Improved Interchange at I-71 and Routes 36/37 and Proposed Sunbury Parkway

Interchange Modification Study

DEL-71-7.91, PID 90200
Delaware County, Ohio

August 28, 2017

ms consultants, inc.
engineers, architects, planners

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by ODOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 11, 2015, and executed by FHWA and ODOT.

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EXECUTIVE SUMMARY

The I-71 and US 36/SR 37 interchange, located in Delaware County, Ohio, currently experiences congestion due to inadequate ramp and arterial capacity. I-71 northbound exit ramp traffic routinely backs-up onto the mainline of I-71 during the afternoon peak travel hour. This congestion is due to the high volumes of passenger car and truck traffic at the interchange and congestion along US 36/SR 37 resulting from the numerous driveways both east and west of I-71. As the only I-71 interchange for 10 miles in either direction, the US 36/SR37 interchange is a critical transportation link for rapidly growing Delaware County. Delaware County has been the fastest growing county in Ohio for over a decade. This growth trend is expected to continue, in particular, in the City of Delaware and Village of Sunbury. This expected growth along with anticipated increases in nationwide freight travel will create more traffic demand on all major routes in Delaware County, but in particular for the already congested I-71 and US 36/SR 37 interchange and along US 36/SR 37 east and west of I-71.

A number of existing conditions, as identified in the Purpose and Need Document, contribute to the inability of the interchange to operate safely and efficiently, including the following:

- Traffic volumes, including high truck volumes, exceed ramp capacities in peak hours
- Congestion along US 36/SR 37 east and west of the I-71 interchange
- Growth and development of the land surrounding the I-71 & US 36/SR 37 interchange

Multiple short-term improvements have been implemented at this interchange, including additional exit ramp lanes and access management. New public roadways have been committed for the area - such as a southern extension of Wilson Road and a new two-lane east-west arterial (Sunbury Parkway) east of the Wilson Road extension in 2019. However, these completed and committed improvements will not solve the long-term problems that the interchange faces. The existing interchange will not support the growth anticipated for Delaware County and additional development currently occurring in the area around the interchange.

Build alternatives were developed and evaluated against the No-Build alternative. A recommended Build alternative was selected for the freeway system and the arterial network, based on criteria including safety, operational efficiency, cost, environmental factors, east-west connectivity, compatibility with existing development, and compatibility with proposed area development. The operational efficiency goal for this project is to obtain level-of-service (LOS) D or better for all freeway, ramp, and intersection components in the Design Year (2038). Both costs and effects to environmental resources are to be minimized. East-west connectivity is to be improved, while providing a road network that best facilitates planned development.

The recommended Build condition concept calls for new ramp connections south of US 36/SR 37, with the new ramps integrated with the existing interchange. The new ramps would connect with Sunbury Parkway, a new east-west arterial route that will relieve congestion on existing US 36/SR 37. This concept meets all four of the primary evaluation criteria - protecting I-71 capacity, improving arterial operations, accommodating existing development, and supporting proposed development.

The Build alternative is summarized as follows:

- Construction of a northbound collector-distributor (CD) system serving Sunbury Parkway and US 36/SR 37
  - A two-lane northbound CD-road will exit from I-71 and serve both Sunbury Parkway and US 36/SR 37
  - A two-lane exit ramp will depart from the CD-road and connect to Sunbury Parkway
  - A single lane CD-road will continue north under Sunbury Parkway toward US 36/SR 37
  - The northbound entrance ramp from Sunbury Parkway will connect to the CD-road. Traffic from Sunbury Parkway bound for I-71 northbound will have to pass through the existing signal at the US 36/SR 37 northbound ramp terminal.
- Construction of new ramp connections from Sunbury Parkway to I-71 southbound
  - A single-lane loop ramp will connect westbound Sunbury Parkway to I-71 southbound
  - A two-lane ramp will connect eastbound Sunbury Parkway to I-71 southbound. This ramp will be narrowed to a single lane prior to reaching I-71
  - No CD-road is proposed in the southbound direction. Both new entrance ramps will merge onto I-71.
  - No changes to the I-71 southbound ramps at US 36/SR 37.
- Construction of Sunbury Parkway west of Wilson Road
  - This roadway section will generally have a six-lane section between Africa Road and Wilson Road
  - A multi-use path and a sidewalk will be included in this roadway section
- Widening of the committed future Sunbury Parkway from two lanes to five lanes east of Wilson Road, including construction of a multi-use path and sidewalk
- Realignment of 3B's & K Road south of Sunbury Parkway to create a 90-degree intersection
  - Cul-de-sacs will be constructed on the existing 3B's & K Road where it meets the new Sunbury Parkway
- Realignment of Africa Road and US 36/SR 37 to create a 4-leg intersection with the new Sunbury Parkway

The phasing plan that shows the proposed construction dates for all the phases of the project is shown on **Figure 1**. With the above recommended improvements (the Build condition), nearly all freeway segments, weaving segments, ramps, ramp junctions, and intersections are predicted to operate at LOS D or better through the Design Year. A small number of locations are expected to operate at LOS E in the Design Year, but operations of all these locations will be improved by the Build condition. Despite the proximity of the proposed Build condition ramps to existing ramps at US 36/SR 37, the improvements will not degrade any freeways or ramps adjacent to the interchange. The recommended Build condition will improve not only capacity and safety, but will also provide east-west connectivity and facilitate planned and future development. The Build condition will result in safe and efficient operation of the road network in this area, meeting the long-term transportation needs of Delaware County. In Phase A, trailblazer signs will be installed to redirect vehicles on Sunbury Parkway wishing to access I-71 northbound to use Wilson Road and US 36/SR 37. These can be removed after the Sunbury Parkway entrance ramp to I-71 northbound is constructed in Phase B.

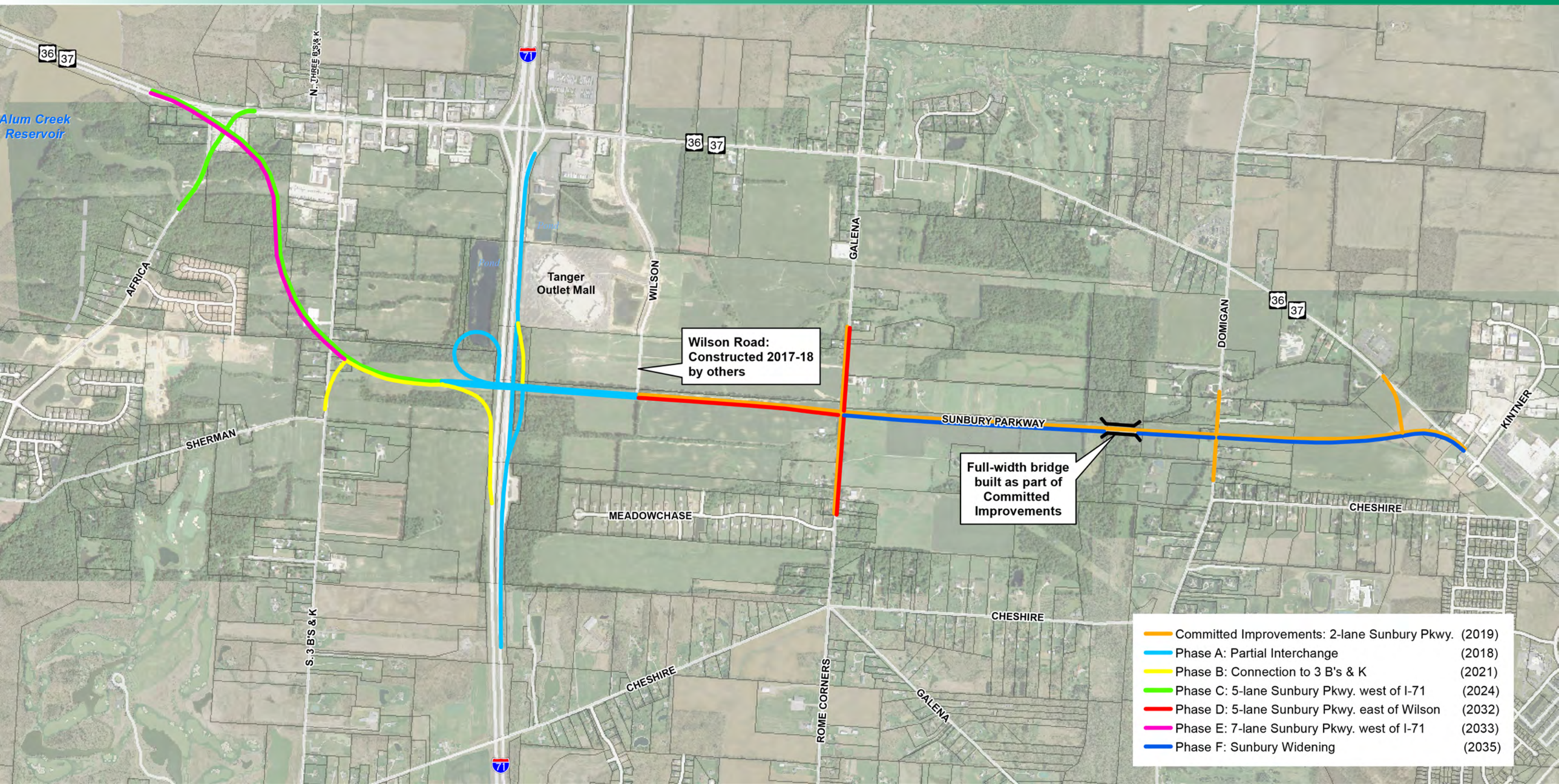

FIGURE 1
Phasing Map of Recommended Improvements at I-71/US 36/SR 37 and Proposed Sunbury Parkway

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BACKGROUND

The I-71 and US 36/SR 37 interchange is located in the central part of Delaware County, Ohio. The Ohio Department of Transportation (ODOT) has undertaken a study of this interchange, DEL-71-7.91, PID 90200, in order to address the issues of high traffic volumes, congestion, and safety concerns. This document serves as a request to modify the existing I-71 & US 36/SR 37 interchange configuration in order to provide increased capacity and safety.

Interstate Route 71 is a north-south freeway that connects Columbus to Cleveland to the north and Cincinnati to the south. US 36/SR 37 is an east-west arterial through central Ohio that connects the City of Delaware and points west with I-71 and the Village of Sunbury and points east. These roadways are used by regional commuter traffic as well as through auto and truck traffic. US 36/SR 37 is classified as a principal arterial throughout the study area.

The I-71 and US 36/SR 37 interchange is located within the planning area of the Mid-Ohio Regional Planning Commission (MORPC), which serves the Columbus and central Ohio region. A location map of the interchange is shown on **Figure 2.** Both I-71 and US 36/SR 37 are routes on the National Highway System (NHS). Addressing the congestion and safety issues on the NHS is a high priority for both ODOT and the Federal Highway Administration.

The I-71 and US 36/SR 37 interchange has been under study for over a decade. In 2010, an Interchange Modification Study was prepared for short-term safety improvements recommended in 2003 and 2007 safety studies, and these improvements were implemented in 2013. In 2016, a second lane was added to the exit ramp from I-71 northbound to US 36/SR 37 due to a new outlet mall at the interchange. This project provided safety and operational benefits, but long-term improvements are needed to meet operational and safety goals as traffic growth continues. In 2012, a Feasibility Study was prepared to evaluate concepts for long-term improvements. The Feasibility Study recommended new ramp connections south of US 36/SR 37 and a new east-west arterial to relieve congestion from US 36/SR 37. In 2014, the Part 2 of the Feasibility Study evaluated configurations for the proposed new ramps. The September 8, 2016 Alternatives Evaluation Report evaluated alignments for the recommended new arterial east-west arterial roadway and determined a preferred alternative to improve the I-71 & US 36/SR 37 interchange.

The need for improvements at this location has support of local agencies in the region, including Delaware County, the Village of Sunbury, the Village of Galena, and two local school districts. These agencies provided letters of support for ODOT funding of such improvements. These support letters can be found in **Appendix A**.

PURPOSE AND NEED

Delaware County has been the fastest growing county in Ohio for over a decade. This growth trend is expected to continue, in particular in the City of Delaware and Village of Sunbury. Examples of continued growth just beyond the project area include the large retail center on US 36/SR 37 on the east side of the City of Delaware, residential subdivisions along Africa Road, and residential development built on the former Sunbury Golf Course site. This expected growth, along with anticipated increases in nationwide freight travel, will create more traffic demand on all major routes in Delaware County, but in particular for the already congested I-71 and US 36/SR 37 interchange and along US 36/SR 37 east and west of I-71.

Over time, many businesses have located along the US 36/SR 37 corridor, and given its proximity to the state capital and to nearby distribution and industrial centers in Delaware County, it has become a busy truck route. Today, over 32,000 vehicles a day access the interchange to enter or exit I-71. Queuing on the exit ramps routinely extends onto the freeway mainline, causing operational and safety concerns. Stopped traffic on I-71 northbound during the afternoon peak hour is a near-daily occurrence as vehicles wait to exit onto US 36/SR 37. A recent safety improvement project completed in 2013 provided some short-term relief to congestion at the interchange. Unfortunately, the steady increase in area traffic is rapidly diminishing the short-term benefits of the project. The existing number of lanes on US 36/SR 37 cannot adequately handle the large volume of traffic, a situation aggravated by the high percentage of trucks using the interchange. The most recent Ohio Department of Transportation (ODOT) daily count data shows that an average of 19% of traffic using the US 36/SR 37 ramps at I-71 is trucks. While some of this truck volume is due to the presence of highway-oriented land uses such as truck stops, most of the truck traffic is through trucks. I-71 northbound approaching the US 36/SR 37 interchange is listed as #11 on ODOT's 2015 Highway Safety Improvement Program (HSIP) Priority List for rural interstates. US 36/SR 37 at the I-71 interchange is listed as #1 on ODOT's 2015 HSIP Priority List for rural non-freeway segments.

Purpose Statement

The purpose of this project is to:

- Reduce congestion and improve the operation of US 36/SR 37 through the interchange while maintaining acceptable level-of-service on I-71
- Improve safety at the interchange by eliminating queuing on I-71
- Support future growth in Delaware County as intended by current land use and economic development plans
- Improve east-west connectivity across Delaware County for commuters and freight

Need Elements

The I-71 and US 36/SR 37 interchange is unable to support the growing transportation demands of the region. A number of existing conditions contribute to the inability of the interchange to operate safely and efficiently, including the following:

- Traffic volumes exceed ramp capacities in peak hours, including high truck volumes
- Congestion along US 36/SR 37 near the I-71 interchange
- Potential growth and economic development of the surrounding land

The interchange and surrounding roadway network is ranked on the ODOT HSIP Priority Locations list, High Risk Rural Roads list, and Congestion Priority Location list.

Figure 2
Project Area

STUDY AREA

The existing I-71 and US 36/SR 37 interchange is located in Delaware County between the City of Delaware on the west and the Village of Sunbury on the east. The study area for the project includes I-71 from the SR 750/Polaris Parkway/Gemini Place interchange (Exit 121) to the SR 61 interchange (Exit 140). Both of these interchanges are approximately 10 miles away from the US 36/SR 37 interchange. Along US 36/SR 37, the study area extends from Africa Road to a point approximately ¼ mile west of Kintner Parkway in the Village of Sunbury.

The proposed interchange modification will include additional ramps south of the existing US 36/SR 37 interchange for access to a proposed new arterial - Sunbury Parkway. The study area extends along the proposed Sunbury Parkway from the US 36/SR 37/Africa Road intersection to a point approximately ¼ mile west of Kintner Parkway on the west side of Sunbury. This study area crosses Africa Road, 3B's & K Road, I-71, Wilson Road, South Galena Road, and Domigan Road. Portions of these roadways are included in the study area. The following intersections are included in the study area:

- US 36/SR 37 & Africa Road/Sunbury Parkway
- US 36/SR 37 & N 3 B's and K Road
- US 36/SR 37 & S 3 B's and K Road
- US 36/SR 37 & Fourwinds Drive
- US 36/SR 37 & McDonald's/Bob Evans
- US 36/SR 37 & Wilson Road
- US 36/SR 37 & Galena Road
- US 36/SR 37 & Domigan Road/Carter's Corner Road
- US 36/SR 37 & Sunbury Parkway
- Sunbury Parkway & Fourwinds Drive
- Sunbury Parkway & I-71 northbound ramps
- Sunbury Parkway & Wilson Road
- Sunbury Parkway & Galena Road
- Sunbury Parkway & Domigan Road

The study area encompasses portions of Berlin Township, Berkshire Township, and the Village of Sunbury. A map of the study area can be found in Figure 2.

EXISTING CONDITIONS

Road Geometry & Access Locations

The existing I-71/US 36/SR 37 interchange is a diamond configuration. I-71 has three lanes in each direction and a speed limit of 70 mph throughout most of the study area. The portion of I-71 south of the Polaris Parkway/Gemini Parkway interchange has a 65 mph speed limit.

US 36/SR 37 has two lanes in each direction west of Wilson Road, with left turn lanes (or two-way left turn lane) provided at all intersections. Between Fourwinds Drive and Wilson Road, left turns to/from driveways are prohibited by traffic pylons. East of Wilson Road, US 36/SR 37 has a single lane in each direction with no turn lanes at intersections. US 36/SR 37 has a speed limit of 35 mph surrounding the I-71 interchange. The speed limit of US 36/SR 37 west of 3B's & K Road is 60 miles per hour, while the speed limit east of Wilson Road is 55 miles per hour. US 36/SR 37 is classified as a principal arterial.

There are no known geometric deficiencies in the study area. US 36/SR 37 does not have any significant horizontal or vertical curves in this area. The existing roadway, intersection, or ramp geometry is not a major factor in the crash patterns in this area. Inadequate capacity and frequent congestion are the primary factors contributing to the rear-end crashes in the study area.

Six of the intersections along US 36/SR 37 are currently signalized: Fourwinds Drive, Bob Evans/McDonald's drive, I-71 Northbound ramps, I-71 Southbound ramps, Wilson Road, and Galena Road. All other intersections operate with minor street stop control conditions.

Physical Conditions – Terrain

The study area has relatively flat terrain, with some small hills near watercourses. Much of the area has been cleared for agriculture or development, but some wooded areas still remain. The terrain has little or no impact in the design or operations of the existing roadways.

Crash Data

The I-71/US 36/SR 37 interchange and surrounding roadway network have been ranked in the most recent (2015) Highway Safety Improvement Program (HSIP) Priority list and most-recent (2014) Congestion Priority list. **Table 7** summarizes the locations ranked in the top 200 statewide.

Table 1: Summary of 2015 HSIP and 2014 Congestion Priority Listings

Rank	Location	Milepost
2015 Highway Safety Improvement Program Priority List - Rural Freeway		
#11	I-71 south of US 36/SR 37	9.00-9.10
#12	I-71/US 36/SR 37 interchange	9.67
#13	I-71 north of US 36/SR 37	10.07-10.17
#17	I-71 north of US 36/SR 37	9.87-9.97
#23	I-71 south of US 36/SR 37	9.57-9.67
2015 Highway Safety Improvement Program Priority List - Rural Non-Freeway		
#1	US 36/SR 37 west of I-71	17.81-17.91
#2	US 36/SR 37 west of I-71	17.76-17.86
#13	US 36/SR 37 east of I-71	18.06-18.16
#17	US 36/SR 37 east of I-71	18.27-18.35
#44	US 36/SR 37 west of I-71	17.66-17.76
#62	US 36/SR 37 east of I-71	18.48-18.58
#78	US 36/SR 37 between I-71 ramps	17.91-17.95
#170	US 36/SR 37 west of I-71	17.46-17.56
2015 Highway Safety Improvement Program Priority List - Rural Intersection		
#5	US 36/SR 37/Galena Road	18.95
#107	US 36/SR 37/Africa Road	17.07
2014 Congestion Priority		
#164	US 36/SR 37 between I-71 ramps	17.95-18.06

Preliminary crash analysis shows that a total of 432 crashes occurred in the study area between 2013 and 2015. This includes 324 crashes on US 36/SR 37 and 128 crashes on I-71. A detailed breakdown of these crashes can be found in **Appendix B**. Rear-end collisions were the most frequent crash type, representing nearly 40% of arterial crashes and 32% of freeway/ramp crashes. The majority (56%) of I-71 crashes occurred in the northbound direction. The largest concentration of freeway crashes occurred on I-71 northbound, about ½ mile south of US 36/SR 37. Inadequate capacity and frequent congestion are the primary factors contributing to the rear-end crashes throughout the study

area. I-71 and US 36/SR 37 do not have any significant horizontal or vertical curves in this area. The existing roadway, intersection, or ramp geometry is not a major factor in the predominant crash patterns.

Due to identified safety issues at the US 36/SR 37/Galena Road intersection, ODOT is pursuing turn lane additions on US 36/SR 37 (PID 104502). These are currently programmed to be constructed in 2020.

Demographics

The municipalities and townships surrounding the I-71 & US 36/SR 37 interchange have all experienced population growth from 2000-2015 and are expected to grow in population through year 2030 by as much as 70.2%. The townships surrounding the I-71 and US 36/SR 37 interchange include Berkshire, Berlin, Kingston and Brown townships. This interchange also serves the City of Delaware and the Village of Sunbury. **Table 2** provides the Delaware County Regional Planning Commission (DCRPC) anticipated growth rates for these locations.

Table 2: Population Growth for Area Townships/Municipalities

	Census Data		*Estimated*	*Projected*			*Growth Rate*	
Townships/ Municipalities	*2000*	*2010*	*2016*	*2020*	*2025*	*2030*	*2000-2016*	*2016-2030*
Berkshire Twp.	1,946	2,428	3,124	3,728	4,426	5,317	60.5%	70.2%
Berlin Twp.	3,313	6,496	7,234	7,541	8,192	9,023	118.4%	24.7%
Brown Twp.	1,290	1,416	1,480	1,518	1,575	1,649	14.7%	11.4%
Kingston Twp.	1,603	2,156	2,255	2,333	2,441	2,579	40.7%	14.3%
Delaware City	25,243	34,753	38,497	40,921	43,671	46,037	52.5%	19.5%
Sunbury Village	2,630	4,389	5,085	5,516	6,051	6,512	93.3%	28.1%
Delaware County	**109,989**	**174,214**	**199,302**	**214,344**	**232,639**	**248,235**	**81.2%**	**24.6%**

Source: Delaware Regional Planning Commission (DCRPC)

In addition to population growth, there is potential for continued commercial, industrial and residential growth in the region, particularly at the I-71 and US 36/SR 37 interchange. Interest in developing the area around the I-71 and US 36/SR 37 interchange has been constant over the past decade. As development continues to progress and planned developments are constructed, the traffic demand in the area will increase, further degrading the performance of the interchange and the US 36/SR 37 corridor. An improved interchange and east-west connectivity will be critical in the developing areas of the region.

Land use

The project area is mostly active agricultural fields, but it also includes some undeveloped wooded areas, single family homes, and existing commercial sites including numerous highway-oriented businesses such as fast-food restaurants, gas stations, and truck stops. However, interest in additional development of the area around the I-71 and US 36/SR 37 interchange has been constant over the past decade and is occurring regardless of any proposed transportation improvements. A Simon-Tanger outlet mall has recently opened in the southeast quadrant of the interchange and plans are moving forward for additional retail and an auto mall directly south of the outlet mall.

As shown in **Table 3**, the land use study area surrounding the I-71 and US 36/SR 37 interchange has a growth potential of over 500 acres of gross commercial and industrial acreage.

Table 3: Commercial and Industrial Land Use of the Interchange Impact Area

Land Usage	Acreage
Existing Zoned Commercial	825 acres
Potential Commercial Land based on Comprehensive Plan	1,231 acres
Existing Zoned Industrial	20 acres
Future Industrial Land based on Comprehensive Plan	147 acres
Total Gross (Commercial + Industrial) Build-Out Acreage	**1,378 acres**

Source: Delaware County Regional Planning Commission (DCRPC)

Environmental Conditions

Alum Creek State Park is located in the western part of the study area, mostly west of Africa Road. Twin-span bridges carry US 36/SR 37 over the Alum Creek Reservoir approximately 1 mile west of I-71. Little Walnut Creek runs north-south through the study area, approximately 1 mile east of I-71. Numerous other small watercourses are located within the study area. Further details can be found in the Environmental Overview section of this document.

ALTERNATIVES CONSIDERED

The I-71/US 36/SR 37 interchange has been under study for over a decade. In 2012 and 2014, ODOT completed Feasibility Studies to determine the best course of action moving forward. The 2012 Feasibility Study determined that new ramps to the south of the existing interchange and a new east-west arterial alignment into Sunbury would address the regional traffic needs of the study area. The 2014 study further refined this preliminary alternative. The alternatives in the 2014 Feasibility Study are summarized below.

- *Alternative 1: No-Build*
- *Alternative 2: Single Interchange*
  New interchange south of US 36/SR 37, with existing US 36/SR 37 ramps removed
- *Alternative 3: Combined Interchange – Parclo B*
  New Parclo-B interchange south of US 36/SR 37, with new ramps integrated into the existing interchange
- *Alternative 4: Combined Interchange – Parclo A*
  New Parclo-A interchange south of US 36/SR 37, with new ramps integrated into the existing interchange

Alternative 4 was recommended as the best alternative for the interchange. This concept met all four of the primary evaluation criteria - protecting I-71 capacity, improving arterial operations, accommodating existing development, and supporting proposed development – while having a lower construction cost than Alternative 3. Alternative 1 and Alternative 2 were dismissed due to poor traffic operations.

The recommended Alternative 4 would construct ramps to/from I-71 at a new arterial, Sunbury Parkway, which would connect to US 36/SR 37 near Africa Road.

In the *Improved Interchange at I-71 and Routes 36/37 and Proposed Sunbury Parkway Alternatives Evaluation Report*, (AER) dated September 8, 2016, three Build alternatives were analyzed for the alignment of Sunbury Parkway west of I-71. Each of the three alternatives – the “Green Alternative”, “Purple Alternative” and the “Blue Alternative” - had the same number of lanes, lane assignments and traffic volumes. The “Blue Alternative”, which had the southernmost

alignment, was rejected due to having the greatest cost and greatest impacts on environmental resources. The "Purple Alignment", which provided a more diagonal connection was dismissed due to its inconsistency with local development plans. The AER recommended the "Green Alternative", which was the middle alignment compared to the other alternatives. The "Green Alternative" from the AER is the Build condition analyzed in this IMS document.

The recommended Build alternative does not provide a direct connection from I-71 southbound to Sunbury Parkway. Southbound I-71 Traffic wishing to make this movement will exit at US 36/SR 37 and use Wilson Road to access Sunbury Parkway. A direct southbound exit ramp to Sunbury Parkway was not included in the Build condition, as the connection would have minimal vehicular demand, result in increased delays, create additional conflict points – including a freeway weaving section, and have a higher frequency of predicted crashes than the recommended Build condition. **Appendix C** provides further documentation of why the southbound exit ramp to Sunbury Parkway was not included in the Build condition.

No-Build Condition

The No-Build condition for the study area is represented in **Figure 3**. The No-Build condition includes the existing roadway network plus committed roadway projects (E+C network). The existing roadway network includes the following projects that were completed in June 2016:

- Modifications to the I-71 northbound exit ramp to US 36/SR 37. The exit has been modified to provide two deceleration lanes departing from I-71 northbound. The first deceleration lane is 2,600', followed by a 1,600' deceleration lane. These deceleration lanes have been added on I-71 to provide additional capacity and keep queued ramp traffic from blocking mainline through lanes. The plan sheets depicting this upgrade can be found in **Appendix D**.
- Wilson Road has been extended south of US 36/SR 37 by approximately 3,000 feet, in conjunction with the construction of an outlet mall. Wilson Road has two lanes in each direction. The US 36/SR 37/Wilson Road intersection configuration plan sheets can be found in Appendix D.

Committed projects that are included as part of the No-Build condition consist of:

- Extension of Wilson Road south from its current terminus at the outlet mall to the future Sunbury Parkway. Two lanes will be provided in each direction. A Traffic Impact Study (*Northgate Phase I TIS*, April 20, 2016) has been approved by the Delaware County Engineer's Office and the Village of Sunbury for development served by this extension of Wilson Road. This committed project is shown on the Village of Sunbury's Comprehensive Plan adopted by Village of Sunbury Council on November 2, 2016. This project is planned for construction by developers by 2018.
- The eastern portion of a new arterial roadway, Sunbury Parkway, will be built from the future Wilson Road extension to US 36/SR 37 in the Village of Sunbury. This committed roadway is listed on the Village of Sunbury's Comprehensive Plan adopted by Village of Sunbury Council on November 2, 2016. The project is planned to be placed on the MORPC 2018-2021 Transportation Improvement Plan (TIP) for construction by the Village of Sunbury New Community Authority 1 (NCA1), by 2019. In the No-Build condition, Sunbury Parkway will have two travel lanes (one in each direction), with left turn lanes at the intersections with South Galena Road, Domigan Road, and US 36/SR 37. Because it was anticipated that a five-lane corridor will be necessary to meet future traffic needs of development expansion, right-of-way, grading, and construction limits along Sunbury Parkway for the ultimate (5-lane) configuration will be built with the committed project. All structures, including the bridge over Little Walnut Creek, will be built wide enough for additional travel lanes. The committed improvements can be found in **Appendix E**.

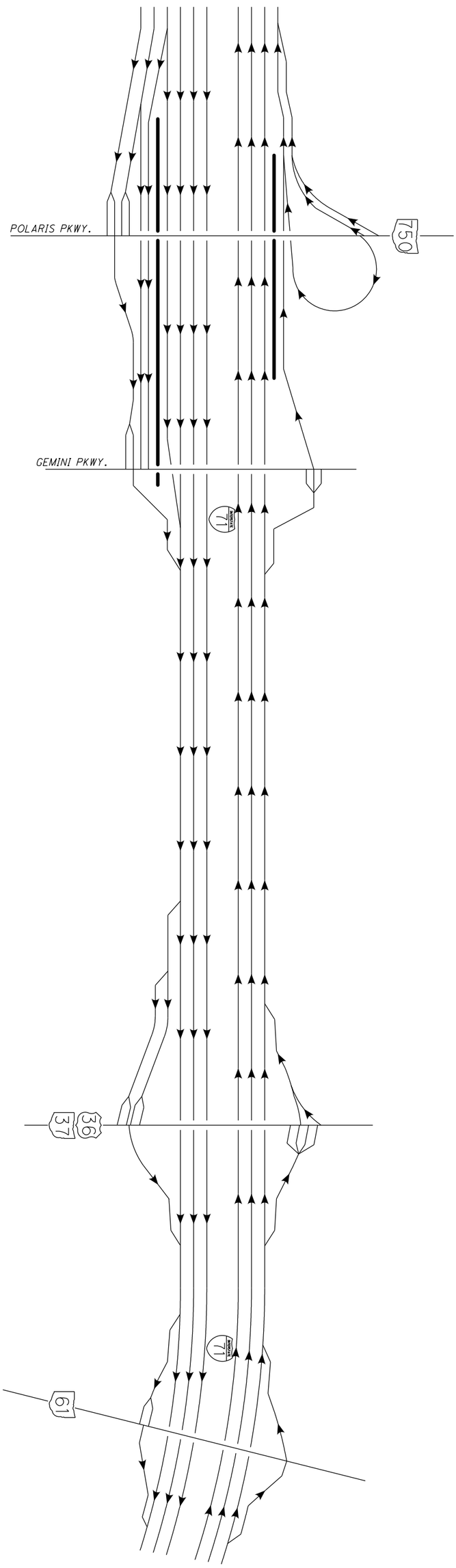
Figure 3 shows the No-Build configuration for the freeway system. A graphic of the No-Build (existing plus committed) arterial network and lane configuration is provided on **Figure 4**.

Build Condition

The Build condition will extend Sunbury Parkway to the west from Wilson Road to meet US 36/SR 37 at the Africa Road intersection. The Build condition will also include ramps at Sunbury Parkway, along with a combined northbound collector-distributor (CD) road for Sunbury Parkway and US 36/SR 37. The following summarizes the Build condition improvements:

- Northbound collector-distributor (CD) system serving both Sunbury Parkway and US 36/SR 37
  - A two-lane northbound CD-road will exit from I-71 and serve both Sunbury Parkway and US 36/SR 37
  - A single-lane exit ramp will depart from the CD-road and connect to Sunbury Parkway
  - A single lane CD-road will continue north under Sunbury Parkway toward US 36/SR 37
  - The northbound entrance ramp from Sunbury Parkway will connect to the CD-road. Traffic from Sunbury Parkway bound for I-71 northbound will have to pass through the existing signal at the US 36/SR 37 northbound ramp terminal.
- New ramp connections from Sunbury Parkway to I-71 southbound
  - A single-lane loop ramp will connect westbound Sunbury Parkway to I-71 southbound
  - A two-lane ramp will connect eastbound Sunbury Parkway to I-71 southbound. This ramp will be narrowed to a single lane prior to reaching I-71
  - No CD-road is proposed in the southbound direction. Both new entrance ramps will merge onto I-71.
  - No changes to the I-71 southbound ramps at US 36/SR 37.
- Construction of Sunbury Parkway west of Wilson Road
  - This roadway section will generally have a six-lane section between Africa Road and Wilson Road
  - A multi-use path and a sidewalk will be included in this roadway section
- Widening of the committed future Sunbury Parkway from two lanes to five lanes east of Wilson Road
- Realignment of 3B's & K Road south of Sunbury Parkway to create a 90-degree intersection
  - Cul-de-sacs will be constructed on the existing 3B's & K Road where it meets the new Sunbury Parkway
- Realignment of Africa Road and US 36/SR 37 to create a 4-leg intersection with the new Sunbury Parkway

Figure 5 shows the Build condition of the freeway system. The Build condition of the arterial network is shown in **Figure 6**. A more detailed layout of the Build condition ramps along I-71 is shown on **Figure 7**. A more detailed layout of the Build condition along Sunbury Parkway is shown on **Figure 8**. A scroll plot and conceptual guide signing plan of the proposed Build condition is provided in **Appendix F**.



NOT TO SCALE

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FIGURE 3

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
NO-BUILD CONDITION - FREEWAY SYSTEM

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Ohio DOT Workspace
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File: \\0330share\n\62\10550\traffic\sheets\MS\No-Build_Arterial_Lanes.dgn

View: FENCE_VIEW1
By: jhowdyshell

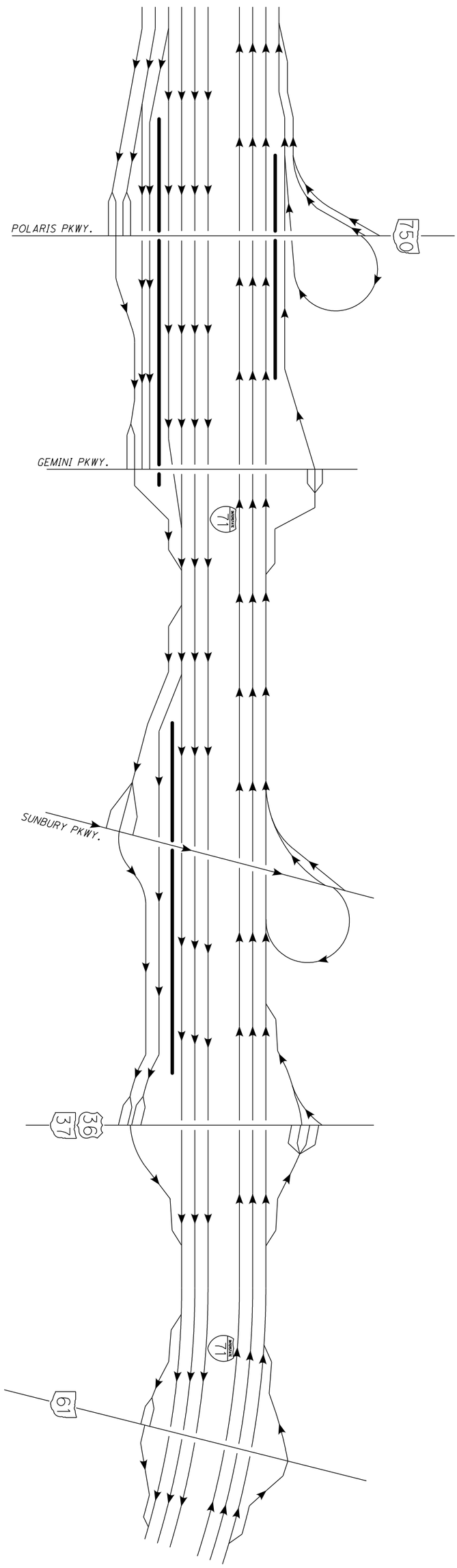
34" x 22"

NOT TO SCALE

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
NO-BUILD CONDITION - ARTERIAL NETWORK

FIGURE 4

ms consultants, inc.



NOT TO SCALE

ms consultants, inc.

