbound |
| Agency or Company | GPD Group | Junction | D-1 (Lovers Lane Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | AM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
$L_{up}$ = ft
$V_u$ = veh/h

| | |
|---|---|
| Freeway Number of Lanes, N | 2 |
| Ramp Number of Lanes, N | 1 |
| Acceleration Lane Length, $L_A$ | |
| Deceleration Lane Length $L_D$ | 150 |
| Freeway Volume, $V_F$ | 2560 |
| Ramp Volume, $V_R$ | 190 |
| Freeway Free-Flow Speed, $S_{FF}$ | 55.0 |
| Ramp Free-Flow Speed, $S_{FR}$ | 35.0 |

Downstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
$L_{down}$ = 1735 ft
$V_D$ = 280 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 2560 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 2838 |
| Ramp | 190 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 211 |
| UpStream | | | | | | | | |
| DownStream | 280 | 0.92 | Level | 3 | 0 | 0.985 | 1.00 | 309 |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)
$P_{FM}$ = using Equation (Exhibit 13-6)
$V_{12}$ = pc/h
$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)
LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)
$S_R$= mph (Exhibit 13-11)
$S_0$= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)
$P_{FD}$ = 1.000 using Equation (Exhibit 13-7)
$V_{12}$ = 2838 pc/h
$V_3$ or $V_{av34}$ 0 pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 2838 | Exhibit 13-8 | 4500 | No |
| $V_{FO} = V_F - V_R$ | 2627 | Exhibit 13-8 | 4500 | No |
| $V_R$ | 211 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 2838 | Exhibit 13-8 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 27.3 (pc/mi/ln)
LOS = C (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.447 (Exhibit 13-12)
$S_R$= 49.2 mph (Exhibit 13-12)
$S_0$= N/A mph (Exhibit 13-12)
S = 49.2 mph (Exhibit 13-13)

# HCM 2010: MAJOR DIVERGE AREA ANALYSIS

| | | | |
|---|---|---|---|
| Analyst: | Brett Ferrell | Freeway/Direction of Travel: | I-77 NB / I-76 WB |
| Date: | 06/01/16 | Junction: | D-2 (Broadway Street Ramp) |
| Analysis Year: | 2040 'No-Build' | Analysis Time Period: | AM Peak Hour |
| Description: | SUM-76-Central Interchange (PID 101402) | | |

**Equation:** $$D_{MD} = 0.0175 * V_f$$

**Inputs:** $D_{MD}$ = density in the major diverge influence area (pc/mi/ln)

$V_F$ = demand flow rate immediately upstream of the major diverge influence area (pc/h)

## Analysis

$D_{MD}$ = ## (pc/mi/ln)

$V_F$ = 1,911 (pc/h/ln)

$$D_{MD} = 0.0175 * 1{,}911$$

$$D_{MD} = 33.44$$

## Level of Service Determination

| Level of Service | Density (pc/mi/ln) |
|---|---|
| A | ≤ 10 |
| B | > 10 – 20 |
| C | > 20 – 28 |
| D | > 28 – 35 |
| E | > 35 |
| F | Demand Exceeds Capacity |

$D_{MD}$ = 33.4 pc/mi/ln

Level of Service for Major Diverge Area: **D**

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# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-76 Eastbound |
| Agency or Company | GPD Group | Junction | D-3 (State Route 8 NB Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | AM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Freeway Number of Lanes, N | 2 | Downstream Adj Ramp | |
|---|---|---|---|---|---|
| ☐ Yes | ☐ On | Ramp Number of Lanes, N | 1 | ☐ Yes | ☐ On |
| ☑ No | ☐ Off | Acceleration Lane Length, $L_A$ | | ☑ No | ☐ Off |
| $L_{up}$ = | ft | Deceleration Lane Length $L_D$ | 500 | $L_{down}$ = | ft |
| $V_u$ = | veh/h | Freeway Volume, $V_F$ | 2720 | $V_D$ = | veh/h |
| | | Ramp Volume, $V_R$ | 1160 | | |
| | | Freeway Free-Flow Speed, $S_{FF}$ | 55.0 | | |
| | | Ramp Free-Flow Speed, $S_{FR}$ | 35.0 | | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 2720 | 0.92 | Level | 12 | 0 | 0.943 | 1.00 | 3134 |
| Ramp | 1160 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 1286 |
| UpStream | | | | | | | | |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = using Equation (Exhibit 13-6)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)

$S_R$= mph (Exhibit 13-11)

$S_0$= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 1.000 using Equation (Exhibit 13-7)

$V_{12}$ = 3134 pc/h

$V_3$ or $V_{av34}$ 0 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 3134 | Exhibit 13-8 | 4500 | No |
| $V_{FO} = V_F - V_R$ | 1848 | Exhibit 13-8 | 4500 | No |
| $V_R$ | 1286 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 3134 | Exhibit 13-8 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 26.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.544 (Exhibit 13-12)

$S_R$= 47.9 mph (Exhibit 13-12)

$S_0$= N/A mph (Exhibit 13-12)

S = 47.9 mph (Exhibit 13-13)



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# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-76 Eastbound |
| Agency or Company | GPD Group | Junction | D-4 (Arlington Street Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | AM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Freeway Number of Lanes, N | 3 | Downstream Adj Ramp | |
|---|---|---|---|---|---|
| ☐ Yes | ☐ On | Ramp Number of Lanes, N | 1 | ☑ Yes | ☑ On |
| ☑ No | ☐ Off | Acceleration Lane Length, $L_A$ | | ☐ No | ☐ Off |
| $L_{up}$ = | ft | Deceleration Lane Length $L_D$ | 600 | $L_{down}$ = | 1825 ft |
| $V_u$ = | veh/h | Freeway Volume, $V_F$ | 3780 | $V_D$ = | 200 veh/h |
| | | Ramp Volume, $V_R$ | 570 | | |
| | | Freeway Free-Flow Speed, $S_{FF}$ | 60.0 | | |
| | | Ramp Free-Flow Speed, $S_{FR}$ | 35.0 | | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 3780 | 0.92 | Level | 12 | 0 | 0.943 | 1.00 | 4355 |
| Ramp | 570 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 632 |
| UpStream | | | | | | | | |
| DownStream | 200 | 0.92 | Level | 6 | 0 | 0.971 | 1.00 | 224 |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = using Equation (Exhibit 13-6)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)