FIGURE 5

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
BUILD CONDITION - FREEWAY SYSTEM

N

34" x 22"
Model: Sheet
Printed: 5/4/2017 @ 12:15:41 PM
File: \\0330share\n\62\10550\traffic\sheets\IMS\Build_Arterial_Lanes.dgn
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By: jhowdyshell
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UCF: ohdotV8i
PCF: 62-10550_Columbus_(No_AScale) Northgate Centre
Ohio DOT Workspace
0 1" 0.5"
ms consultants, inc.
msconsultants.com
PLOT.CEL
www.msconsultants.com

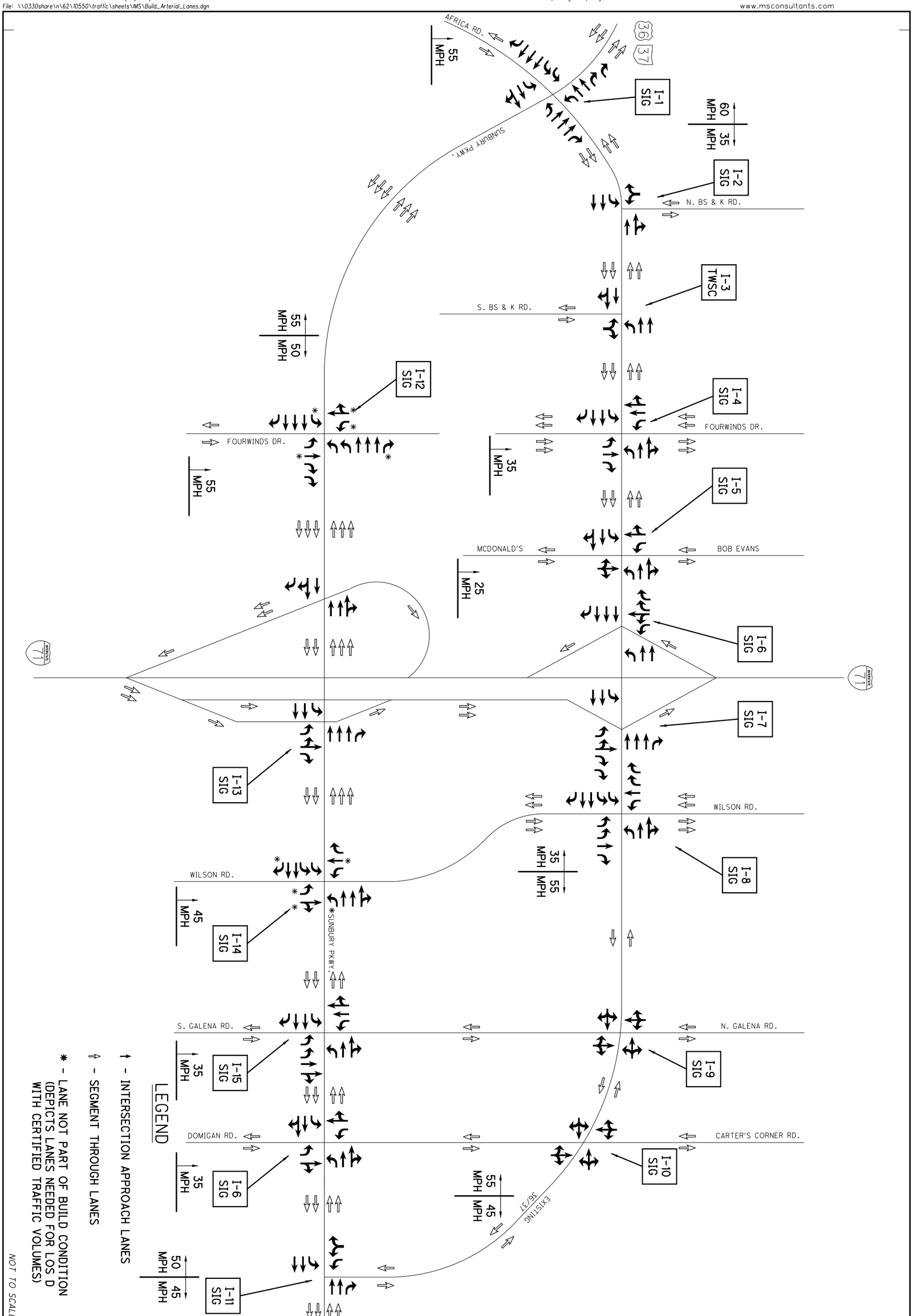
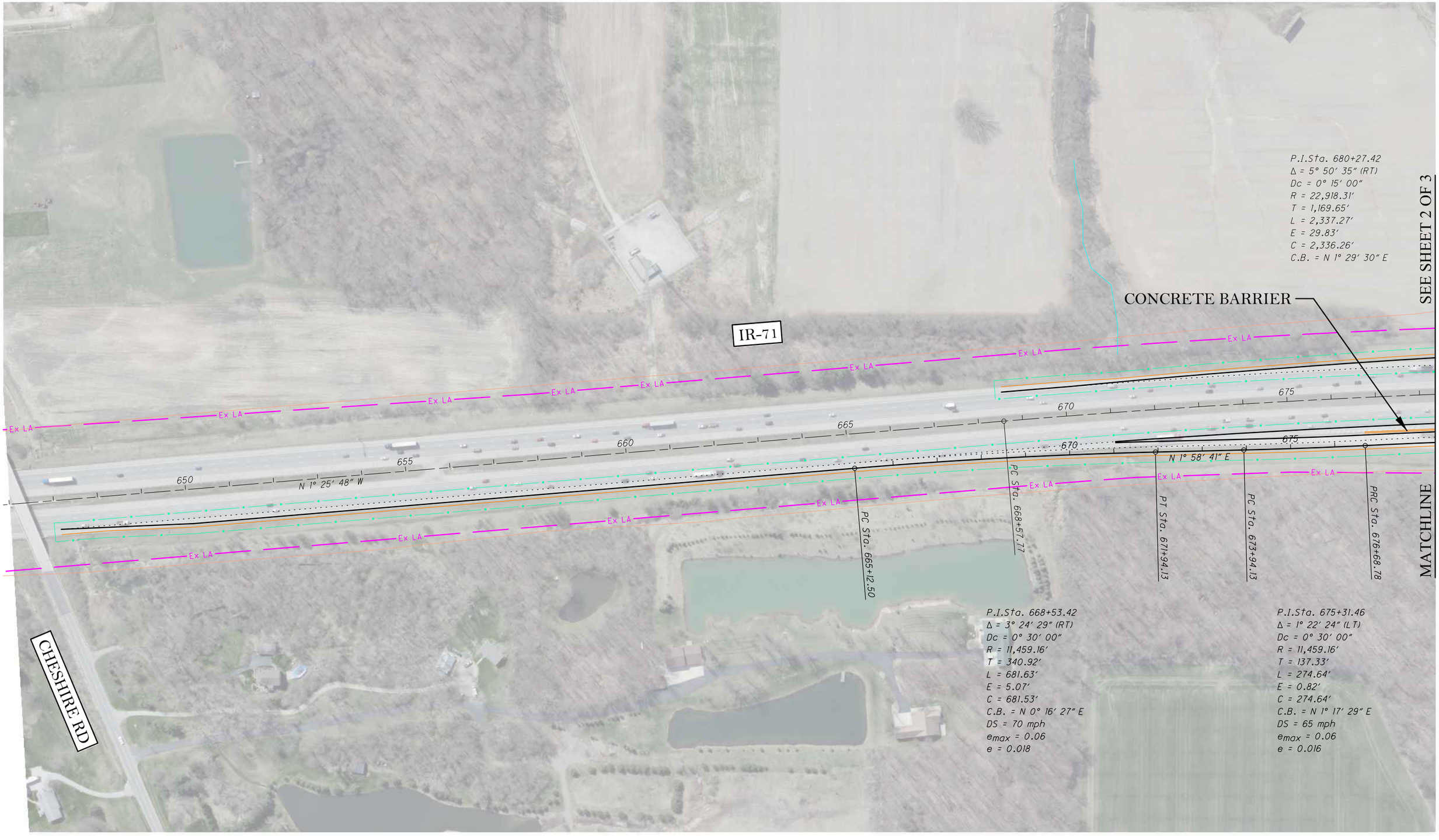


FIGURE 6

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
BUILD CONDITION - ARTERIAL NETWORK



I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

LEGEND

- Construction Limit
- Study Boundary
- Wetland
- Stream
- Archaeology Area

FIGURE 7
BUILD CONDITION - I-71
SHEET 1 OF 3

MAY 3, 2017

PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

SEE SHEET 1 OF 3

MATCHLINE

SUNBURY PARKWAY

CONCRETE BARRIER

IR-71

P.I.Sta. 680+27.42
Δ = 5° 50′ 35″ (RT)
Dc = 0° 15′ 00″
R = 22,918.31′
T = 1,169.65′
L = 2,337.27′
E = 29.83′
C = 2,336.26′
C.B. = N 1° 29′ 30″ E

POT Sta. 680+68.30

PCC Sta. 680+89.80

P.I. STA. 693+95.36
Ls = 200.00′
f s = 10° 00′ 00″
LT = 133.55′
ST = 66.86′
x = 199.39′
y = 11.61′
k = 99.90′
p = 2.91′

TS Sta. 692+61.81

SC Sta. 694+61.81

P.I. STA. 701+28.27
Ls = 200.00′
f s = 11° 00′ 00″
LT = 127.55′
ST = 72.98′
x = 199.19′
y = 13.93′
k = 99.88′
p = 2.62′

P.I.Sta. 704+93.97
Δ = 4° 46′ 15″ (LT)
Dc = 1° 00′ 00″
R = 5,729.58′
T = 238.67′
L = 477.07′
E = 4.97′
C = 476.94′
C.B. = N 82° 16′ 52″ W

PT Sta. 707+32.37

SC Sta. 702+55.29

CS Sta. 700+55.29

P.I.Sta. 697+88.28
Δ = 59° 20′ 53″ (LT)
Dc = 10° 00′ 00″
R = 572.96′
T = 326.47′
L = 593.48′
E = 86.48′
C = 567.30′
C.B. = N 39° 13′ 18″ W

P.I.Sta. 19+40.05
Δ = 229° 36′ 53″ (LT)
Dc = 16° 45′ 00″
R = 342.06′
T = 740.05′
L = 1,370.83′
E = 1,157.34′
C = 621.00′
C.B. = S 52° 51′ 21″ W
DS = 35 mph
emax = 0.06
e = 0.06

P.I. STA. 26+41.91
Ls = 200.00′
f s = 17° 45′ 00″
LT = 130.29′
ST = 71.07′
x = 197.98′
y = 21.67′
k = 99.68′
p = 4.57′

CS Sta. 25+70.83

SC Sta. 27+70.83

ST Sta. 10+00.00

SC Sta. 12+00.00

P.I. STA. 11+33.94
Ls = 200.00′
f s = 16° 45′ 00″
LT = 133.94′
ST = 67.21′
x = 198.30′
y = 19.37′
k = 99.72′
p = 4.86′

PT Sta. 691+95.04

PT Sta. 34+12.78

PC Sta. 707+17.59

CS Sta. 709+62.81

N 0° 27′ 09″ E

N 18° 28′ 49″ E

N 3° 52′ 44″ E

N 12° 16′ 04″ W

P.I.Sta. 684+85.17
Δ = 7° 53′ 42″ (RT)
Dc = 1° 00′ 00″
R = 5,729.58′
T = 395.37′
L = 789.50′
E = 13.63′
C = 788.87′
C.B. = N 5° 35′ 51″ E
DS = 60 mph
emax = 0.06
e = 0.027

P.I.Sta. 689+78.78
Δ = 8° 56′ 07″ (RT)
Dc = 4° 30′ 00″
R = 1,273.24′
T = 99.48′
L = 198.56′
E = 3.88′
C = 198.36′
C.B. = N 14° 00′ 46″ E
DS = 50 mph
emax = 0.06
e = 0.054

PCC Sta. 688+79.30

PT Sta. 690+77.86

PC Sta. 694+03.64

P.I.Sta. 695+66.76
Δ = 14° 36′ 05″ (LT)
Dc = 4° 30′ 00″
R = 1,273.24′
T = 163.12′
L = 324.47′
E = 10.41′
C = 323.60′
C.B. = N 11° 10′ 47″ E
DS = 40 mph
emax = 0.06
e = 0.043

PT Sta. 697+28.11

POT Sta. 700+15.00

PC Sta. 701+64.68

POT Sta. 699+85.27

P.I.Sta. 703+45.28
Δ = 16° 08′ 48″ (LT)
Dc = 4° 30′ 00″
R = 1,273.24′
T = 180.60′
L = 358.82′
E = 12.75′
C = 357.63′
C.B. = N 4° 11′ 40″ W
DS = 40 mph
emax = 0.06
e = 0.043

PT Sta. 705+23.50

P.I.Sta. 708+40.58
Δ = 11° 02′ 07″ (RT)
Dc = 4° 30′ 00″
R = 1,273.24′
T = 122.99′
L = 245.23′
E = 5.93′
C = 244.85′
C.B. = N 6° 45′ 01″ W
DS = 50 mph
emax = 0.06
e = 0.054

SEE SHEET 3 OF 3

MATCHLINE

I-71 & US 36/SR 37 IMPROVEMENTS
INTERCHANGE MODIFICATION STUDY

LEGEND

- Construction Limit
- Study Boundary
- Wetland
- Stream
- Archaeology Area

FIGURE 7
BUILD CONDITION - I-71
SHEET 2 OF 3

MAY 3, 2017
PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

SEE SHEET 2 OF 3

MATCHLINE

IR-71

CONCRETE BARRIER

ST Sta. 711+62.81

P.I. STA. 710+29.52
Ls = 200.00'
fs = 4° 30' 00"
LT = 133.38'
ST = 66.71'
x = 199.88'
y = 5.23'
k = 99.98'
p = 1.31'

PC Sta. 20+00.00

P.I.Sta. 23+29.04
Δ = 28° 58' 47" (RT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 329.04'
L = 644.00'
E = 41.83'
C = 637.15'
C.B. = N 18° 54' 11" E
DS = 50 mph
emax = 0.06
e = 0.054

PRC Sta. 26+44.00

PT Sta. 28+43.42

P.I.Sta. 27+44.87
Δ = 21° 18' 31" (LT)
Dc = 10° 41' 06"
R = 536.23'
T = 100.88'
L = 199.43'
E = 9.41'
C = 198.28'
C.B. = N 22° 44' 19" E

715 720 725 730 735 740

Ex LA

I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

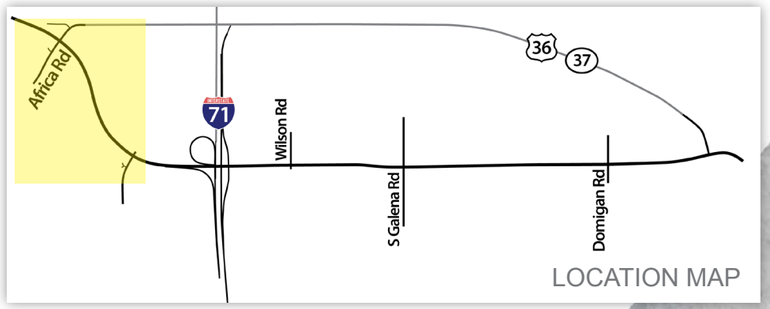
LEGEND

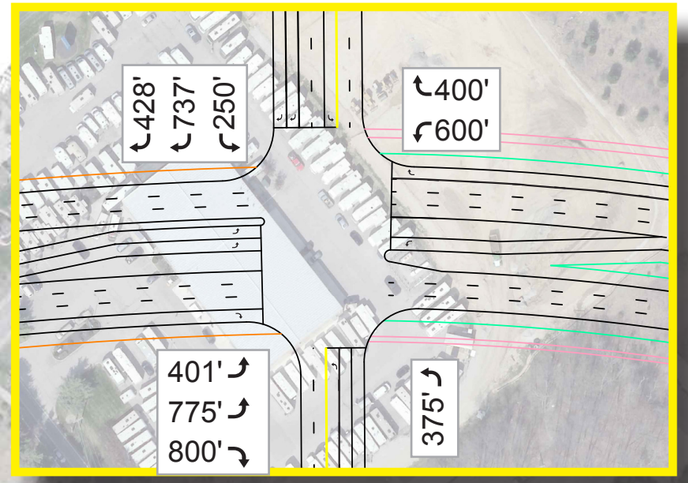
- Construction Limit
- Study Boundary
- Wetland
- Stream
- Archaeology Area

FIGURE 7
BUILD CONDITION - I-71
SHEET 3 OF 3

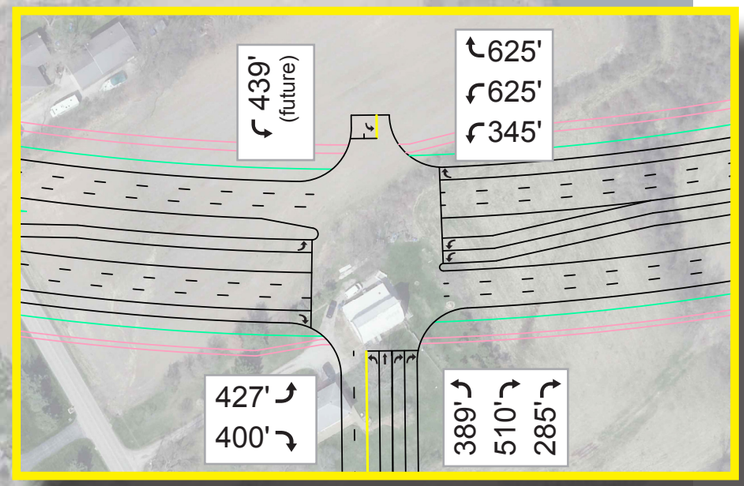
MAY 3, 2017

PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229





Africa Road Intersection



Fourwinds Drive Intersection

US 36/SR 37

US 36/SR 37

Africa Road

S. 3 B's & K Road

Sunbury Parkway

Fourwinds Drive

S. 3 B's & K Road

BEGIN WORK LIMITS

UNITED STATES OF AMERICA
ALUM CREEK STATE PARK

Turn lane lengths shown include storage, deceleration, and taper.

FIGURE 8
BUILD CONDITION - SUNBURY PARKWAY
SHEET 1 OF 4

0 50 100 200

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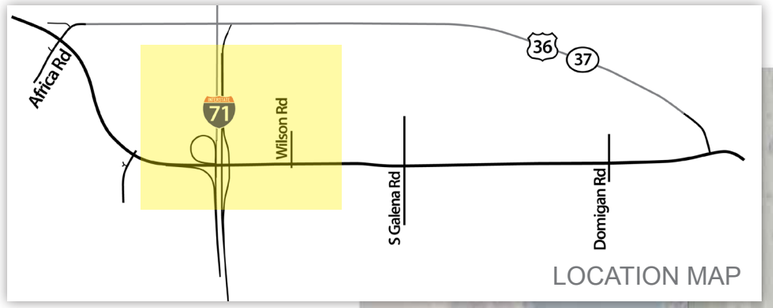
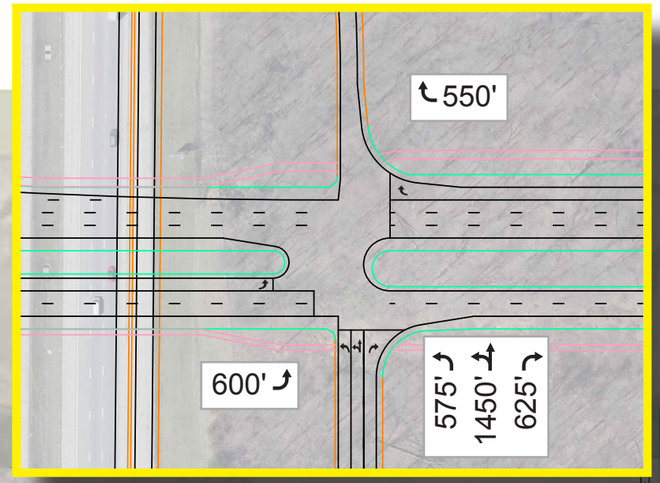
2221 Schrock Road
Columbus, Ohio 43229



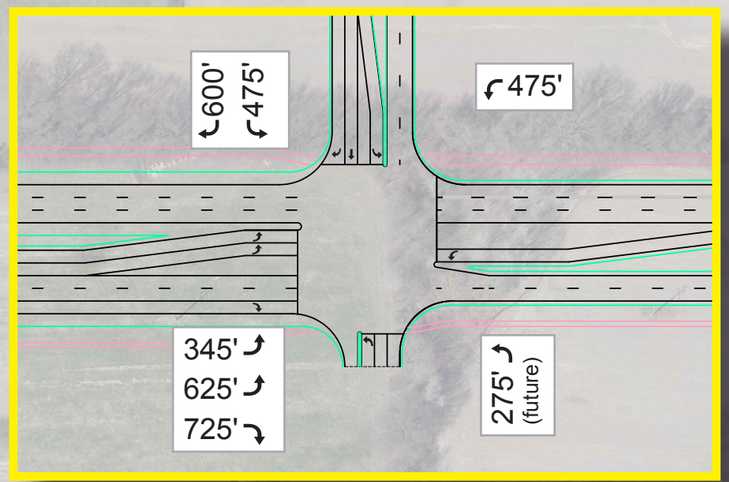


I-71 Northbound Ramps Intersection

INTERSTATE 71

Wilson Road

Sunbury Parkway



Wilson Road Intersection

INTERSTATE 71

Turn lane lengths shown include storage, deceleration, and taper.

FIGURE 8
BUILD CONDITION - SUNBURY PARKWAY
SHEET 2 OF 4

0 50 100 200

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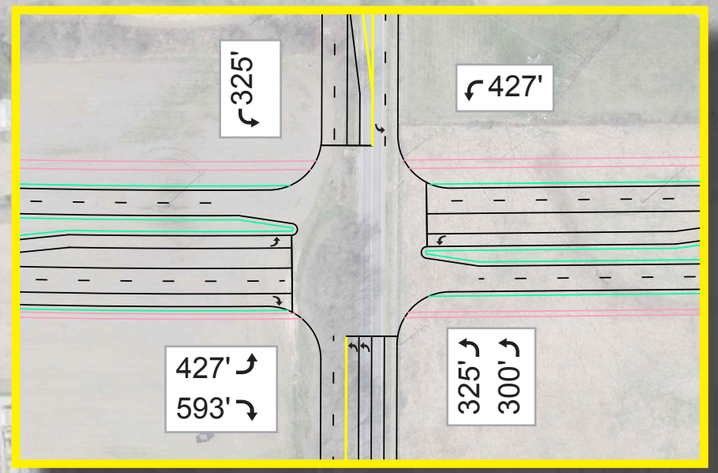
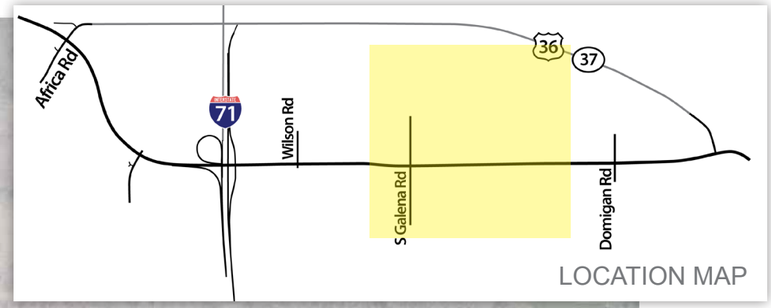
2221 Schrock Road
Columbus, Ohio 43229



Galena Road Intersection



LOCATION MAP

Sunbury Parkway

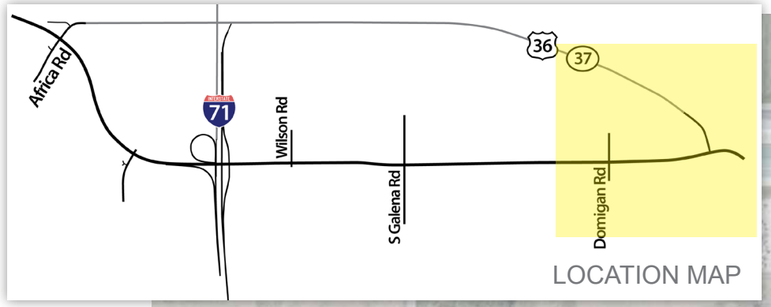
Galena Road

Turn lane lengths shown include storage, deceleration, and taper.

FIGURE 8
BUILD CONDITION - SUNBURY PARKWAY
SHEET 3 OF 4

0 50 100 200

PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229



LOCATION MAP

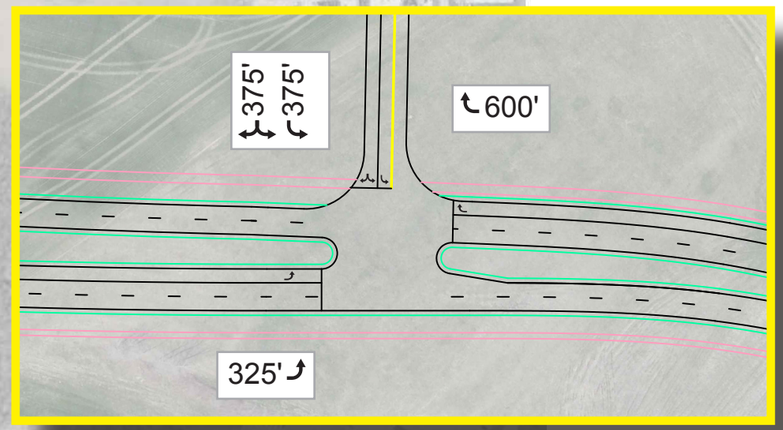
US 36/SR 37

Sunbury Parkway

US 36/SR 37

Domigan Road

Cheshire Road



US 36/ SR 37 and Sunbury Parkway Intersection

Domigan Road Intersection

Turn lane lengths shown include storage, deceleration, and taper.

FIGURE 8
BUILD CONDITION - SUNBURY PARKWAY
SHEET 4 OF 4

0 50 100 200

PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

The Build condition will not require any design exceptions. Horizontal and vertical geometry along the new Sunbury Parkway will comply with ODOT Location & Design (L&D) Manual criteria. Limited-access right-of-way (L/A) is proposed for Sunbury Parkway through the I-71 interchange. L/A on Sunbury Parkway will be provided from the east edge of the Fourwinds Drive intersection to a point 1,000 feet east of the I-71 northbound ramp intersection, as shown in **Figure 9**. This meets ODOT L&D criteria, which require a minimum of 600 feet of L/A from ramp intersections under stop/signal control and 1,000 feet of L/A from free-flow ramp intersections.

TRAFFIC VOLUMES

Opening & Design Years

The Opening Year for this study is 2018 and the Design Year is 2038. Only Design Year traffic volumes have been analyzed in this report.

Certified traffic forecasts were developed by ODOT Office of Statewide Planning & Research in December 2015 and revised in November 2016. The No-Build condition forecasts include the existing plus committed (E+C) road network, including Sunbury Parkway from Wilson Road to US 36/SR 37 to the east and the extension of Wilson Road south to Sunbury Parkway. The certified traffic volumes used for this study do not include a potential new I-71 interchange at Big Walnut Road, approximately six miles to the south, which is currently being studied by Delaware County. The certified traffic volumes can be found in **Appendix G**.

TRAFFIC ANALYSES

Capacity Analysis

Capacity analyses have been performed for the Design Year (2038) No-Build and Build conditions using Highway Capacity Software (HCS2010). Capacity analyses were performed for the existing, committed, and proposed freeways, ramps, and intersections. A graphical summary of the No-Build capacity analyses is provided on **Figure 10**, while a graphical summary of the No-Build capacity analyses is provided on **Figure 11**. The capacity analyses reports for the No-Build condition can be found in **Appendix H**. The capacity analyses reports for the Build condition can be found in **Appendix I**.

Freeway Segments

The freeway segment analyses are summarized in **Table 4**. In the No-Build Condition, two freeway segments are predicted to operate at LOS E – I-71 northbound from Gemini Parkway to US 36/SR 37 and I-71 southbound from US 36/SR 37 to Gemini Parkway.

All but one of the freeway segments are expected to operate at LOS D or better in the Build condition. The segment of I-71 northbound between Gemini Parkway and Sunbury Parkway is predicted to operate at LOS E in the Build condition. However, the Build condition density is expected to be lower than the No-Build condition. Thus, no degradation will occur.

Ramp Junctions

The ramp junction analyses are summarized in **Table 5**. In the No-Build condition, two locations are expected to operate at LOS E or worse. The I-71 southbound merge at US 36/SR 37 is predicted to operate at LOS E. The I-71 southbound merge at Polaris Parkway/Gemini Parkway is predicted to operate at LOS F.

In the Build condition, the only location that operates at LOS E or worse is the I-71 southbound merge from Polaris Parkway/Gemini Parkway. This will be an improvement from the LOS F in the No-Build condition.

Although AASHTO design criteria requires one-mile spacing between interchanges, the new Build condition ramps proposed within one mile of ramps at the US 36/SR 37 interchange will not degrade the operation of any existing freeway segments or ramp junctions. The Build condition will continue to have two access points (one exit, one entrance) on I-71 northbound. The Build condition will have two additional entrance points in the southbound direction. However, these new entrance ramps are located south of the US 36/SR 37 exit ramp and are nearly 10 miles from the next downstream exit ramp, thus not introducing any new weaving movements. The new entrance ramps operate at acceptable levels-of-service and their spacing meets *ODOT Location & Design Manual* criteria.

Weaves

There are no weaving locations in the No-Build condition. The only weave location in the Build condition is the northbound weave along the collector-distributor road between Sunbury Parkway and US 36/SR 37. The location is predicted to operate at LOS A in the AM peak and LOS B in the PM peak. The analyses are summarized in **Table 6**.

Intersections

The intersection analyses along US 36/SR 37 and Sunbury Parkway are summarized in **Table 7**. The analyses indicate that the existing US 36/SR 37 corridor will operate at LOS F, with most intersections experiencing several minutes of delays. Of particular concern are the I-71 ramp terminal intersections, as ineffective operations result in long queues backing up onto I-71. While the recently-completed (June 2016) ramp improvements help to keep queued vehicles out of the I-71 through lanes, these improvements did not improve the capacity of the ramp terminal signal.

All of the intersections in the Build condition are predicted to operate at LOS D or better, with the exception of one location. The US 36/SR 37 & Galena Road intersection is expected to operate at LOS E in the PM peak hour. However, this is a major improvement over the No-Build condition, as intersection delays are predicted to be reduced in the Build condition by over 90%. The Build condition will substantially reduce traffic volumes at this location by providing an alternate route for US 36/SR 37 through traffic. The HCS queuing analysis and SimTraffic queuing analyses (see Queuing Analysis section) indicates that eastbound queue lengths from this intersection would not interfere with interchange operations.

The Build condition certified traffic plates show volumes on Fourwinds Drive north of Sunbury Parkway. The Build condition capacity analyses and turn lane sizing have been performed using these volumes and a four-legged intersection configuration. However, it should be noted that the Build condition does not include construction of Fourwinds Drive north of Sunbury Parkway. The construction of Fourwinds Drive north of Sunbury Parkway is a proposed local project with no construction date established. Thus, the actual Build condition may be a three-legged intersection, which is likely to operate better than as shown in Table 7.

Similarly, the Build condition certified traffic plates show volumes on Wilson Road south of Sunbury Parkway. The Build condition capacity analyses and turn lane sizing have been performed using these volumes and a four-legged intersection configuration. However, the Build condition does not include construction of Wilson Road south of Sunbury Parkway. The construction of Wilson Road south of Sunbury Parkway is a proposed local project with no construction date established. Thus, the actual Build condition may be a three-legged intersection, which is likely to operate better than as shown in Table 7.

In many cases, the Build condition is predicted to reduce delays by hundreds of seconds per vehicle at study area intersections. The Build condition would adequately address the capacity issues on the existing US 36/SR 37, while also providing efficient operations on the proposed Sunbury Parkway. Two locations are expected to have major movements with volume-to-capacity (v/c) ratios in excess of 0.93. These locations are described below:

US 36/SR 37 & Africa Road – WB through movement (from Sunbury Parkway to US 36/SR 37)
The westbound through movement at the US 36/SR 37 & Africa Road intersection is expected to have a v/c ratio of 0.94 in the PM peak hour. There are no additional lanes that could be provided at the intersection to reduce the v/c ratio below 0.93. Three westbound through lanes are already planned for the Build condition, with one of the lanes being tapered out prior to reaching the bridge over Alum Creek Reservoir. Adding a fourth westbound through lane would require tapering out multiple lanes prior to the bridge, which would be undesirable, or require the high cost of widening the westbound bridge over the Reservoir.

US 36/SR 37 & Bob Evans/McDonald's signal – WB through movement
The westbound through/right turn movements at the US 36/SR 37 & Bob Evans/McDonald's signal is expected to have a v/c ratio of over 0.99 in the PM peak hour. This represents a substantial improvement over the No-Build condition, for which v/c ratios of over 1.7 are expected. Providing additional lanes on this approach is not necessary to maintain acceptable operations for the interchange.

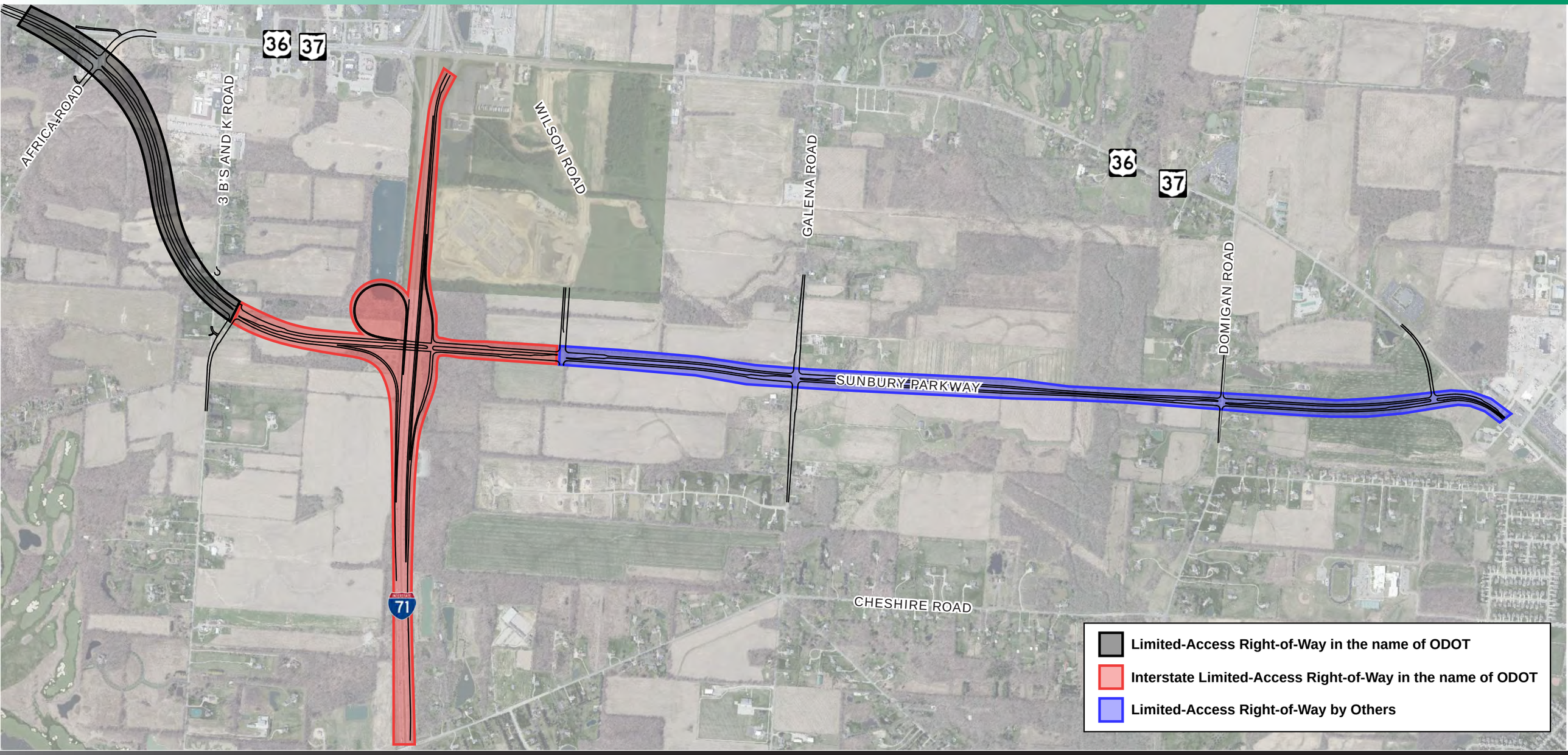


FIGURE 9
Limited Access Right-of-Way

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engineers, architects, planners

PLOT.CEL

ms consultants, inc.
msconsultants.com

$MESSAGE1$

$UCFDESC$
$PCFDESC$

1"
0.5"
0

UCF: UCF
PCF: PCF

Batchplot Spec: $BATCH$
Pen Table: $PENTABLE$
Plot Driver: $PLOTDRIVER$

34" x 22"

View: $VIEW$
By: $USER$

Model: $MODEL$
Printed: $DATE$ @ $TIME$
File: $FILE$

AFRICA RD.
I-1 F/F
I-2 E/F
N. 3 B'S & K RD.
S. 3 B'S & K RD.
I-4 F/F
I-3 F/F
FOURWINDS DR.
I-5 F/F
MCDONALDS
BOB EVANS
I-6 F/F
I-7 F/F
I-8 D/D
I-9 F/F
I-10 E/F
I-11 C/C
I-15 C/C
I-16 C/F
WILSON RD.
S. GALENA RD.
N. GALENA RD.
DOMIGAN RD.
CARTER'S CORNER RD.
SUNBURY PKWY.
POLARIS PKWY.
GEMINI PKWY.
750
71
36
37
61
F-14A F/D
J-16 F/F
F-14B D/F
F-14 D/B
J-15 D/C
F-10 E/B
J-12 E/C
F-9 B/A
J-11 B/B
F-8 C/B
J-10 C/B
F-7 B/B
J-9 B/B
J-1 C/D
F-1 A/D
J-2 A/D
F-2 B/E
J-4 A/A
F-4 A/C
J-5 B/C
F-5 A/C
J-6 A/C
F-6 A/C
J-7 B/C

LEGEND

F-XX A/B — LOCATION ID; LOS AM/PM

F - FREEWAY SEGMENT
J - RAMP JUNCTION
I - INTERSECTION
W - WEAVE

NOT TO SCALE

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
2038 HCS LEVELS OF SERVICE (LOS) - NO-BUILD CONDITION

FIGURE 10

$MESSAGE2$

PLOT.CEL

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$MESSAGE1$

$UCFDESC$
$PCFDESC$

1"
0.5"
0

UCF: UCF
PCF: PCF

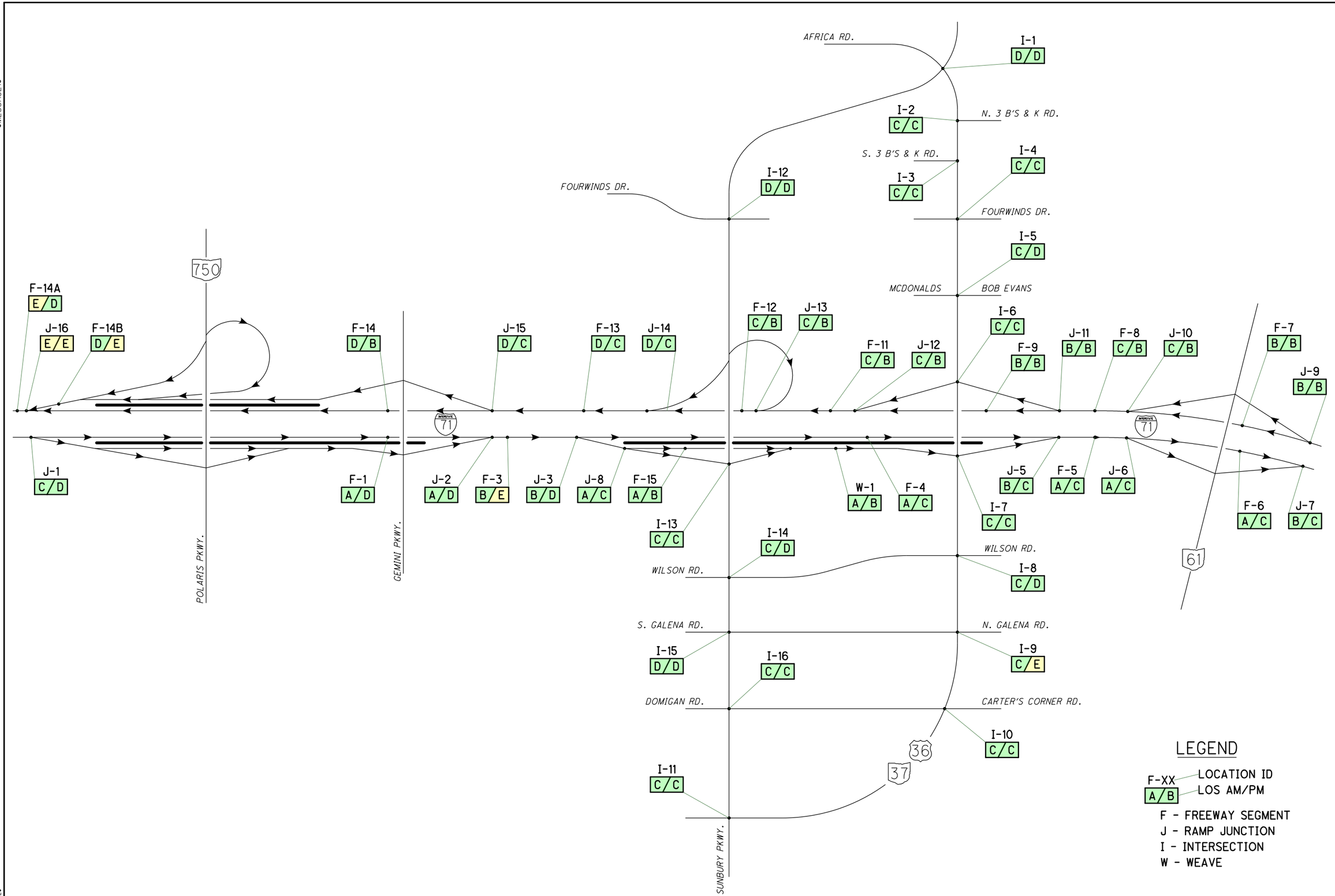
Batchplot Spec: $BATCH$
Pen Table: $PENTABLE$
Plot Driver: $PLOTDRIVER$

34" x 22"

View: $VIEW$
By: $USER$

Model: $MODEL$
Printed: $DATE$ @ $TIME$
File: $FILE$

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
2038 HCS LEVELS OF SERVICE (LOS) - BUILD CONDITION



LEGEND

F-XX — LOCATION ID
A/B — LOS AM/PM

F - FREEWAY SEGMENT
J - RAMP JUNCTION
I - INTERSECTION
W - WEAVE

NOT TO SCALE

FIGURE 11

$MESSAGE2$

Table 4: 2038 Capacity Analysis for Freeway Segments

			No-Build Condition				Build Condition			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-71 NB	F-1	South of Polaris Pkwy/Gemini Pkwy	10.3	A	34.3	D	10.3	A	33.3	D
	F-2	Gemini Pkwy to US 36/SR 37	11.6	B	42.4	E	*N/A*	*N/A*	*N/A*	*N/A*
	F-3	Polaris Pkwy/Gemini Pkwy to Sunbury Pkwy/US 36/SR 37	*N/A*	*N/A*	*N/A*	*N/A*	11.8	B	42.3	E
	F-4	Under US 36/SR 37	7.6	A	19.7	C	7.6	A	20.0	C
	F-5	US 36/SR 37 to SR 61	10.9	A	24.6	C	10.9	A	24.6	C
	F-6	North of SR 61 exit ramp	9.3	A	18.2	C	9.3	A	18.2	C
I-71 SB	F-7	North of SR 61 entrance ramp	12.8	B	13.8	B	12.9	B	13.8	B
	F-8	SR 61 to US 36/SR 37	19.0	C	16.1	B	19.0	C	16.1	B
	F-9	Under US 36/SR 37	16.7	B	11.0	A	16.4	B	11.5	B
	F-10	US 36/SR 37 to Gemini Pkwy/Polaris Pkwy	39.1	E	17.2	B	*N/A*	*N/A*	*N/A*	*N/A*
	F-11	US 36/SR 37 to north of WB Sunbury Pkwy ramp	*N/A*	*N/A*	*N/A*	*N/A*	20.1	C	13.8	B
	F-12	South of WB Sunbury Pkwy ramp to north of EB Sunbury Pkwy ramp	*N/A*	*N/A*	*N/A*	*N/A*	22.9	C	15.0	B
	F-13	South of EB Sunbury Pkwy ramp to Gemini Pkwy/Polaris Pkwy	*N/A*	*N/A*	*N/A*	*N/A*	34.7	D	18.9	C
	F-14	South of Gemini Pkwy/Polaris Pkwy exit ramp	32.2	D	15.5	B	27.5	D	16.7	B
NBCD	F-15	Under Sunbury Pkwy	*N/A*	*N/A*	*N/A*	*N/A*	6.7	A	17.3	B

N/A refers to locations that are only in either the No-Build or Build conditions.

Table 5: 2038 Capacity Analysis for Ramp Junctions

				No-Build Condition				Build Condition			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-71 NB	J-1	I-71 NB at Polaris/Gemini*	Diverge	24.8	C	32.5	D	23.8	C	31.3	D
	J-2	I-71 NB at Polaris/Gemini	Merge	9.6	A	32.4	D	9.9	A	32.6	D
	J-3	I-71 NB at Sunbury/US 36/SR 37*	Diverge	*N/A*	*N/A*	*N/A*	*N/A*	10.8	B	30.5	D
	J-4	I-71 NB at US 36/SR 37	Diverge	2.9	A	4.3	A	*N/A*	*N/A*	*N/A*	*N/A*
	J-5	I-71 NB at US 36/SR 37	Merge	13.0	B	26.2	C	13.0	B	26.0	C
	J-6	I-71 NB at SR 61	Diverge	9.8	A	24.6	C	9.8	A	24.6	C
	J-7	I-71 NB at SR 61	Merge	11.3	B	20.1	C	11.3	B	20.1	C
NBCD	J-8	NBCD at Sunbury Pkwy**	Diverge	*N/A*	*N/A*	*N/A*	*N/A*	8.3	A	21.6	C
I-71 SB	J-9	I-71 SB at SR 61	Diverge	13.9	B	14.9	B	13.9	B	14.9	B
	J-10	I-71 SB at SR 61	Merge	21.1	C	16.0	B	21.1	C	16.0	B
	J-11	I-71 SB at US 36/SR 37	Diverge	19.6	B	17.9	B	19.7	B	17.7	B
	J-12	I-71 SB at US 36/SR 37	Merge	40.3	E	20.4	C	21.5	C	14.7	B
	J-13	I-71 SB at WB Sunbury	Merge	*N/A*	*N/A*	*N/A*	*N/A*	23.2	C	15.2	B
	J-14	I-71 SB at EB Sunbury	Merge	*N/A*	*N/A*	*N/A*	*N/A*	33.8	D	20.7	C
	J-15	I-71 SB at Polaris/Gemini	Diverge	33.8	D	20.1	C	32.5	D	21.9	C
	J-16	I-71 SB at Polaris/Gemini	Merge	47.5	F	45.0	F	40.1	E	42.6	E

N/A refers to locations that are only in either the No-Build or Build conditions.
*Major Diverge Location – junction analyzed as a major diverge as per HCM, Equation 13-26.
**Single-lane NBCD towards US 36/SR 37 analyzed as a two-lane freeway segment with volumes doubled.

Table 6: 2038 Capacity Analysis for Weaves

			No-Build Condition				Build Condition			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
NBCD	W-1	North of Sunbury Pkwy to south of US 36/SR 37	*N/A*	*N/A*	*N/A*	*N/A*	5.6	A	18.5	B

N/A refers to locations that are only in either the No-Build or Build conditions.

Table 7: 2038 Capacity Analysis for Intersections

			No-Build Condition				Build Condition			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
US 36/SR 37	I-1	US 36/SR 37 & Africa Road*	256.7	F	275.7	F	35.2	D	40.3^^	D
	I-2	US 36/SR 37 & N 3 Bs & K Road*	62.4	E	98.2^	F	21.7	C	24.2	C
	I-3	US 36/SR 37 & S 3 Bs & K Road**	2510.5	F	255.0	F	16.1	C	17.8	C
	I-4	US 36/SR 37 & Fourwinds Drive	107.0	F	183.5	F	26.1	C	31.2	C
	I-5	US 36/SR 37 & Bob Evans/McDonalds	178.1^^	F	283.6^^	F	29.7	C	42.2	D
	I-6	US 36/SR 37 & I-71 SB ramps	93.3	F	187.3	F	27.8	C	33.6	C
	I-7	US 36/SR 37 & I-71 NB ramps	98.3	F	188.5	F	27.6	C	31.0	C
	I-8	US 36/SR 37 & Wilson Road	40.8	D	36.0	D	32.6	C	35.9	D
	I-9	US 36/SR 37 & Galena Road	249.9	F	757.5	F	32.5	C	61.2	E
	I-10	US 36/SR 37 & Domigan Road/Carters Corner Road*	61.3	E	348.2	F	23.3	C	29.8	C
	I-11	US 36/SR 37 & Sunbury Parkway	23.5	C	26.9	C	25.8	C	23.8	C
Sunbury Parkway	I-12	Sunbury Parkway & Fourwinds Drive	*N/A*	*N/A*	*N/A*	*N/A*	35.0	D	36.3	D
	I-13	Sunbury Parkway & I-71 NB ramps	*N/A*	*N/A*	*N/A*	*N/A*	23.7	C	31.1	C
	I-14	Sunbury Parkway & Wilson Road	*N/A*	*N/A*	*N/A*	*N/A*	32.5	C	35.2	D
	I-15	Sunbury Parkway & Galena Road	23.5	C	25.2	C	43.3	D	37.9	D
	I-16	Sunbury Parkway & Domigan Road	15.9	C	123.5	F	24.3	C	22.1	C

Note: The worst of the NB/SB and EB/WB delays were balanced within 3 seconds of each other, except in cases where obtaining that balance would reduce green times below the minimum value (10 seconds for a through movement, 7 seconds for a left turn movement).

N/A refers to locations that are only in the Build condition.

*This intersection was analyzed as a signal, even though it is an existing two-way stop-control intersection. By the Design Year, it will meet signal warrants, therefore it was analyzed as a signal.

**Unsignalized intersection; delay reported is from stopped approach with largest delay

^Protected + permitted signal phasing for the US 36/SR 37 approaches was analyzed, however it provided worse operations. Therefore, the intersection was analyzed with permitted-only left turn movements for US 36/SR 37.

^^Protected + permitted signal phasing for the minor street approaches was analyzed, however it provided worse operations. Therefore, the intersection was analyzed with permitted-only left turn movements for the minor streets.

Queuing Analysis

Synchro/SimTraffic modeling was performed to verify that the improvements to the arterial system would be sufficient to prevent ramp queues from reaching the freeway. Analysis was also performed to verify that queues from adjacent intersections, particularly those with v/c ratios greater than 0.93 or LOS E, would not extend into the I-71 ramp terminal intersections or otherwise impede operations within the L/A.

A total of 10 SimTraffic runs were performed for the Build condition in the design year AM and PM peak hours. The 10 runs were averaged and the results for key approaches are summarized in **Table 8**. Based on the data, all 95th-percentile intersection queues are expected to be considerably shorter than the roadway link lengths. Therefore, the Build condition will not result in queues extending onto the freeway system, nor will any queues along US 36/SR 37 or Sunbury Parkway adversely impact the operations of the ramp terminal intersections. Copies of the SimTraffic queuing reports can be found **Appendix J**.

Table 8: Design Year 95th-Percentile Queue Lengths (Build Condition)
Table values represent longest SimTraffic queue length among all lanes on each approach

	Approach	AM Queue Length	PM Queue Length	Roadway Link Length
Locations with v/c > 0.93 or LOS E				
US 36/SR 37 & Africa Road	WB	144’	298’	1,851’
US 36/SR 37 & Bob Evans/McDonald’s	WB	192’	513’	775’
US 36/SR 37 & Galena Road	EB	372’	2,449’	3,513’
Exit Ramps				
US 36/SR 37 & I-71 SB ramps	SB	203’	463’	975’
US 36/SR 37 & I-71 NB ramps	NB	249’	435’	2,400’
Sunbury Parkway & I-71 NB ramps	NB	214’	545’	1,450’
Adjacent Intersections to Ramps				
US 36/SR 37 & Wilson Road	EB	196’	431’	1,075’
Sunbury Parkway & Fourwinds Drive	WB	181’	270’	2,000’
Sunbury Parkway & Wilson Road	EB	166’	243’	1,625’

Turn Lane Sizing

Turn lane length requirements were calculated using the ODOT Location & Design (L&D) Manual methodology, and are shown in **Table 9**. Most recommended turn lanes are the same or greater than the L&D calculations. Copies of the L&D Manual sizing calculations can be found in **Appendix K**.

The locations where turn lane sizes are recommended to be less than L&D values are described further below:

Several turn lanes at intersections on the existing US 36/SR 37 are proposed to remain shorter than L&D lengths. The Build condition will substantially reduce volumes at these intersections, greatly improving operations and queuing. The turn lanes will be much closer to meeting L&D criteria in the Build condition compared to the No-Build condition. The costs of modifying these turn lanes to provide L&D storage would be large and provide limited benefits, especially considering that the Build condition will greatly improve operations and queues. Many of the left turn lanes along US 36/SR 37 are back-to-back with adjacent lanes and thus are at their maximum length without widening to provide side-by-side left turn lanes. These locations along US 36/SR 37 that are not recommended to be improved are:

- US 36/SR 37 & N. 3B’s & K Road
  - Eastbound left turn lane (No-Block condition not met)
- US 36/SR 37 & S. 3B’s & K Road
  - Westbound left turn lane (No-Block condition not met)
- US 36/SR 37 & Fourwinds Drive
  - Eastbound left turn lane (No-Block condition not met)
  - Eastbound right turn lane (No-Block condition not met)
  - Westbound left turn lane (No-Block condition not met)
  - Southbound left turn lane (No-Block condition not met)
- US 36/SR 37 & Bob Evans/McDonald’s
  - Eastbound left turn lane (No-Block condition not met)
  - Westbound left turn lane (No-Block condition not met)
  - Southbound left turn lane (Storage length not met)
- US 36/SR 37 & I-71 Northbound ramps
  - Westbound right turn lane (Storage length not met)

Table 9 shows that the left turn lanes on US 36/SR 37 at the two I-71 ramp intersections are just short of meeting L&D criteria. However, both of these turn lanes extend beyond the upstream ramp signal. If these additional lengths are included, both turn lanes would easily satisfy L&D sizing criteria. Therefore, no changes to these two turn lanes are recommended.

Table 9: Turn Lane Sizing

			# of Lanes	Design Speed	Existing	AM Peak		PM Peak		Recommended Length	Comments
						L&D Length	No-Block Length*	L&D Length	No-Block Length*		
I-1	US 36/SR 37 & Africa Road	EBLT	2	60	N/A	475'**	775'	650'**	625'	650'**	Inside lane = 401' (220' storage)', Outside lane = 775' (430' storage)
		EBRT	1	60	345'	381'	775'	345'	725'	800'	
		WBLT	1	55	N/A	285'	325'	285'	625'	600'	315' storage + 285' deceleration
		WBRT	1	55	N/A	285'	325'	285'	625'	400'	Low-volume movement - recommended length is between L&D Length & No-Block length
		NBLT	1	55	N/A	285'	325'	339'	275'	375'	
		SBLT	1	35	130'	100'	200'	100'	350'	250'	Low-volume movement - recommended length is between L&D Length & No-Block
		SBRT	2	35	N/A	700'**	200'	1065'**	350'	1065'**	Inside lane = 737' (687' storage), Outside/rightmost lane = 428' (378' storage)
I-2	US 36/SR 37 & N 3 Bs & K Road	EBLT	1	35	TWLTL	100'	500'	150'	600'	250'	When future signal is installed, a 250' turn lane should be striped
I-3	US 36/SR 37 & S 3 Bs & K Road^	WBLT	1	35	TWLTL	100'	N/A	150'	N/A	TWLTL	No change recommended to two-way left turn lane striping
I-4	US 36/SR 37 & Fourwinds Drive	EBLT	1	35	300'	200'	525'	150'	550'	300'	No change recommended – intersection volumes reduced from No-Build condition
		EBRT	1	35	300'	150'	525'	150'	550'	300'	No change recommended – intersection volumes reduced from No-Build condition
		WBLT	1	35	290'	225'	475'	250'	915'	290'	No change recommended – intersection volumes reduced from No-Build condition
		NBLT	1	35	330'	100'	50'	250'	150'	330'	No change recommended – intersection volumes reduced from No-Build condition
		NBRT	1	35	330'	100'	50'	150'	150'	330'	No change recommended – intersection volumes reduced from No-Build condition
		SBLT	1	35	330'	200'	50'	100'	50'	330'	No change recommended – intersection volumes reduced from No-Build condition
I-5	US 36/SR 37 & Bob Evans/McDonalds	EBLT	1	35	400'	200'	525'	150'	600'	400'	No change recommended – intersection volumes reduced from No-Build condition
		WBLT	1	35	340'	250'	500'	225'	945'	340'	No change recommended – intersection volumes reduced from No-Build condition
		SBLT	1	25	150'	300'	100'	250'	100'	150'	No change recommended – intersection volumes reduced from No-Build condition
I-6	US 36/SR 37 & I-71 SB ramps	EBRT	1	35	500'	450'	325'	375'	400'	500'	Existing to remain
		WBLT	1	35	540'	500'	325'	375'	600'	540'	No change recommended, as additional storage is provided beyond the adjacent I-71NB signal
		SBLT	2	***	725'**	150'**	325'	175'**	475'	725'**	Existing to remain
		SBRT	2	***	945'**	575'**	50'	855'**	100'	945'**	Existing to remain
I-7	US 36/SR 37 & I-71 NB ramps	EBLT	1	35	540'	525'	250'	550'	400'	540'	No change recommended, as additional storage is provided beyond the adjacent I-71NB signal
		WBRT	1	35	200'	250'	275'	250'	325'	200'	No change recommended – volumes substantially reduced from No-Build condition
		NBLT	2	***	775'**	450'**	150'	800'**	375'	775'**	No change recommended – volumes substantially reduced from No-Build condition
		NBRT	2	***	920'**	300'**	250'	650'**	450'	920'**	Existing to remain
I-8	US 36/SR 37 & Wilson Road	EBLT	2	35	1055'**	425'**	250'	775'**	400'	1055'**	Existing storage lengths to remain
		EBRT	1	35	750'	150'	250'	150'	400'	750'	Existing to remain
		WBLT	1	35	464'	100'	325'	100'	375'	464'	Existing to remain
		NBLT	2	45	1410'*	100'	200'	100'	250'	1410'	Existing storage lengths to remain
		NBRT	1	45	900'	150'	200'	150'	250'	900'	Existing to remain
		SBLT	1	45	575'	100'	100'	100'	100'	575'	Existing to remain
		SBRT	2	45	1150'**	575'**	100'	500'**	100'	1150'**	Existing storage lengths to remain (Inside lane = 575', Outside lane = 575')
I-11	US 36/SR 37 & Sunbury Parkway	EBLT	1	50	N/A	225'	400'	225'	600'	325'	Low-volume movement - recommended length is between L&D Length & No-Block
		WBRT	1	45	N/A	600'	600'	1010'	450'	600'	Maximum length due to spacing for drop lanes
		SBLT	2	45	N/A	375'**	N/A	750'**	N/A	750'**	Two lanes of 375' storage length each are recommended with 75' of deceleration
I-12	Sunbury Parkway & Fourwinds Drive	EBLT	1	50	N/A	293'	750'	243'	625'	427'	202' of storage + 225' deceleration distance
		EBRT	1	50	N/A	225'	750'	225'	625'	400'	Low-volume movement - recommended length is between L&D Length & No-Block
		WBLT	2	50	N/A	343'**	325'	275'**	625'	602'**	Inside lane = 345' (202' storage), Outside lane = 625' (400' storage)
		WBRT	1	50	N/A	418'	325'	493'	625'	625'	Turn lane not part of Build condition
		NBLT	1	55	N/A	285'	200'	285'	200'	285'	
		NBRT	2	55	N/A	450'**	200'	275'**	200'	450'**	Inside lane = 510' (225' storage); Outside/rightmost lane = 389' (225' storage)
		SBLT	1	55	N/A	314'	150'	439'	150'	439'	Turn lane not part of Build condition
I-13	Sunbury Parkway & I-71 NB ramps	EBLT	1	50	N/A	293'	375'	318'	600'	600'	
		WBRT	1	50	N/A	225'	500'	243'	500'	550'	
		NBLT	2	***	N/A	425'**	150'	1125'**	500'	1975'**	Inside/leftmost lane = 575' (525' storage), Outside/center lane = 1450' (600' storage)
		NBRT	1	***	N/A	200'	200'	550'	625'	625'	
I-14	Sunbury Parkway & Wilson Road	EBLT	2	50	N/A	325'**	325'	375'**	725'	602'**	Inside lane = 345' (202' storage), Outside lane = 625' (400' storage)
		EBRT	1	50	N/A	225'	325'	243'	725'	725'	Turn lane not part of Build condition
		WBLT	1	50	N/A	243'	475'	225'	325'	475'	Turn lane not part of Build condition (250' storage + 225' deceleration distance)
		NBLT	1	45	N/A	225'	100'	275'	175'	275'	Turn lane not part of Build condition
		SBLT	1	45	N/A	225'	100'	300'	50'	425'	250' of storage + 175' deceleration distance
		SBRT	1	45	N/A	400'	100'	600'	50'	600'	
I-15	Sunbury Parkway & Galena Road	EBLT	1	50	N/A	293'	250'	293'	550'	427'	202' of storage + 225' deceleration distance
		EBRT	1	50	N/A	343'	250'	593'	550'	593'	
		WBLT	1	50	N/A	243'	550'	243'	375'	427'	202' of storage + 225' deceleration distance
		NBLT	2	35	N/A	525'**	325'	275'**	325'	525'**	Inside lane = 300' (250' storage); Outside lane = 325' (275' storage)
		SBLT	1	35	N/A	150'	325'	150'	250'	325'	
I-16	Sunbury Parkway & Domigan Road	EBLT	1	50	N/A	243'	275'	293'	550'	427'	202' of storage + 225' deceleration distance
		WBLT	1	50	N/A	225'	600'	225'	450'	427'	202' of storage + 225' deceleration distance
		NBLT	1	35	N/A	100'	150'	100'	150'	150'	
		SBLT	1	35	N/A	400'	175'	200'	250'	400'	

*No-Block value represents storage only. Does not include 50' drop taper.

^Unsignalized intersection

**Double turn lane – value shown is combined storage length of both turn lanes

***Exit ramp – turn lane sizing is based on storage length only. Deceleration is assumed to occur upstream.

COST ESTIMATE

Preliminary cost estimates were developed for the Build alternative. Costs for roadway and pavement quantities were determined using Estimator software with unit prices generated by ODOT's 2013 interactive Bid History Catalog. Costs for the erosion control, traffic control, maintenance of traffic, and utility work were established using ODOT's 2013 Procedure for Construction Budget Estimating spreadsheet and/or input from specific manufacturers. The preliminary cost estimates do not include costs for utility relocations, costs related to right-of-way acquisition, or costs for environmental mitigation.

A contingency of 30% was included in preliminary cost estimates to account for non-itemized pay items and for the uncertainty associated with the preliminary plans available at this time. To adjust costs to 2018, an 8.4% inflation factor was added to the estimates, according to ODOT's FY16-18 Business Plan Inflation Calculator. The Build condition is estimated to cost $52.1 million (2018 dollars).

ENVIRONMENTAL OVERVIEW

The project area for this overview is located in Berkshire Township, Ohio, which is located in Delaware County. The project runs along I-71 south of the US 36/SR 37 interchange. The study area for this overview extends along I-71 from north of the I-71 and US 36/SR 37 interchange to south of the Cheshire Road bridge. The study area includes land west of I-71 to the Alum Creek Reservoir and Africa Road, and land east of I-71 to US 36/SR 37 and the Village of Sunbury.

The Build condition has several impacts to the study area. Approximately 65 acres of right-of-way acquisition will be required, with 17 property owners impacted. This will include two residential homes and two commercial businesses. The Build condition will involve roughly 33 acres of land that is planned or zoned for development but being farmed until the development is realized.

This project is being processed as an Environmental Assessment. A Level II Ecological Survey Report (ESR) was performed and submitted for agency review on September 30, 2016. Agency field reviews have been conducted and the US Army Corps of Engineers is expected to issue a Jurisdictional Determination relative to study area streams and wetlands in May 2017. Based upon the impacts identified in the Level II ESR and confirmed during Agency field reviews, an Individual Section 404 waterway permit will be required from the US Army Corps of Engineers. A Section 401 Water Quality Certification will also be required from Ohio EPA.

The preferred alternative will impact nine streams with a total impact of 3,464 linear feet. It is assumed that culverts will be placed at all stream crossings; however, this assumption is subject to change as the project advances through the Project Development Process. The Build condition will likely impact 2.05 acres of Category 1 and Modified Category 2 wetlands. It is assumed that fill will be placed in the wetlands to allow construction of roadways per ODOT's design standards; however, the wetland impacts are subject to change as the project advances through the Project Development Process.

An Environmental Site Assessment (ESA) Screening was prepared for the project in July 2016 which recommended three sites to be further investigated. A Phase I ESA was prepared for the study area and approved on November 22, 2016. No sites were recommended for a Phase II ESA investigation.

An Air Quality Analysis was performed and submitted to ODOT August 29, 2016. It found that there would be no appreciable difference in overall Mobile Source Air Toxic emissions. A Noise Analysis was performed and approved by ODOT on October 17, 2016. While some noise impacts were identified, noise mitigation was not feasible or reasonable according to the criteria set forth in ODOT Traffic Noise Analysis Manual.

Phase I Archaeology and History/Architecture investigations have been conducted and are being reviewed by the Ohio Historic Preservation Office. No Adverse Effects on archaeological resources are anticipated. There is one National Register eligible historic site along Galena Road. The project will likely have No Adverse Effect on this site.

ODOT has assumed the presence of federally listed species within the study area and within the preliminary work limits of the project's Preferred Alternative. Based upon the project type, location, and anticipated impacts, the project May Affect and is Likely to Adversely Affect the Indiana and Northern long-eared bats. The following mitigation steps will be undertaken:

- To avoid impacts to summer roosting bats, suitable wooded habitat will only be cleared between October 1st and March 31st, when the species would not be present.
- The project will implement conservation of high quality suitable wooded habitat at the Sunday Creek Coal Company 2 pooled conservation area to offset the removal of 27.82 acres of Suitable Wooded Habitat (SWH) within the preliminary work limits plus 33 acres of SWH that is likely to be indirectly affected by the project.

Public involvement meetings were held on April 25, 2016 and October 20, 2016, both at the Northgate Church, which is located at the US 36/SR 37 & Fourwinds Drive intersection. The purpose of the April meeting was to gain input on three potential alignment alternatives for Sunbury Parkway west of I-71. The purpose of the October meeting was to announce the preferred alternative and the next steps in the planning and design process. Approximately 300 people attended the April meeting and approximately 200 people attended the October meeting. Reponses to public comments from both meetings were distributed to attendees and stakeholders. The public comments covered a wide range of topics; however some of the most common topics included the project timeline, funding, and the right-of-way acquisition process.

CONCLUSION AND RECOMMENDATIONS

The I-71 and US 36/SR 37 interchange, located in Delaware County, Ohio, currently experiences congestion due to inadequate ramp and arterial capacity. I-71 northbound exit ramp traffic routinely backs-up onto the mainline of I-71 during the afternoon peak travel hour. This congestion is due to the high volumes of passenger car and truck traffic at the interchange and congestion along US 36/SR 37 resulting from numerous driveways both east and west of I-71.

With the above recommended improvements (the Build condition), nearly all freeway segments, weaving segments, ramps, ramp junctions, and intersections are predicted to operate at LOS D or better through the Design Year. A small number of locations are expected to operate at LOS E, but operations at all of these locations will be improved by the Build condition. Despite the proximity of the proposed Build condition ramps to existing ramps at US 36/SR 37, the improvements will not degrade any adjacent freeways, ramps or interchanges. The recommended Build condition will improve not only capacity and safety, but will also provide east-west connectivity and facilitate planned and future development. The Build condition will result in safe and efficient operation of the road network in this area, meeting the long-term transportation needs of Delaware County.

The Build condition consists of the following improvements:

- Construction of a northbound collector-distributor (CD) system serving Sunbury Parkway and US 36/SR 37
  - A two-lane northbound CD-road will exit from I-71 and serve both Sunbury Parkway and US 36/SR 37
  - A two-lane exit ramp will depart from the CD-road and connect to Sunbury Parkway
  - A single lane CD-road will continue north under Sunbury Parkway toward US 36/SR 37
  - The northbound entrance ramp from Sunbury Parkway will connect to the CD-road. Traffic from Sunbury Parkway bound for I-71 northbound will have to pass through the existing signal at the US 36/SR 37 northbound ramp terminal.
- Construction of new ramp connections from Sunbury Parkway to I-71 southbound
  - A single-lane loop ramp will connect westbound Sunbury Parkway to I-71 southbound
  - A two-lane ramp will connect eastbound Sunbury Parkway to I-71 southbound. This ramp will be narrowed to a single lane prior to reaching I-71
  - No CD-road is proposed in the southbound direction. Both new entrance ramps will merge onto I-71.
  - No changes to the I-71 southbound ramps at US 36/SR 37.
- Construction of Sunbury Parkway west of Wilson Road
  - This roadway section will generally have a six-lane section between Africa Road and Wilson Road
  - A multi-use path and a sidewalk will be included in this roadway section
- Widening of the committed future Sunbury Parkway from two lanes to five lanes east of Wilson Road
- Realignment of 3B's & K Road south of Sunbury Parkway to create a 90-degree intersection
  - Cul-de-sacs will be constructed on the existing 3B's & K Road where it meets the new Sunbury Parkway
- Realignment of Africa Road and US 36/SR 37 to create a 4-leg intersection with the new Sunbury Parkway

Appendix A

Letters of Project Support

RESOLUTION 2016-05

A RESOLUTION SUPPORTING THE ATTRIBUTABLE FUNDING APPLICATION TO IMPROVE THE INTERCHANGE AT INTERSTATE 71 AND ROUTE 36/37 THROUGH CONSTRUCTION OF NEW COMPANION RAMPS TO THE SOUTH OF THE EXISTING INTERCHANGE AT THE PROPOSED SUNBURY PARKWAY TO THE MID-OHIO REGIONAL PLANNING COMMISSION (MORPC).

WHEREAS, the improved interchange at Interstate 71 and Route 36/37 through construction of new companion ramps to the south of the existing interchange at proposed Sunbury Parkway is included in the pending Village of Sunbury Comprehensive Plan; and

WHEREAS, this project provides improved access to Interstate 71 and a western link from the interchange area to the Village of Sunbury; and

WHEREAS, the project provides dedicated bike and pedestrian ways along Sunbury Parkway; and

WHEREAS, relieving congestion on the existing interchange at Interstate 71 and Route 36/37 through construction of new companion ramps to the south of the existing interchange at proposed Sunbury Parkway, as well as a western link from the interchange area to the Village of Sunbury, will improve driving conditions in the Village of Sunbury and neighboring portions of the region.

NOW, THEREFORE, BE IT RESOLVED by the Council for the Village of Sunbury State of Ohio as follows:

SECTION I: The Village of Sunbury Council respectively supports all efforts to obtain funding from the Mid-Ohio Regional Planning Commission (MORPC) to assist in advancing the construction of new companion ramps to the south of the existing interchange at proposed Sunbury Parkway.

SECTION II: The Village of Sunbury Council is committed to the local funding level included with this request.

SECTION III: It is found and determined that all formal actions of this Council concerning and relating to the adoption of this resolution were adopted in an open meeting of this Council, and that all deliberations of this Council and of any of its committees that resulted in such formal action were meetings open to the public, and in compliance with all legal requirements, including Section 121.22 of the Ohio Revised Code.

SECTION IV: This Resolution is hereby declared to be an emergency measure necessary for the immediate preservation of the public peace, health, safety and welfare of the citizens of the Village of Sunbury to meet MORPC application deadlines.

VOTE ON SUSPENSION OF THE RULES: YEA 5 NAY 0

VOTE ON RESOLUTION 2016-05 YEAS 5 NAYS 0

PASSED: September 21, **2016**

Tommy Hatfield

Tommy Hatfield, Mayor

ATTEST: Kathy Belcher

Kathy Belcher, Fiscal Officer

CERTIFICATION

I hereby certify on this 21 day of September, 2016, that the foregoing is a true and accurate copy of the Resolution passed at the meeting held on September 21, 2016, of the Village of Sunbury, County of Delaware, State of Ohio.

Kathy Belcher

Fiscal Officer

109 Harrison Street, PO Box 386, Galena, Ohio 43021 740-965-2484 740-965-5424 (fax)
mayor@galenaohio.org wwwgalenaohio.org

October 3, 2016

Mr. Jerry Wray
Director – Ohio Department of Transportation
1980 West Broad Street
Columbus, Ohio 43223

RE: DEL-71-7.91 (PID 90200) I-71 and US 36/SSR 37 Interchange

Dear Mr. Wray,

The Village of Galena supports the improvement of the I-71 and US 36/SR 37 interchange and surrounding area in eastern Delaware County.

Development in and around the I-71 and US 36/SR 37 interchange has grown significantly over the last few years. Estimates show this area will continue to grow in population and traffic. This has been especially true since completion of the Tanger Outlet Mall which has led to lengthy traffic delays on area roadways.

It is extremely important to Galena that we maintain a corridor that will not only service the existing businesses but also area residents and future commercial and residential growth in and around I-71 and US 36/SR37. The Village is very concerned that the current traffic situation will not only continue to clog traffic flow on US 36/SR 37 but spill over to local roads in the area as people attempt to find alternate pathways. Several of these possible alternates go through Galena. Such an increase in traffic through the Village would have a very negative impact on the daily life of the residents.

The planned interchange improvements, which include the addition of the southern interchange at the proposed Sunbury Parkway, are important to the entire area's transportation system. They are needed for both a viable economic future for our region and maintenance of a high quality of life for area residents.

These improvements will serve the entire region surrounding the interchange including the townships and both Sunbury and Galena. These improvements are the best alternate to address the current and future safety and congestion issues at the existing I-71 and US 36/SR 37 interchange.

Thank you so much for your consideration to fund this critical project through the Transportation Review Advisory Council (TRAC).

Sincerely,

Thomas W. Hopper, Mayor
Village of Galena

cc: Sunbury

Delaware County Commissioners

Jeff Benton
Barb Lewis
Gary Merrell

County Administrator
Ferzan M. Ahmed

Clerk to the Commissioners
Jennifer Walraven

Sept. 19, 2016

Mr. Jerry Wray
Director, Ohio Department of Transportation
1980 W. Broad St.
Columbus, OH 43223

RE: DEL-71-7.91 (PID 90200) I-71 and US 36/SR 37 Interchange

Dear Mr. Wray,

Please regard this letter from the Delaware County Board of Commissioners as an expression of firm support for the improvement of the Interstate 71 and U.S. Route 36/State Route 37 interchange in Delaware County, which is in line with ODOT's preferred alternative for the corridor.

Development and continued growth in the area that surrounds the existing interchange are some of the most pressing concerns facing the County today, and managing these issues has been a top priority for this Board for many years.

It is essential to Delaware County that this corridor and interchange continue to be developed and maintained such that the needs of our residents, business owners and visitors are met. The planned interchange improvements, which include ramps at the proposed Sunbury Parkway, would be critical to the safe and efficient operation of our transportation system and would enable the County to continue developing economically in a prudent and thoughtful manner. We believe these improvements would also address current safety and congestion issues that exist already at the current interchange.

We encourage you to approve the funding for this necessary public improvement because we firmly believe it is a project that will yield long-term benefits not just for those who live and work in the vicinity of this interchange, but for the County as a whole.

Sincerely,

Barb Lewis
County Commissioner

Gary Merrell
County Commissioner

Jeff Benton
County Commissioner

Delaware County Commissioners, 101 North Sandusky Street, P.O. Box 8006 Delaware, Ohio 43015
(740) 833-2100 (740) 548-7313 FAX: (740) 833-2099

September 22, 2016

Mr. Jerry Wray
Director – Ohio Department of Transportation
1980 West Broad Street
Columbus, Ohio 43223

RE: DEL-71-7.91 (PID 90200) I-71 and US 36/SSR 37 Interchange

Dear Mr. Wray,

The Big Walnut Area Chamber of Commerce would like to express our support for the proposed improvement of the I-71 and US 36/SR 37 interchange in Delaware County.

Development in and around the I-71 and US 36/SR 37 has grown significantly over the last few years, and estimates show this area will continue to grow in population and traffic.

It is extremely important to Delaware County that we maintain a corridor that will service the residents, business, and future growth in and around I-71 and US 36/SR37.

The planned interchange improvements, which include ramps at the proposed Sunbury Parkway, are important to our transportation system and needed for a more sustainable economic future for our region.

It will address the current and future safety and congestion issues at the existing I-71 and US 36/SR 37 interchange.

Thank you so much for your consideration to fund this critical project through the Transportation Review Advisory Council.

Sincerely,

Chauncey Montgomery, President

John Fox, Executive Director

OLENTANGY | LOCAL SCHOOLS

OFFICE OF THE SUPERINTENDENT

814 Shanahan Road, Suite 100
Lewis Center, OH 43035

September 20, 2016

Mr. Jerry Wray
Director – Ohio Department of Transportation
1980 West Broad Street
Columbus, Ohio 43223

RE: DEL-71-7.91 (PID 90200) I-71 and US 36/SSR 37 Interchange

Dear Mr. Wray,

The Olentangy School District supports the improvement of the I-71 and US 36/SR 37 interchange in Delaware County. Delaware County has been the fastest growing County for over a decade and traffic has increased with this growth, creating congestion and safety concerns.

Our District boundaries extend north and south of US 36/SR 37 from I-71 west to the Scioto River. The interchange improvements include a proposed east west regional arterial route, the proposed Sunbury Parkway which will address existing and future traffic needs. The planned interchange improvements, which include ramps at the proposed Sunbury Parkway, is important to our transportation system and will assist with improving safety for our bus drivers when transporting students to and from school. We also understand the proposed Sunbury Parkway will include a sidewalk and multi-use path that will provide opportunities for walking and biking to our schools.

Thank you so much for your consideration to fund this critical project through the Transportation Review Advisory Council (TRAC).

Sincerely,

Mark T. Raiff

Mark T. Raiff
Superintendent

T (740) 657-4050

F (740) 657-4001

www.olentangy.k12.oh.us

Appendix B

Crash Data

- - (-) From // to //

US 36/SR 37 from Africa Road to west of Kintner Parkway

	Number
Total	**304**

CRASH_SEVERITY	Number	%
Injury Crash	**95**	31.3%
Property Damage Crash	**209**	68.8%
Grand Total	**304**	**100.0%**

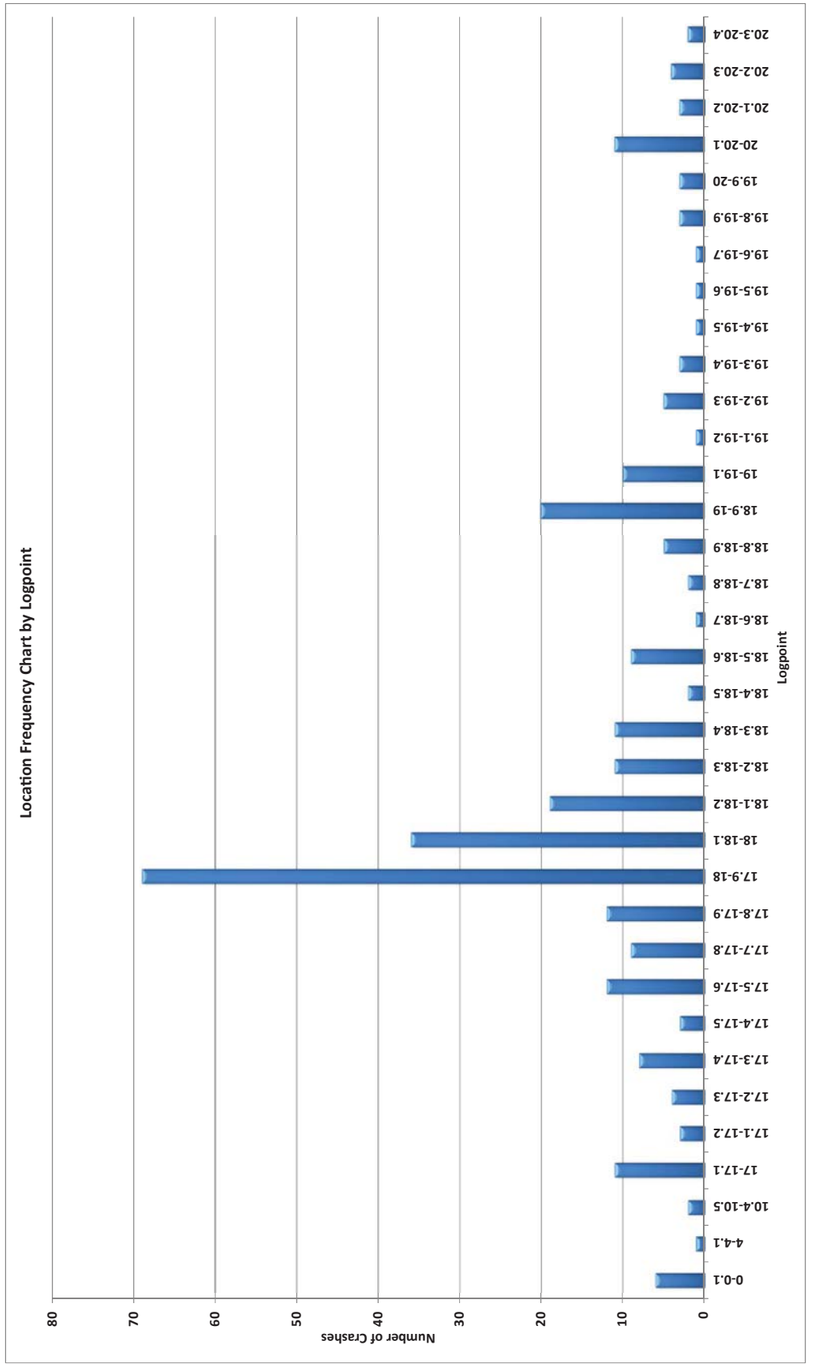
TRAFFIC_CRASH_YEAR	Number	%
2013	**99**	32.6%
2014	**100**	32.9%
2015	**105**	34.5%
Grand Total	**304**	**100.0%**

DAY_OF_WEEK	Number	%
Wednesday	**50**	16.4%
Friday	**49**	16.1%
Monday	**49**	16.1%
Tuesday	**49**	16.1%
Thursday	**47**	15.5%
Saturday	**32**	10.5%
Sunday	**28**	9.2%
Grand Total	**304**	**100.0%**

HOUR_OF_DAY	Number	%
0	**4**	1.3%
1	**1**	0.3%
3	**6**	2.0%
4	**1**	0.3%
5	**4**	1.3%
6	**20**	6.6%
7	**34**	11.2%
8	**18**	5.9%
9	**18**	5.9%
10	**21**	6.9%
11	**15**	4.9%
12	**15**	4.9%
13	**13**	4.3%
14	**15**	4.9%
15	**23**	7.6%
16	**11**	3.6%
17	**30**	9.9%
18	**22**	7.2%
19	**8**	2.6%
20	**9**	3.0%
21	**4**	1.3%
22	**9**	3.0%
23	**3**	1.0%
Grand Total	**304**	**100.0%**

TYPE_OF_CRASH	Number	%
Rear End	**119**	39.1%
Left Turn	**44**	14.5%
Sideswipe - Passing	**44**	14.5%
Angle	**34**	11.2%
Animal	**22**	7.2%
Fixed Object	**15**	4.9%
Other Non-Collision	**7**	2.3%
Backing	**6**	2.0%
Sideswipe - Meeting	**6**	2.0%
Parked Vehicle	**3**	1.0%
Head On	**1**	0.3%
Overturning	**1**	0.3%
Other Object	**1**	0.3%
Pedestrian	**1**	0.3%
Grand Total	**304**	**100.0%**

US 36/SR 37 from Africa Road to west of Kintner Parkway



- - (-) From // to // **I-71 in vicinity of US 36/SR 37 interchange**

	Number
Total	**128**

CRASH_SEVERITY	Number	%
Fatal Crash	**1**	0.8%
Injury Crash	**41**	32.0%
Property Damage Crash	**86**	67.2%
Grand Total	**128**	**100.0%**

TRAFFIC_CRASH_YEAR	Number	%
2013	**42**	32.8%
2014	**48**	37.5%
2015	**38**	29.7%
Grand Total	**128**	**100.0%**

DAY_OF_WEEK	Number	%
Wednesday	**26**	20.3%
Friday	**26**	20.3%
Sunday	**22**	17.2%
Monday	**17**	13.3%
Thursday	**15**	11.7%
Tuesday	**11**	8.6%
Saturday	**11**	8.6%
Grand Total	**128**	**100.0%**

HOUR_OF_DAY	Number	%
0	**5**	3.9%
1	**3**	2.3%
2	**8**	6.3%
3	**4**	3.1%
4	**2**	1.6%
5	**3**	2.3%
6	**3**	2.3%
7	**3**	2.3%
8	**3**	2.3%
9	**3**	2.3%
10	**2**	1.6%
11	**4**	3.1%
12	**3**	2.3%
13	**6**	4.7%
14	**13**	10.2%
15	**3**	2.3%
16	**13**	10.2%
17	**17**	13.3%
18	**6**	4.7%
19	**7**	5.5%
20	**4**	3.1%
21	**1**	0.8%
22	**6**	4.7%
23	**6**	4.7%
Grand Total	**128**	**100.0%**

TYPE_OF_CRASH	Number	%
Rear End	**41**	32.0%
Sideswipe - Passing	**26**	20.3%
Fixed Object	**23**	18.0%
Animal	**13**	10.2%
Other Object	**13**	10.2%
Other Non-Collision	**9**	7.0%
Parked Vehicle	**1**	0.8%
Pedestrian	**1**	0.8%
Overturning	**1**	0.8%
Grand Total	**128**	**100.0%**

- - (-) From // to // **I-71 in vicinity of US 36/SR 37 interchange**

DIRECTION_FROM1	Number	%
South	**72**	56.3%
North	**53**	41.4%
East	**2**	1.6%
West	**1**	0.8%
Grand Total	**128**	**100.0%**

DIRECTION_TO1	Number	%
North	**72**	56.3%
South	**54**	42.2%
West	**1**	0.8%
East	**1**	0.8%
Grand Total	**128**	**100.0%**

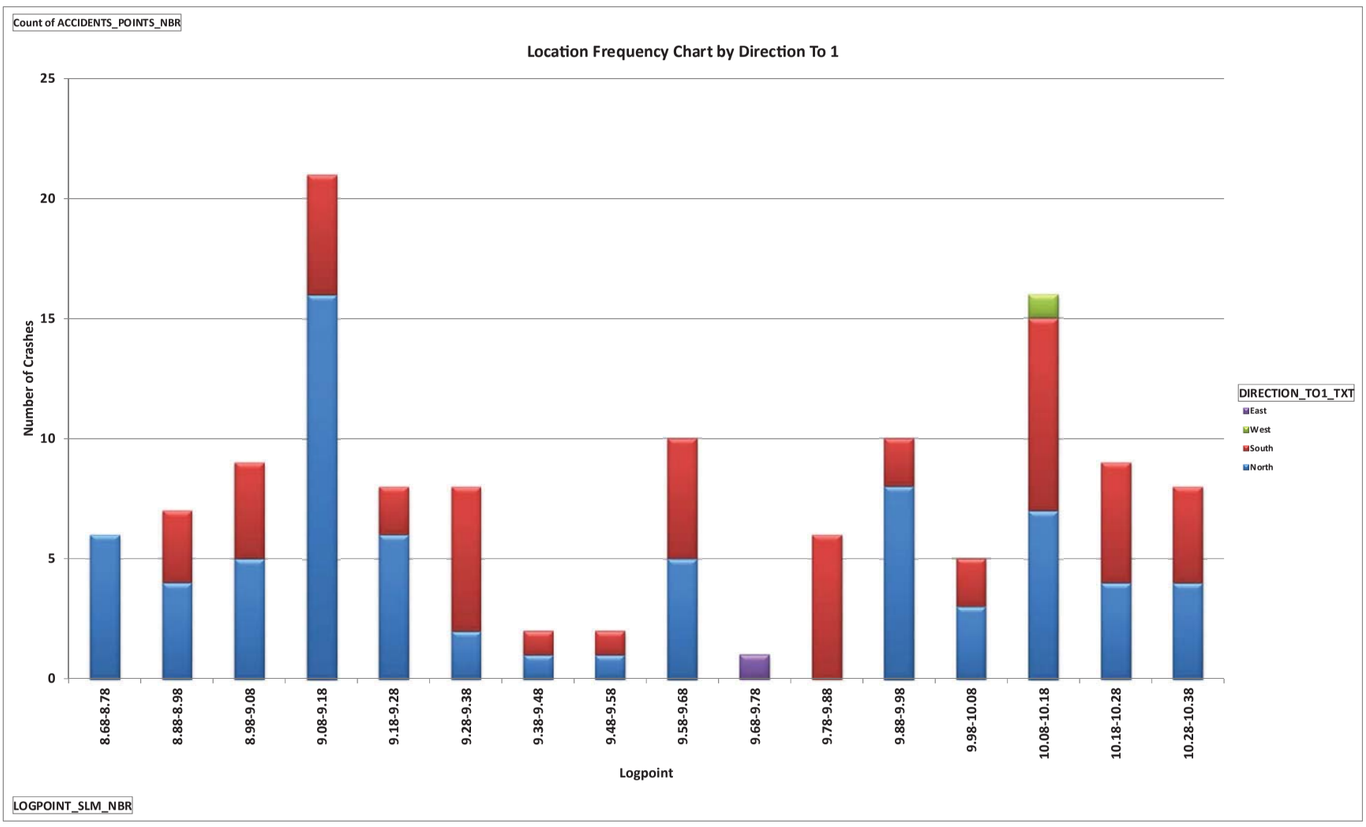
POSTED_SPEED1	Number	%
Posted Speed Over 65	**96**	75.0%
Posted Speed 61-65	**27**	21.1%
Posted Speed 51-55	**2**	1.6%
Posted Speed Not Stated	**2**	1.6%
Posted Speed 31-35	**1**	0.8%
Grand Total	**128**	**100.0%**

ESTIMATED_SPEED1	Number	%
Unit Speed 61-65	**32**	25.0%
Unit Speed Over 65	**28**	21.9%
Unit Speed Not Stated	**15**	11.7%
Unit Speed 56-60	**15**	11.7%
Unit Speed 51-55	**11**	8.6%
Unit Speed 20 and Under	**8**	6.3%
Unit Speed 46-50	**7**	5.5%
Unit Speed 41-45	**3**	2.3%
Unit Speed 31-35	**3**	2.3%
Unit Speed 36-40	**2**	1.6%
Unit Speed 26-30	**2**	1.6%
Unit Speed 21-25	**2**	1.6%
Grand Total	**128**	**100.0%**

VEHICLE_TYPE1	Number	%
Mid Size	**49**	38.3%
Sport Utility Vehicle	**27**	21.1%
Tractor/Semi-Trailer	**13**	10.2%
Pickup	**13**	10.2%
Compact	**10**	7.8%
Full Size	**3**	2.3%
Tractor/Double	**2**	1.6%
Single Unit Truck Or Van 2 Axle, 6 Tires	**2**	1.6%
Sub-Compact	**2**	1.6%
Van	**2**	1.6%
Unknown Or Hit/Skip	**1**	0.8%
Single Unit Truck/Trailer	**1**	0.8%
Pedestrian/Skater	**1**	0.8%
Minivan	**1**	0.8%
Truck/Tractor (Bobtail)	**1**	0.8%
Grand Total	**128**	**100.0%**

VEHICLE_TYPE2	Number	%
	50	39.1%
Mid Size	**25**	19.5%
Sport Utility Vehicle	**21**	16.4%
Compact	**6**	4.7%
Minivan	**5**	3.9%
Pickup	**5**	3.9%
Van	**4**	3.1%
Unknown Or Hit/Skip	**3**	2.3%
Tractor/Semi-Trailer	**3**	2.3%
Single Unit Truck/Trailer	**2**	1.6%
Bus (16+ Seats, Inc Driver)	**1**	0.8%
Other Passenger Vehicle	**1**	0.8%
Full Size	**1**	0.8%
Single Unit Truck Or Van 2 Axle, 6 Tires	**1**	0.8%
Grand Total	**128**	**100.0%**

I-71 in vicinity of US 36/SR 37 interchange



Appendix C

Analysis of Sunbury Full Interchange Alternative

ms consultants, inc.
engineers, architects, planners

Analysis of Sunbury Full Interchange Alternative

Delaware County, Ohio

August 28, 2017

ms consultants, inc.
engineers, architects, planners

TABLE OF CONTENTS

FIGURES

APPENDIX

PURPOSE

The recommended Build Condition of the Interchange Modification Study does not provide a direct ramp connection from I-71 southbound to Sunbury Parkway. In the Build condition, I-71 southbound traffic bound for Sunbury Parkway would exit at US 36/SR 37 and use Wilson Road to access Sunbury Parkway. All other movements are provided in the Build condition. The purpose of this document is to analyze an alternative where this direct ramp connection is provided and explain why it was not recommended.