$S_R$= mph (Exhibit 13-11)

$S_0$= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.622 using Equation (Exhibit 13-7)

$V_{12}$ = 2948 pc/h

$V_3$ or $V_{av34}$ 1407 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 4355 | Exhibit 13-8 | 6900 | No |
| $V_{FO} = V_F - V_R$ | 3723 | Exhibit 13-8 | 6900 | No |
| $V_R$ | 632 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 2948 | Exhibit 13-8 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 24.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.485 (Exhibit 13-12)

$S_R$= 51.3 mph (Exhibit 13-12)

$S_0$= 64.2 mph (Exhibit 13-12)

S = 54.8 mph (Exhibit 13-13)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-76 Westbound |
| Agency or Company | GPD Group | Junction | D-5 (I-77 Southbound Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | AM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Freeway Number of Lanes, N | 2 | Downstream Adj Ramp | |
|---|---|---|---|---|---|
| ☐ Yes | ☐ On | Ramp Number of Lanes, N | 1 | ☐ Yes | ☐ On |
| ☑ No | ☐ Off | Acceleration Lane Length, $L_A$ | | ☑ No | ☐ Off |
| $L_{up}$ = | ft | Deceleration Lane Length $L_D$ | 475 | $L_{down}$ = | ft |
| $V_u$ = | veh/h | Freeway Volume, $V_F$ | 5200 | $V_D$ = | veh/h |
| | | Ramp Volume, $V_R$ | 1300 | | |
| | | Freeway Free-Flow Speed, $S_{FF}$ | 55.0 | | |
| | | Ramp Free-Flow Speed, $S_{FR}$ | 35.0 | | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 5200 | 0.92 | Level | 13 | 0 | 0.939 | 1.00 | 6020 |
| Ramp | 1300 | 0.92 | Level | 5 | 0 | 0.976 | 1.00 | 1448 |
| UpStream | | | | | | | | |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = using Equation (Exhibit 13-6)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)

$S_R$ = mph (Exhibit 13-11)

$S_0$ = mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 1.000 using Equation (Exhibit 13-7)

$V_{12}$ = 6020 pc/h

$V_3$ or $V_{av34}$ 0 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 6020 | Exhibit 13-8 | 4500 | Yes |
| $V_{FO} = V_F - V_R$ | 4572 | Exhibit 13-8 | 4500 | Yes |
| $V_R$ | 1448 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 6020 | Exhibit 13-8 | 4400:All | Yes |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 51.7 (pc/mi/ln)

LOS = F (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.558 (Exhibit 13-12)

$S_R$ = 47.7 mph (Exhibit 13-12)

$S_0$ = N/A mph (Exhibit 13-12)

S = 47.7 mph (Exhibit 13-13)

# HCM 2010: MAJOR DIVERGE AREA ANALYSIS

| | | | |
|---|---|---|---|
| Analyst: | Brett Ferrell | Freeway/Direction of Travel: | SR-8 Southbound |
| Date: | 06/01/16 | Junction: | D-6 (I-76 EB / WB Ramp) |
| Analysis Year: | 2040 'No-Build' | Analysis Time Period: | AM Peak Hour |
| Description: | SUM-76-Central Interchange (PID 101402) | | |

**Equation:** $$D_{MD} = 0.0175 * V_f$$

**Inputs:** $D_{MD}$ = density in the major diverge influence area (pc/mi/ln)

$V_F$ = demand flow rate immediately upstream of the major diverge influence area (pc/h)

## Analysis

$D_{MD}$ = ## (pc/mi/ln)

$V_F$ = 1,959 (pc/h/ln)

$$D_{MD} = 0.0175 * 1{,}959$$

$$D_{MD} = 34.28$$

## Level of Service Determination

| Level of Service | Density (pc/mi/ln) |
|---|---|
| A | ≤ 10 |
| B | > 10 – 20 |
| C | > 20 – 28 |
| D | > 28 – 35 |
| E | > 35 |
| F | Demand Exceeds Capacity |

$D_{MD}$ = 34.28 pc/mi/ln

Level of Service for Major Diverge Area: **D**

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PM PEAK HOUR

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-77 Southbound |
| Agency or Company | GPD Group | Junction | D-1 (Lovers Lane Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | PM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
$L_{up}$ = ft
$V_u$ = veh/h

| | |
|---|---|
| Freeway Number of Lanes, N | 2 |
| Ramp Number of Lanes, N | 1 |
| Acceleration Lane Length, $L_A$ | |
| Deceleration Lane Length $L_D$ | 150 |
| Freeway Volume, $V_F$ | 3370 |
| Ramp Volume, $V_R$ | 160 |
| Freeway Free-Flow Speed, $S_{FF}$ | 55.0 |
| Ramp Free-Flow Speed, $S_{FR}$ | 35.0 |

Downstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
$L_{down}$ = 1735 ft
$V_D$ = 440 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 3370 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 3736 |
| Ramp | 160 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 177 |
| UpStream | | | | | | | | |
| DownStream | 440 | 0.92 | Level | 3 | 0 | 0.985 | 1.00 | 485 |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)
$P_{FM}$ = using Equation (Exhibit 13-6)
$V_{12}$ = pc/h
$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)
LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)
$S_R$= mph (Exhibit 13-11)
$S_0$= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)
$P_{FD}$ = 1.000 using Equation (Exhibit 13-7)
$V_{12}$ = 3736 pc/h
$V_3$ or $V_{av34}$ 0 pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 3736 | Exhibit 13-8 | 4500 | No |
| $V_{FO} = V_F - V_R$ | 3559 | Exhibit 13-8 | 4500 | No |
| $V_R$ | 177 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 3736 | Exhibit 13-8 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 35.0 (pc/mi/ln)
LOS = E (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.444 (Exhibit 13-12)
$S_R$= 49.2 mph (Exhibit 13-12)
$S_0$= N/A mph (Exhibit 13-12)
S = 49.2 mph (Exhibit 13-13)