During the Feasibility Study phase of the project, traffic forecasts determined that there was minimal demand for a connection from I-71 southbound to Sunbury Parkway. The *June 9, 2014 Preliminary Traffic Analysis Report* found that the road network would operate acceptably without such a connection, and recommended that it be dismissed from further consideration. This document will use updated traffic volumes and other data to reevaluate and confirm the earlier findings.

ALTERNATIVE DESCRIPTION

The "Sunbury Full Interchange" alternative would be similar to the recommended Build condition, except that a direct ramp connection would be made from I-71 southbound to Sunbury Parkway. In the Build condition, I-71 southbound traffic bound for Sunbury Parkway would exit at US 36/SR 37 and use Wilson Road to access Sunbury Parkway.

A summary of the Sunbury Full Interchange alternative is provided below:

- A ramp connection for the I-71 southbound movement to Sunbury Parkway.
  - This ramp would intersect Sunbury Parkway at a new signalized intersection.
  - Two southbound approach lanes (left turn/through, right turn) would be provided.
  - An auxiliary lane would be built on I-71 southbound between the US 36/SR 37 entrance ramp and this new exit ramp.
- A two-lane ramp for traffic entering I-71 southbound from both directions of Sunbury Parkway.
  - Both entrance ramp lanes would reach I-71 southbound mainline at the same merge point
  - 1,000' acceleration lanes are proposed in accordance with AASHTO criteria. (ODOT Location & Design Manual criteria call for 2,000' acceleration lanes.) These lanes would not impact the Cheshire Road bridge, located on I-71 south of Sunbury Parkway.
- Double westbound left turn lanes on Sunbury Parkway at the I-71 southbound entrance ramp.
  - This would replace the westbound-to-southbound loop ramp in the Build condition.
- The eastbound Sunbury Parkway to I-71 southbound movement under signal control.
  - As with the Build condition, an exclusive right turn lane and a shared through/right turn lane would be provided.
  - This movement could not operate with a single free-flow right turn lane, as it is necessary to have two eastbound lanes connecting to I-71 southbound to avoid lane imbalance issues at the upstream Sunbury Parkway/Fourwinds Drive intersection.

All other aspects of the Sunbury Full Interchange alternative would be identical to the Build condition. Graphics of this alternative are provided on **Figure C-1, Figure C-2 and Figure C-3**.

Analysis of Sunbury Full Interchange Alternative
DEL-71-7.91 Interchange Modification Study, PID 90200
Delaware County, Ohio

TRAFFIC VOLUMES

Development of 2038 Forecasts for Sunbury Full Interchange Alternative

Traffic forecasts for the Sunbury Full Interchange configuration were developed using certified traffic volumes previously developed for an alternative with full interchanges at both US 36/SR 37 and Sunbury Parkway. These previously certified volumes for a 2032 Design Year, prepared in February 2012, were used to derive the percentage of southbound exiting vehicles that would use a ramp to Sunbury Parkway – approximately 15% in each peak hour. This percentage was applied to the certified Design Year 2038 forecasts (Appendix G) to obtain 2038 ramp volumes for the Sunbury Full Interchange alternative. The vehicles on the southbound Sunbury Parkway exit ramp were assumed to distribute in the same manner than vehicles distribute on the US 36/SR 37 southbound exit ramp. The 2038 traffic volumes for the Diamond Interchange alternative is provided on **Figure C-4**.

The volumes on Figure C-4 indicate that there is relatively minimal traffic demand for the movement from I-71 southbound to Sunbury Parkway - a total of 60 vehicles in the AM peak hour and 110 vehicles in the PM peak hour are predicted in the 2038 Design Year. The vast majority of the exiting I-71 southbound traffic would continue to use the US 36/SR 37 exit ramp, rather than a Sunbury Parkway exit ramp.

Reexamination of Previous Traffic Forecasts

The previously developed certified traffic volumes were reexamined by the ODOT Office of Statewide Planning & Research to confirm that there is minimal demand for a southbound exit ramp to Sunbury Parkway. OSPR's reexamination confirmed the certified traffic forecasts and conclusions. OSPR used state-of-the-practice procedures to develop the traffic forecasts. These procedures are consistent with the newly-released NCHRP 765 which provides guidelines for traffic forecasting. In fact, much of NCHRP 765 is based on these OSPR procedures. The most-recent land-use projections, including development plans for the interchange vicinity were incorporated into the forecasts. Traffic analysis zones (TAZ's) in the interchange vicinity were split to better estimate turning movements at intersections. Further documentation of OSPR's methodology, data inputs, and findings are included in **Appendix C-A**.

The OSPR model indicates that the vast majority of traffic using this interchange is to/from the south, where the Columbus metropolitan area is located. Compared with Columbus and its suburbs, the areas to the north have far lower populations. For the traffic coming from the north, the modeling finds that a large majority of those vehicles would exit at US 36/SR 37 instead of Sunbury Parkway. For traffic trying to reach destinations east and west of the study area (Delaware, Sunbury), it will be faster for southbound vehicles to exit at US 36/SR 37, rather than use Sunbury Parkway. Similarly, it will be faster for traffic trying to access existing or most future development in the interchange vicinity by exiting at US 36/SR 37, as it would avoid backtracking. Only future development planned for south of Sunbury Parkway, which comprises a small percentage of the development around this interchange, would attract vehicles to use a southbound exit ramp to Sunbury Parkway.

CAPACITY ANALYSIS

Capacity analyses were performed for the Sunbury Full Interchange alternative using Highway Capacity Software (HCS). Freeway junction and weave capacity analyses are shown on **Table C-1**, while intersection capacity analyses are shown on **Table C-2**. Copies of these HCS analyses are provided in **Appendix C-B**. **Figure C-5** summarizes the LOS results in graphical form.

Table C-1: Capacity Analyses for Ramp Junctions and Weaving Segments

			Build Condition				Sunbury Full Interchange (w/SB Exit Ramp to Sunbury Pkwy.)			
			2038 AM Peak		2038 PM Peak		2038 AM Peak		2038 PM Peak	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-71 SB	J-11	Diverge: I-71 SB at US 36/SR 37 exit	19.7	B	17.7	B	19.6	B	17.4	B
	F-9	Freeway Segment: I-71 SB under US 36/SR 37	16.4	B	11.5	B	16.7	B	12.1	B
	W-2	Weave: from US 36/SR 37 to Sunbury Pkwy	*N/A*	*N/A*	*N/A*	*N/A*	16.8	B	11.4	B
	J-13	Merge: I-71 SB at Sunbury Parkway WB	23.2	C	15.2	B	*N/A*	*N/A*	*N/A*	*N/A*
	F-12	Freeway Segment: I-71 SB under Sunbury Parkway	22.9	C	15.0	B	20.1	C	14.1	B
	J-14	Merge: I-71 SB at Sunbury Parkway*	33.8	D	20.7	C	11.4	B	2.4**	A

*In Build Condition, this location represents merge point of ramp from eastbound Sunbury Parkway. The Build condition is a single-lane merge with 900' of acceleration lane distance. The Sunbury Full Interchange condition is a two-lane merge with two 1500' acceleration lanes. If the Sunbury Full Interchange condition were a single-lane merge with 900' acceleration lane (similar to Build condition), it would operate at LOS E (35.0 pc/mi/ln) in the AM and LOS C (21.0 pc/mi/ln) in the PM.
**HCS calculates a negative density, which is impossible

Analysis of W-2 (Sunbury Full Interchange) and F-9 (Build condition)

As shown in Table C-1, the Sunbury Full Interchange alternative would add a weave section (W-2) that does not exist in the Build condition. This weave is expected to operate acceptably through the Design Year, although it would create additional conflict points along I-71 southbound.

Analysis of Sunbury Full Interchange Alternative
DEL-71-7.91 Interchange Modification Study, PID 90200
Delaware County, Ohio

Analysis of I-71 Southbound merge (J-14)

While southbound merge in the Sunbury Full Interchange is expected to operate at LOS B compared with LOS D in the Build condition, this is largely irrelevant, as the downstream freeway segment is predicted to operate at LOS E. The Build condition will provide more storage for future ramp metering of this downstream LOS E freeway segment. The Sunbury Full Interchange alternative would require metering a shorter two-lane ramp, creating risk of queuing into the ramp terminal signal.

Table C-2: Capacity Analyses for Intersections

			Build Condition				Sunbury Full Interchange (w/SB Ramp to Sunbury Pkwy.)			
			2038 AM Peak		2038 PM Peak		2038 AM Peak		2038 PM Peak	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
US 36/ SR 37	I-4	US 36/SR 37 & Fourwinds Drive	26.1	C	31.2	C	26.2	C	31.7	C
	I-5	US 36/SR 37 & Bob Evans/McDonalds	29.7	C	42.2	D	29.3	C	38.7	D
	I-6	US 36/SR 37 & I-71 SB ramps	27.8	C	33.6	C	27.1	C	31.0	C
	I-7	US 36/SR 37 & I-71 NB ramps	27.6	C	31.0	C	27.7	C	31.1	C
	I-8	US 36/SR 37 & Wilson Road	32.6	C	35.9	D	32.6	C	35.9	D
Sunbury Parkway	I-12	Sunbury Parkway & Fourwinds Drive	35.0	D	36.3	D	36.6	D	36.8	D
	I-12A	Sunbury Parkway & I-71 SB ramps	All movements free-flow (LOS A, 0 seconds of delay)				33.7	C*	26.9	C*
	I-13	Sunbury Parkway & I-71 NB ramps	23.7	C	31.1	C	23.7	C	31.2	C
	I-14	Sunbury Parkway & Wilson Road	32.5	C	35.2	D	32.4	C	35.1	D

*As per ODOT typical practice, v/c ratios on eastbound approach were balanced. However, this results in over 50% of the EBRT vehicles using the shared lane in the AM peak hour. This is inconsistent with typical observed behavior on approaches with double right turn movements, which generally see a large majority of vehicles using the curb lane. If less than 40% of the EBRTs use the shared lane, the EBRT movement would operate at LOS F. If less than 20% of the EBRTs use the shared lane, the entire intersection would operate at LOS F.

Table C-2 shows that the Sunbury Parkway/I-71 southbound ramps intersection (I-12A) would have considerably greater delay in with the Sunbury Full Interchange alternative, compared with the Build condition. This location would be signalized, unlike the free-flow operations in the Build condition – representing an increase of 35 hours of delay in the AM peak and 31 hours of delay in the PM peak hour over the Build condition. The signal is predicted to operate at LOS C in the AM peak hour, but that assumes that 54% of eastbound right turning vehicles use the shared lane in order to balance v/c ratios, as per ODOT practice. Though little data on the subject is available, double right turn movements – especially

those involving a shared through/right turn lane - are typically observed to have most of the traffic using the curb lane. Delays for this movement and this intersection would be much worse if a lower percentage of vehicles were assumed to use the shared lane.

All other intersections have no difference in LOS between the two alternatives.

CONNECTIVITY

As evidenced by Table C-1 and Table C-2, the Build condition road network can adequately handle the southbound I-71 traffic trying to reach Sunbury Parkway, without constructing the dedicated ramp provided in the Sunbury Full Interchange alternative. Sunbury Parkway and existing US 36/37 are parallel roadways that split less than a mile to the west of I-71 and 2.5 miles east of I-71. Thus, southbound drivers can access Sunbury Parkway by turning in either direction from the US 36/SR 37 exit. These vehicles can also access Wilson Road, a 4-lane arterial located one signal east of I-71, to reach Sunbury Parkway. It is anticipated that as development increases in the area, Fourwinds Drive will be extended from US 36/SR 37 to Sunbury Parkway, giving vehicles an another way to access areas south of Sunbury Parkway.

The I-71 southbound to Sunbury Parkway movement is predicted to have minimal demand (110 or fewer vehicles in the Design Year). Additionally, this movement would not serve major freight routes. The areas south of Sunbury Parkway, with the exception of some commercial development in the interchange vicinity, are residential in nature. Vehicles wanting to make this connection would be almost exclusively commuters or shoppers – not through truck traffic. These types of trips are appropriate to assign to the arterial street system.

SAFETY ANALYSIS

Safety analyses were performed to compare the Sunbury Full Interchange alternative with the Build condition. The ODOT Economic Crash Analysis Tool (ECAT) was utilized to analyze Sunbury Parkway/I-71 southbound ramp terminal intersections for both alternatives. The ECAT results indicate that Sunbury Parkway/I-71 southbound ramp area would experience an average of 4.5 crashes/year in the Build condition, which has free-flow ramp terminals. ECAT predicts that the signalized ramp terminal would experience an average of over 7 crashes/year – over 60% more than the Build condition, including nearly double the number of fatal/incapacitating injury crashes. The ECAT results are shown in **Appendix C-C.**

The Sunbury Full Interchange alternative would have more conflict points than the Build condition, both on I-71 and on the arterial system. A 1,500-foot weaving segment would be created on I-71 southbound, which has a 70mph speed limit. The introduction of an I-71 southbound exit ramp intersection on Sunbury Parkway with the I-71 southbound ramps would create 17 conflict points, compared with the 2 conflict points that would exist in the Build alternative on Sunbury Parkway at the I-71 southbound ramps.

RIGHT-OF-WAY

The Sunbury Full Interchange alternative would require less overall right-of-way than the Build condition. Much of the acreage associated with the westbound-to-southbound ramp would not be needed. An

additional small area of right-of-way in the southwest interchange quadrant would be needed, beyond the Build condition right-of-way limits. This additional area comprises less than 1 acre. This additional right-of-way could be avoided design refinements and use of retaining walls.

COST ESTIMATE

A planning-level cost analysis was performed to determine how the Sunbury Full Interchange compared with the Build alternative. The analysis indicates that the Sunbury Full Interchange and the Build condition would have similar cost, with less than $100,000 difference between the alternatives. The Sunbury Full Interchange would involve more pavement and greater traffic control costs (signals, major signs), but require less right-of-way. The cost of the Sunbury Full Interchange alternative would likely increase if retaining walls were used to eliminate right-of-way impacts. Further details on this cost analysis are shown in **Appendix C-D**.

SUMMARY

The Sunbury Full Interchange alternative would provide a direct ramp connection from I-71 southbound to Sunbury Parkway. However, a ramp from I-71 southbound to Sunbury Parkway is not expected to have much traffic demand – 60 vehicles in the AM peak hour and 110 vehicles in the PM peak hour. Compared with the Build alternative, the Sunbury Full Interchange alternative has a number of disadvantages, including:

- Introduction of a ¼ mile weave segment on I-71 southbound
- Additional delays of about 30 seconds/vehicle on Sunbury Parkway, eliminating free-flow movements from Sunbury Parkway onto I-71 southbound
    - This represents 30-35 hours of delay in the AM/PM peak hours, compared with 0 hours of delay in the Build condition
- Additional conflict points and crashes predicted on Sunbury Parkway
- Increased challenges to effectively implement future ramp metering on the entrance ramp to I-71 southbound, which is expected to operate at LOS E

The Build condition is predicted to operate acceptably through the Design Year. In the Build condition, the limited number of vehicles wanting to go from I-71 southbound to Sunbury Parkway can use the arterial road network to easily access their destination. Therefore, it is recommended that the Sunbury Full Interchange alternative be dismissed from further consideration. This is consistent with the conclusion that was reached during the 2014 Feasibility Study.

Given the minimal traffic demand for this ramp, and ODOT's confidence in the traffic projections, there is very limited risk in not constructing a direct connection from I-71 southbound to Sunbury Parkway. This risk is far outweighed by the benefits of avoiding a mainline weave, minimizing conflict points on Sunbury Parkway, and minimizing delays for Sunbury Parkway.

N:\62\10550\admin\reports\2017-08-28 IMS\2017-08-28 Appendix C for IMS.docx

Figures

FIGURE C-1: Sunbury Full Interchange Alternative
Conceptual Design for I-71 Southbound
Northbound direction matches Build Condition

N

August 28, 2017

ms consultants, inc.
engineers, architects, planners

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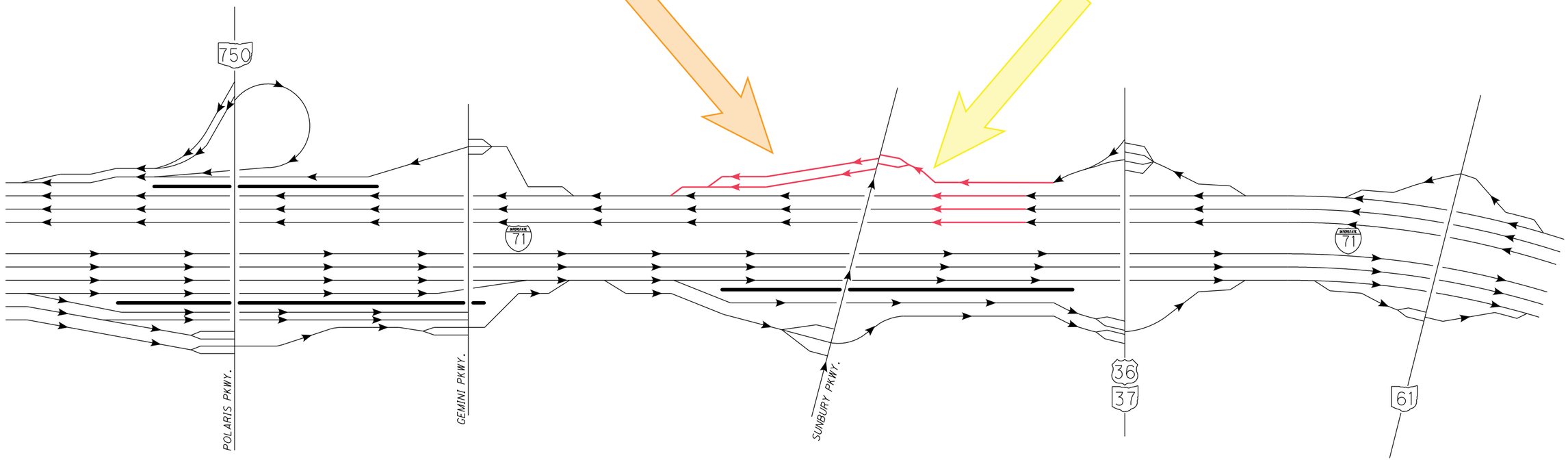
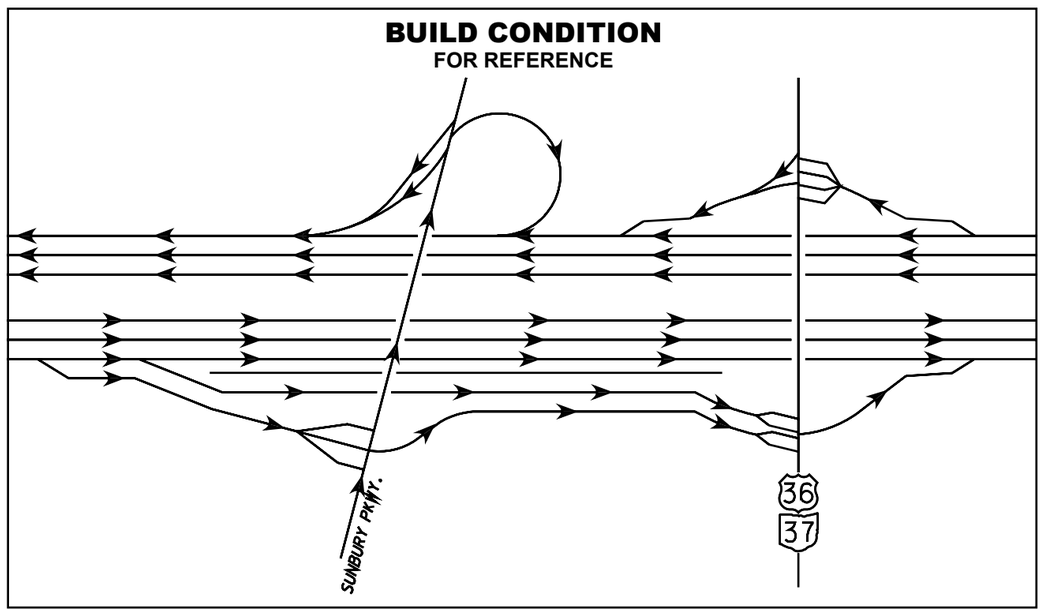
A two-lane ramp for traffic entering I-71 southbound from both directions of Sunbury Parkway.

- Both entrance ramp lanes would reach I-71 southbound mainline at the same merge point

A ramp connection for the I-71 southbound movement to Sunbury Parkway.

- This ramp would intersect Sunbury Parkway at a new signalized intersection.
- Two southbound approach lanes (left turn/through, right turn) would be provided.
- An auxiliary lane would be built on I-71 southbound between the US 36/SR 37 entrance ramp and this new exit ramp.





NOT TO SCALE

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
SUNBURY FULL INTERCHANGE - FREEWAY SYSTEM

FIGURE C-2

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Ohio DOT Workspace

UCF: ohdot\V8i
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By: jhowdyshell

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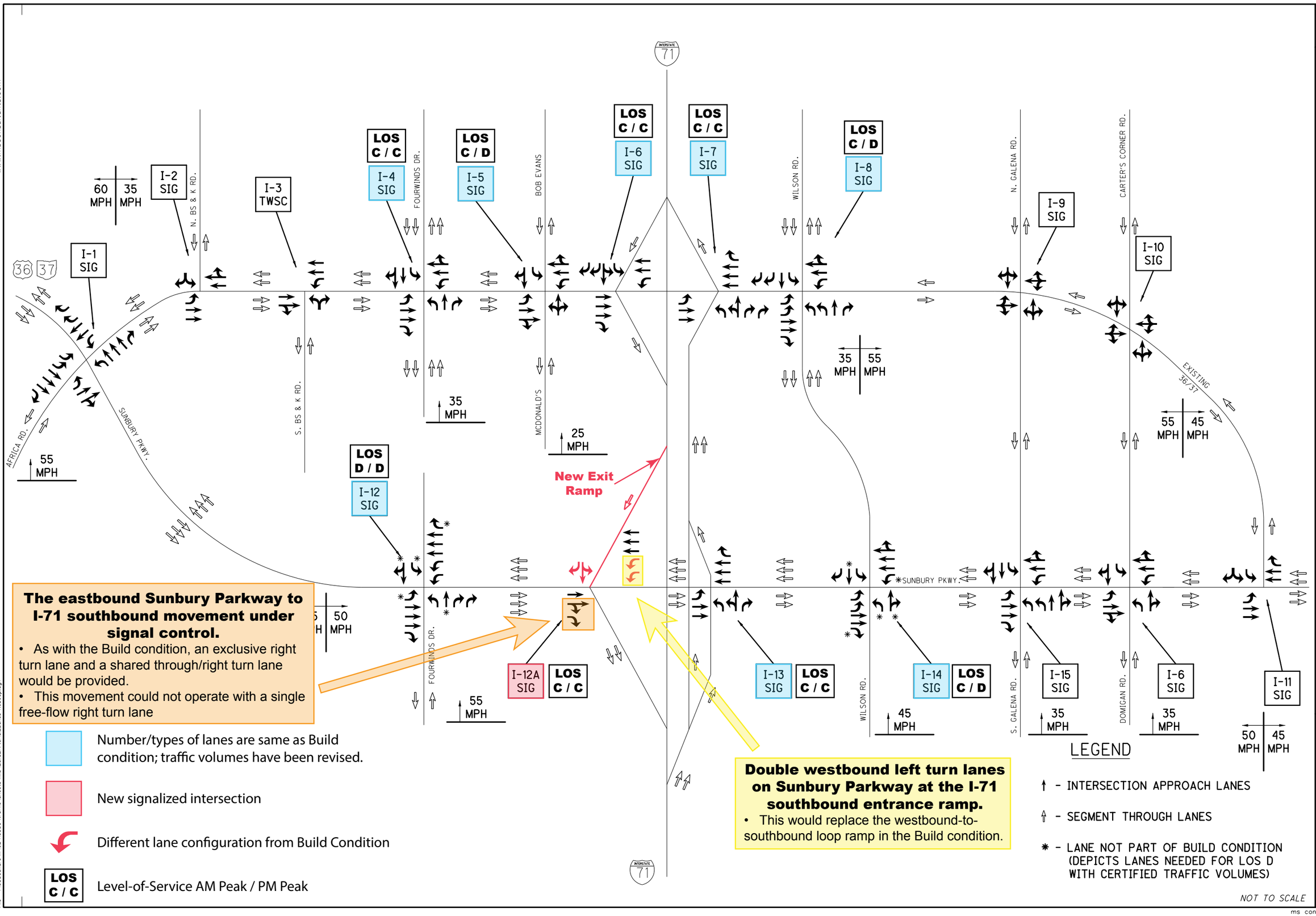
I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
SUNBURY FULL INTERCHANGE - ARTERIAL NETWORK

FIGURE C-3



The eastbound Sunbury Parkway to I-71 southbound movement under signal control.

- As with the Build condition, an exclusive right turn lane and a shared through/right turn lane would be provided.
- This movement could not operate with a single free-flow right turn lane

Double westbound left turn lanes on Sunbury Parkway at the I-71 southbound entrance ramp.

- This would replace the westbound-to-southbound loop ramp in the Build condition.

Number/types of lanes are same as Build condition; traffic volumes have been revised.

New signalized intersection

Different lane configuration from Build Condition

LOS C / C — Level-of-Service AM Peak / PM Peak

LEGEND

↑ - INTERSECTION APPROACH LANES

⇑ - SEGMENT THROUGH LANES

* - LANE NOT PART OF BUILD CONDITION (DEPICTS LANES NEEDED FOR LOS D WITH CERTIFIED TRAFFIC VOLUMES)

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DEL-71-9.67
PID 90200

36 37

71

N 3 Bs & K Rd.

S 3 Bs & K Rd.

Fourwinds Dr.

Bob Evans/
McDonalds

Wilson Rd.

"A" Rd.

N Galena Rd.

Carters Corner Rd.

Africa Rd.

Sunbury Pkwy

Wilson Rd.

Sunbury Pkwy

S Galena Rd.

Domigan Rd.

Volumes different than
Build Condition

N

Figure C-4

DEL-71-9.67 PID NO. 90200
FULL BUILD 2038 AM PEAK/PM PEAK
WITH SOUTHBOUND EXIT RAMP TO SUNBURY PARKWAY
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF STATEWIDE PLANNING & RESEARCH
AUGUST 24, 2017 — NOT TO SCALE

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I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY
2038 HCS LEVELS OF SERVICE - SUNBURY FULL INTERCHANGE

FIGURE C-5

AFRICA RD.
FOURWINDS DR.
N. 3 B'S & K RD.
S. 3 B'S & K RD.
FOURWINDS DR.
MCDONALDS
BOB EVANS
WILSON RD.
WILSON RD.
S. GALENA RD.
N. GALENA RD.
DOMIGAN RD.
CARTER'S CORNER RD.
POLARIS PKWY.
GEMINI PKWY.
SUNBURY PKWY.

750
INTERSTATE 71
INTERSTATE 71
61
36
37

F-14A E/D	J-16 E/E	F-14B D/E	F-14 D/B
J-15 D/C	F-13 D/C	J-14 B/A	I-12A C/C
F-12 C/B	W-2 B/B	I-6 C/C	F-9 B/B
J-11 B/B	F-8 C/B	J-10 C/B	F-7 B/B
J-9 B/B			

J-1 C/D	F-1 A/D	J-2 A/D	F-3 B/E
J-3 B/D	J-8 A/C	F-15 A/B	W-1 A/B
F-4 A/C	J-5 B/C	F-5 A/C	J-6 A/C
F-6 A/C	J-7 B/C		

I-1 D/D	I-2 C/C	I-3 C/C	I-4 C/C
I-5 C/D	I-12 D/D	I-13 C/C	I-14 C/D
I-7 C/C	I-8 C/D	I-9 C/E	I-10 C/C
I-11 C/C	I-15 D/D	I-16 C/C	

Number/types of lanes are same as Build condition; traffic volumes have been revised.

New analysis point

LEGEND

F-XX A/B — LOCATION ID, LOS AM/PM

F - FREEWAY SEGMENT
J - RAMP JUNCTION
I - INTERSECTION
W - WEAVE

NOT TO SCALE

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Appendix C-A

ODOT OSPR Support Data

ms consultants, inc.
engineers, architects, planners

Explanation of ODOT OSPR process in developing certified traffic, in relation to I-71 southbound connection to Sunbury Parkway

When the initial analysis regarding a modified split interchange on IR 71 at US 36/SR 37 was proposed, a full southern interchange was analyzed. The latest two alternatives for which certified design traffic was developed for a full southern interchange are Alternative 5 and Alternative 9. The main difference between these two alternatives is that the speed limit on Sunbury Parkway was modeled at 35 mph in Alternative 5 and at 55mph for Alternative 9. Note that the proposed speed limit for Sunbury Parkway is 50mph. Both memos with design traffic for the entire project are attached at the end of the document. The interchange volumes are shown below in Figure 1.A and 1.B.

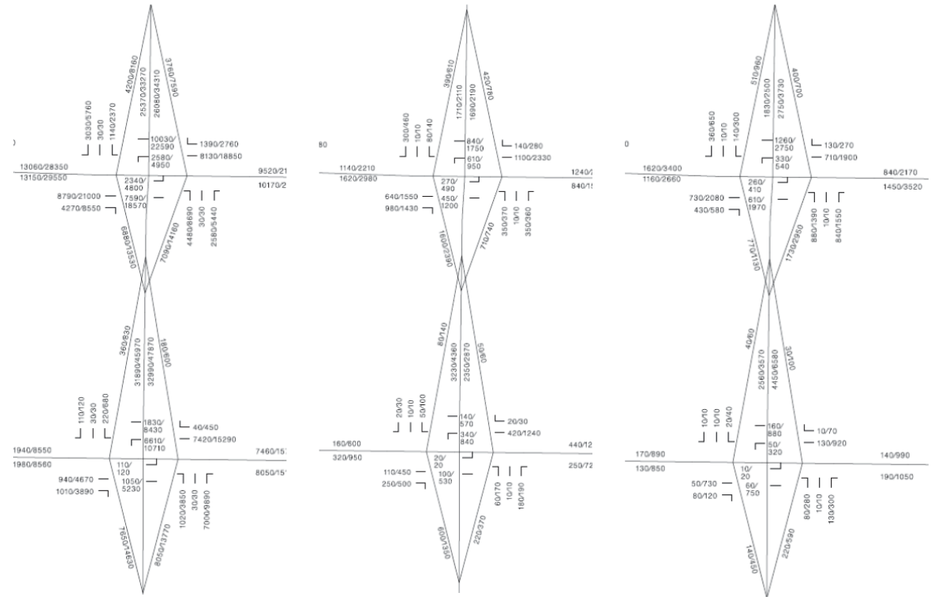


Figure 1: Alternative 5 ADT, AM Design Hour and PM Design Hour Traffic (2012/2032 volumes)

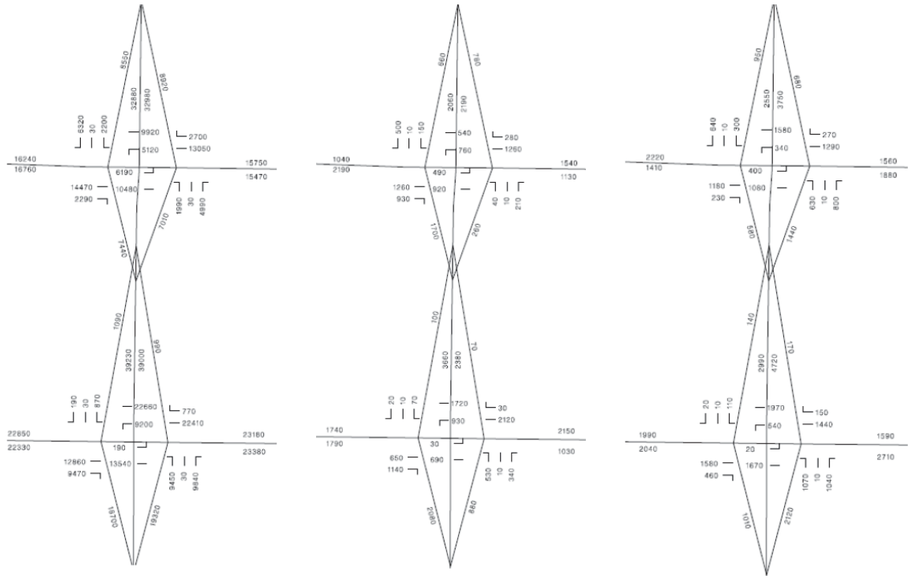


Figure 2: Alternative 9 ADT, AM Design Hour and PM Design Hour Traffic (2032 volumes)

The model seeks to minimize each vehicle's travel costs, which include both time and operating costs (calculated as a cost per mile). As vehicles destined for Delaware or Sunbury/Newark exit at the northern exit ramp so as to minimize their travel costs, the only vehicles using the southern ramp are destined for local development.

Based on the analysis conducted for the development of design traffic, it was determined that the additional delay to the approximately 40,000 daily east and westbound vehicles from a traffic signal (which would be required by a southbound exit ramp at Sunbury Parkway) would greatly outweigh the minimal additional time for the approximately 1000 daily vehicles which would then be required to use the northern exit ramp to access the local businesses.

The Mid-Ohio Regional Planning Commission (MORPC) is the MPO for the Columbus and Delaware, Ohio urbanized areas. As such, they have jurisdiction over the model and its inputs. The MORPC model was exclusively used for this project as its Traffic Analysis Zones (TAZs) are much smaller than the statewide model and its land use has been developed by a demographer with local knowledge.

ODOT has a cooperative relationship with MORPC and the agencies worked jointly on the modeling for this project. Nancy Reger was the Manager of Transportation Data at MORPC when this project was analyzed. (She has since retired.) Attached is the latest land use forecast for the region, which she developed with Delaware County development staff. These land use assumptions were reviewed and agreed upon by all interested parties. Outside of the study area, the land use assumptions approved for the MORPC Long Range Transportation Plan were used.

The TAZs provided by MORPC were split by ODOT using the percentages and boundaries shown in Figure

3.

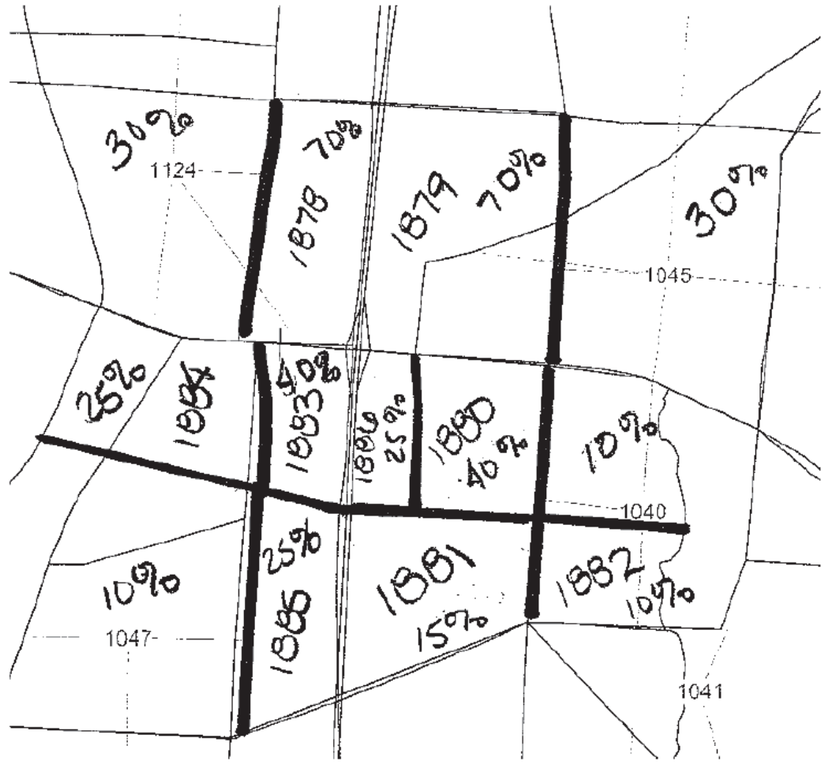


Figure 3: Boundaries showing Traffic Analysis Zone (TAZ) splits in the US 36/SR 37 area

IR 71 at the Delaware/Morrow County line is considered an external zone. As such, MORPC forecasts the traffic at the external zone using a program that takes into account the regression of past counts at that location and the proposed land use growth with access to that location. Additionally, ODOT OSPR used SHIFT, which is our rural certified design traffic tool, to forecast future year volumes that are based on past count regression as well as the statewide model. The information from both SHIFT and the MORPC model were combined to develop the final certified design traffic values.

It is important to note that the same land use assumptions are used for both the Build and the No Build conditions and fixed trip tables are used for all alternatives. Hence traffic from the North does not vary much with the addition of a southern interchange as it does not greatly affect the travel costs of vehicles from the North, especially given that the northern ramps of the IR 71 at US 36/SR 37 interchange are not very congested. As seen above, the majority of southbound vehicles intend to exit at the northern exit ramp even if a southern exit ramp were available.

The development of a southern interchange, however, does affect the travel costs of vehicles from the south as the existing ramps are highly congested today. Hence building additional capacity allows for the reduction of travel costs to residents south of the interchange, thus causing some of those residents to change their routes to save them time.

Regardless of whether most of the traffic is coming from the south (a fair amount is coming from the north), exiting at a southern exit if you are coming from the north requires more distance and generally more time to back-track back north to get to your final destination than it would to just get off at the northern exit and drive straight there. Generally, people don't like to back track. The model is based on math that says people try to minimize their travel costs and if it takes longer and incurs more expense (in terms of operating costs), the model will predict that people don't want to do that. This is what is being seen in the Certified Design Traffic Volumes. You do see, however, that people from the south use both exits and that due partly to congestion and partly due to there being destinations north of SR 37. The road network south of SR 37 does not give you any shorter path if you want to continue south. You still must travel north to Africa and you save no distance to the east either. The majority of destinations are either north of SR 37 or between SR 37 and Sunbury Parkway. There are relatively few destinations south of Sunbury Pkwy. This is the same reason why the split interchange to the north was removed from consideration. When the new road was north of SR 37, very few people from the south exited at the north interchange. Since the majority of travelers are from the south, this interchange did not relieve congestion and was then removed from further consideration.

In conclusion, OSPR used state of the practice procedures to develop the certified design traffic and there is no additional information that can be used to justify volumes higher than 100/140/1090 (2032 AM DHV/PM DHV/ADT) for the I-71 SB to Sunbury Parkway. With the location of Alum Creek Lake to the immediate west, there really isn't any foreseeable road network that would change these values.

morpc
Mid-Ohio Regional Planning Commission

Memo

To: Scott Sanders
From: Nancy Reger
Re: US 36/SR37 and I-71 Land use projections for 2035
Date: May 5, 2014 (revision to April 29, 2014 memo)-

Scott-
New data is attached. Per your recommendation, I decreased the residential, both in number of units and density.

How does this look?
Can do today??

Thanks,
Nancy

	Housing Units		Office Square Feet		Retail Square Feet		Industrial/ Warehouse Square Feet		Pct Developed in 2035
	2010	2035	2010	2035	2010	2035	2010	2035	2035
1605 (NE)	64	584	0	288,000	14,000	254,000	0	0	70%
1603 (SE)	71	831	0	260,000	22,800	805,000	0	0	78%
1631 (NW)	67	417	4,000	7,500	146,000	441,000	23,000	23,000	77%
1621 (SW)	189	589	2,400	19,200	40,600	140,500	34,000	41,800	83%

1605 (NE)	2010	2035	
Households	64	584	(400 units at 2 units per acre+120 units at 8 units per acre)
Office Square Feet	0	288,000	
Retail Square Feet	14,000	254,000	
Industrial Square Feet	0	0	
Pct of Zone Developed	38%	70%	

Assumptions:
1/2 of Northstar residential
1/2 of Northstar Commercial
Commercial mix:
30% multifamily (120 units at 8 units per acre)
40% retail at 10,000 square feet per acre
30% office at 10,000 square feet per acre)

1603 (SW)	2010	2035
Households	71	831
Office Square Feet	0	260,000
Retail Square Feet	22,800	805,300
Industrial Square Feet	0	0
Pct of Zone Developed	21%	78%

Ciminello	sqft/du	
Outlet mall	350,000	
Misc retail (1/2 developed)	148,750	(35 acres: assume 1/2 developed at 8,500 square feet per acre)
Residential MF	120	(6 units per acre)
Residential SF	100	(2 units per acre)

Northgate	sqft/du	
Outlet mall	220,000	
Miscellaneous Retail	63,750	(15 acres: assume 1/2 developed at 8,500 square feet per acre)
Residential	120	(6 units per acre)
Residential	120	(2 units per acre)

East of Harley Davidson	sqft/du	
Flex Office - 1/2 developed	260,000	(80 acres: assume 1/2 developed at 6,500 square feet per acre)

South of Northgate	sqft/du	
Residential	300	(1000 acres: assume 1/3 is developed at 1 units per acre)

1631 (NW)	2010	2035	
Households	67	417	(350 acres at 1.0 units per acre)
Office Square Feet	4,000	7,500	
Retail Square Feet	146,400	441,100	(includes restaurants and hotels)
Industrial Square Feet	23,000	23,000	
Pct of Zone Developed	24%	77%	(includes parkland and water)

1621 (SW)	2010	2035	
Households	189	589	(260 acres at 1.5 units per acre)
Office Square Feet	2,400	19,200	
Retail Square Feet	40,600	140,500	(includes restaurants and hotels)
Industrial Square Feet	34,000	41,800	
Pct of Zone Developed	61%	83%	(includes parkland and water)

INTER-OFFICE COMMUNICATION

TO: Steve Fellinger, District 6
David Carlin, District 6

FROM: Rebekah Anderson, Office of Multimodal Planning

SUBJECT: DEL-71-9.67 – IR 71 at US36/SR 37 IMS – No PID

DATE: June 2, 2010 – Revised Memo only

This update only replaces text in the memo that was in error. The traffic has not changed from the April 6, 2010 memo.

In reply to a request received on December 14, 2009, the Office of Multimodal Planning (OMP) has provided year 2012 and 2032 ADT and A.M. DHV and P.M. DHV turning movements for the IR 71 at US36/SR 37 IMS project for your use.

Six alternatives are provided. They are as follows:

No Build – This project includes the existing and committed projects in the area. Furthermore, it includes the extension of Wilson Rd., Fourwinds Dr., the new Sunbury Parkway, and the new road north of US 36/SR 37 that connects Wilson Rd. to N. 3Bs and K. Note that Sunbury Pkwy extends from Fourwinds Dr. east to the intersection of Cheshire and Domigan Rds.. South 3B's and K Rd., south of Sunbury Pkwy, is realigned to intersect with Sunbury Pkwy at Fourwinds Dr.. South 3B's and K Rd. north of Sunbury is left to provide local access, but dead ends just south of US 36/SR 37. Only Right In-Right Out turning movements are permitted at the intersection of N. 3Bs and K with US 36/SR 37. The effects of this policy are evident in the number of southbound to eastbound left turns, and the lack of westbound to northbound right turns. Also note that the proposed speed limit on Fourwinds Dr. is 35mph, while the speed limit on N. 3Bs and K Rd. is unchanged, thus making N. 3Bs and K a more attractive route if permitted. All new roadways have speed limits of 35 mph.

No Build with Big Walnut – This is similar to the No Build alternative, but includes a new interchange on IR 71 at Big Walnut.

Alternative 5 – In addition to the No Build, this alternative includes a new interchange at IR 71 at Sunbury Parkway. The ramps are braided such that traffic entering northbound at the Sunbury Rd. interchange or southbound at the US 36/SR 37 interchange does not have the ability to exit at the adjacent interchange.

Alternative 5 with Big Walnut – This is similar to Alternative 5, but includes a new interchange on IR 71 at Big Walnut.

Alternative 6 – In addition to the No Build, this alternative includes a new interchange on IR 71 north of US 36/SR 37. This interchange is with a yet unnamed new road. The ramps are braided such that traffic entering southbound at the new interchange or northbound at the US 36/SR 37 interchange does not have the ability to exit at the adjacent interchange.

Alternative 6 with Big Walnut – This is similar to Alternative 6 but includes a new interchange on IR 71 at Big Walnut.

Note: North 3B's and K Rd. intersects with Fourwinds Dr. somewhere north of US 36 and south of the new road. Because N 3B's and K Rd. has a higher speed limit, the traffic favors using that highway if the turns are permissible. Hence, the traffic on N. Fourwinds Dr. looks somewhat lopsided due to this preference.

Also of note is that this traffic does not assume that other needed improvements are made to county roads, as was done for the August 2008 IR 71 at Big Walnut certified traffic. Therefore, some highways in the attached plates show traffic above capacity. Furthermore, this traffic differs somewhat from the June 2007 certified traffic as it includes the new warehouse development east of the interchange, which not only increases the traffic traveling east on US 36/SR 37, but also increases the reverse commute to the area.

If you have any questions, please contact me at (614) 752-5735.

RSA:rsa

attachment

c: M. Byram, L. Duguid, OMP – File

INTER-OFFICE COMMUNICATION

TO: Steve Fellinger, District 6
David Carlin, District 6

FROM: Rebekah Anderson, Statewide Planning and Research

SUBJECT: DEL-71-9.67 – IR 71 at US36/SR 37 IMS – PID 90200

DATE: February 29, 2012

In reply to a request received on August 31, 2011, the Office of Statewide Planning and Research has provided year 2032 ADT and A.M. DHV and P.M. DHV turning movements for the IR 71 at US36/SR 37 IMS – Alternatives 9 and 10 for your use.

Alternatives 9 and 10 include the reroute of US 36 along a new 4 lane southern road (Sunbury Pkwy), while SR 37 continues along the existing alignment. The traffic was modeled per the diagrams previously submitted. Sunbury Pkwy assumes a 55 mph speed.

Alternative 9 includes the split diamond interchanges, similar to Alternative 5.

Alternative 10 includes the removal of the existing interchange at SR 37 and a new interchange is constructed at US 36 and IR 71 according to the design forward from District 6. While the traffic is shown on the plates in a diamond interchange configuration, the movements were developed for the submitted diagram. However, any interchange, such as a SPUI could be developed to accommodate the traffic.

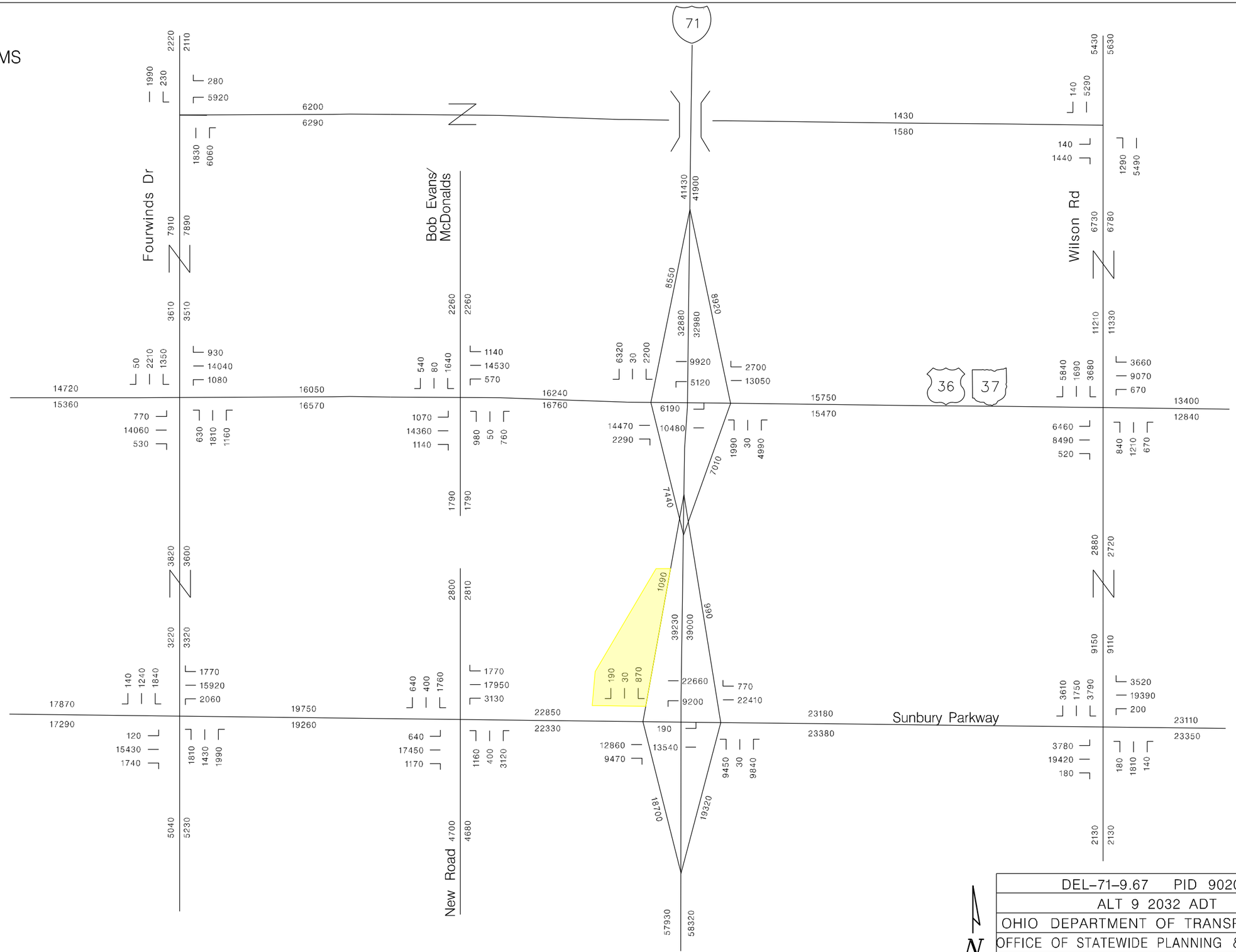
If you have any questions, please contact me at 614-752-5735.

RSA:rsa

attachment

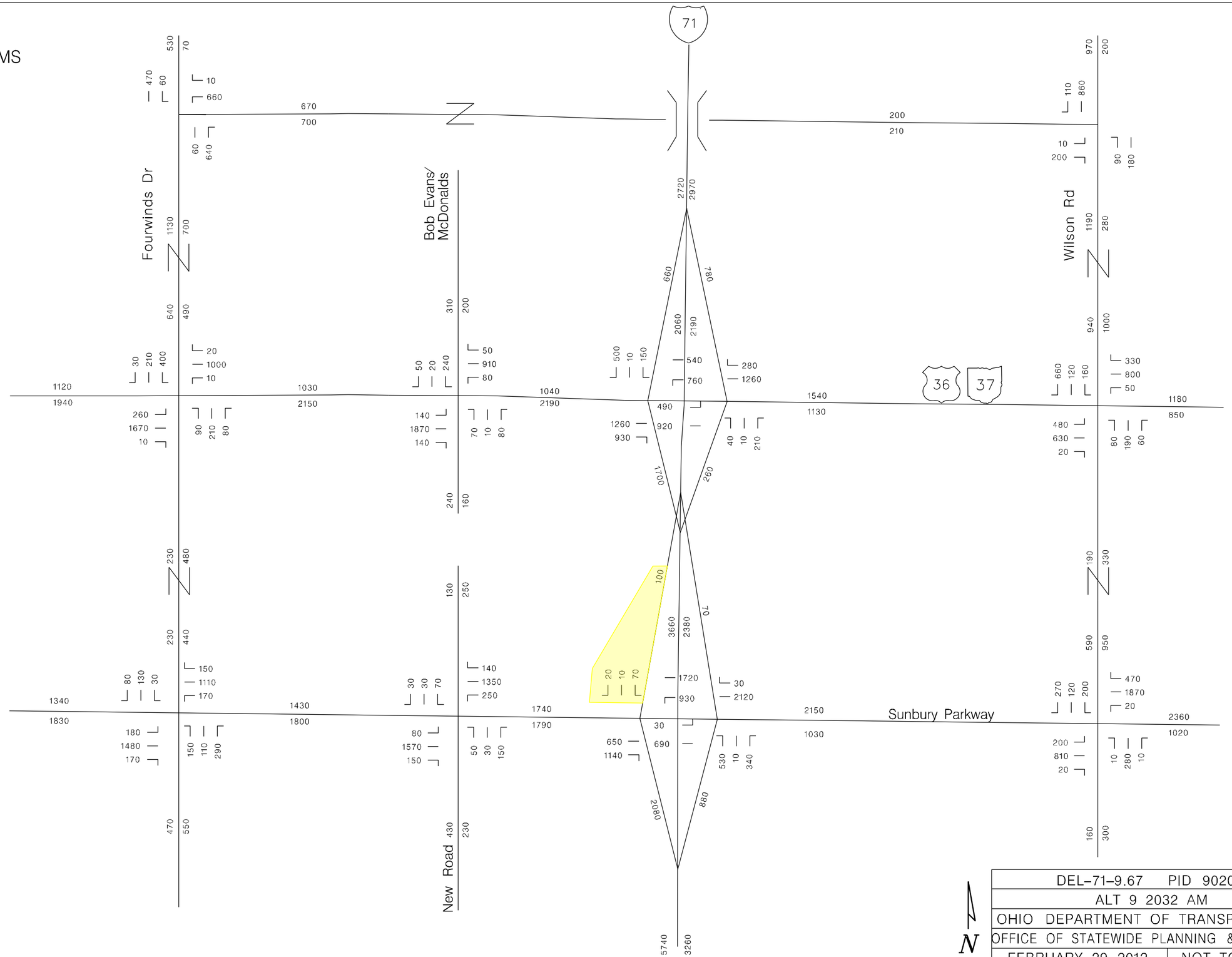
c: M. Byram - OSPR, N. Gill - MORPC, D. Gross, H. McColeman, ORE – File

DEL–71–9.67–IR–71
AT US–36 / SR–37 IMS
PID 90200
ALTERNATIVE 9
2032
PLATE 1 OF 6



DEL–71–9.67 PID 90200	
ALT 9 2032 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
FEBRUARY 29, 2012	NOT TO SCALE

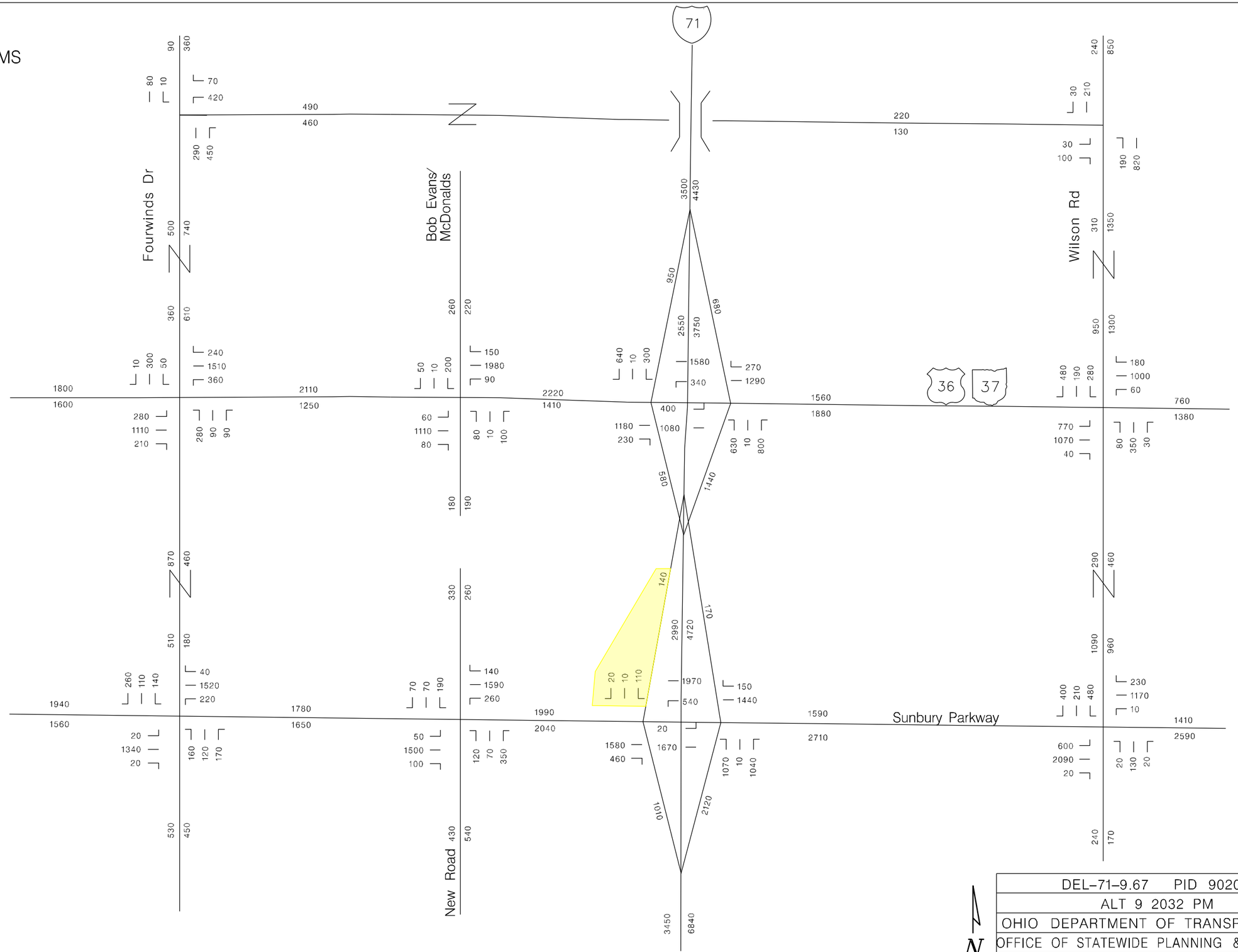
DEL–71–9.67–IR–71
AT US–36 / SR–37 IMS
PID 90200
ALTERNATIVE 9
2032
PLATE 2 OF 6



DEL–71–9.67 PID 90200
ALT 9 2032 AM
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF STATEWIDE PLANNING & RESEARCH
FEBRUARY 29, 2012 | NOT TO SCALE

N

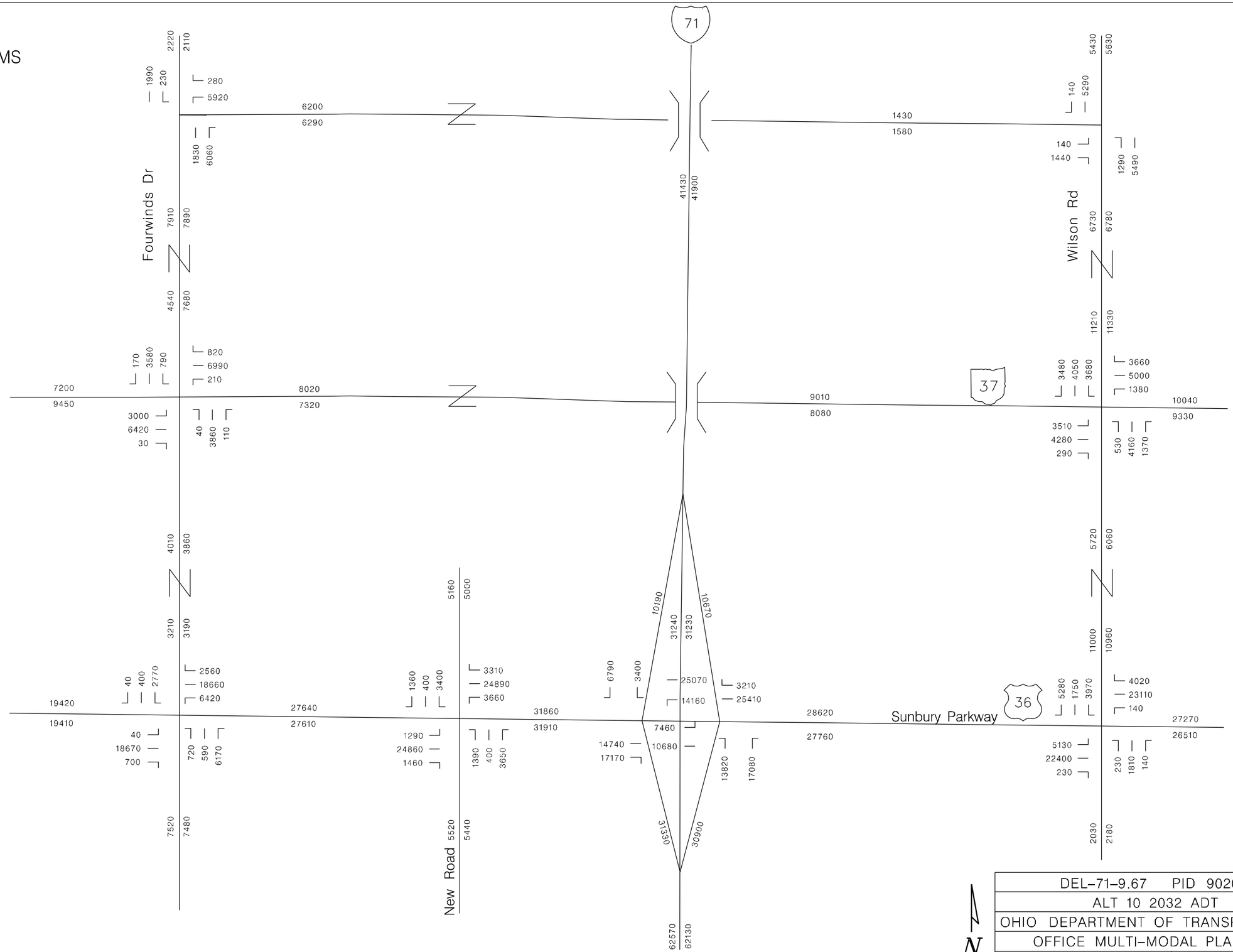
DEL–71–9.67–IR–71
AT US–36 / SR–37 IMS
PID 90200
ALTERNATIVE 9
2032
PLATE 3 OF 6



DEL–71–9.67 PID 90200	
ALT 9 2032 PM	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
FEBRUARY 29, 2012	NOT TO SCALE

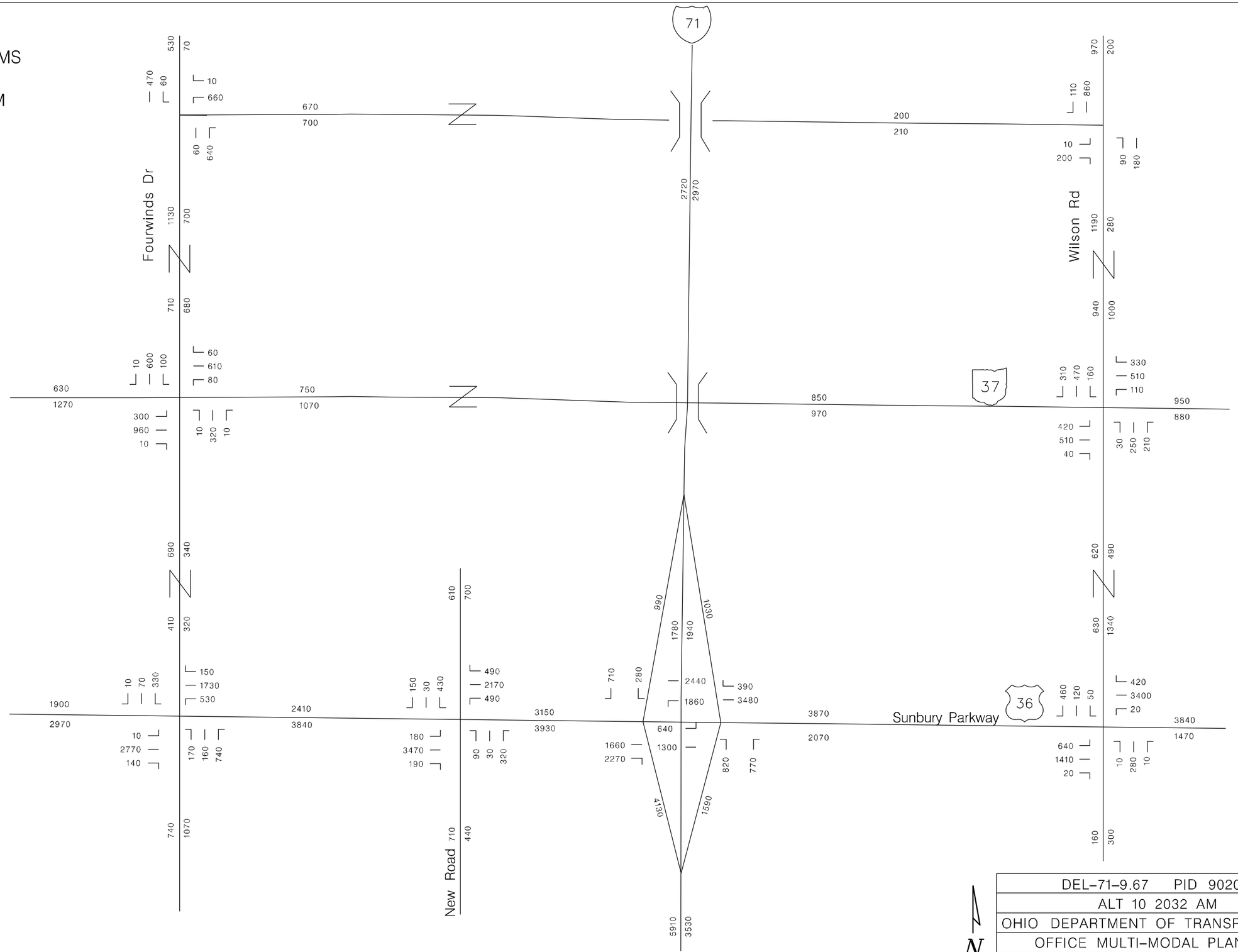
N

DEL–71–9.67–IR–71
AT US–36 / SR–37 IMS
PID 90200
ALTERNATIVE 10
2032
PLATE 4 OF 6



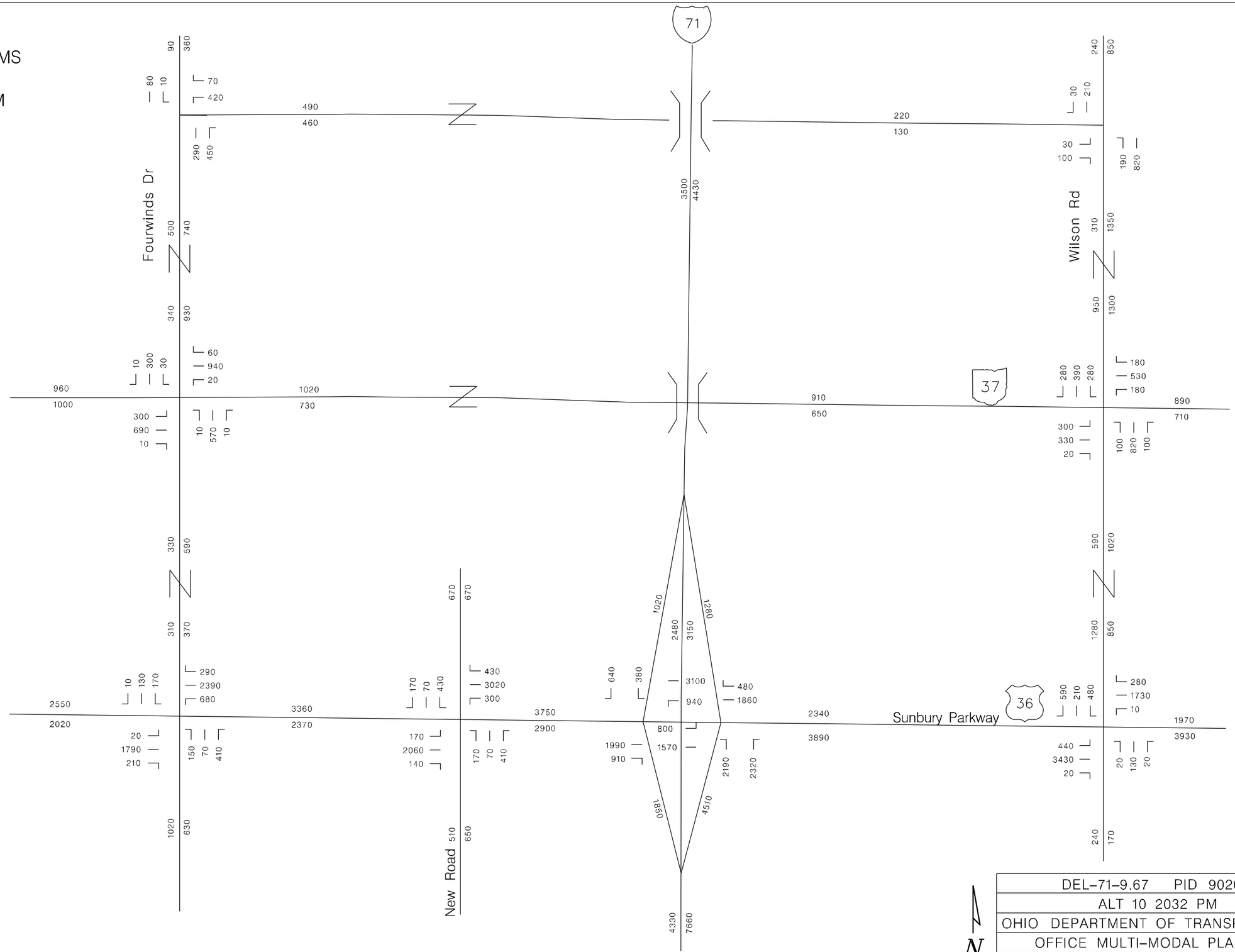
DEL–71–9.67 PID 90200	
ALT 10 2032 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE MULTI–MODAL PLANNING	
JANUARY 13, 2012	NOT TO SCALE

DEL–71–9.67–IR–71
AT US–36 / SR–37 IMS
PID 90200
ALTERNATIVE 10 AM
2032
PLATE 5 OF 6

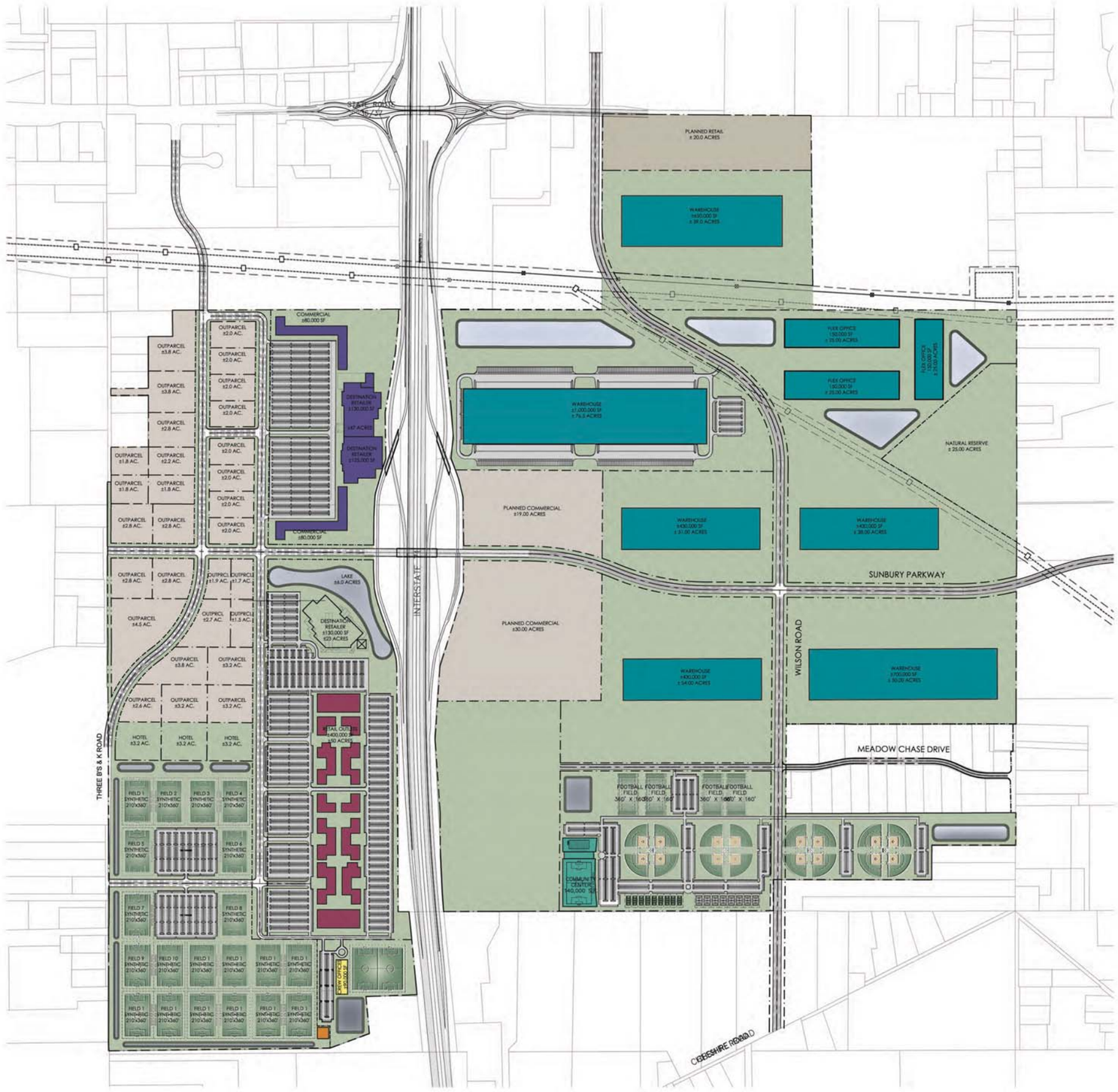


DEL–71–9.67	PID 90200
ALT 10 2032 AM	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE MULTI–MODAL PLANNING	
JANUARY 13, 2012	NOT TO SCALE

DEL–71–9.67–IR–71
AT US–36 / SR–37 IMS
PID 90200
ALTERNATIVE 10 PM
2032
PLATE 6 OF 6



DEL–71–9.67	PID 90200
ALT 10 2032 PM	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE MULTI–MODAL PLANNING	
JANUARY 13, 2012	NOT TO SCALE