# HCM 2010: MAJOR DIVERGE AREA ANALYSIS

| | | | |
|---|---|---|---|
| Analyst: | Brett Ferrell | Freeway/Direction of Travel: | I-77 NB / I-76 WB |
| Date: | 06/01/16 | Junction: | D-2 (Broadway Street Ramp) |
| Analysis Year: | 2040 'No-Build' | Analysis Time Period: | PM Peak Hour |
| Description: | SUM-76-Central Interchange (PID 101402) | | |

**Equation:** $$D_{MD} = 0.0175 * V_f$$

**Inputs:** $D_{MD}$ = density in the major diverge influence area (pc/mi/ln)

$V_F$ = demand flow rate immediately upstream of the major diverge influence area (pc/h)

## Analysis

$D_{MD}$ = ## (pc/mi/ln)

$V_F$ = 1,281 (pc/h/ln)

$$D_{MD} = 0.0175 * 1{,}281$$

$$D_{MD} = 22.42$$

## Level of Service Determination

| Level of Service | Density (pc/mi/ln) |
|---|---|
| A | ≤ 10 |
| B | > 10 – 20 |
| C | > 20 – 28 |
| D | > 28 – 35 |
| E | > 35 |
| F | Demand Exceeds Capacity |

$D_{MD}$ = 22.42 pc/mi/ln

Level of Service for Major Diverge Area: **C**

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# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-76 Eastbound |
| Agency or Company | GPD Group | Junction | D-3 (State Route 8 NB Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | PM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
$L_{up}$ = ft
$V_u$ = veh/h

| | |
|---|---|
| Freeway Number of Lanes, N | 2 |
| Ramp Number of Lanes, N | 1 |
| Acceleration Lane Length, $L_A$ | |
| Deceleration Lane Length $L_D$ | 500 |
| Freeway Volume, $V_F$ | 4050 |
| Ramp Volume, $V_R$ | 1120 |
| Freeway Free-Flow Speed, $S_{FF}$ | 55.0 |
| Ramp Free-Flow Speed, $S_{FR}$ | 35.0 |

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
$L_{down}$ = ft
$V_D$ = veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 4050 | 0.92 | Level | 12 | 0 | 0.943 | 1.00 | 4666 |
| Ramp | 1120 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 1242 |
| UpStream | | | | | | | | |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)
$P_{FM}$ = using Equation (Exhibit 13-6)
$V_{12}$ = pc/h
$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)
LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)
$S_R$= mph (Exhibit 13-11)
$S_0$= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)
$P_{FD}$ = 1.000 using Equation (Exhibit 13-7)
$V_{12}$ = 4666 pc/h
$V_3$ or $V_{av34}$ 0 pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 4666 | Exhibit 13-8 | 4500 | Yes |
| $V_{FO} = V_F - V_R$ | 3424 | Exhibit 13-8 | 4500 | No |
| $V_R$ | 1242 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 4666 | Exhibit 13-8 | 4400:All | Yes |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 39.9 (pc/mi/ln)
LOS = F (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.540 (Exhibit 13-12)
$S_R$= 48.0 mph (Exhibit 13-12)
$S_0$= N/A mph (Exhibit 13-12)
S = 48.0 mph (Exhibit 13-13)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-76 Eastbound |
| Agency or Company | GPD Group | Junction | D-4 (Arlington Street Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | PM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
$L_{up}$ = ft
$V_u$ = veh/h

| | |
|---|---|
| Freeway Number of Lanes, N | 3 |
| Ramp Number of Lanes, N | 1 |
| Acceleration Lane Length, $L_A$ | |
| Deceleration Lane Length $L_D$ | 600 |
| Freeway Volume, $V_F$ | 5190 |
| Ramp Volume, $V_R$ | 460 |
| Freeway Free-Flow Speed, $S_{FF}$ | 60.0 |
| Ramp Free-Flow Speed, $S_{FR}$ | 35.0 |

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
$L_{down}$ = 1825 ft
$V_D$ = 250 veh/h

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 5190 | 0.92 | Level | 12 | 0 | 0.943 | 1.00 | 5980 |
| Ramp | 460 | 0.92 | Level | 4 | 0 | 0.980 | 1.00 | 510 |
| UpStream | | | | | | | | |
| DownStream | 250 | 0.92 | Level | 6 | 0 | 0.971 | 1.00 | 280 |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)
$P_{FM}$ = using Equation (Exhibit 13-6)
$V_{12}$ = pc/h
$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)
LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)
$S_R$= mph (Exhibit 13-11)
$S_0$= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)
$P_{FD}$ = 0.587 using Equation (Exhibit 13-7)
$V_{12}$ = 3721 pc/h
$V_3$ or $V_{av34}$ 2259 pc/h (Equation 13-14 or 13-17)
Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No
Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No
If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 5980 | Exhibit 13-8 | 6900 | No |
| $V_{FO} = V_F - V_R$ | 5470 | Exhibit 13-8 | 6900 | No |
| $V_R$ | 510 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 3721 | Exhibit 13-8 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 30.9 (pc/mi/ln)
LOS = D (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.474 (Exhibit 13-12)
$S_R$= 51.5 mph (Exhibit 13-12)
$S_0$= 60.9 mph (Exhibit 13-12)
S = 54.7 mph (Exhibit 13-13)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-76 Westbound |
| Agency or Company | GPD Group | Junction | D-5 (I-77 Southbound Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | PM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Downstream Adj Ramp |
|---|---|---|
| ☐ Yes ☐ On | Freeway Number of Lanes, N: 2 | ☐ Yes ☐ On |
| ☑ No ☐ Off | Ramp Number of Lanes, N: 1 | ☑ No ☐ Off |
| $L_{up}$ = ft | Acceleration Lane Length, $L_A$: | $L_{down}$ = ft |
| $V_u$ = veh/h | Deceleration Lane Length $L_D$: 475 | $V_D$ = veh/h |
| | Freeway Volume, $V_F$: 3450 | |
| | Ramp Volume, $V_R$: 1390 | |
| | Freeway Free-Flow Speed, $S_{FF}$: 55.0 | |
| | Ramp Free-Flow Speed, $S_{FR}$: 35.0 | |