GLAVAN FEHER **ARCHITECTS** INC

PROPOSED MASTER PLAN

NORTHGATE
DELAWARE, OHIO
MARCH 13, 2009

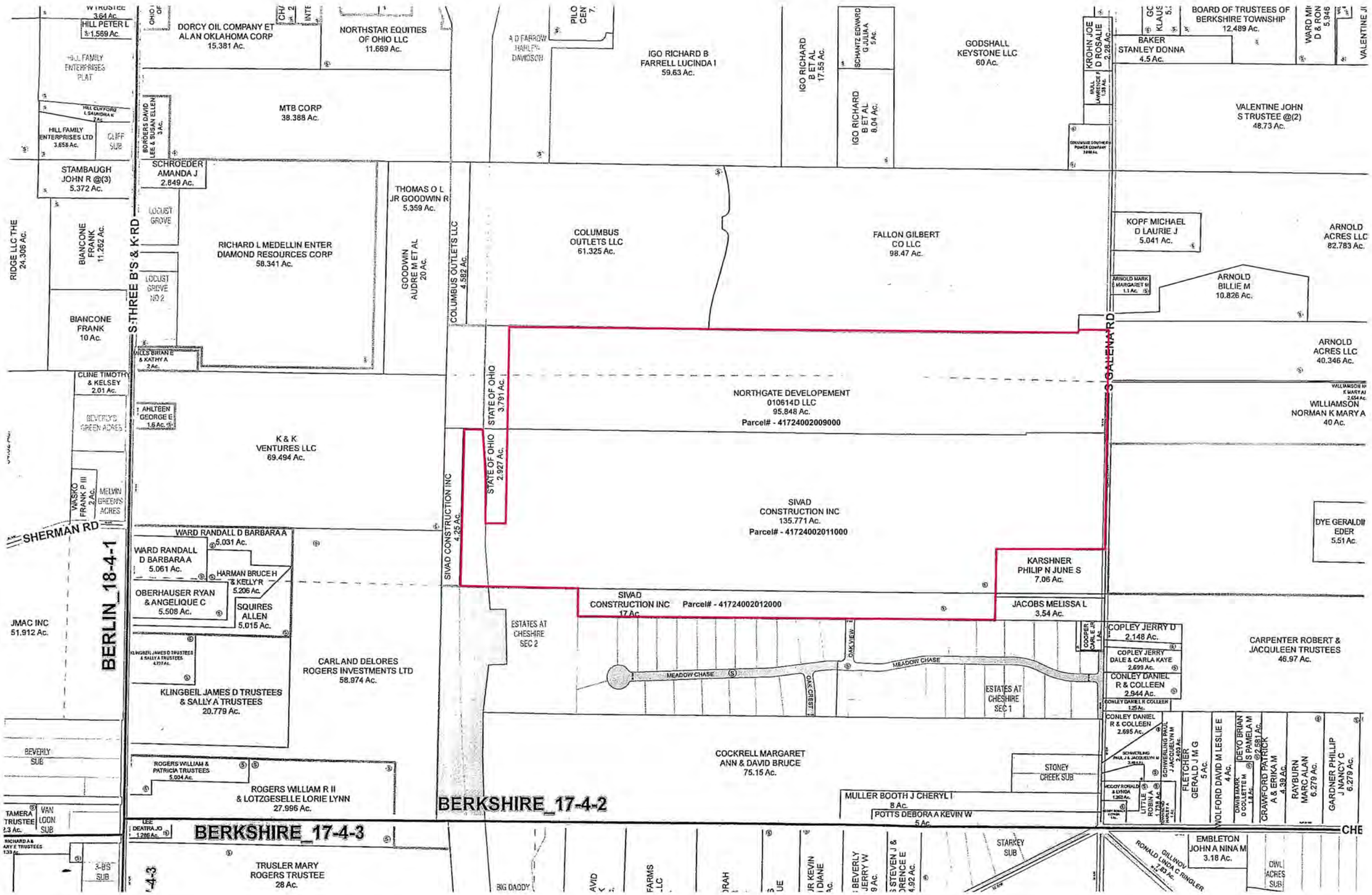


EXHIBIT B - PROPERTY OWNERSHIP

NORTHGATE COMMERCE DISTRICT

NOVEMBER 17, 2015

EDGE PLANNING LANDSCAPE ARCHITECTURE URBAN DESIGN

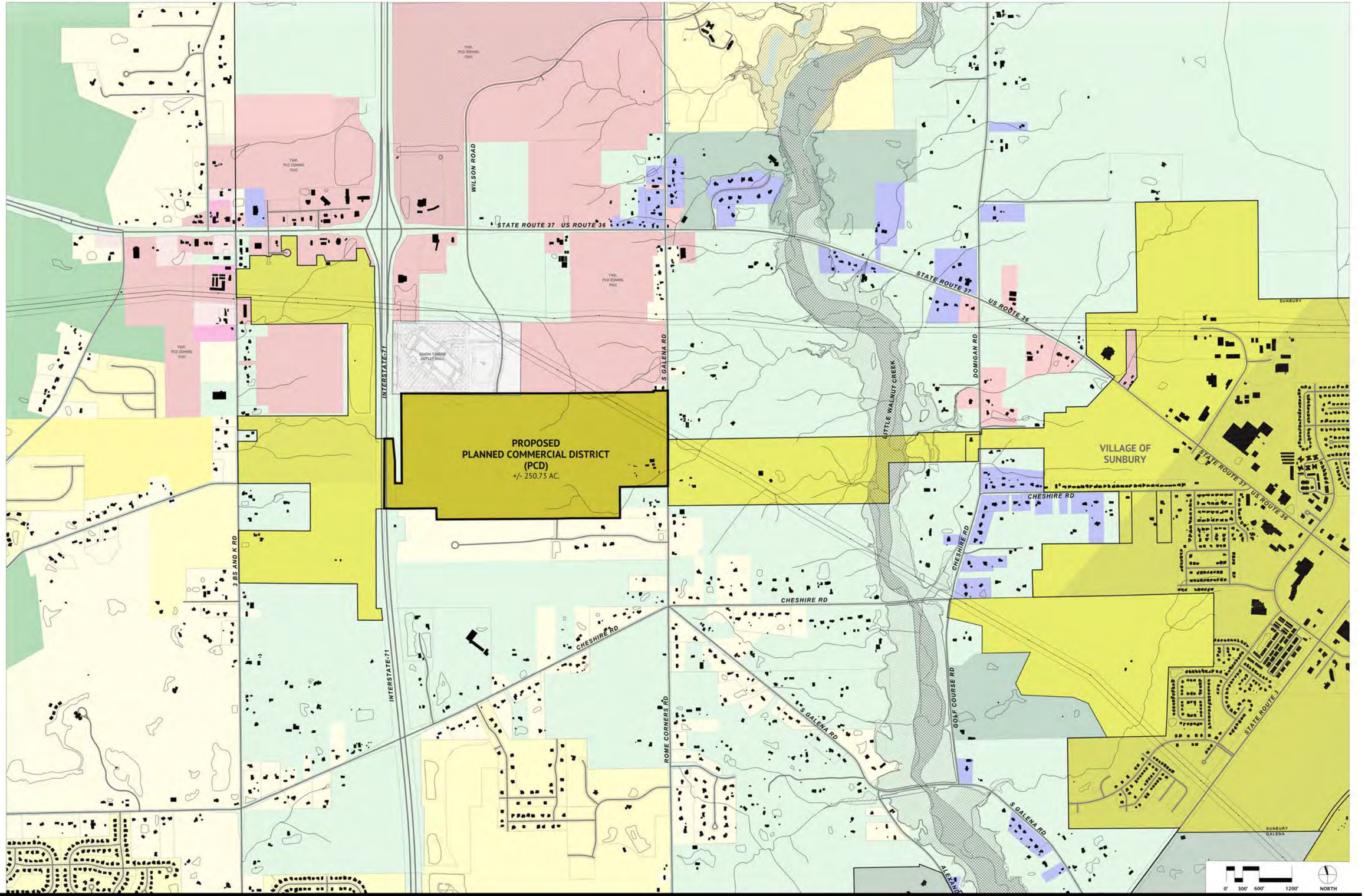


EXHIBIT C - CONTEXT MAP

NORTHGATE COMMERCE DISTRICT

NOVEMBER 17, 2015

EDGE PLANNING LANDSCAPE ARCHITECTURE URBAN DESIGN

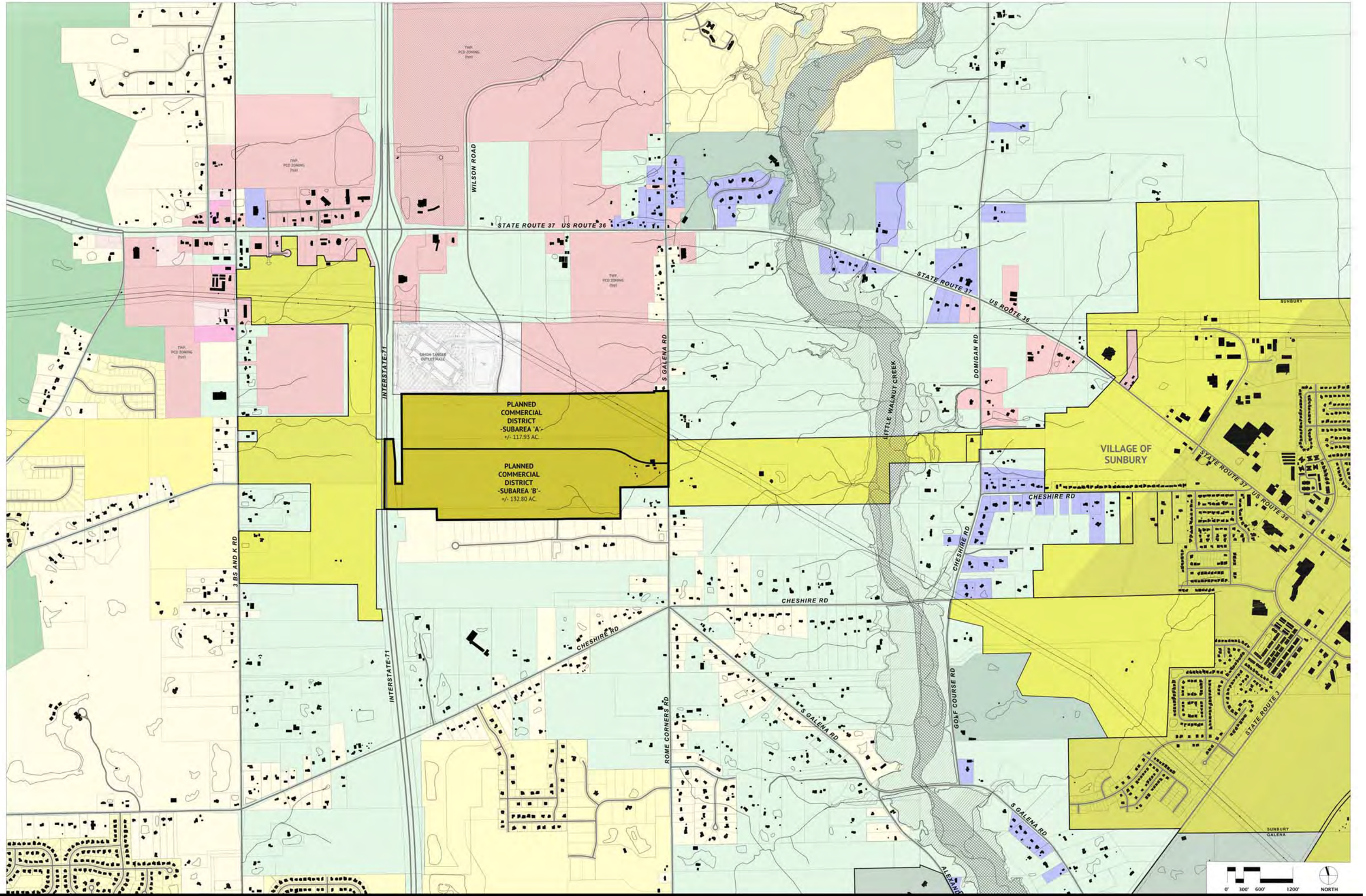


EXHIBIT D - SUBAREA PLAN

NORTHGATE COMMERCE DISTRICT

NOVEMBER 17, 2015

EDGE PLANNING LANDSCAPE ARCHITECTURE URBAN DESIGN

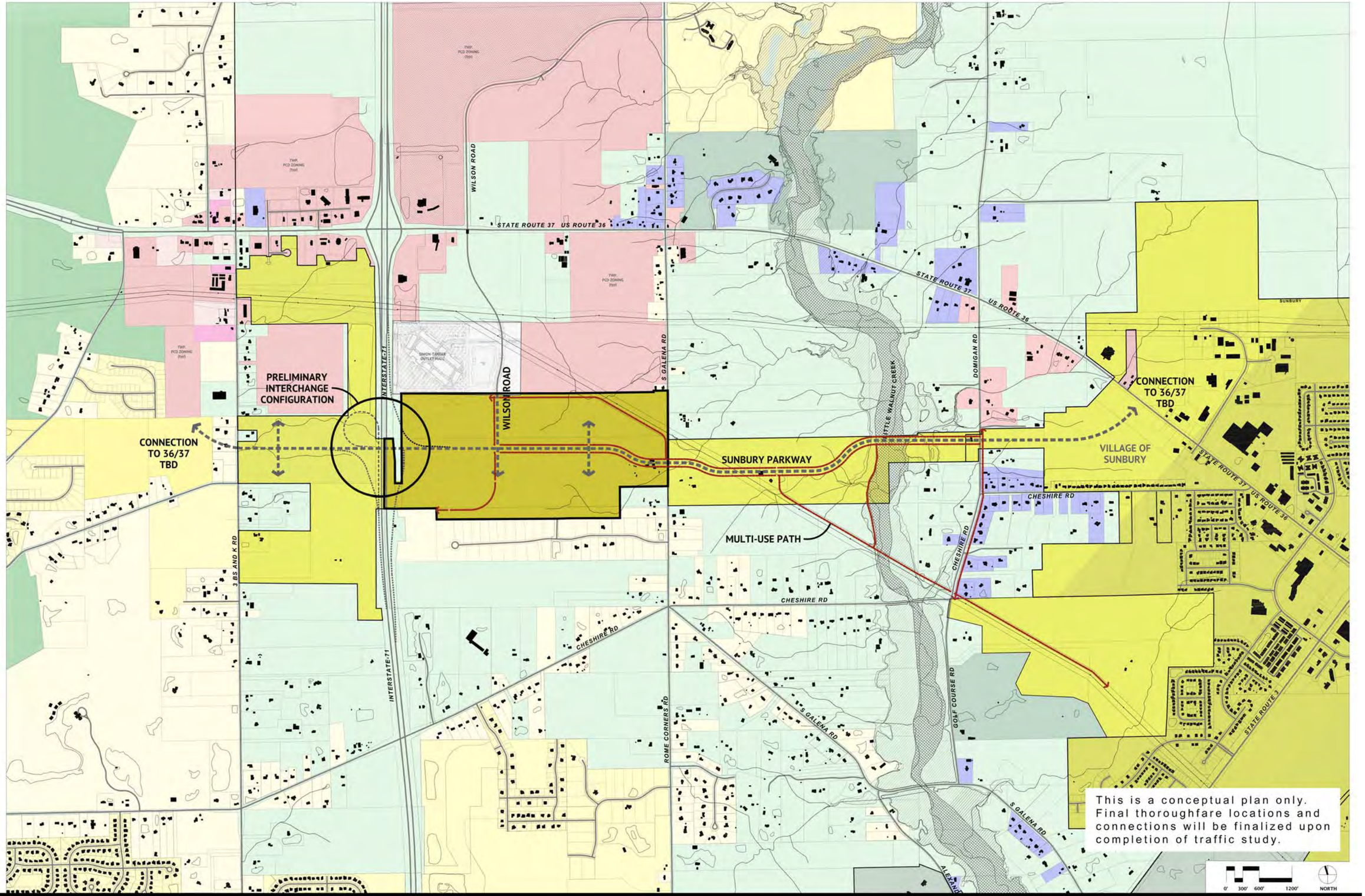


EXHIBIT E - THOROUGHFARE PLAN

NORTHGATE COMMERCE DISTRICT

NOVEMBER 17, 2015

EDGE PLANNING LANDSCAPE ARCHITECTURE URBAN DESIGN

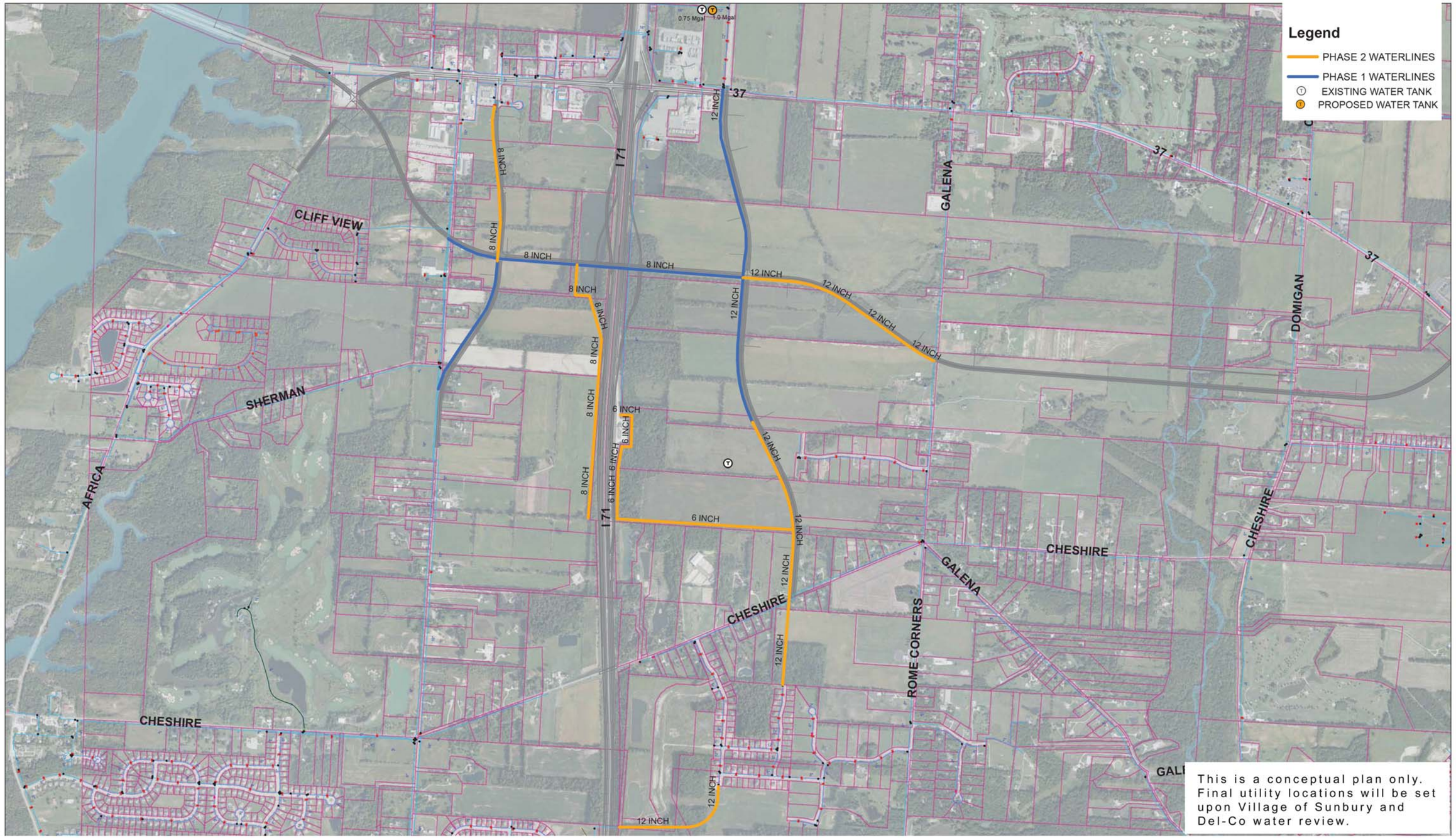


EXHIBIT F - PRELIMINARY UTILITIES PLAN - WATER

NORTHGATE COMMERCE DISTRICT

NOVEMBER 17, 2015

ms consultants, inc.
engineers, architects, planners

EDGE PLANNING LANDSCAPE ARCHITECTURE URBAN DESIGN

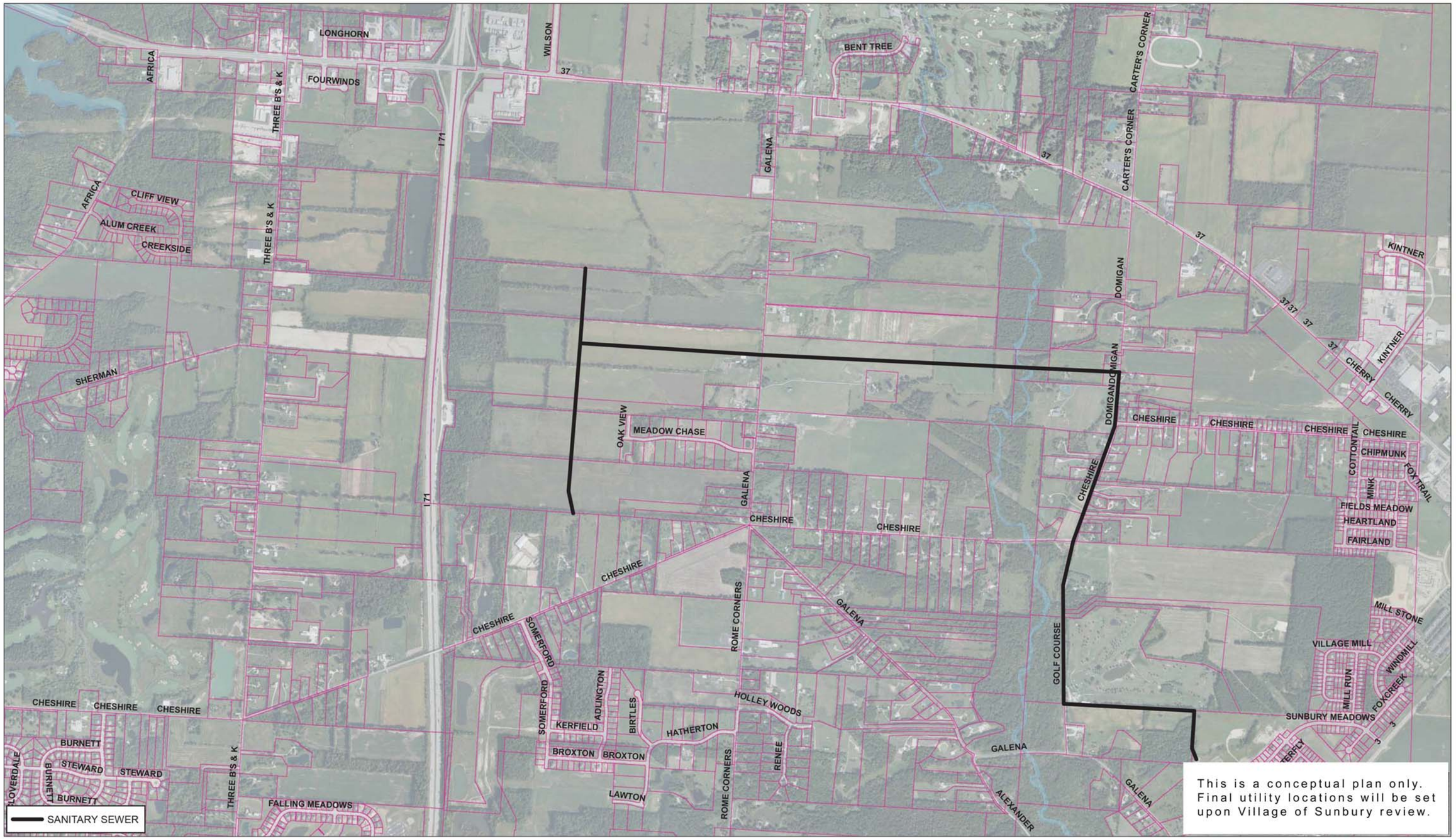


EXHIBIT G - PRELIMINARY UTILITIES PLAN - SANITARY

NORTHGATE COMMERCE DISTRICT

NOVEMBER 17, 2015

ms consultants, inc.
engineers, architects, planners

EDGE PLANNING LANDSCAPE ARCHITECTURE URBAN DESIGN

Appendix C-B

HCS Analyses

ms consultants, inc.
engineers, architects, planners

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	36/37 Off-Ramp
Date Performed	8/25/2017	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-11 - 2038 Sunbury Full Interchange

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	900
Freeway Volume, V_F	3580
Ramp Volume, V_R	430
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3580	0.94	Level	9	0	0.957	1.00	3980
Ramp	430	0.94	Level	24	0	0.893	1.00	512
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} = 0.637 using Equation (Exhibit 13-7)

V_{12} = 2721 pc/h

V_3 or V_{av34} 1259 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	3980	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3468	Exhibit 13-8	7200	No
V_R	512	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2721	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 = 19.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.214 (Exhibit 13-12)

S_R= 64.0 mph (Exhibit 13-12)

S_0= 75.8 mph (Exhibit 13-12)

S = 67.3 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	36/37 Off-Ramp
Date Performed	8/25/2017	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-11 - 2038 Sunbury Full Interchange

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	900
Freeway Volume, V_F	3040
Ramp Volume, V_R	760
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3040	0.94	Level	9	0	0.957	1.00	3380
Ramp	760	0.94	Level	24	0	0.893	1.00	906
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} = 0.634 using Equation (Exhibit 13-7)

V_{12} = 2474 pc/h

V_3 or V_{av34} 906 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	3380	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2474	Exhibit 13-8	7200	No
V_R	906	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2474	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 = 17.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.250 (Exhibit 13-12)

S_R= 63.0 mph (Exhibit 13-12)

S_0= 76.8 mph (Exhibit 13-12)

S = 66.2 mph (Exhibit 13-13)

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*8/25/2017*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-9 - Sunbury Full Interchange*

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

Flow Inputs

Volume, V	*3150*	veh/h	Peak-Hour Factor, PHF	*0.94*
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	*mi*
			Up/Down %	

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			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)	*70.0*	mph	FFS	*70.0*	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)	*1167*	pc/h/ln	Design LOS		
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*16.7*	pc/mi/ln	S		mph
LOS	*B*		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	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*8/25/2017*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-9 - Sunbury Full Interchange*

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

Flow Inputs

Volume, V	*2280*	veh/h	Peak-Hour Factor, PHF	*0.94*
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	*mi*
			Up/Down %	

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			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)	*70.0*	mph	FFS	*70.0*	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)	*845*	pc/h/ln	Design LOS		
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*12.1*	pc/mi/ln	S		mph
LOS	*B*		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	

FREEWAY WEAVING WORKSHEET

General Information

Analyst	JRH
Agency/Company	ms consultants
Date Performed	8/25/2017
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	I-71 Southbound
Weaving Segment Location	US 36/SR 37 & Sunbury Parkway
Analysis Year	2038

Project Description W-2 - Sunbury Full Interchange

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1400ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	75 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}	3090	0.94	9	0	1.5	1.2	0.957	1.00	3435
V_{RF}	690	0.94	6	0	1.5	1.2	0.971	1.00	756
V_{FR}	60	0.94	6	0	1.5	1.2	0.971	1.00	66
V_{RR}	0	0.94	6	0	1.5	1.2	0.971	1.00	0
V_{NW}	3435							V =	4257
V_W	822								
VR	0.193								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	822 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1182 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	696 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1878 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	481

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4086 veh/h	Weaving intensity factor, W	0.285
Weaving segment capacity, c_w	8287 veh/h	Weaving segment speed, S	63.5 mph
Weaving segment v/c ratio	0.493	Average weaving speed, S_W	61.7 mph
Weaving segment density, D	16.8 pc/mi/ln	Average non-weaving speed, S_{NW}	64.0 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	4466 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	ms consultants
Date Performed	8/25/2017
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	I-71 Southbound
Weaving Segment Location	US 36/SR 37 & Sunbury Parkway
Analysis Year	2038

Project Description W-2 - Sunbury Full Interchange

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1400ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	75 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}	2170	0.94	9	0	1.5	1.2	0.957	1.00	2412
V_{RF}	440	0.94	6	0	1.5	1.2	0.971	1.00	482
V_{FR}	110	0.94	6	0	1.5	1.2	0.971	1.00	121
V_{RR}	0	0.94	6	0	1.5	1.2	0.971	1.00	0
V_{NW}	2412							V =	3015
V_W	603								
VR	0.200								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	603 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	963 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	485 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1448 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	338

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2894 veh/h	Weaving intensity factor, W	0.232
Weaving segment capacity, c_w	8268 veh/h	Weaving segment speed, S	66.3 mph
Weaving segment v/c ratio	0.350	Average weaving speed, S_W	63.7 mph
Weaving segment density, D	11.4 pc/mi/ln	Average non-weaving speed, S_{NW}	67.0 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	4536 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".

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*under Sunbury Parkway*
Date Performed	*8/25/2017*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-12 - Sunbury Full Interchange*

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

Flow Inputs

Volume, V	*3780*	veh/h	Peak-Hour Factor, PHF	*0.94*
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	*mi*
			Up/Down %	

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			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)	*70.0*	mph	FFS	*70.0*	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)	*1401*	pc/h/ln	Design LOS		
S	*69.5*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*20.1*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*under Sunbury Parkway*
Date Performed	*8/25/2017*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-12 - Sunbury Full Interchange*

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

Flow Inputs

Volume, V	*2670*	veh/h	Peak-Hour Factor, PHF	*0.94*
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	*mi*
			Up/Down %	

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			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)	*70.0*	mph	FFS	*70.0*	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)	*989*	pc/h/ln	Design LOS		
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*14.1*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	Sunbury Pkwy. On-Ramp
Date Performed	8/25/2017	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-14 - 2038 Sunbury Full Interchange

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1500	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3780	
	Ramp Volume, V_R: 1920	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 55.0	

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	0.94	Level	9	0	0.957	1.00	4202
Ramp	1920	0.94	Level	6	0	0.971	1.00	2104
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.555 using Equation (Exhibit 13-6)

V_{12} = 2332 pc/h

V_3 or V_{av34} 1870 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} = 2401 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6306	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4505	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 = 11.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.179 (Exibit 13-11)

S_R= 65.0 mph (Exhibit 13-11)

S_0= 65.3 mph (Exhibit 13-11)

S = 65.1 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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	Sunbury Pkwy. On-Ramp
Date Performed	8/25/2017	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-14 - 2038 Sunbury Full Interchange

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1500	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2610	
	Ramp Volume, V_R: 970	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 55.0	

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	2610	0.94	Level	9	0	0.957	1.00	2902
Ramp	970	0.94	Level	6	0	0.971	1.00	1063
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.555 using Equation (Exhibit 13-6)

V_{12} = 1611 pc/h

V_3 or V_{av34} 1291 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}	3965	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2674	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 = -2.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = -0.117 (Exibit 13-11)

S_R= 73.3 mph (Exhibit 13-11)

S_0= 67.2 mph (Exhibit 13-11)

S = 71.2 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)

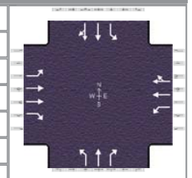
S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Fourwinds	File Name	I-4_36-37_B-Full_AM_2038.xus		
Project Description	I-4 - Sunbury Full Interchange				



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	880	60	70	760	20	30	20	20	90	30	20

Signal Information					1	2	3	4	5	6	7	8
Cycle, s	120.0	Reference Phase	2	Green	7.0	52.0	43.0	0.0	0.0	0.0		
Offset, s	0	Reference Point	End	Yellow	4.0	4.0	4.0	0.0	0.0	0.0		
Uncoordinated	Yes	Simult. Gap E/W	On	Red	2.0	2.0	2.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On									

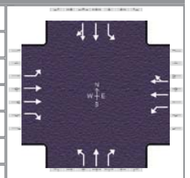
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		5.0		6.0
Phase Duration, s	13.0	58.0	13.0	58.0		49.0		49.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.2		3.2
Queue Clearance Time (*g s*), s	5.3	29.2	4.9	23.7		5.2		8.8
Green Extension Time (*g e*), s	0.0	4.6	0.0	4.7		0.4		0.4
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.03	1.00	0.01		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	87	957	65	76	426	422	33	22	22	98	27	27
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1675	1491	1675	1759	1743	1344	1863	1579	1384	1863	1627
Queue Service Time (*g s*), s	3.3	27.2	3.1	2.9	21.7	21.7	1.9	0.9	1.1	5.9	1.1	1.3
Cycle Queue Clearance Time (*g c*), s	3.3	27.2	3.1	2.9	21.7	21.7	3.2	0.9	1.1	6.8	1.1	1.3
Green Ratio (*g/C*)	0.49	0.43	0.43	0.49	0.43	0.43	0.36	0.36	0.36	0.36	0.36	0.36
Capacity (*c*), veh/h	302	1452	646	263	762	755	527	667	566	546	667	583
Volume-to-Capacity Ratio (*X*)	0.288	0.659	0.101	0.290	0.559	0.559	0.062	0.033	0.038	0.179	0.041	0.046
Back of Queue (*Q*), ft/ln (95 th percentile)	61.3	428.7	51.7	53.3	369.5	344.8	28.6	18.4	18.5	89.6	23.3	23
Back of Queue (*Q*), veh/ln (95 th percentile)	2.3	16.1	1.9	2.0	13.9	13.8	1.1	0.7	0.7	3.5	0.9	0.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.25	0.00	0.21	0.22	0.00	0.00	0.10	0.00	0.07	0.32	0.00	0.00
Uniform Delay (*d 1*), s/veh	19.1	27.0	20.1	20.4	25.4	25.4	26.2	25.0	25.0	27.2	25.1	25.1
Incremental Delay (*d 2*), s/veh	0.2	0.9	0.0	0.2	0.6	0.6	0.0	0.0	0.0	0.1	0.0	0.0
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	19.3	27.9	20.2	20.6	26.0	26.0	26.2	25.0	25.1	27.3	25.1	25.1
Level of Service (LOS)	B	C	C	C	C	C	C	C	C	C	C	C
Approach Delay, s/veh / LOS	26.7	C		25.5	C		25.5	C		26.5	C	
Intersection Delay, s/veh / LOS	26.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.4	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	1.2	A	0.6	A	0.6	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Fourwinds	File Name	I-4_36-37_B-Full_PM_2038.xus		
Project Description	I-4 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	910	60	50	1570	80	130	80	60	30	30	50

Signal Information					1	2	3	4	5	6	7	8
Cycle, s	120.0	Reference Phase	2	Green	7.0	67.0	28.0	0.0	0.0	0.0		
Offset, s	0	Reference Point	End	Yellow	4.0	4.0	4.0	0.0	0.0	0.0		
Uncoordinated	Yes	Simult. Gap E/W	On	Red	2.0	2.0	2.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On									

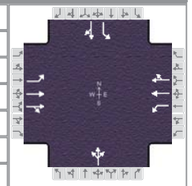
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		5.0		6.0
Phase Duration, s	13.0	73.0	13.0	73.0		34.0		34.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.2		3.2
Queue Clearance Time (*g s*), s	3.5	24.2	3.5	58.8		16.9		9.0
Green Extension Time (*g e*), s	0.0	9.9	0.0	5.1		0.7		0.8
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	0.58	0.07	0.58	0.70		0.01		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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	989	65	54	899	894	141	87	65	33	33	54
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1675	1491	1675	1759	1729	1305	1863	1579	1305	1863	1579
Queue Service Time (*g s*), s	1.5	22.2	2.4	1.5	55.4	56.8	11.6	4.5	4.0	2.5	1.6	3.3
Cycle Queue Clearance Time (*g c*), s	1.5	22.2	2.4	1.5	55.4	56.8	14.9	4.5	4.0	7.0	1.6	3.3
Green Ratio (*g/C*)	0.62	0.56	0.56	0.62	0.56	0.56	0.23	0.23	0.23	0.23	0.23	0.23
Capacity (*c*), veh/h	175	1870	832	349	982	965	329	435	368	316	435	368
Volume-to-Capacity Ratio (*X*)	0.311	0.529	0.078	0.156	0.915	0.927	0.430	0.200	0.177	0.103	0.075	0.148
Back of Queue (*Q*), ft/ln (95 th percentile)	41.2	350.8	39.9	26.2	890.8	852.6	170.6	94	70.1	36.4	34.2	58
Back of Queue (*Q*), veh/ln (95 th percentile)	1.5	13.2	1.5	1.0	33.5	34.1	6.7	3.7	2.8	1.4	1.3	2.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.16	0.00	0.16	0.11	0.00	0.00	0.61	0.00	0.25	0.13	0.00	0.00
Uniform Delay (*d 1*), s/veh	26.5	16.6	12.2	11.8	23.9	24.2	42.4	37.0	36.8	39.8	35.9	36.5
Incremental Delay (*d 2*), s/veh	0.4	1.1	0.2	0.1	14.4	15.9	0.3	0.1	0.1	0.1	0.0	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	26.9	17.7	12.4	11.9	38.3	40.1	42.8	37.1	36.9	39.9	35.9	36.6
Level of Service (LOS)	C	B	B	B	D	D	D	D	D	D	D	D
Approach Delay, s/veh / LOS	17.8	B		38.4	D		39.8	D		37.3	D	
Intersection Delay, s/veh / LOS	31.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.4	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	2.0	B	1.0	A	0.6	A

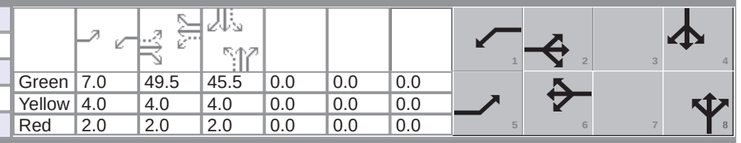
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Bob Evan…	File Name	I-5_36-37_B-Full_AM_2038.xus		
Project Description	I-5 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	90	800	100	130	750	40	60	10	50	180	10	40

Signal Information			
Cycle, s	120.0	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	7.0	49.5	45.5	0.0	0.0	0.0			
Yellow	4.0	4.0	4.0	0.0	0.0	0.0			
Red	2.0	2.0	2.0	0.0	0.0	0.0			

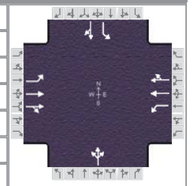
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		6.0
Phase Duration, s	13.0	55.5	13.0	55.5		51.5		51.5
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1		3.4		3.4
Queue Clearance Time (*g* $_s$), s	5.9	29.9	7.8	25.0		9.8		25.8
Green Extension Time (*g* $_e$), s	0.0	3.9	0.0	4.0		0.9		0.8
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.06	1.00	0.03		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	98	499	479	141	433	425		130		196	54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1759	1690	1675	1759	1727		1453		1201	1470	
Queue Service Time (*g* $_s$), s	3.9	27.9	27.9	5.8	23.0	23.0		4.9		16.0	2.9	
Cycle Queue Clearance Time (*g* $_c$), s	3.9	27.9	27.9	5.8	23.0	23.0		7.8		23.8	2.9	
Green Ratio (*g/C*)	0.47	0.41	0.41	0.47	0.41	0.41		0.38		0.38	0.38	
Capacity (*c*), veh/h	281	726	697	246	726	713		596		437	557	
Volume-to-Capacity Ratio (*X*)	0.348	0.687	0.687	0.574	0.597	0.597		0.219		0.447	0.098	
Back of Queue (*Q*), ft/ln (95 th percentile)	73	467.7	452.9	113.7	392.2	363.3		116.1		226	49.5	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7	17.6	17.0	4.3	14.7	14.5		4.6		8.2	1.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.21	0.00	0.00	0.39	0.00	0.00		0.00		2.26	0.00	
Uniform Delay (*d* $_1$), s/veh	21.0	28.9	28.9	23.4	27.5	27.5		25.6		33.7	24.0	
Incremental Delay (*d* $_2$), s/veh	0.3	2.3	2.4	2.1	0.9	1.0		0.1		0.3	0.0	
Initial Queue Delay (*d* $_3$), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (*d*), s/veh	21.2	31.2	31.3	25.5	28.4	28.4		25.6		34.0	24.0	
Level of Service (LOS)	C	C	C	C	C	C		C		C	C	
Approach Delay, s/veh / LOS	30.3	C		28.0	C		25.6	C		31.8	C	
Intersection Delay, s/veh / LOS	29.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.3	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.4	A	1.3	A	0.7	A	0.9	A

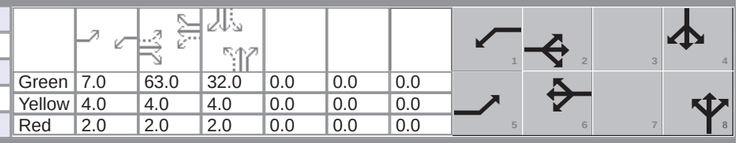
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Bob Evan…	File Name	I-5_36-37_B-Full_PM_2038.xus		
Project Description	I-5 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	890	80	100	1580	60	70	10	100	140	10	50

Signal Information			
Cycle, s	120.0	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	7.0	63.0	32.0	0.0	0.0	0.0			
Yellow	4.0	4.0	4.0	0.0	0.0	0.0			
Red	2.0	2.0	2.0	0.0	0.0	0.0			

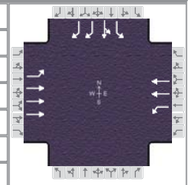
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		6.0
Phase Duration, s	13.0	69.0	13.0	69.0		38.0		38.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.4		3.4
Queue Clearance Time (*g* $_s$), s	4.0	26.9	5.5	61.9		16.0		31.6
Green Extension Time (*g* $_e$), s	0.0	8.6	0.0	0.9		0.9		0.1
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.11	1.00	1.00		0.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	65	535	519	109	893	889		196		152	65	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1759	1708	1675	1759	1736		1460		1144	1462	
Queue Service Time (*g* $_s$), s	2.0	24.9	24.9	3.5	58.8	59.9		9.9		15.7	4.1	
Cycle Queue Clearance Time (*g* $_c$), s	2.0	24.9	24.9	3.5	58.8	59.9		14.0		29.6	4.1	
Green Ratio (*g/C*)	0.58	0.52	0.52	0.58	0.52	0.52		0.27		0.27	0.27	
Capacity (*c*), veh/h	160	924	897	309	924	912		431		232	390	
Volume-to-Capacity Ratio (*X*)	0.407	0.579	0.579	0.352	0.967	0.976		0.454		0.656	0.167	
Back of Queue (*Q*), ft/ln (95 th percentile)	46.2	401.7	392.2	60.6	995.7	952.6		215.6		230.3	72.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.7	15.1	14.7	2.3	37.4	38.1		8.5		8.3	2.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.13	0.00	0.00	0.21	0.00	0.00		0.00		2.30	0.00	
Uniform Delay (*d* $_1$), s/veh	27.4	19.5	19.5	15.0	27.5	27.8		37.4		50.0	33.8	
Incremental Delay (*d* $_2$), s/veh	0.6	0.6	0.6	0.3	21.8	23.8		0.3		5.3	0.1	
Initial Queue Delay (*d* $_3$), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (*d*), s/veh	28.0	20.1	20.1	15.2	49.3	51.6		37.7		55.2	33.8	
Level of Service (LOS)	C	C	C	B	D	D		D		E	C	
Approach Delay, s/veh / LOS	20.5	C		48.4	D		37.7	D		48.8	D	
Intersection Delay, s/veh / LOS	38.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.3	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.4	A	2.0	B	0.8	A	0.8	A

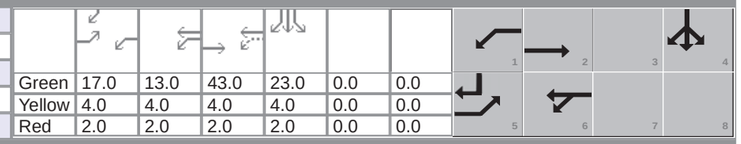
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 SB ra…	File Name	I-6_36-37_B-Full_AM_2038.xus		
Project Description	I-6 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	700		360	460					30	0	400

Signal Information			
Cycle, s	120.0	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	17.0	13.0	43.0	23.0	0.0	0.0	
Yellow	4.0	4.0	4.0	4.0	0.0	0.0	
Red	2.0	2.0	2.0	2.0	0.0	0.0	

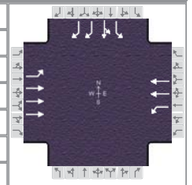
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6				4
Case Number	2.0	4.0	1.1	4.0				9.0
Phase Duration, s	23.0	49.0	42.0	68.0				29.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0				3.4
Queue Clearance Time (g_s), s	2.1	26.4	13.9	12.2				21.2
Green Extension Time (g_e), s	0.0	2.4	0.7	3.3				0.3
Phase Call Probability	1.00	1.00	1.00	1.00				1.00
Max Out Probability	0.00	0.17	0.00	0.00				1.00

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		1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h	1	761		391	500					18	0	449
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645	1053		1675	1675					1459	1532	1159
Queue Service Time (g_s), s	0.1	24.4		11.9	10.2					1.2	0.0	19.2
Cycle Queue Clearance Time (g_c), s	0.1	24.4		11.9	10.2					1.2	0.0	19.2
Green Ratio (*g*/*C*)	0.14	0.36		0.67	0.52					0.19	0.19	0.33
Capacity (*c*), veh/h	233	1131		665	1731					280	294	770
Volume-to-Capacity Ratio (*X*)	0.005	0.672		0.588	0.289					0.064	0.000	0.584
Back of Queue (*Q*), ft/ln (95 th percentile)	1.4	282.4		196.1	187.7					23.3	0	274.8
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	10.6		7.4	7.1					0.8	0.0	9.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.40	0.00					0.05	0.00	0.32
Uniform Delay (d_1), s/veh	44.2	32.5		14.3	16.5					39.7	0.0	33.1
Incremental Delay (d_2), s/veh	0.0	3.2		0.9	0.4					0.0	0.0	0.8
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh	44.2	35.7		15.2	16.9					39.7	0.0	33.8
Level of Service (LOS)	D	D		B	B					D		C
Approach Delay, s/veh / LOS	35.8	D		16.2	B		0.0			34.1	C	
Intersection Delay, s/veh / LOS	27.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.6	B	3.2	C	3.0	C
Bicycle LOS Score / LOS	0.9	A	1.2	A			1.3	A

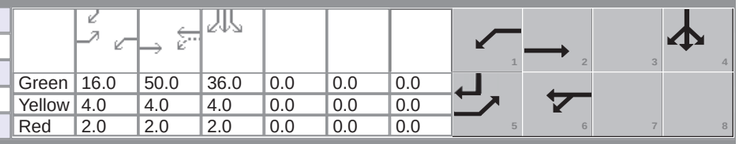
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 SB ra…	File Name	I-6_36-37_B-Full_PM_2038.xus		
Project Description	I-6 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	950		220	990					90	0	670

Signal Information			
Cycle, s	120.0	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	16.0	50.0	36.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

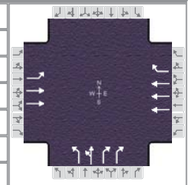
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6				4
Case Number	2.0	4.0	1.1	4.0				9.0
Phase Duration, s	22.0	56.0	22.0	56.0				42.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0				3.4
Queue Clearance Time (g_s), s	2.1	25.7	11.0	35.1				35.6
Green Extension Time (g_e), s	0.0	6.4	0.2	5.5				0.1
Phase Call Probability	1.00	1.00	1.00	1.00				1.00
Max Out Probability	0.00	0.04	0.18	0.17				1.00

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		1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h	1	1033		239	1076					54	0	772
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645	1359		1675	1675					1459	1727	1167
Queue Service Time (g_s), s	0.1	23.7		9.0	33.1					3.2	0.0	33.6
Cycle Queue Clearance Time (g_c), s	0.1	23.7		9.0	33.1					3.2	0.0	33.6
Green Ratio (*g*/*C*)	0.13	0.42		0.55	0.42					0.30	0.30	0.43
Capacity (*c*), veh/h	219	1698		387	1396					438	518	1007
Volume-to-Capacity Ratio (*X*)	0.005	0.608		0.618	0.771					0.123	0.000	0.767
Back of Queue (*Q*), ft/ln (95 th percentile)	1.4	328.7		169.1	527.6					60.8	0	435.7
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	12.4		6.4	19.8					2.0	0.0	14.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.35	0.00					0.12	0.00	0.51
Uniform Delay (d_1), s/veh	45.1	27.3		19.3	30.1					30.5	0.0	28.8
Incremental Delay (d_2), s/veh	0.0	1.6		2.2	4.2					0.0	0.0	3.3
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh	45.1	29.0		21.5	34.3					30.6	0.0	32.1
Level of Service (LOS)	D	C		C	C					C		C
Approach Delay, s/veh / LOS	29.0	C		31.9	C		0.0			32.0	C	
Intersection Delay, s/veh / LOS	31.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.6	B	3.2	C	3.0	C
Bicycle LOS Score / LOS	1.1	A	1.6	A			1.9	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 NB ra…	File Name	I-7_36-37_B-Full_AM_2038.xus		
Project Description	I-7 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	390	340			580	130	240	90	180			

Signal Information					1	2	3	4
Cycle, s	120.0	Reference Phase	2					
Offset, s	0	Reference Point	End	Green	23.0	44.0	35.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0

	5	6	7	8
Green	0.0	0.0		
Yellow	0.0	0.0		
Red	0.0	0.0		

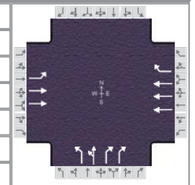
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	29.0	79.0		50.0		41.0		
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.1		3.1		3.2		
Queue Clearance Time (g_s), s	18.8	7.7		23.2		12.2		
Green Extension Time (g_e), s	0.4	2.9		2.8		1.2		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	0.51	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	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	424	370			630	141	170	189	196			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			963	1519	1723	1768	1357			
Queue Service Time (g_s), s	16.8	5.7			21.2	7.8	9.3	10.2	6.6			
Cycle Queue Clearance Time (g_c), s	16.8	5.7			21.2	7.8	9.3	10.2	6.6			
Green Ratio (*g*/*C*)	0.57	0.61			0.37	0.37	0.29	0.29	0.29			
Capacity (*c*), veh/h	532	2076			1059	557	503	516	792			
Volume-to-Capacity Ratio (*X*)	0.797	0.178			0.595	0.254	0.337	0.367	0.247			
Back of Queue (*Q*), ft/ln (95 th percentile)	308.3	99.6			229.8	140.2	181.3	202.5	101.4			
Back of Queue (*Q*), veh/ln (95 th percentile)	11.8	3.8			8.8	5.3	7.0	7.8	3.9			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.63	0.00			0.00	0.93	0.28	0.00	0.11			
Uniform Delay (d_1), s/veh	19.3	10.3			30.8	26.5	33.4	33.7	32.4			
Incremental Delay (d_2), s/veh	7.7	0.2			2.5	1.1	0.1	0.2	0.1			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	27.0	10.5			33.3	27.6	33.5	33.9	32.5			
Level of Service (LOS)	C	B			C	C	C	C	C			
Approach Delay, s/veh / LOS	19.3	B		32.2	C		33.3	C		0.0		
Intersection Delay, s/veh / LOS	27.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	1.4	A		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 NB ra…	File Name	I-7_36-37_B-Full_PM_2038.xus		
Project Description	I-7 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	410	630			670	150	540	160	550			

Signal Information					1	2	3	4
Cycle, s	120.0	Reference Phase	2					
Offset, s	0	Reference Point	End	Green	29.0	34.0	39.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0

	5	6	7	8
Green	0.0	0.0		
Yellow	0.0	0.0		
Red	0.0	0.0		

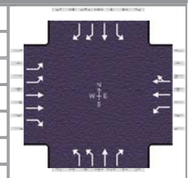
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	35.0	75.0		40.0		45.0		
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.1		3.1		3.2		
Queue Clearance Time (g_s), s	21.4	14.8		17.1		25.0		
Green Extension Time (g_e), s	0.6	4.3		3.9		3.1		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	0.06	0.00		0.04		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	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	446	685			728	163	382	379	598			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1628	1519	1723	1763	1357			
Queue Service Time (g_s), s	19.4	12.8			15.1	10.3	23.0	22.2	22.9			
Cycle Queue Clearance Time (g_c), s	19.4	12.8			15.1	10.3	23.0	22.2	22.9			
Green Ratio (*g*/*C*)	0.54	0.57			0.28	0.28	0.32	0.32	0.32			
Capacity (*c*), veh/h	582	1962			1383	430	560	573	882			
Volume-to-Capacity Ratio (*X*)	0.765	0.349			0.526	0.379	0.681	0.662	0.678			
Back of Queue (*Q*), ft/ln (95 th percentile)	337.8	222.8			266.3	193	392.5	386.1	316.6			
Back of Queue (*Q*), veh/ln (95 th percentile)	12.9	8.5			10.2	7.4	15.1	14.8	12.2			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.69	0.00			0.00	1.29	0.61	0.00	0.34			
Uniform Delay (d_1), s/veh	20.1	13.6			36.2	34.5	35.1	34.8	35.1			
Incremental Delay (d_2), s/veh	5.4	0.5			1.4	2.5	2.8	2.3	1.7			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	25.6	14.0			37.7	37.0	37.9	37.1	36.8			
Level of Service (LOS)	C	B			D	D	D	D	D			
Approach Delay, s/veh / LOS	18.6	B		37.5	D		37.2	D		0.0		
Intersection Delay, s/veh / LOS	31.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.4	A	1.0	A	2.7	B		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Wilson Road	File Name	I-8_36-37_B-Full_AM_2038.xus		
Project Description	I-8 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	290	310	50	10	450	10	20	140	50	30	60	430

Signal Information			
Cycle, s	120.0	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	18.0	42.0	7.0	29.0	0.0	0.0	
Yellow	4.0	4.0	4.0	4.0	0.0	0.0	
Red	2.0	2.0	2.0	2.0	0.0	0.0	

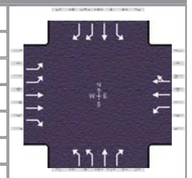
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	1.1	3.0
Phase Duration, s	24.0	48.0	24.0	48.0	13.0	35.0	13.0	35.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.3	3.1	3.3
Queue Clearance Time (*g s*), s	12.7	10.5	2.4	14.7	2.8	11.0	3.7	17.7
Green Extension Time (*g e*), s	0.4	1.8	0.0	1.8	0.0	1.8	0.0	1.6
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.14	0.00	0.00	0.00	0.07	0.00	0.67	0.03

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	315	337	54	11	251	249	22	152	54	33	65	467
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1778	1569	1696	1464	1675	1759	1319
Queue Service Time (*g s*), s	10.7	8.5	2.6	0.4	12.7	12.7	0.8	9.0	2.8	1.7	3.5	15.7
Cycle Queue Clearance Time (*g c*), s	10.7	8.5	2.6	0.4	12.7	12.7	0.8	9.0	2.8	1.7	3.5	15.7
Green Ratio (*g/C*)	0.15	0.35	0.41	0.50	0.35	0.35	0.06	0.24	0.39	0.30	0.24	0.39
Capacity (*c*), veh/h	497	1194	620	578	627	622	183	410	573	332	425	1034
Volume-to-Capacity Ratio (*X*)	0.634	0.282	0.088	0.019	0.400	0.400	0.119	0.371	0.095	0.098	0.153	0.452
Back of Queue (*Q*), ft/ln (95 th percentile)	210.2	163.9	44.3	7	242.5	230.3	15.4	183.8	47.2	32.3	72.2	226.6
Back of Queue (*Q*), veh/ln (95 th percentile)	8.0	6.3	1.7	0.3	9.3	9.2	0.6	6.7	1.7	1.2	2.7	8.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.30	0.00	0.06	0.02	0.00	0.00	0.01	0.00	0.07	0.05	0.00	0.91
Uniform Delay (*d 1*), s/veh	47.9	28.1	21.8	15.6	29.5	29.5	53.6	37.9	23.1	30.5	35.8	27.0
Incremental Delay (*d 2*), s/veh	2.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.0	0.0	0.1	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	49.9	28.2	21.8	15.6	29.6	29.6	53.7	38.1	23.1	30.5	35.9	27.1
Level of Service (LOS)	D	C	C	B	C	C	D	D	C	C	D	C
Approach Delay, s/veh / LOS	37.4	D		29.3	C		36.0	D		28.3	C	
Intersection Delay, s/veh / LOS	32.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	2.8	C	3.1	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	0.9	A	1.4	A

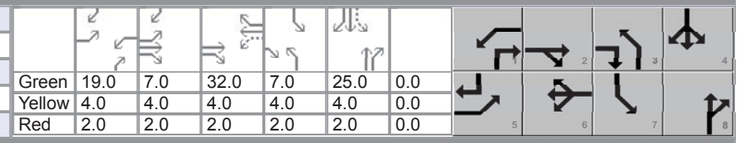
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Wilson Road	File Name	I-8_36-37_B-Full_PM_2038.xus		
Project Description	I-8 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	630	630	50	10	580	10	40	160	50	30	60	340

Signal Information			
Cycle, s	120.0	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	19.0	7.0	32.0	7.0	25.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	

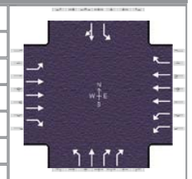
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	1.1	3.0
Phase Duration, s	38.0	51.0	25.0	38.0	13.0	31.0	13.0	31.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0	3.1	3.2	3.1	3.2
Queue Clearance Time (*g s*), s	24.9	20.8	2.4	21.3	3.6	12.9	3.7	12.3
Green Extension Time (*g e*), s	1.2	3.1	0.0	2.6	0.0	1.4	0.0	1.4
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.12	0.00	0.00	0.13	0.56	0.01	0.78	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	685	685	54	11	322	320	43	174	54	33	65	370
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1782	1569	1696	1438	1675	1759	1319
Queue Service Time (*g s*), s	22.9	18.8	2.5	0.4	19.2	19.3	1.6	10.9	3.0	1.7	3.7	10.3
Cycle Queue Clearance Time (*g c*), s	22.9	18.8	2.5	0.4	19.2	19.3	1.6	10.9	3.0	1.7	3.7	10.3
Green Ratio (*g/C*)	0.27	0.38	0.43	0.42	0.27	0.27	0.06	0.21	0.37	0.27	0.21	0.48
Capacity (*c*), veh/h	884	1280	658	476	478	475	183	353	527	273	367	1253
Volume-to-Capacity Ratio (*X*)	0.775	0.535	0.083	0.023	0.673	0.673	0.238	0.492	0.103	0.119	0.178	0.295
Back of Queue (*Q*), ft/ln (95 th percentile)	387.3	318.6	42.1	8.3	356.4	339	31	220.4	50.3	34.2	75.9	148.3
Back of Queue (*Q*), veh/ln (95 th percentile)	14.8	12.2	1.6	0.3	13.6	13.6	1.1	8.0	1.8	1.3	2.9	5.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.55	0.00	0.06	0.02	0.00	0.00	0.02	0.00	0.07	0.05	0.00	0.59
Uniform Delay (*d 1*), s/veh	40.7	29.3	20.0	20.2	39.3	39.3	54.0	41.9	25.0	33.6	39.1	19.2
Incremental Delay (*d 2*), s/veh	3.9	0.2	0.0	0.0	3.0	3.0	0.2	0.4	0.0	0.1	0.1	0.0
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	44.6	29.6	20.0	20.2	42.3	42.4	54.2	42.3	25.0	33.7	39.1	19.3
Level of Service (LOS)	D	C	C	C	D	D	D	D	C	C	D	B
Approach Delay, s/veh / LOS	36.4	D		42.0	D		40.7	D		23.1	C	
Intersection Delay, s/veh / LOS	35.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	2.9	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	1.0	A	0.9	A	1.3	A

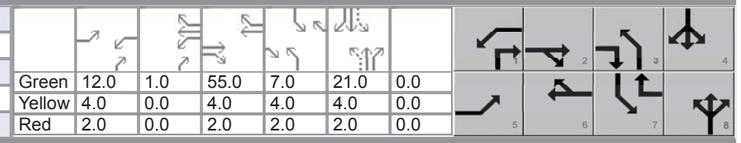
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Fourw…	File Name			
Project Description	I12 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	1970	30	190	710	200	10	130	350	90	70	10

Signal Information			
Cycle, s	120.0	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	12.0	1.0	55.0	7.0	21.0	0.0	
Yellow	4.0	0.0	4.0	4.0	4.0	0.0	
Red	2.0	0.0	2.0	2.0	2.0	0.0	

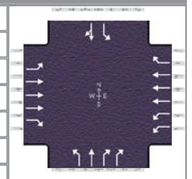
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	1.1	3.0	1.1	4.0
Phase Duration, s	18.0	61.0	19.0	62.0	13.0	27.0	13.0	27.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.2	3.1	3.2
Queue Clearance Time (*g s*), s	7.3	52.2	9.5	14.8	2.6	15.6	7.4	7.0
Green Extension Time (*g e*), s	0.0	2.4	0.2	14.3	0.0	0.9	0.0	1.3
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.10	1.00	0.68	0.10	0.04	0.31	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	2141	33	207	772	217	11	141	380	98	87	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1616	1638	1438	1569	1540	1438	1774	1863	1397	1774	1822	
Queue Service Time (*g s*), s	5.3	50.2	1.3	7.5	12.8	10.2	0.6	8.1	13.6	5.4	5.0	
Cycle Queue Clearance Time (*g c*), s	5.3	50.2	1.3	7.5	12.8	10.2	0.6	8.1	13.6	5.4	5.0	
Green Ratio (*g/C*)	0.10	0.46	0.52	0.11	0.47	0.53	0.23	0.18	0.28	0.23	0.18	
Capacity (*c*), veh/h	162	2253	743	340	2157	755	316	326	792	276	319	
Volume-to-Capacity Ratio (*X*)	0.471	0.951	0.044	0.608	0.358	0.288	0.034	0.433	0.481	0.354	0.273	
Back of Queue (*Q*), ft/ln (95 th percentile)	107.6	783.8	22.5	150.2	223	170.5	11.3	171.9	205.8	107.1	102.5	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.9	28.6	0.8	5.5	8.1	6.2	0.4	6.8	8.1	4.2	4.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00	0.03	0.25	0.00	0.27	0.05	0.00	0.46	0.28	0.00	
Uniform Delay (*d 1*), s/veh	51.0	31.2	14.3	51.1	20.5	15.9	35.7	44.2	35.7	37.8	42.9	
Incremental Delay (*d 2*), s/veh	0.8	10.5	0.1	2.3	0.5	1.0	0.0	0.3	0.2	0.3	0.2	
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	51.8	41.7	14.5	53.3	21.0	16.9	35.7	44.5	35.8	38.1	43.1	
Level of Service (LOS)	D	D	B	D	C	B	D	D	D	D	D	
Approach Delay, s/veh / LOS	41.6	D		25.8	C		38.1	D		40.4	D	
Intersection Delay, s/veh / LOS	36.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	C	3.4	C
Bicycle LOS Score / LOS	1.7	A	1.1	A	1.4	A	0.8	A

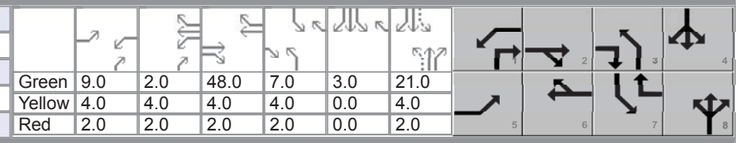
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Fourw…	File Name			
Project Description	I12 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1560	20	300	1550	250	30	130	200	190	60	10

Signal Information			
Cycle, s	120.0	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	9.0	2.0	48.0	7.0	3.0	21.0	
Yellow	4.0	4.0	4.0	4.0	0.0	4.0	
Red	2.0	2.0	2.0	2.0	0.0	2.0	

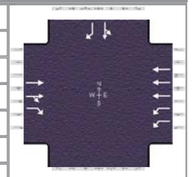
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	1.1	3.0	1.1	4.0
Phase Duration, s	15.0	54.0	23.0	62.0	13.0	27.0	16.0	30.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.2	3.1	3.2
Queue Clearance Time (*g s*), s	5.9	43.7	13.9	38.7	3.7	10.1	12.0	6.2
Green Extension Time (*g e*), s	0.0	3.7	0.3	11.4	0.0	0.8	0.0	0.9
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.98	0.95	1.00	0.56	0.75	0.01	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	1696	22	326	1685	272	33	141	217	207	76	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1616	1540	1438	1569	1540	1438	1774	1863	1397	1774	1816	
Queue Service Time (*g s*), s	3.9	41.7	1.0	11.9	36.7	12.6	1.7	8.1	6.9	10.0	4.2	
Cycle Queue Clearance Time (*g c*), s	3.9	41.7	1.0	11.9	36.7	12.6	1.7	8.1	6.9	10.0	4.2	
Green Ratio (*g/C*)	0.08	0.40	0.46	0.14	0.47	0.55	0.23	0.18	0.32	0.26	0.20	
Capacity (*c*), veh/h	121	1848	659	444	2157	791	359	326	885	341	363	
Volume-to-Capacity Ratio (*X*)	0.449	0.917	0.033	0.734	0.781	0.344	0.091	0.433	0.246	0.605	0.209	
Back of Queue (*Q*), ft/ln (95 th percentile)	78.4	636.9	17.1	236.5	535.9	208.7	34.2	171.9	106.2	41.2	86	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.9	23.2	0.6	8.6	19.6	7.6	1.3	6.8	4.2	1.6	3.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14	0.00	0.02	0.39	0.00	0.33	0.15	0.00	0.24	0.11	0.00	
Uniform Delay (*d 1*), s/veh	53.1	34.1	17.9	49.3	26.9	15.0	36.0	44.2	30.4	38.8	40.1	
Incremental Delay (*d 2*), s/veh	1.0	8.7	0.1	5.4	2.9	1.2	0.0	0.3	0.1	2.2	0.1	
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	54.1	42.9	18.0	54.8	29.8	16.2	36.0	44.5	30.4	41.0	40.2	
Level of Service (LOS)	D	D	B	D	C	B	D	D	C	D	D	
Approach Delay, s/veh / LOS	42.9	D		31.7	C		36.0	D		40.8	D	
Intersection Delay, s/veh / LOS	36.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	C	3.4	C
Bicycle LOS Score / LOS	1.5	A	1.7	A	1.1	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/I-71 S…	File Name			
Project Description	I12A - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		660	1470	450	1040					10	0	50

Signal Information			
Cycle, s	120.0	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	23.0	61.0	18.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

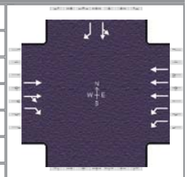
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				11.0
Phase Duration, s		67.0	29.0	96.0				24.0
Change Period, (*Y*+*R* $_c$), s		6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s		3.1	3.1	3.1				3.3
Queue Clearance Time (g_s), s		57.3	18.8	11.0				5.7
Green Extension Time (g_e), s		3.1	0.6	17.4				0.1
Phase Call Probability		1.00	1.00	1.00				1.00
Max Out Probability		0.97	0.47	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		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		1580	735	489	1130						11	54
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1643	1519	1658	1628						1740	1548
Queue Service Time (g_s), s		54.6	55.3	16.8	9.0						0.6	3.7
Cycle Queue Clearance Time (g_c), s		54.6	55.3	16.8	9.0						0.6	3.7
Green Ratio (*g*/*C*)		0.51	0.51	0.19	0.75						0.15	0.15
Capacity (*c*), veh/h		1671	772	635	3662						261	232
Volume-to-Capacity Ratio (*X*)		0.946	0.952	0.770	0.309						0.042	0.234
Back of Queue (*Q*), ft/ln (95 th percentile)		811.2	831.6	307.1	124.4						12.9	66.5
Back of Queue (*Q*), veh/ln (95 th percentile)		31.0	31.7	11.7	4.7						0.5	2.6
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.63	0.00						0.00	0.08
Uniform Delay (d_1), s/veh		27.9	28.1	46.0	4.9						43.6	44.9
Incremental Delay (d_2), s/veh		12.5	22.6	5.2	0.2						0.0	0.2
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	0.0
Control Delay (*d*), s/veh		40.4	50.7	51.2	5.1						43.6	45.1
Level of Service (LOS)		D	D	D	A						D	D
Approach Delay, s/veh / LOS	43.7	D		19.0	B		0.0			44.9	D	
Intersection Delay, s/veh / LOS	33.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.6	A	3.1	C	3.2	C
Bicycle LOS Score / LOS	2.4	B	1.4	A			0.6	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/I-71 S…	File Name			
Project Description	I12A - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1140	750	220	2010					10	0	100

Signal Information			
Cycle, s	120.0	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	22.0	55.0	25.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

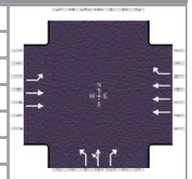
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				11.0
Phase Duration, s		61.0	28.0	89.0				31.0
Change Period, (*Y*+*R* $_c$), s		6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s		3.1	3.1	3.1				3.3
Queue Clearance Time (g_s), s		47.6	9.6	32.0				9.2
Green Extension Time (g_e), s		6.4	0.4	23.9				0.2
Phase Call Probability		1.00	1.00	1.00				1.00
Max Out Probability		0.90	0.00	0.39				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		1443	611	239	2185						11	109
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1750	1491	1658	1628						1740	1548
Queue Service Time (g_s), s		45.6	45.2	7.6	30.0						0.6	7.2
Cycle Queue Clearance Time (g_c), s		45.6	45.2	7.6	30.0						0.6	7.2
Green Ratio (*g*/*C*)		0.46	0.46	0.18	0.69						0.21	0.21
Capacity (*c*), veh/h		1604	683	608	3377						362	323
Volume-to-Capacity Ratio (*X*)		0.900	0.895	0.393	0.647						0.030	0.337
Back of Queue (*Q*), ft/ln (95 th percentile)		723.1	684.1	147.1	390.3						11.9	127.3
Back of Queue (*Q*), veh/ln (95 th percentile)		27.6	25.7	5.6	14.9						0.5	4.9
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.30	0.00						0.00	0.15
Uniform Delay (d_1), s/veh		30.0	29.8	43.1	10.3						37.8	40.4
Incremental Delay (d_2), s/veh		8.5	16.6	0.2	1.0						0.0	0.2
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	0.0
Control Delay (*d*), s/veh		38.4	46.4	43.3	11.3						37.9	40.7
Level of Service (LOS)		D	D	D	B						D	D
Approach Delay, s/veh / LOS	40.8	D		14.5	B		0.0			40.4	D	
Intersection Delay, s/veh / LOS	26.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.6	A	3.1	C	3.2	C
Bicycle LOS Score / LOS	2.2	B	1.8	A			0.7	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/I-71 N…	File Name			
Project Description	I13 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	610			1200	20	290	5	90			

Signal Information					1	2	3	4
Cycle, s	120.0	Reference Phase	2					
Offset, s	0	Reference Point	End	Green	7.0	52.0	43.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0

	5	6	7	8
Green	0.0	0.0	0.0	
Yellow	0.0	0.0	0.0	
Red	0.0	0.0	0.0	

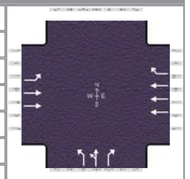
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	13.0	71.0		58.0		49.0		
Change Period, (*Y*+*R c*), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.0		3.0		3.1		
Queue Clearance Time (*g s*), s	4.8	15.3		27.5		9.9		
Green Extension Time (*g e*), s	0.0	6.3		5.9		0.8		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	1.00	0.00		0.03		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	76	663			1304	22	158	163	98			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1593	1519	1740	1743	1548			
Queue Service Time (*g s*), s	2.8	13.3			25.5	1.0	7.7	7.9	5.2			
Cycle Queue Clearance Time (*g c*), s	2.8	13.3			25.5	1.0	7.7	7.9	5.2			
Green Ratio (*g/C*)	0.51	0.54			0.43	0.43	0.36	0.36	0.36			
Capacity (*c*), veh/h	249	1849			2071	658	623	625	555			
Volume-to-Capacity Ratio (*X*)	0.306	0.359			0.630	0.033	0.253	0.261	0.176			
Back of Queue (*Q*), ft/ln (95 th percentile)	50.5	227.5			382.1	16.5	147.6	153.1	89			
Back of Queue (*Q*), veh/ln (95 th percentile)	1.9	8.7			14.6	0.6	5.7	5.9	3.4			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.09	0.00			0.00	0.02	0.12	0.00	0.12			
Uniform Delay (*d 1*), s/veh	19.1	15.6			26.5	19.5	27.2	27.3	26.4			
Incremental Delay (*d 2*), s/veh	0.3	0.0			0.5	0.0	0.1	0.1	0.1			
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	19.3	15.7			27.0	19.6	27.2	27.3	26.4			
Level of Service (LOS)	B	B			C	B	C	C	C			
Approach Delay, s/veh / LOS	16.1	B		26.8	C		27.1	C		0.0		
Intersection Delay, s/veh / LOS	23.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.1	A	1.2	A	1.2	A		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/I-71 N…	File Name			
Project Description	I13 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	120	1030			1180	40	1050	5	420			

Signal Information					1	2	3	4
Cycle, s	120.0	Reference Phase	2					
Offset, s	0	Reference Point	End	Green	7.0	45.0	50.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0

	5	6	7	8
Green	0.0	0.0	0.0	
Yellow	0.0	0.0	0.0	
Red	0.0	0.0	0.0	

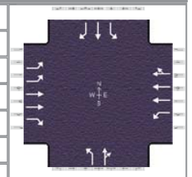
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	13.0	64.0		51.0		56.0		
Change Period, (*Y*+*R c*), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.0		3.0		3.2		
Queue Clearance Time (*g s*), s	7.5	32.3		28.7		36.6		
Green Extension Time (*g e*), s	0.0	8.0		6.9		3.4		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	1.00	0.08		0.22		0.15		

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	130	1120			1283	43	571	576	457			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1628	1519	1740	1741	1548			
Queue Service Time (*g s*), s	5.5	30.3			26.7	2.2	34.2	34.6	29.3			
Cycle Queue Clearance Time (*g c*), s	5.5	30.3			26.7	2.2	34.2	34.6	29.3			
Green Ratio (*g/C*)	0.45	0.48			0.38	0.38	0.42	0.42	0.42			
Capacity (*c*), veh/h	222	1650			1831	570	725	725	645			
Volume-to-Capacity Ratio (*X*)	0.586	0.679			0.700	0.076	0.787	0.794	0.708			
Back of Queue (*Q*), ft/ln (95 th percentile)	108.9	462.3			412.6	37.5	548.4	556.5	427.7			
Back of Queue (*Q*), veh/ln (95 th percentile)	4.2	17.6			15.7	1.4	21.3	21.6	16.6			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00			0.00	0.06	0.43	0.00	0.57			
Uniform Delay (*d 1*), s/veh	24.7	23.8			31.8	24.1	30.4	30.5	29.0			
Incremental Delay (*d 2*), s/veh	2.7	0.9			1.0	0.0	5.3	5.6	3.1			
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	27.4	24.8			32.8	24.1	35.7	36.1	32.0			
Level of Service (LOS)	C	C			C	C	D	D	C			
Approach Delay, s/veh / LOS	25.0	C		32.5	C		34.8	C		0.0		
Intersection Delay, s/veh / LOS	31.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.5	A	1.2	A	3.1	C		

HCS 2010 Signalized Intersection Results Summary

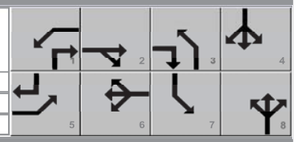
General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Wilso…	File Name			
Project Description	I14 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	230	480	40	60	1110	110	50	20	40	50	30	190

Signal Information			
Cycle, s	120.0	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	7.0	11.0	41.0	7.0	24.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	



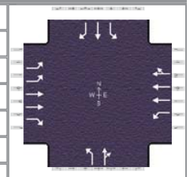
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	1.1	4.0	1.1	3.0
Phase Duration, s	30.0	64.0	13.0	47.0	13.0	30.0	13.0	30.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.3	3.1	3.3
Queue Clearance Time (*g s*), s	9.8	13.2	4.9	28.4	5.0	6.2	5.0	13.6
Green Extension Time (*g e*), s	0.5	5.2	0.0	4.2	0.0	0.6	0.0	0.5
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.00	1.00	0.19	1.00	0.00	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	250	522	43	65	898	428	54	65		54	33	207
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1707	1675	1571		1675	1759	1491
Queue Service Time (*g s*), s	7.8	11.2	1.6	2.9	26.4	26.4	3.0	4.2		3.0	1.8	11.6
Cycle Queue Clearance Time (*g c*), s	7.8	11.2	1.6	2.9	26.4	26.4	3.0	4.2		3.0	1.8	11.6
Green Ratio (*g/C*)	0.20	0.48	0.54	0.40	0.34	0.34	0.26	0.20		0.26	0.20	0.40
Capacity (*c*), veh/h	663	1650	823	448	1225	583	376	314		345	352	596
Volume-to-Capacity Ratio (*X*)	0.377	0.316	0.053	0.146	0.733	0.734	0.145	0.208		0.158	0.093	0.346
Back of Queue (*Q*), ft/ln (95 th percentile)	150.7	203.6	25.7	54.1	451	444.5	58.4	77.2		58.4	37.7	194.7
Back of Queue (*Q*), veh/ln (95 th percentile)	5.8	7.8	1.0	2.1	17.2	17.0	2.2	2.9		2.2	1.4	7.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.21	0.00	0.04	0.11	0.95	0.94	0.26	0.00		0.23	0.00	0.35
Uniform Delay (*d 1*), s/veh	41.5	18.9	13.0	22.5	34.7	34.7	34.2	40.1		34.3	39.1	25.1
Incremental Delay (*d 2*), s/veh	0.1	0.0	0.0	0.1	2.0	4.2	0.1	0.1		0.1	0.0	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	41.7	18.9	13.0	22.5	36.7	38.9	34.2	40.2		34.4	39.2	25.2
Level of Service (LOS)	D	B	B	C	D	D	C	D		C	D	C
Approach Delay, s/veh / LOS	25.6	C		36.7	D		37.5	D		28.4	C	
Intersection Delay, s/veh / LOS	32.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.8	C	3.0	C	3.4	C
Bicycle LOS Score / LOS	1.2	A	1.3	A	0.7	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

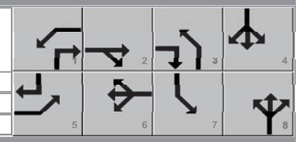
General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Aug 25, 2017	Area Type	Other
Jurisdiction	Delaware County, OH	Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Wilso…	File Name			
Project Description	I14 - Sunbury Full Interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	290	1230	60	30	670	50	70	40	60	100	20	380

Signal Information			
Cycle, s	120.0	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	10.0	11.0	36.0	8.0	25.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	1.1	4.0	1.1	3.0
Phase Duration, s	33.0	59.0	16.0	42.0	14.0	31.0	14.0	31.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0	3.1	3.3	3.1	3.3
Queue Clearance Time (*g s*), s	11.8	45.2	3.4	16.6	6.1	8.8	7.9	27.0
Green Extension Time (*g e*), s	0.7	4.0	0.0	6.1	0.0	1.2	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.52	0.00	0.11	1.00	0.00	1.00	1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	315	1337	65	33	527	256	76	109		109	22	413
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1726	1707	1618		1707	1792	1519
Queue Service Time (*g s*), s	9.8	43.2	2.6	1.4	14.5	14.6	4.1	6.8		5.9	1.2	25.0
Cycle Queue Clearance Time (*g c*), s	9.8	43.2	2.6	1.4	14.5	14.6	4.1	6.8		5.9	1.2	25.0
Green Ratio (*g/C*)	0.22	0.44	0.51	0.38	0.30	0.30	0.28	0.21		0.28	0.21	0.43
Capacity (*c*), veh/h	746	1507	772	228	1075	518	416	337		340	373	658
Volume-to-Capacity Ratio (*X*)	0.423	0.887	0.084	0.143	0.490	0.494	0.183	0.323		0.320	0.058	0.627
Back of Queue (*Q*), ft/ln (95 th percentile)	187.1	666.5	42.8	27.6	271.6	266.2	79.4	128.8		115.9	24.3	371.8
Back of Queue (*Q*), veh/ln (95 th percentile)	7.1	25.4	1.6	1.1	10.4	10.2	3.0	4.9		4.4	0.9	14.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.26	0.00	0.06	0.06	0.57	0.56	0.35	0.00		0.46	0.00	0.68
Uniform Delay (*d 1*), s/veh	39.8	30.8	15.2	26.9	34.5	34.5	33.1	40.3		34.0	38.1	26.5
Incremental Delay (*d 2*), s/veh	0.1	6.6	0.0	0.1	0.1	0.3	0.1	0.2		0.2	0.0	1.4
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	40.0	37.3	15.2	27.0	34.6	34.8	33.1	40.5		34.2	38.1	27.9
Level of Service (LOS)	D	D	B	C	C	C	C	D		C	D	C
Approach Delay, s/veh / LOS	37.0	D		34.3	C		37.5	D		29.6	C	
Intersection Delay, s/veh / LOS	35.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.8	C	3.0	C	3.4	C
Bicycle LOS Score / LOS	1.9	A	0.9	A	0.8	A	1.4	A

Appendix C-C

ECAT Analyses

Project and Site Conditions Information

Proposed Conditions: General Information and Data for Ramp Terminal Intersection

General Information		Location Information	
Analyst	JRH	Route	Sunbury Parkway
Agency or Company	ms consultants	Logpoint	0
Date Performed	08/25/17	Common Name	Build Condition Alternative
Intersection	I-71 SB ramps	Analysis Year	
Signalized/Unsignalized	Unsignalized		

Input Data		Proposed Conditions	HSM Base Conditions	
Basic Intersection Data				
Area Type		Urban	--	
Ramp Terminal Configuration	Select Ramp Configuration	A4	--	Four-leg term
Presence of a non-ramp public street leg I_{ps}		[redacted]	Signalized Only	
Exit ramp skew angle I_{sk} (degrees)		0.00	--	
Distance to the next public street intersection on the outside crossroad leg L_{up} (mi)		0.33	No adjacent public street intersection with 6 miles	
Distance to the adjacent ramp terminal L_{ramp} (mi)		0.13	No adjacent ramp intersection with 6 miles	
Crossroad median width W_m (ft) (Width includes left turn lane width)		50	12 ft	
Intersection Stop Control Operation		One-way stop	One-way stop	
Crossroad Inside Approach				
	Through Lanes $n_{th,\ in}$	3	--	
		[redacted]		
	Right-Turn Channelization present $I_{ch,\ in}$		Signalized Only	
	Right Turn Lane or bay present $I_{bay,\ rt,\ in}$	Not Present	Not Present	
	$AADT_{in}$ (veh/day)	18,820	AADT Valid	ADT Range: 0 to 21,000
Crossroad Outside Approach				
	Through Lanes $n_{th,\ out}$	2	--	
		[redacted]		
	Right-Turn Channelization present $I_{ch,\ out}$		Signalized Only	
	Right Turn Lane or bay present $I_{bay,\ rt,\ out}$	Present	Not Present	
	$AADT_{out}$ (veh/day)	20,810	AADT Valid	ADT Range: 0 to 21,000
	Number of driveways on the outside crossroad leg n_{dw}	0	0	
	Number of public street approaches on the outside crossroad leg n_{ps}	0	0	
Ramp Approaches				
	Exit Ramp Through Lanes n_{ex} Lane Configuration Help	0	--	
	Exit ramp Right Turn Protected-only mode $I_{s,p,m}$	Free-Flow	Not Present	
	Exit Ramp Right-Turn Channelization present $I_{ch,\ ex}$	[redacted]	Signalized Only	
	Exit Ramp Volume, $AADT_{ex}$ (veh/day)	1	AADT Valid	ADT Range: 0 to 12,000
	Entrance Ramp Volume, $AADT_{en}$ (veh/day)	9,430		
	Loop Entrance Ramp Volume $AADT_{loop}$ (veh/day)	2,970	Only Required if Ramp Terminal Type A4 or B4	

Predictive Analysis

Proposed Conditions: Crash Modification Factors (CMFs) for Ramp Terminal Intersection

Crash Severity Level	Exit Ramp Capacity $CMF_{10,\ w\ n,\ at,\ z}$	Crossroad left-turn lane $CMF_{11,\ w\ n,\ at,\ z}$	Crossroad right-turn lane $CMF_{12,\ w\ n,\ at,\ z}$	Access point frequency $CMF_{13,\ w\ n,\ at,\ z}$	Segment length $CMF_{14,\ w\ n,\ at,\ z}$	Median width $CMF_{15,\ w\ n,\ at,\ z}$
	From Equation 19-42	From Equation 19-45	From Equation 19-48	From Equation 19-49	From Equation 19-50	From Equation 19-51
Fatal and Injury (FI)	1.0000	1.0000	0.9413	1.0000	0.8637	1.0000
Property Damage Only (PDO)		1.0000	0.9413	Signalized Only	Signalized Only	Signalized Only

Crash Severity Level	Protected left-turn operation $CMF_{16,\ w\ SGn,\ at,\ z}$	Chan. right turn on crossroad $CMF_{17,\ w\ SGn,\ at,\ z}$	Chan. right turn on exit ramp $CMF_{18,\ w\ SGn,\ at,\ z}$	Non-ramp public street leg $CMF_{19,\ w\ SGn,\ at,\ z}$	Skew angle $CMF_{20,\ w\ STn,\ at,\ s}$	All -Way Stop Control CMF_{awsc}
	From Equation 19-53	From Equation 19-55	From Equation 19-56	From Equation 19-57	From Equation 19-58	From Section 19-10
Fatal and Injury (FI)	Signalized Only	Signalized Only	Signalized Only	Signalized Only	1.0000	1.0000
Property Damage Only (PDO)	Signalized Only	Signalized Only	Signalized Only	Signalized Only		

Proposed Conditions: Predicted Crash Summary for Ramp Terminal Intersection

Crash Severity Level	Predicted $N_{p,\ w,\ x,\ at,\ z,\ s}$ (cr/yr) From Equation 14-28 and 14-29	Overdispersion $k_{w,\ x,\ at,\ z}$	Combined Countermeasures (multiply all CMFs evaluated)	Calibration Factor $C_{at5,\ x,\ at,\ z}$	Predicted average crash frequency $N_{c,\ w,\ x,\ at,\ z,\ s}$ (cr/yr)
Total	5.0551	--	--	--	4.5400
Fatal and Injury (FI)	1.7031	0.15	0.8130	1.00	1.3847
Property Damage Only (PDO)	3.3520	0.15	0.9413	1.00	3.1553

Sel Lane Configuration Help

Proposed Conditions: Predicted Number of Crashes by Severity Level and Collision Type

Collision Type	$N_{predicted}$ (KABCO) (crashes/mi/year)	$N_{predicted}$ (KA) (crashes/mi/year)	$N_{predicted}$ (B) (crashes/mi/year)	$N_{predicted}$ (C) (crashes/mi/year)	$N_{predicted}$ (O) (crashes/mi/year)
Total	***4.5398***	***0.0692***	***0.4983***	***0.8169***	***3.1554***

Project and Site Conditions Information

Proposed Intersection: Summary Results (Without Animal Crashes) (Crashes/Year)

	KA	B	C	O	Total
$N_{predicted}$	0.0692	0.4983	0.8169	3.1554	**4.5398**
$N_{predicted}$ - Proposed Conditions All CMFs	0.0692	0.4983	0.8169	3.1554	**4.5398**

ms consultants, inc.
engineers, architects, planners

Project and Site Conditions Information

Proposed Conditions: General Information and Data for Ramp Terminal Intersection

General Information		Location Information	
Analyst	JRH	Route	Sunbury Parkway
Agency or Company	ms consultants	Logpoint	0
Date Performed	08/24/17	Common Name	Sunbury Full Interchange alternative
Intersection	I-71 SB Ramps	Analysis Year	2038
Signalized/Unsignalized	Signalized		

Input Data		Proposed Conditions	HSM Base Conditions	
Basic Intersection Data				
Area Type		Urban	--	
Ramp Terminal Configuration	Select Ramp Configuration	D4	--	Four-leg term
Presence of a non-ramp public street leg I_{ps}		Not Present	No public street approaches present	
Exit ramp skew angle I_{sk} (degrees)			Unsignalized Intersection Only	
Distance to the next public street intersection on the outside crossroad leg L_{pi} (mi)		0.33	No adjacent public street intersection with 6 miles	
Distance to the adjacent ramp terminal L_{ramp} (mi)		0.13	No adjacent ramp intersection with 6 miles	
Crossroad median width W_m (ft) (Width includes left turn lane width)		50	12 ft	
Crossroad Inside Approach				
	Through Lanes $n_{th,\ in}$	3	--	
	Left Turn Lane or bay present $I_{bay,\ lt,\ in}$	Present	Not Present	
	Left Turn Lane or bay width $W_{lt,\ in}$ (ft)	24	Not Present	
	Left-Turn Operational Mode Protected-only mode lp,lt,in	Present	Not Present	
	$AADT_{in}$ (veh/day)	18,820	AADT Valid	ADT Range: 0 to 47,000
Crossroad Outside Approach				
	Through Lanes $n_{th,\ out}$	2	--	
	Right-Turn Channelization present $I_{ch,\ out}$	Not Present	Not Present	
	Right Turn Lane or bay present $I_{bay,\ rt,\ out}$	Present	Not Present	
	$AADT_{out}$ (veh/day)	20,810	AADT Valid	ADT Range: 0 to 47,000
	Number of driveways on the outside crossroad leg n_{dw}	0	0	
	Number of public street approaches on the outside crossroad leg n_{ps}	0	0	
Ramp Approaches				
	Exit Ramp Through Lanes n_{ex} Lane Configuration Help	1	--	
	Exit ramp Right Turn Protected-only mode $I_{p,lt,in}$	Signal	Not Present	
	Exit Ramp Right-Turn Channelization present $I_{ch,\ ex}$	Not Present	Not Present	
	Exit Ramp Volume, $AADT_{ex}$ (veh/day)	1,080	AADT Valid	ADT Range: 0 to 31,000
	Entrance Ramp Volume, $AADT_{en}$ (veh/day)	12,400		

Predictive Analysis

Proposed Conditions: Crash Modification Factors (CMFs) for Ramp Terminal Intersection

Crash Severity Level	Exit Ramp Capacity $CMF_{10,\ w\ n,\ st,\ s}$	Crossroad left-turn lane $CMF_{11,\ w\ n,\ st,\ z}$	Crossroad right-turn lane $CMF_{12,\ w\ n,\ st,\ z}$	Access point frequency $CMF_{13,\ w\ n,\ st,\ z}$	Segment length $CMF_{15,\ w\ n,\ st,\ z}$	Median width $CMF_{16,\ w\ n,\ st,\ z}$
	From Equation 19-42	From Equation 19-45	From Equation 19-48	From Equation 19-49	From Equation 19-50	From Equation 19-51
Fatal and Injury (FI)	1.0032	0.8760	0.8289	1.0000	0.8233	1.1659
Property Damage Only (PDO)		0.8866	0.9557	1.0000	0.8224	1.1650

Crash Severity Level	Protected left-turn operation $CMF_{16,\ w\ SGn,\ st,\ z}$	Chan. right turn on crossroad $CMF_{17,\ w\ SGn,\ st,\ z}$	Chan. right turn on exit ramp $CMF_{18,\ w\ SGn,\ st,\ z}$	Non-ramp public street leg $CMF_{19,\ w\ SGn,\ st,\ z}$	Skew angle $CMF_{20,\ w\ STn,\ st,\ ti}$	All -Way Stop Control CMF_{aasc}
	From Equation 19-53	From Equation 19-55	From Equation 19-56	From Equation 19-57	From Equation 19-58	From Section 19-10
Fatal and Injury (FI)	0.6148	1.0000	1.0000	1.0000	Unsignalized Only	Unsignalized Only
Property Damage Only (PDO)	0.7315	1.0000	1.0000	1.0000	Unsignalized Only	Unsignalized Only

Proposed Conditions: Predicted Crash Summary for Ramp Terminal Intersection

Crash Severity Level	Predicted $N_{p,\ w,\ x,\ st,\ z,\ y}$ (cr/yr) From Equation 14-28 and 14-29	Overdispersion $k_{w,\ x,\ st,\ z}$	Combined Countermeasures (multiply all CMFs evaluated)	Calibration Factor $C_{st5,\ x,\ st,\ z}$	Predicted average crash frequency $N_{e,\ w,\ x,\ st,\ z,\ s}$ (cr/yr)
Total	13.4273	--	--	--	7.3969
Fatal and Injury (FI)	5.5991	0.09	0.4299	0.62	1.4924
Property Damage Only (PDO)	7.8282	0.14	0.5939	1.27	5.9045

Sel Lane Configuration Help

Proposed Conditions: Predicted Number of Crashes by Severity Level and Collision Type

Collision Type	$N_{predicted}$ (KABCO) (crashes/mi/year)	$N_{predicted}$ (KA) (crashes/mi/year)	$N_{predicted}$ (B) (crashes/mi/year)	$N_{predicted}$ (C) (crashes/mi/year)	$N_{predicted}$ (O) (crashes/mi/year)
Total	***7.3967***	***0.1299***	***0.5353***	***0.8269***	***5.9046***

Project and Site Conditions Information

Proposed Intersection: Summary Results (Without Animal Crashes) (Crashes/Year)

	KA	B	C	O	Total
$N_{predicted}$	0.1299	0.5353	0.8269	5.9046	**7.3967**
$N_{predicted}$ - Proposed Conditions All CMFs	0.1299	0.5353	0.8269	5.9046	**7.3967**

ms consultants, inc.
engineers, architects, planners

Appendix C-D

Cost Estimate Comparison

COST ESTIMATE COMPARISON

8/25/2017

Build Condition & Sunbury Full Interchange alternatives

Cost estimate in 2015 dollars
Assumes 20% contingency, 18% engineering, and 10% inspection for all items
Number of lanes accounts for width of ramp shoulders

Build Condition elements that are not part of Sunbury Full Interchange alternative
(i.e. cost "savings" with Sunbury Full Interchange alternative)

	Length (ft)	Lanes*	Unit Cost		Subtotal	Conting.+ Eng.+Insp.	TOTAL
Entrance Ramp from Sunbury Pkwy EB to I-71 SB							
Northern half	1000	3	$300	ln/ft.	$900,000	$432,000	$1,330,000
Southern half	1700	2	$300	ln/ft.	$1,020,000	$489,600	$1,510,000
Entrance Ramp (loop) from Sunbury Pkwy WB to I-71 SB	3200	2	$300	ln/ft.	$1,920,000	$921,600	$2,840,000
Right-of-Way (approximately 4.5 add'l acres in NW int. quad.)			$300,000	acre	$1,350,000	$0	$1,350,000
					TOTAL NET COST - Build Condition		**$7,030,000**