## Conversion to pc/h Under Base Conditions

| | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 3450 | 0.92 | Level | 13 | 0 | 0.939 | 1.00 | 3994 |
| Ramp | 1390 | 0.92 | Level | 5 | 0 | 0.976 | 1.00 | 1549 |
| UpStream | | | | | | | | |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = using Equation (Exhibit 13-6)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | | Exhibit 13-8 | | |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$M_S$ = (Exibit 13-11)

$S_R$ = mph (Exhibit 13-11)

$S_0$ = mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 1.000 using Equation (Exhibit 13-7)

$V_{12}$ = 3994 pc/h

$V_3$ or $V_{av34}$ 0 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☑ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | 3994 | Exhibit 13-8 | 4500 | No |
| $V_{FO} = V_F - V_R$ | 2445 | Exhibit 13-8 | 4500 | No |
| $V_R$ | 1549 | Exhibit 13-10 | 2000 | No |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | 3994 | Exhibit 13-8 | 4400:All | No |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = 34.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

### Speed Determination

$D_s$ = 0.567 (Exhibit 13-12)

$S_R$ = 47.6 mph (Exhibit 13-12)

$S_0$ = N/A mph (Exhibit 13-12)

S = 47.6 mph (Exhibit 13-13)



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# HCM 2010: MAJOR DIVERGE AREA ANALYSIS

| | | | |
|---|---|---|---|
| Analyst: | Brett Ferrell | Freeway/Direction of Travel: | SR-8 Southbound |
| Date: | 06/01/16 | Junction: | D-6 (I-76 EB / WB Ramp) |
| Analysis Year: | 2040 'No-Build' | Analysis Time Period: | PM Peak Hour |
| Description: | SUM-76-Central Interchange (PID 101402) | | |

**Equation:** $$D_{MD} = 0.0175 * V_f$$

**Inputs:** $D_{MD}$ = density in the major diverge influence area (pc/mi/ln)

$V_F$ = demand flow rate immediately upstream of the major diverge influence area (pc/h)

## Analysis

$D_{MD}$ = ## (pc/mi/ln)

$V_F$ = 2,784 (pc/h/ln)

$$D_{MD} = 0.0175 * 2{,}784$$

$$D_{MD} = 48.72$$

## Level of Service Determination

| Level of Service | Density (pc/mi/ln) |
|---|---|
| A | ≤ 10 |
| B | > 10 – 20 |
| C | > 20 – 28 |
| D | > 28 – 35 |
| E | > 35 |
| F | Demand Exceeds Capacity |

$D_{MD}$ = 48.72 pc/mi/ln

Level of Service for Major Diverge Area: **E**

GPD GROUP®
Glaus, Pyle, Schomer, Burns & DeHaven, Inc.

# MERGE JUNCTION ANALYSIS

# DESIGN YEAR 2040 'NO-BUILD' CONDITIONS

AM PEAK HOUR

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-77 Southbound/I-76 Eastbound |
| Agency or Company | GPD Group | Junction | M-1 (Main Street Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | AM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Downstream Adj Ramp |
|---|---|---|
| ☑ Yes ☑ On | Freeway Number of Lanes, N: 4 | ☐ Yes ☐ On |
| ☐ No ☐ Off | Ramp Number of Lanes, N: 1 | ☑ No ☐ Off |
| $L_{up}$ = 1150 ft | Acceleration Lane Length, $L_A$: 850 | $L_{down}$ = ft |
| $V_u$ = 490 veh/h | Deceleration Lane Length $L_D$: | $V_D$ = veh/h |
| | Freeway Volume, $V_F$: 3800 | |
| | Ramp Volume, $V_R$: 180 | |
| | Freeway Free-Flow Speed, $S_{FF}$: 55.0 | |
| | Ramp Free-Flow Speed, $S_{FR}$: 35.0 | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 3800 | 0.92 | Level | 8 | 0 | 0.962 | 1.00 | 4296 |
| Ramp | 180 | 0.92 | Level | 5 | 0 | 0.976 | 1.00 | 201 |
| UpStream | 490 | 0.92 | Level | 1 | 0 | 0.995 | 1.00 | 535 |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.193 using Equation (Exhibit 13-6)

$V_{12}$ = 828 pc/h

$V_3$ or $V_{av34}$ = 1734 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes, $V_{12a}$ = 1718 pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 4497 | Exhibit 13-8 | | No |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 1919 | Exhibit 13-8 | 4600:All | No |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = 15.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

### Speed Determination

$M_S$ = 0.288 (Exibit 13-11)

$S_R$ = 51.3 mph (Exhibit 13-11)

$S_0$ = 52.2 mph (Exhibit 13-11)

S = 51.8 mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = using Equation (Exhibit 13-7)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ = pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 13-8 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 13-8 | | |
| $V_R$ | | Exhibit 13-10 | | |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$D_s$ = (Exhibit 13-12)

$S_R$ = mph (Exhibit 13-12)

$S_0$ = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | State Route 8 Southbound |
| Agency or Company | GPD Group | Junction | M-2 (Goodkirk Street Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | AM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Downstream Adj Ramp |
|---|---|---|
| ☐ Yes ☐ On | Freeway Number of Lanes, N: 3 | ☐ Yes ☐ On |
| ☑ No ☐ Off | Ramp Number of Lanes, N: 1 | ☑ No ☐ Off |
| $L_{up}$ = ft | Acceleration Lane Length, $L_A$: 900 | $L_{down}$ = ft |
| $V_u$ = veh/h | Deceleration Lane Length $L_D$: | $V_D$ = veh/h |
| | Freeway Volume, $V_F$: 4600 | |
| | Ramp Volume, $V_R$: 650 | |
| | Freeway Free-Flow Speed, $S_{FF}$: 55.0 | |
| | Ramp Free-Flow Speed, $S_{FR}$: 35.0 | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 4600 | 0.92 | Level | 6 | 0 | 0.971 | 1.00 | 5150 |
| Ramp | 650 | 0.92 | Level | 3 | 0 | 0.985 | 1.00 | 717 |
| UpStream | | | | | | | | |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.603 using Equation (Exhibit 13-6)

$V_{12}$ = 3104 pc/h

$V_3$ or $V_{av34}$ 2046 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes,$V_{12a}$ = 3104 pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 5867 | Exhibit 13-8 | | No |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 3821 | Exhibit 13-8 | 4600:All | No |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = 29.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

### Speed Determination

$M_S$ = 0.436 (Exibit 13-11)

$S_R$= 49.3 mph (Exhibit 13-11)

$S_0$= 49.4 mph (Exhibit 13-11)

S = 49.4 mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = using Equation (Exhibit 13-7)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes,$V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 13-8 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 13-8 | | |
| $V_R$ | | Exhibit 13-10 | | |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$D_s$ = (Exhibit 13-12)

$S_R$= mph (Exhibit 13-12)

$S_0$= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

PM PEAK HOUR

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | I-77 Southbound/I-76 Eastbound |
| Agency or Company | GPD Group | Junction | M-1 (Main Street Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | PM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Freeway Number of Lanes, N | 4 | Downstream Adj Ramp | |
|---|---|---|---|---|---|
| ☑ Yes | ☑ On | Ramp Number of Lanes, N | 1 | ☐ Yes | ☐ On |
| ☐ No | ☐ Off | Acceleration Lane Length, $L_A$ | 850 | ☑ No | ☐ Off |
| $L_{up}$ = | 1150 ft | Deceleration Lane Length $L_D$ | | $L_{down}$ = | ft |
| $V_u$ = | 1210 veh/h | Freeway Volume, $V_F$ | 5530 | $V_D$ = | veh/h |
| | | Ramp Volume, $V_R$ | 500 | | |
| | | Freeway Free-Flow Speed, $S_{FF}$ | 55.0 | | |
| | | Ramp Free-Flow Speed, $S_{FR}$ | 35.0 | | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 5530 | 0.92 | Level | 8 | 0 | 0.962 | 1.00 | 6251 |
| Ramp | 500 | 0.92 | Level | 5 | 0 | 0.976 | 1.00 | 557 |
| UpStream | 1210 | 0.92 | Level | 1 | 0 | 0.995 | 1.00 | 1322 |
| DownStream | | | | | | | | |

### Merge Areas

#### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.148 using Equation (Exhibit 13-6)

$V_{12}$ = 926 pc/h

$V_3$ or $V_{av34}$ = 2662 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☑ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes, $V_{12a}$ = 2500 pc/h (Equation 13-16, 13-18, or 13-19)

#### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 6808 | Exhibit 13-8 | | No |

#### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 3057 | Exhibit 13-8 | 4600:All | No |

#### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = 23.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

#### Speed Determination

$M_S$ = 0.344 (Exibit 13-11)

$S_R$ = 50.5 mph (Exhibit 13-11)

$S_0$ = 50.0 mph (Exhibit 13-11)

S = 50.3 mph (Exhibit 13-13)

### Diverge Areas

#### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = using Equation (Exhibit 13-7)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ = pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

#### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 13-8 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 13-8 | | |
| $V_R$ | | Exhibit 13-10 | | |

#### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 13-8 | | |

#### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

#### Speed Determination

$D_s$ = (Exhibit 13-12)

$S_R$ = mph (Exhibit 13-12)

$S_0$ = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

# RAMPS AND RAMP JUNCTIONS WORKSHEET

## General Information / Site Information

| | | | |
|---|---|---|---|
| Analyst | Brett Ferrell | Freeway/Dir of Travel | State Route 8 Southbound |
| Agency or Company | GPD Group | Junction | M-2 (Goodkirk Street Ramp) |
| Date Performed | 06/01/16 | Jurisdiction | 'No-Build' |
| Analysis Time Period | PM Peak Hour | Analysis Year | 2040 |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| Upstream Adj Ramp | | Freeway Number of Lanes, N | 3 | Downstream Adj Ramp | |
|---|---|---|---|---|---|
| ☐ Yes | ☐ On | Ramp Number of Lanes, N | 1 | ☐ Yes | ☐ On |
| ☑ No | ☐ Off | Acceleration Lane Length, $L_A$ | 900 | ☑ No | ☐ Off |
| $L_{up}$ = | ft | Deceleration Lane Length $L_D$ | | $L_{down}$ = | ft |
| $V_u$ = | veh/h | Freeway Volume, $V_F$ | 6410 | $V_D$ = | veh/h |
| | | Ramp Volume, $V_R$ | 1050 | | |
| | | Freeway Free-Flow Speed, $S_{FF}$ | 55.0 | | |
| | | Ramp Free-Flow Speed, $S_{FR}$ | 35.0 | | |

## Conversion to pc/h Under Base Conditions

| (pc/h) | V (Veh/hr) | PHF | Terrain | %Truck | %Rv | $f_{HV}$ | $f_p$ | v = V/PHF x $f_{HV}$ x $f_p$ |
|---|---|---|---|---|---|---|---|---|
| Freeway | 6410 | 0.92 | Level | 6 | 0 | 0.971 | 1.00 | 7176 |
| Ramp | 1050 | 0.92 | Level | 3 | 0 | 0.985 | 1.00 | 1158 |
| UpStream | | | | | | | | |
| DownStream | | | | | | | | |

## Merge Areas

### Estimation of $v_{12}$

$V_{12} = V_F ( P_{FM} )$

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.603 using Equation (Exhibit 13-6)

$V_{12}$ = 4325 pc/h

$V_3$ or $V_{av34}$ = 2851 pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☑ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☑ Yes ☐ No

If Yes, $V_{12a}$ = 4476 pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_{FO}$ | 8334 | Exhibit 13-8 | | Yes |

### Flow Entering Merge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{R12}$ | 5634 | Exhibit 13-8 | 4600:All | Yes |

### Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

$D_R$ = 43.2 (pc/mi/ln)

LOS = F (Exhibit 13-2)

### Speed Determination

$M_S$ = 1.349 (Exibit 13-11)

$S_R$ = 37.5 mph (Exhibit 13-11)

$S_0$ = 46.1 mph (Exhibit 13-11)

S = 39.9 mph (Exhibit 13-13)

## Diverge Areas

### Estimation of $v_{12}$

$V_{12} = V_R + (V_F - V_R)P_{FD}$

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = using Equation (Exhibit 13-7)

$V_{12}$ = pc/h

$V_3$ or $V_{av34}$ = pc/h (Equation 13-14 or 13-17)

Is $V_3$ or $V_{av34}$ > 2,700 pc/h? ☐ Yes ☐ No

Is $V_3$ or $V_{av34}$ > 1.5 * $V_{12}$/2 ☐ Yes ☐ No

If Yes, $V_{12a}$ = pc/h (Equation 13-16, 13-18, or 13-19)

### Capacity Checks

| | Actual | Capacity | | LOS F? |
|---|---|---|---|---|
| $V_F$ | | Exhibit 13-8 | | |
| $V_{FO} = V_F - V_R$ | | Exhibit 13-8 | | |
| $V_R$ | | Exhibit 13-10 | | |

### Flow Entering Diverge Influence Area

| | Actual | Max Desirable | | Violation? |
|---|---|---|---|---|
| $V_{12}$ | | Exhibit 13-8 | | |

### Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

$D_R$ = (pc/mi/ln)

LOS = (Exhibit 13-2)

### Speed Determination

$D_s$ = (Exhibit 13-12)

$S_R$ = mph (Exhibit 13-12)

$S_0$ = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

# APPENDIX E
# HCS WEAVE SEGMENT ANALYSIS

# DESIGN YEAR 2040 'NO-BUILD' CONDITIONS

AM PEAK HOUR

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | AM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-77 Southbound |
| Weaving Segment Location | W-1 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 1700ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 2770 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 3101 |
| $V_{RF}$ | 2370 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 2628 |
| $V_{FR}$ | 280 | 0.92 | 3 | 0 | 1.5 | 1.2 | 0.985 | 1.00 | 309 |
| $V_{RR}$ | 0 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 0 |
| $V_{NW}$ | 3101 | | | | | | | V = | 6038 |
| $V_W$ | 2937 | | | | | | | | |
| VR | 0.486 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 1.0 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 0 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 2 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | 527 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 5892 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 4790 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.230 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 7668 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | AM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-77 Northbound |
| Weaving Segment Location | W-2 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 2570ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 4920 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 5455 |
| $V_{RF}$ | 680 | 0.92 | 2 | 0 | 1.5 | 1.2 | 0.990 | 1.00 | 747 |
| $V_{FR}$ | 2850 | 0.92 | 3 | 0 | 1.5 | 1.2 | 0.985 | 1.00 | 3144 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 5455 | | | | | | | V = | 9346 |
| $V_W$ | 3891 | | | | | | | | |
| VR | 0.416 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 0.8 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 2 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 0 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 9185 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 5652 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.625 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 6865 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | AM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-76 Westbound |
| Weaving Segment Location | W-3 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 50 |
| Weaving segment length, $L_S$ | 1570ft | Freeway maximum capacity, $C_{IFL}$ | 2300 |
| Freeway free-flow speed, FFS | 60 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 6300 | 0.92 | 11 | 0 | 1.5 | 1.2 | 0.948 | 1.00 | 7224 |
| $V_{RF}$ | 410 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 459 |
| $V_{FR}$ | 110 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 123 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 7224 | | | | | | | V = | 7806 |
| $V_W$ | 582 | | | | | | | | |
| VR | 0.075 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | 582 lc/h |
| Interchange density, ID | 0.8 int/mi | Weaving lane changes, $LC_W$ | 938 lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 1 lc/pc | Non-weaving lane changes, $LC_{NW}$ | 1569 lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 1 lc/pc | Total lane changes, $LC_{ALL}$ | 2507 lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | 907 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 7414 veh/h | Weaving intensity factor, W | 0.327 |
| Weaving segment capacity, $c_w$ | 8220 veh/h | Weaving segment speed, S | 47.1 mph |
| Weaving segment v/c ratio | 0.902 | Average weaving speed, $S_W$ | 57.5 mph |
| Weaving segment density, D | 41.4 pc/mi/ln | Average non-weaving speed, $S_{NW}$ | 46.4 mph |
| Level of Service, LOS | E | Maximum weaving length, $L_{MAX}$ | 3294 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | AM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | State Route 8 Northbound |
| Weaving Segment Location | W-4 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 2100ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 4390 | 0.92 | 5 | 0 | 1.5 | 1.2 | 0.976 | 1.00 | 4891 |
| $V_{RF}$ | 2670 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 2960 |
| $V_{FR}$ | 1210 | 0.92 | 2 | 0 | 1.5 | 1.2 | 0.990 | 1.00 | 1328 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 4891 | | | | | | | V = | 9179 |
| $V_W$ | 4288 | | | | | | | | |
| VR | 0.467 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 0.8 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 0 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 2 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 8990 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 5012 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.794 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 7445 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

PM PEAK HOUR

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | PM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-77 Southbound |
| Weaving Segment Location | W-1 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 1700ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 4950 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 5542 |
| $V_{RF}$ | 3210 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 3559 |
| $V_{FR}$ | 440 | 0.92 | 3 | 0 | 1.5 | 1.2 | 0.985 | 1.00 | 485 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 5542 | | | | | | | V = | 9586 |
| $V_W$ | 4044 | | | | | | | | |
| VR | 0.422 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 1.0 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 0 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 2 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 9348 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 5523 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.693 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 6928 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | PM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-77 Northbound |
| Weaving Segment Location | W-2 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 2570ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 3140 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 3481 |
| $V_{RF}$ | 500 | 0.92 | 2 | 0 | 1.5 | 1.2 | 0.990 | 1.00 | 549 |
| $V_{FR}$ | 2640 | 0.92 | 3 | 0 | 1.5 | 1.2 | 0.985 | 1.00 | 2913 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 3481 | | | | | | | V = | 6943 |
| $V_W$ | 3462 | | | | | | | | |
| VR | 0.499 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 0.8 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 2 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 0 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | 716 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 6827 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 4719 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.447 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 7810 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | PM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-76 Westbound |
| Weaving Segment Location | W-3 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 50 |
| Weaving segment length, $L_S$ | 1570ft | Freeway maximum capacity, $C_{IFL}$ | 2300 |
| Freeway free-flow speed, FFS | 60 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 3830 | 0.92 | 11 | 0 | 1.5 | 1.2 | 0.948 | 1.00 | 4392 |
| $V_{RF}$ | 550 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 616 |
| $V_{FR}$ | 110 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 123 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 4392 | | | | | | | V = | 5131 |
| $V_W$ | 739 | | | | | | | | |
| VR | 0.144 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | 739 lc/h |
| Interchange density, ID | 0.8 int/mi | Weaving lane changes, $LC_W$ | 1095 lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 1 lc/pc | Non-weaving lane changes, $LC_{NW}$ | 985 lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 1 lc/pc | Total lane changes, $LC_{ALL}$ | 2080 lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | 552 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 4881 veh/h | Weaving intensity factor, W | 0.282 |
| Weaving segment capacity, $c_w$ | 8023 veh/h | Weaving segment speed, S | 49.7 mph |
| Weaving segment v/c ratio | 0.608 | Average weaving speed, $S_W$ | 57.8 mph |
| Weaving segment density, D | 25.8 pc/mi/ln | Average non-weaving speed, $S_{NW}$ | 48.5 mph |
| Level of Service, LOS | C | Maximum weaving length, $L_{MAX}$ | 3972 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | PM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | State Route 8 Northbound |
| Weaving Segment Location | W-4 |
| Analysis Year | 2040 'No-Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 2100ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 3020 | 0.92 | 5 | 0 | 1.5 | 1.2 | 0.976 | 1.00 | 3365 |
| $V_{RF}$ | 2050 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 2273 |
| $V_{FR}$ | 620 | 0.92 | 2 | 0 | 1.5 | 1.2 | 0.990 | 1.00 | 681 |
| $V_{RR}$ | 0 | 0.92 | 0 | 0 | 1.5 | 1.2 | 1.000 | 1.00 | 0 |
| $V_{NW}$ | 3365 | | | | | | | V = | 6319 |
| $V_W$ | 2954 | | | | | | | | |
| VR | 0.467 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 0.8 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 0 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 2 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | 565 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 6185 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 5009 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.235 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 7449 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# DESIGN YEAR 2040 'BUILD' CONDITIONS

AM PEAK HOUR

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett M. Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | AM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-77 Southbound |
| Weaving Segment Location | W-1 |
| Analysis Year | 2040 'Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 1250ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 2770 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 3101 |
| $V_{RF}$ | 2370 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 2628 |
| $V_{FR}$ | 280 | 0.92 | 3 | 0 | 1.5 | 1.2 | 0.985 | 1.00 | 309 |
| $V_{RR}$ | 190 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 211 |
| $V_{NW}$ | 3312 | | | | | | | V = | 6249 |
| $V_W$ | 2937 | | | | | | | | |
| VR | 0.470 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 1.0 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 0 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 2 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | 414 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 6098 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 4958 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.230 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 7478 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

PM PEAK HOUR

# FREEWAY WEAVING WORKSHEET

## General Information

| | |
|---|---|
| Analyst | Brett M. Ferrell |
| Agency/Company | GPD Group |
| Date Performed | 06/01/16 |
| Analysis Time Period | PM Peak Hour |

## Site Information

| | |
|---|---|
| Freeway/Dir of Travel | I-77 Southbound |
| Weaving Segment Location | W-1 |
| Analysis Year | 2040 'Build' |

Project Description SUM-76-Central Interchange (PID 101402)

## Inputs

| | | | |
|---|---|---|---|
| Weaving configuration | One-Sided | Segment type | Freeway |
| Weaving number of lanes, N | 4 | Freeway minimum speed, $S_{MIN}$ | 45 |
| Weaving segment length, $L_S$ | 1250ft | Freeway maximum capacity, $C_{IFL}$ | 2250 |
| Freeway free-flow speed, FFS | 55 mph | Terrain type | Level |

## Conversions to pc/h Under Base Conditions

| | V (veh/h) | PHF | Truck (%) | RV (%) | $E_T$ | $E_R$ | $f_{HV}$ | $f_p$ | v (pc/h) |
|---|---|---|---|---|---|---|---|---|---|
| $V_{FF}$ | 4950 | 0.92 | 6 | 0 | 1.5 | 1.2 | 0.971 | 1.00 | 5542 |
| $V_{RF}$ | 3210 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 3559 |
| $V_{FR}$ | 440 | 0.92 | 3 | 0 | 1.5 | 1.2 | 0.985 | 1.00 | 485 |
| $V_{RR}$ | 160 | 0.92 | 4 | 0 | 1.5 | 1.2 | 0.980 | 1.00 | 177 |
| $V_{NW}$ | 5719 | | | | | | | V = | 9763 |
| $V_W$ | 4044 | | | | | | | | |
| VR | 0.414 | | | | | | | | |

## Configuration Characteristics

| | | | |
|---|---|---|---|
| Minimum maneuver lanes, $N_{WL}$ | 2 lc | Minimum weaving lane changes, $LC_{MIN}$ | lc/h |
| Interchange density, ID | 1.0 int/mi | Weaving lane changes, $LC_W$ | lc/h |
| Minimum RF lane changes, $LC_{RF}$ | 0 lc/pc | Non-weaving lane changes, $LC_{NW}$ | lc/h |
| Minimum FR lane changes, $LC_{FR}$ | 2 lc/pc | Total lane changes, $LC_{ALL}$ | lc/h |
| Minimum RR lane changes, $LC_{RR}$ | lc/pc | Non-weaving vehicle index, $I_{NW}$ | |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| | | | |
|---|---|---|---|
| Weaving segment flow rate, v | 9522 veh/h | Weaving intensity factor, W | |
| Weaving segment capacity, $c_w$ | 5625 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.693 | Average weaving speed, $S_W$ | mph |
| Weaving segment density, D | pc/mi/ln | Average non-weaving speed, $S_{NW}$ | mph |
| Level of Service, LOS | F | Maximum weaving length, $L_{MAX}$ | 6841 ft |

## Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

# APPENDIX F
# COST ESTIMATE

**Northeast Interchange Safety Improvement Project**

| ITEM | DESCRIPTION | TOTAL QUANTITY | UNIT | ESTIMATED PRICE | TOTAL COST |
|---|---|---|---|---|---|
| | **PAVEMENT** | | | | |
| | MAINLINE & RAMPS - LANES & SHOULDERS - ASPHALT | 14,423 | SY | $52 | $750,000 |
| | CONCRETE BARRIER | 2,400 | FT | $125 | $300,000 |
| | **PAVEMENT SUBTOTAL:** | | | | **$1,050,000** |
| | **ROADWAY** | | | | |
| | PAVEMENT REMOVAL | 14,434 | SY | $10 | $150,000 |
| | EARTHWORK | | | | |
| | EXCAVATION - SOIL | 37,474 | CY | $9 | $350,000 |
| | FILL - EMBANKMENT | 250,335 | CY | $10 | $2,500,000 |
| | **ROADWAY SUBTOTAL:** | | | | **$3,000,000** |
| | **DRAINAGE** | | | | |
| | 15% of Roadway and Pavement | 0.15 | LS | $4,050,000 | $610,000 |
| | **DRAINAGE SUBTOTAL:** | | | | **$610,000** |
| | **EROSION CONTROL** | | | | |
| | 5% of Roadway and Pavement | 0.05 | LS | $4,050,000 | $210,000 |
| | **EROSION CONTROL SUBTOTAL:** | | | | **$210,000** |
| | **UTILITIES** | | | | |
| | 5% of Roadway and Pavement | 0.05 | LS | $4,050,000 | $210,000 |
| | **UTILITIES SUBTOTAL:** | | | | **$210,000** |
| | **LIGHTING** | | | | |
| | PARTIAL INTERCHANGE | 0.25 | LS | $340,000 | $85,000 |
| | **MAINTENANCE OF TRAFFIC SUBTOTAL:** | | | | **$85,000** |
| | **TRAFFIC CONTROL** | | | | |
| | SIGNING (Urban Freeway) | 0.25 | MILE | $400,000 | $100,000 |
| | PAVEMENT MARKING (Multi-lane freeway) | 0.81 | MILE | $37,000 | $30,000 |
| | EDGE LINE | 2.38 | MILE | $6,000 | $15,000 |
| | **TRAFFIC CONTROL SUBTOTAL:** | | | | **$145,000** |
| | **STRUCTURES** | | | | |
| | BRIDGE REMOVAL | | | | |
| | STANDARD BRIDGE REMOVAL | 29,282 | SF | $25 | $730,000 |
| | COMPLEX BRIDGE REMOVAL | 21,484 | SF | $40 | $860,000 |
| | PROPOSED BRIDGE | | | | |
| | SIMPLE, SINGLE SPAN STRUCTURE | 7,530 | SF | $159 | $1,200,000 |
| | MULTI-SPAN > 4000 SQ FT | 70,291 | SF | $250 | $17,600,000 |
| | **STRUCTURES SUBTOTAL:** | | | | **$20,390,000** |

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| | **RETAINING WALLS** | | | | |
| | MSE RETAINING WALL | 7,895 | SF | $165 | $1,300,000 |
| | **RETAINING WALLS SUBTOTAL:** | | | | **$1,300,000** |
| | **MAINTENANCE OF TRAFFIC** | | | | |
| | 5% OF ABOVE ITEMS | 0.05 | LS | $27,000,000 | $1,350,000 |
| | WIRE FACED TEMPORARY MSE WALLS (FOR PART-WIDTH) | 18,300 | SF | $30 | $550,000 |
| | **MAINTENANCE OF TRAFFIC SUBTOTAL:** | | | | **$1,900,000** |
| | **MISCELLANEOUS** | | | | |
| 623 | CONSTRUCTION LAYOUT STAKES (0.5% OF ABOVE ITEMS) | 0.005 | LS | $28,900,000 | $145,000 |
| 624 | MOBILIZAITON (PER 2013 CMS) | 1 | LS | $800,000 | $800,000 |
| | PERFORMANCE BOND (0.5% OF ABOVE ITEMS) | 0.005 | LS | $28,900,000 | $145,000 |
| 619 | FIELD OFFICE | 18 | MO | $3,000 | $54,000 |
| | **MISCELLANEOUS SUBTOTAL:** | | | | **$1,144,000** |
| | **RIGHT OF WAY** | | | | |
| | TOTAL RIGHT-OF-WAY COST | 1 | LS | $1,000,000 | $1,000,000 |
| | **RIGHT OF WAY SUBTOTAL:** | | | | **$1,000,000** |
| | **TOTAL CONSTRUCTION AND RIGHT OF WAY COST:** | | | | **$31,044,000** |
| | **DESIGN ENGINEERING COST:** | (16.1% OF CONSTR. & R/W COST) | | | **$5,000,000** |
| | **GEOTECHNICAL ENGINEERING COST:** | (2.4% OF CONSTR. & R/W COST) | | | **$750,000** |
| | **ENVIRONMENTAL COST:** | (2.4% OF CONSTR. & R/W COST) | | | **$750,000** |
| | **SUBSURFACE UTILITY ENGINEERING (SUE):** | (1.6% OF CONSTR. & R/W COST) | | | **$500,000** |
| | **DESIGN CONTINGENCY COSTS** | (25.1% OF CONSTR. & R/W COST) | | | **$7,800,000** |
| | | | **PROJECT SUBTOTAL:** | | **$45,844,000** |
| | | **15.6% INFLATION CONTINGENCY:** | | | **$7,156,000** |
| | | | | **TOTAL:** | **$53,000,000** |