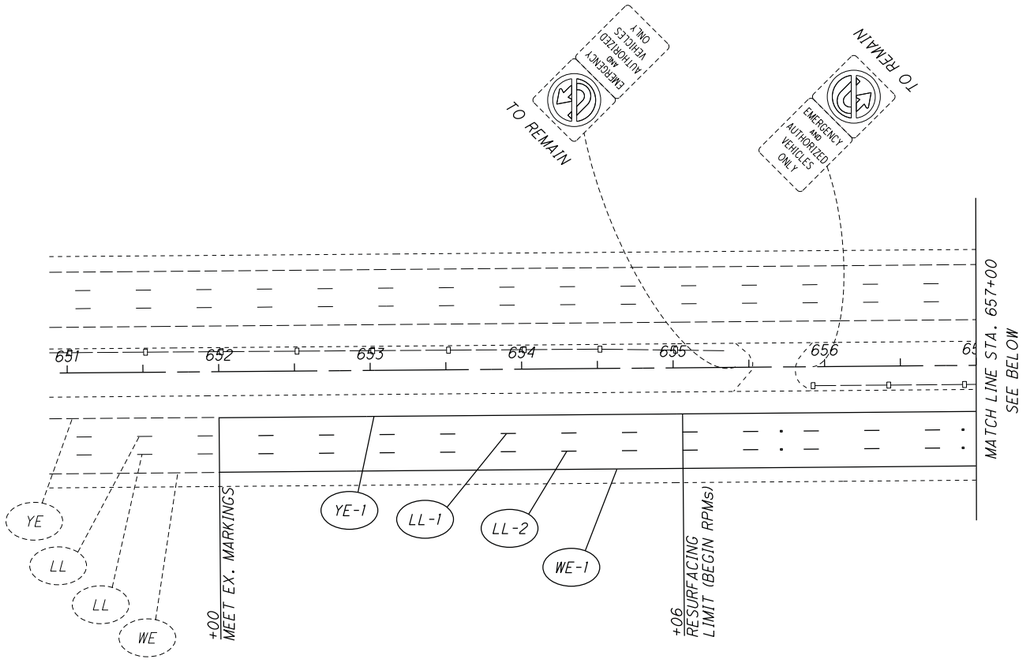
Sunbury Full Interchange alternative elements that are not part of Build Condition
(i.e. additional costs associated with Sunbury Full Interchange alternative)

Auxiliary Lane I-71 SB from 36/37 entrance to Sunbury exit	1516	1	$300	ln/ft.	$454,800	$218,304	$670,000
Exit Ramp from I-71 SB to Sunbury Pkwy							
Northern portion	1100	2	$300	ln/ft.	$660,000	$316,800	$980,000
Southern portion	300	3	$300	ln/ft.	$270,000	$129,600	$400,000
Entrance Ramp from Sunbury Pkwy to I-71 SB							
Entrance Ramp	1700	3	$300	ln/ft.	$1,530,000	$734,400	$2,260,000
Right Acceleration Lane	1420	1	$300	ln/ft.	$426,000	$204,480	$630,000
Left Acceleration Lane	2840	1	$300	ln/ft.	$852,000	$408,960	$1,260,000
Sunbury Parkway							
Additional EB lane west of SB ramp	700	1	$300	ln/ft.	$210,000	$100,800	$310,000
Traffic Control							
Cantilever signs		2	$18,000	each	$ 36,000	$17,280	$50,000
Sign trusses		2	$45,000	each	$ 90,000	$43,200	$130,000
Traffic Signal at SB ramp terminal		1	$ 180,000	each	$ 180,000	$86,400	$270,000
					TOTAL NET COST - Sunbury Full Interchange		**$6,960,000**

Appendix D

No-Build Condition
I-71 Northbound Exit Ramp Capacity Addition Project
Part of No-Build Condition - Constructed in 2016

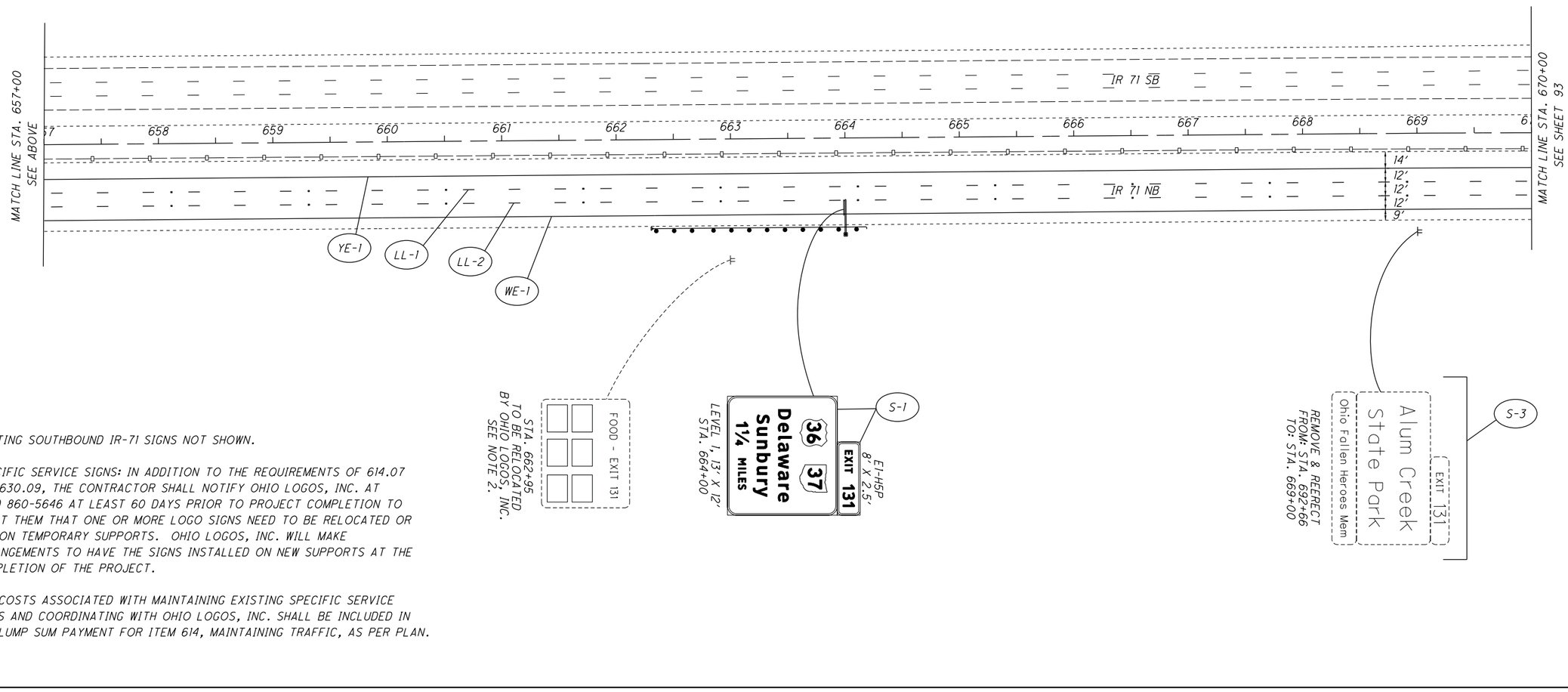
ms consultants, inc.
engineers, architects, planners



PAVEMENT MARKING LEGEND	
WE	PROPOSED PAVEMENT MARKINGS, ITEM 644
WE	EXISTING PAVEMENT MARKINGS (TO REMAIN)
¤	RAISED PAVEMENT MARKERS: INSTALL PER STD.CONST.DWGS TC-65.10 AND TC-65.11

INTERSTATE LINE SPECIFICATIONS	
YE	EDGE LINE, 6" YELLOW
WE	EDGE LINE, 6" WHITE
LL	LANE LINE, 6" WHITE
CH	CHANNELIZING LINE, 12" WHITE
WD	DOTTED LINE, 6" WHITE (3' SEGMENT/9' GAP)

SIGN LEGEND	
	PROPOSED SIGN
	EXISTING SIGN (TO BE REMOVED)
	EXISTING SIGN (TO REMAIN)



NOTES:

1. EXISTING SOUTHBOUND IR-71 SIGNS NOT SHOWN.

2. SPECIFIC SERVICE SIGNS: IN ADDITION TO THE REQUIREMENTS OF 614.07 AND 630.09, THE CONTRACTOR SHALL NOTIFY OHIO LOGOS, INC. AT (800) 860-5646 AT LEAST 60 DAYS PRIOR TO PROJECT COMPLETION TO ALERT THEM THAT ONE OR MORE LOGO SIGNS NEED TO BE RELOCATED OR ARE ON TEMPORARY SUPPORTS. OHIO LOGOS, INC. WILL MAKE ARRANGEMENTS TO HAVE THE SIGNS INSTALLED ON NEW SUPPORTS AT THE COMPLETION OF THE PROJECT.

   ALL COSTS ASSOCIATED WITH MAINTAINING EXISTING SPECIFIC SERVICE SIGNS AND COORDINATING WITH OHIO LOGOS, INC. SHALL BE INCLUDED IN THE LUMP SUM PAYMENT FOR ITEM 614, MAINTAINING TRAFFIC, AS PER PLAN.

HORIZONTAL SCALE IN FEET
0 50 100

CALCULATED RJ
CHECKED JF

TRAFFIC CONTROL PLAN
STA. 657+00 TO STA. 670+00

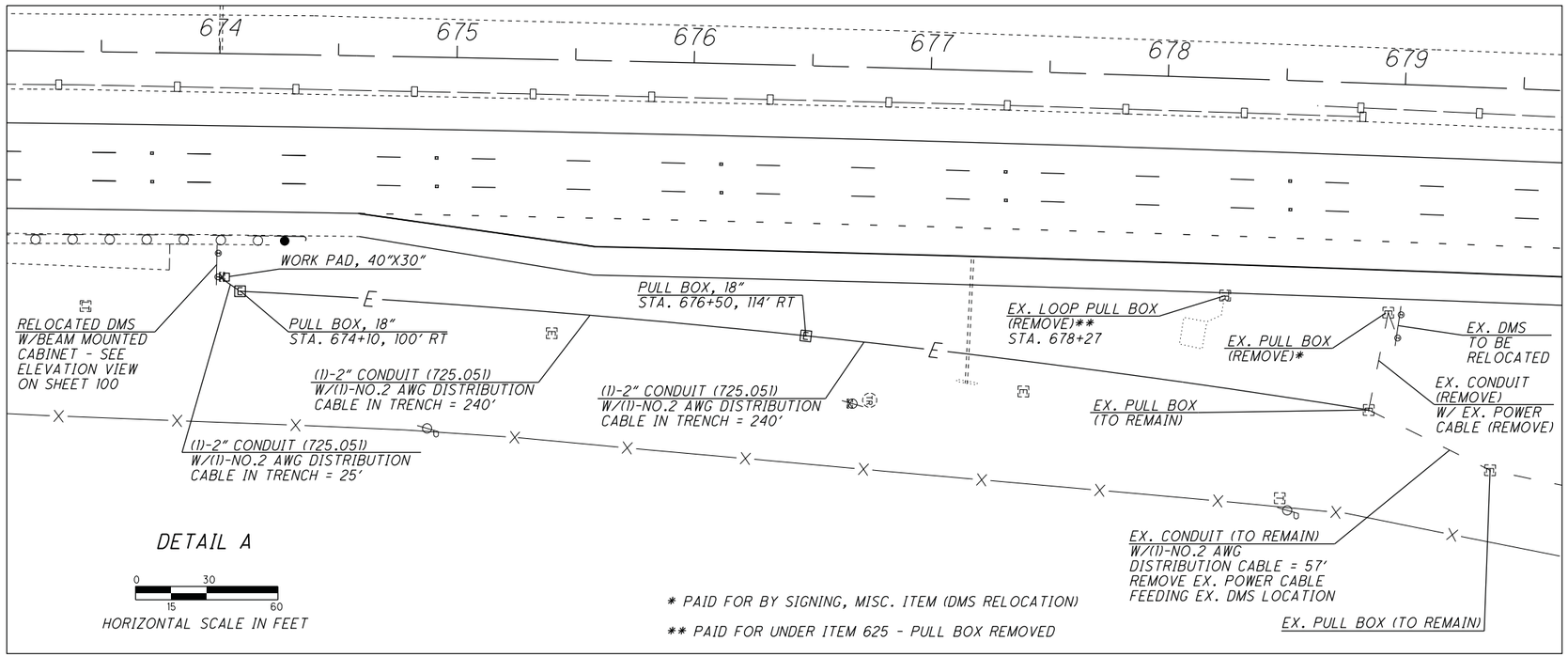
IR71 NB OFF-RAMP IMPROVEMENTS

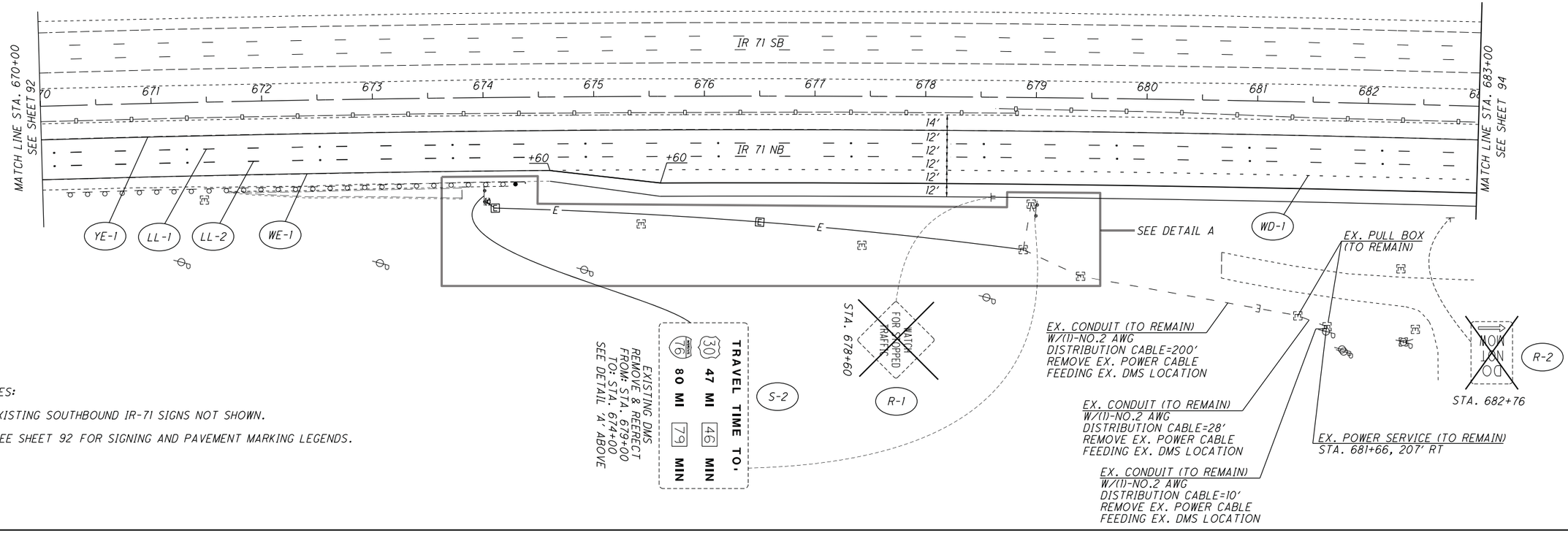
ITEM 630 SIGNING, MISC.: REMOVAL OF GROUND MOUNTED DMS AND REERECTION

UNDER THIS ITEM OF WORK, THE CONTRACTOR SHALL RELOCATE THE EXISTING GROUND MOUNTED DYNAMIC MESSAGE SIGN (DMS) AND CONTROLLER CABINET AS SHOWN ON THIS SHEET. PRIOR TO THE DEACTIVATION OR REMOVAL OF ANY SIGNS OR EQUIPMENT, THE CONTRACTOR AND THE ENGINEER SHALL INSPECT THE EQUIPMENT FOR THE PURPOSE OF DOCUMENTING ANY EXISTING DAMAGE. ANY DAMAGE IDENTIFIED AFTER RELOCATION AND NOT DOCUMENTED PRIOR TO THE RELOCATION PROCESS WILL BE PRESUMED TO HAVE BEEN CAUSED BY THE CONTRACTOR. THE CONTRACTOR WILL BE REQUIRED TO REPAIR OR REPLACE THE DAMAGED EQUIPMENT AT THE OPTION OF THE ENGINEER. NO ADDITIONAL COMPENSATION WILL BE AWARDED.

PAYMENT SHALL BE PER 630 AND SHALL INCLUDE ALL LABOR, EQUIPMENT, AND MATERIALS NECESSARY TO REMOVE AND REERECT THE DMS GUIDE SIGN AND CABINET. REMOVAL OF EXISTING POWER CABLE, CONDUIT AND PULL BOX AS INDICATED ON THE PLAN SHALL ALSO BE INCLUDED IN THIS ITEM OF WORK. NO SEPARATE PAYTMENT SHALL BE MADE.

A QUANTITY OF 1 EACH HAS BEEN CARRIED TO THE SIGNING SUB SUMMARY.





NOTES:

1. EXISTING SOUTHBOUND IR-71 SIGNS NOT SHOWN.
2. SEE SHEET 92 FOR SIGNING AND PAVEMENT MARKING LEGENDS.

HORIZONTAL SCALE IN FEET
0 25 50 100

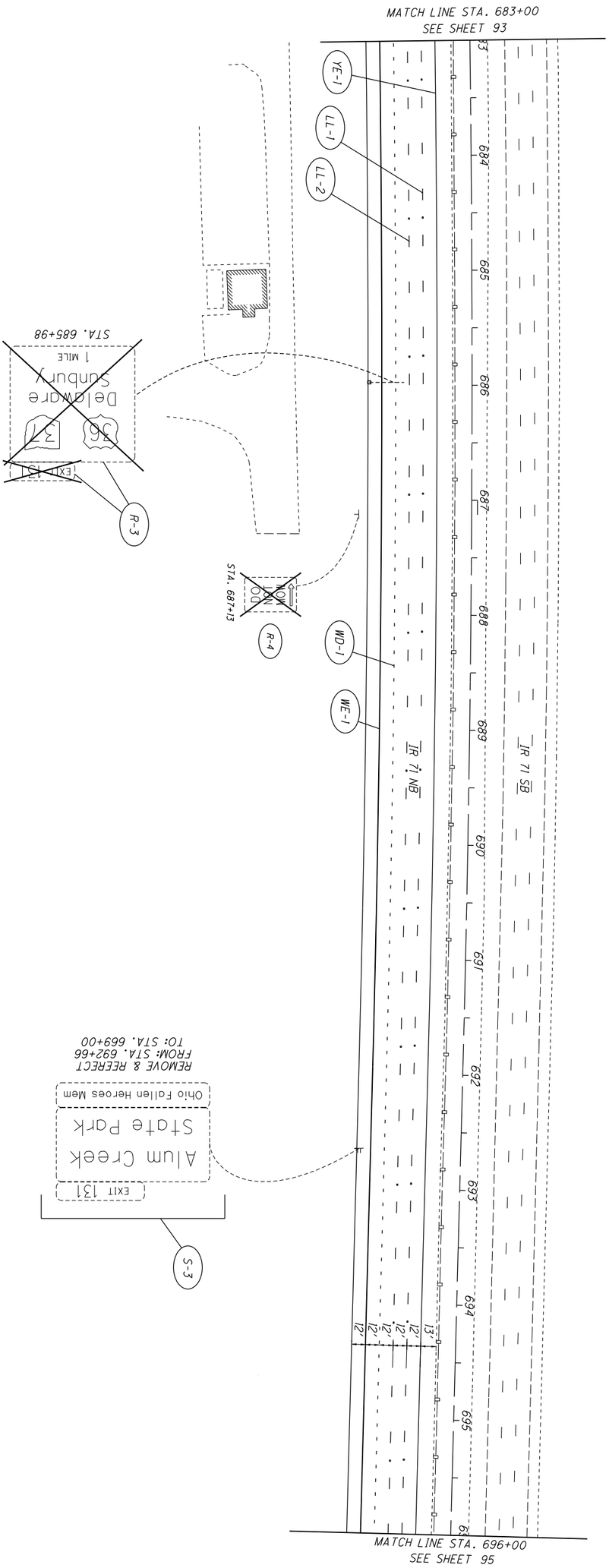
CALCULATED RJ
CHECKED JF

TRAFFIC CONTROL PLAN
STA. 670+00 TO STA. 683+00

IR71 NB OFF-RAMP IMPROVEMENTS

NOTES:

1. EXISTING SOUTHBOUND IR-71 SIGNS NOT SHOWN.
2. SEE SHEET 92 FOR SIGNING AND PAVEMENT MARKING LEGENDS.



IR71 NB OFF-RAMP IMPROVEMENTS

TRAFFIC CONTROL PLAN
STA. 683+00 TO STA. 696+00

CALCULATED RJI
CHECKED JF

0 50 100
HORIZONTAL SCALE IN FEET

N

NOTES:

1. EXISTING SOUTHBOUND IR-71 SIGNS NOT SHOWN.

2. SEE SHEET 92 FOR SIGNING AND PAVEMENT MARKING LEGENDS.

3. SPECIFIC SERVICE SIGNS: IN ADDITION TO THE REQUIREMENTS OF 614.07 AND 630.09, THE CONTRACTOR SHALL NOTIFY OHIO LOGOS, INC. AT (800) 860-5646 AT LEAST 60 DAYS PRIOR TO PROJECT COMPLETION TO ALERT THEM THAT ONE OR MORE LOGO SIGNS ARE ON TEMPORARY SUPPORTS. OHIO LOGOS, INC. WILL MAKE ARRANGEMENTS TO HAVE THE SIGNS INSTALLED ON PERMANENT SUPPORTS AT THE COMPLETION OF THE PROJECT.

   ALL COSTS ASSOCIATED WITH MAINTAINING EXISTING SPECIFIC SERVICE SIGNS AND COORDINATING WITH OHIO LOGOS, INC. SHALL BE INCLUDED IN THE LUMP SUM PAYMENT FOR ITEM 614, MAINTAINING TRAFFIC, AS PER PLAN.

HORIZONTAL SCALE IN FEET
0 50 100

CALCULATED RJI
CHECKED JF

TRAFFIC CONTROL PLAN
STA. 696+00 TO STA. 709+00

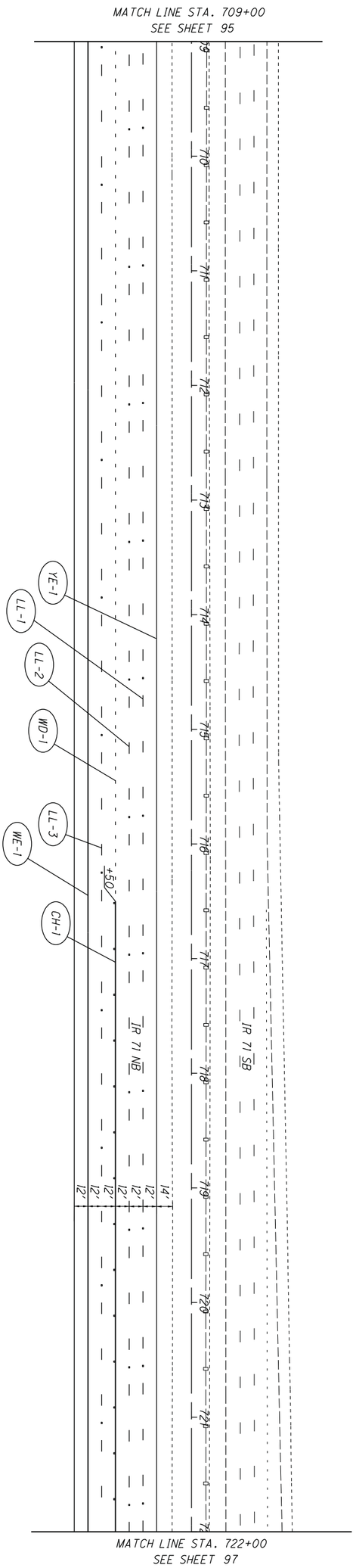
IR71 NB OFF-RAMP IMPROVEMENTS

95
106

J:\20132074\ODOT\DEL\22222\traffic\sheets\22222TP004.dgn 2/25/2016 4:45:56 PM oburger

NOTES:

1. EXISTING SOUTHBOUND IR-71 SIGNS NOT SHOWN.
2. SEE SHEET 92 FOR SIGNING AND PAVEMENT MARKING LEGENDS.



IR71 NB OFF-RAMP IMPROVEMENTS

TRAFFIC CONTROL PLAN
STA. 709+00 TO STA. 722+00

CALCULATED RJI
CHECKED JF

0 50 100
HORIZONTAL SCALE IN FEET

N

NOTES:

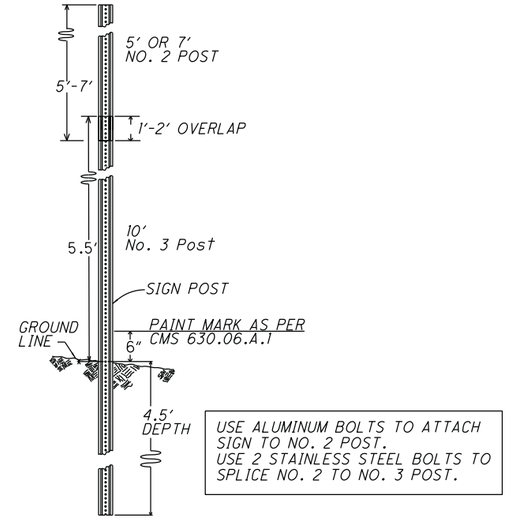
1. EXISTING SOUTHBOUND IR-71 SIGNS NOT SHOWN.

2. SEE SHEET 92 FOR SIGNING AND PAVEMENT MARKING LEGENDS.

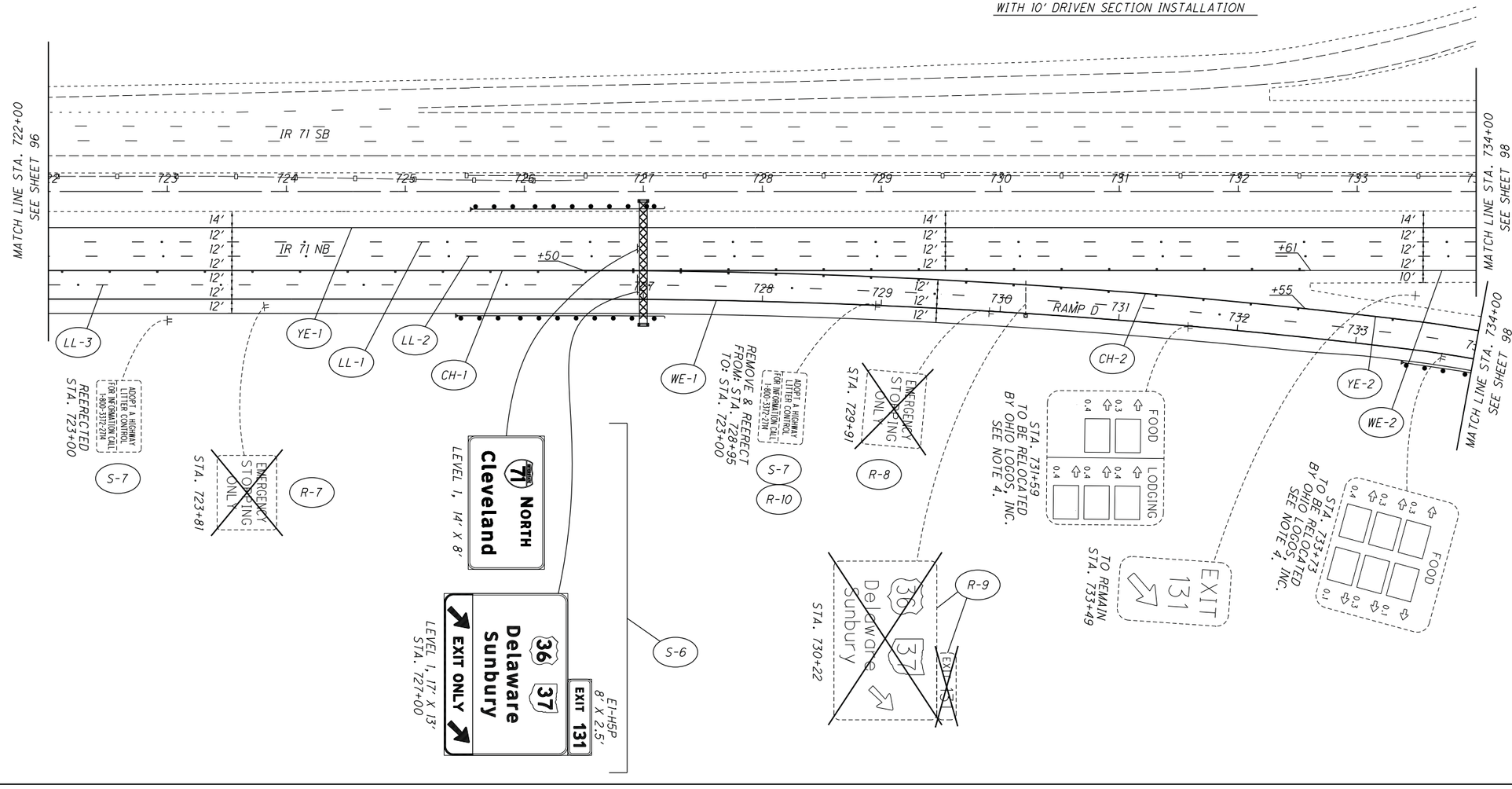
3. FOR CLARITY, UNDERGROUND UTILITIES HAVE NOT BEEN SHOWN. SEE PLAN AND PROFILE SHEETS.

4. SPECIFIC SERVICE SIGNS: IN ADDITION TO THE REQUIREMENTS OF 614.07 AND 630.09, THE CONTRACTOR SHALL NOTIFY OHIO LOGOS, INC. AT (800) 860-5646 AT LEAST 60 DAYS PRIOR TO PROJECT COMPLETION TO ALERT THEM THAT ONE OR MORE LOGO SIGNS ARE ON TEMPORARY SUPPORTS. OHIO LOGOS, INC. WILL MAKE ARRANGEMENTS TO HAVE THE SIGNS INSTALLED ON PERMANENT SUPPORTS AT THE COMPLETION OF THE PROJECT.

   ALL COSTS ASSOCIATED WITH MAINTAINING EXISTING SPECIFIC SERVICE SIGNS AND COORDINATING WITH OHIO LOGOS, INC. SHALL BE INCLUDED IN THE LUMP SUM PAYMENT FOR ITEM 614, MAINTAINING TRAFFIC, AS PER PLAN.



TYPICAL NO. 2
AND NO. 3 U - CHANNEL SPLICE
WITH 10' DRIVEN SECTION INSTALLATION



HORIZONTAL SCALE IN FEET
0 50 100

CALCULATED R.J
CHECKED JF

TRAFFIC CONTROL PLAN
STA. 722+00 TO STA. 734+00

IR71 NB OFF-RAMP IMPROVEMENTS

POLE L, STA. 965+61, 85' LT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

1 - 2" C w/ 1-2C, 1-5C
IN TRENCH = 2'

PULLBOX STA. 965+58.5, 85.5' LT

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 41'

POLE D, STA. 965+26.5, 60' LT
TC-81.10 DESIGN 14

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 5'

PULLBOX STA. 965+25, 57.5' LT

1 - 2" C w/ 1-2C, 1-5C
IN TRENCH = 3'

POLE K, STA. 965+26, 54.5' LT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

POLE J, STA. 965+23.5, 71' RT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

1 - 2" C w/ 1 - 2C, 1 - 5C
TRENCH = 4'

PULLBOX STA. 965+23, 73.5' RT

1 - 2" C w/ 1 - 2C, 1 - 5C
TRENCH = 14'

POLE C, STA. 965+35, 81' RT
TC-81.10 DESIGN 14

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 31'

PULLBOX STA. 965+57.5, 101.5' RT

1 - 2" C w/ 1 - 2C, 1 - 5C
TRENCH = 10.5'

POLE I, STA. 965+67, 97' RT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

POLE E, STA. 966+57, 85.5' LT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

1 - 2" C w/ 1-2C, 1-5C
IN TRENCH = 2'

PULLBOX STA. 966+60, 86' LT

1 - 2" C w/ 1-2C, 1-5C
IN TRENCH = 34'

POLE A, STA. 966+82.5, 62' LT
T.C.-81.10 DESIGN 14

2-3" C w/ 6-2C, 6-5C, 5-7C, 1-9C
IN TRENCH = 7'

Ex. 24" PULLBOX (TO REMAIN)
STA. 966+88, 66.5' LT

2-3" C w/ 8-2C, 8-5C, 5-7C, 1-9C
IN TRENCH = 7'

Ex. CONTROLLER, (TO REMAIN)
STA. 966+97, 66' LT

1 - 2" C w/ 1-2C, 1-5C
IN TRENCH = 16'

PULLBOX STA. 966+98, 54.5' LT

1 - 2" C w/ 1-2C, 1-5C
IN TRENCH = 3'

POLE F, STA. 966+98, 51.5' LT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

POLE G, STA. 966+98, 52.5' RT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 4.5'

PULLBOX STA. 966+98, 56.5' RT

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 18.5'

POLE B, STA. 966+85.5, 70.5' RT
T.C.-81.10 DESIGN 14

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 20.5'

PULLBOX STA. 966+79.5, 90' RT

1 - 2" C w/ 1 - 2C, 1 - 5C
IN TRENCH = 7'

POLE H, STA. 966+72.5, 90.5' RT
w/ PEDESTRIAN PUSHBUTTON
& 1 PEDESTRIAN HEAD

34 KV UNDRGRND ELEC

6" PVC

12" PVC

4" MED PRESSURE

964+00 965+00 966+00 967+00 969+00 40+00 41+00

LEGEND

- PROPOSED PULL BOX
- PROPOSED CONTROLLER AND WORK PAD
- PROPOSED SIGNAL SUPPORT
- PROPOSED PEDESTAL
- PROPOSED 3 or 4 SECTION SIGNAL HEAD
- PROPOSED 5 SECTION RIGHT TURN SIGNAL HEAD
- PROPOSED 3 SECTION LEFT TURN SIGNAL HEAD
- PROPOSED VIDEO DETECTION
- PROPOSED ONE-WAY PEDESTRIAN SIGNAL HEAD
- PROPOSED TWO-WAY PEDESTRIAN SIGNAL HEAD
- PROPOSED PEDESTRIAN PUSHBUTTON

PEDESTRIAN HEADS

18

N, S, E, W

SIGNAL HEADS

1, 4, 5, 8, 9, 12	2, 3, 6, 10, 13	7, 11, 14
R Y G	R Y G	R Y Y G G

ALL HEADS ARE 12"
ALL LENSES ARE TO BE GLASS
ALL LAMPS ARE TO BE L.E.D.
ALL SIGNAL HEADS TO HAVE 5" BACKPLATE

BID SET

NOT TO BE USED FOR CONSTRUCTION

PLAN SET DATE: JANUARY 26, 2015

HORIZONTAL SCALE IN FEET
0 10 20 40

Drawn By: AMC
Checked By: MIM

SIGNAL PLAN SHEET
US 36 / SR 37 AND WILSON ROAD
US 36 / SR 37 IMPROVEMENTS

92
93

Appendix E

No-Build Condition
Committed Improvements

Wilson Road Extension
Sunbury Parkway east of Wilson Road

ms consultants, inc.
engineers, architects, planners

CONNECT TO EXISTING WILSON RD

POT Sta. 22+87.03

WILSON RD

N 3° 52' 44" E

20

15

SEE COMMITTED SHEET 1 OF 6

S 86° 07' 16" E

MATCHLINE

POT Sta. 10+00.00

FUTURE WILSON RD
(BY OTHERS)

IR-71

Ex LA

Ex U

℄

X=1849720.7303
Y=214230.8209

I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

LEGEND

- Wetland
- Stream
- Archaeology Area

COMMITTED ROADWAY SHEET 1 OF 6

0 25 50 100

JANUARY 3, 2017
PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

LEGEND

- Wetland
- Stream
- Archaeology Area

COMMITTED ROADWAY SHEET 2 OF 6

0 25 50 100

JANUARY 3, 2017

PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

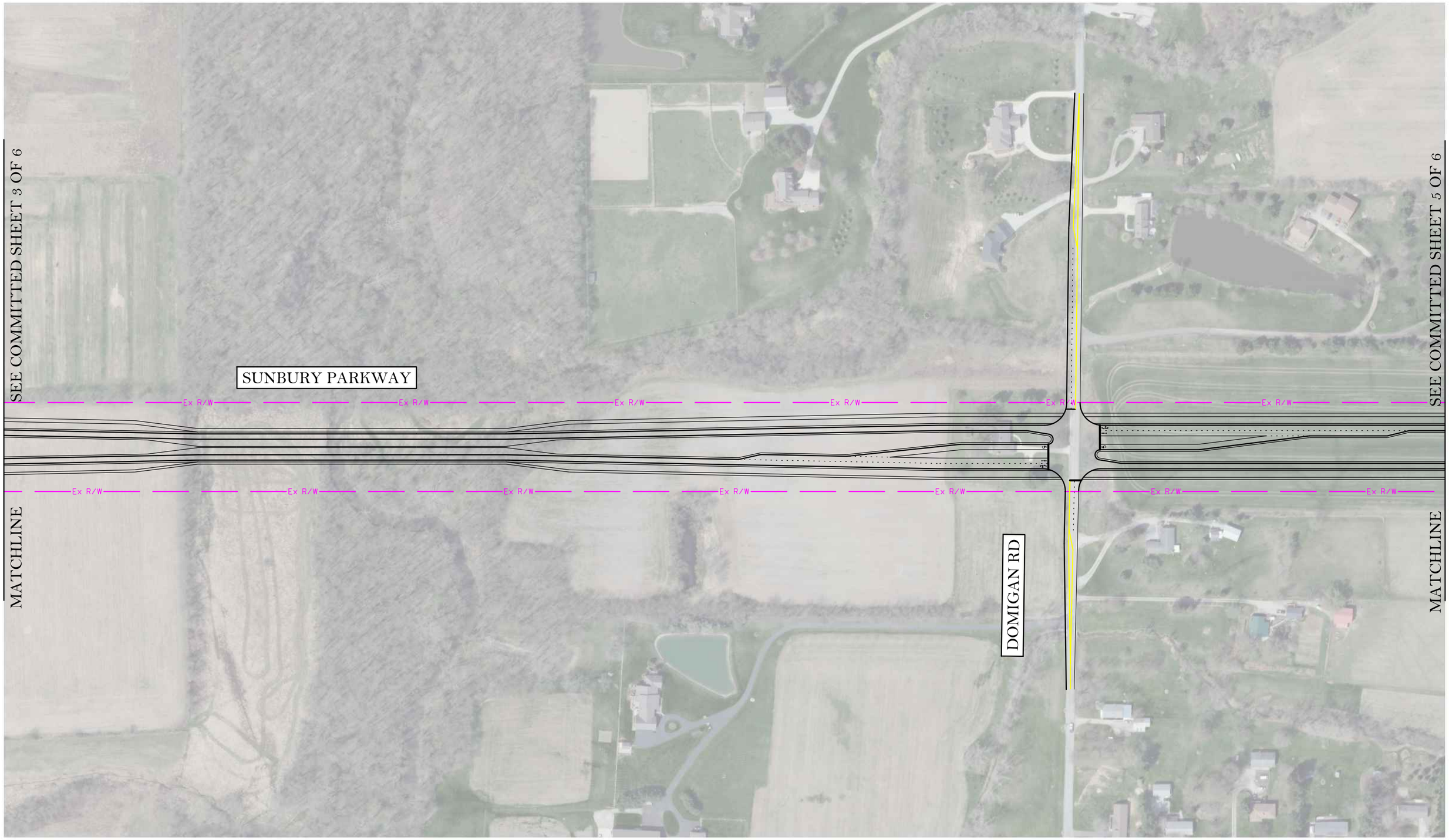
LEGEND

- Wetland
- Stream
- Archaeology Area

COMMITTED ROADWAY
SHEET 3 OF 6

0 25 50 100

JANUARY 3, 2017
PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229



I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

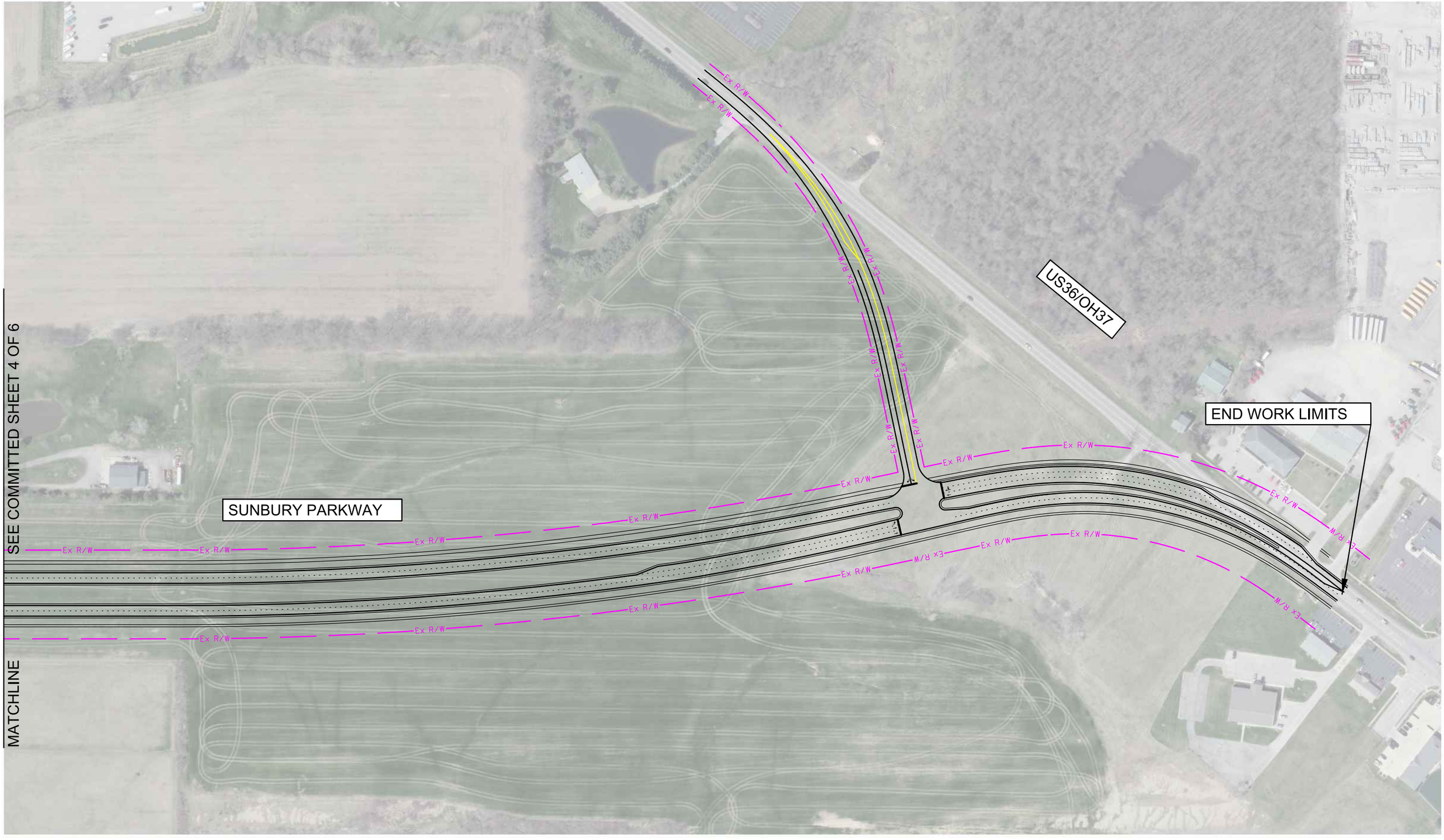
LEGEND

- Wetland
- Stream
- Archaeology Area

COMMITTED ROADWAY SHEET 4 OF 6

0 25 50 100

JANUARY 3, 2017
PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229



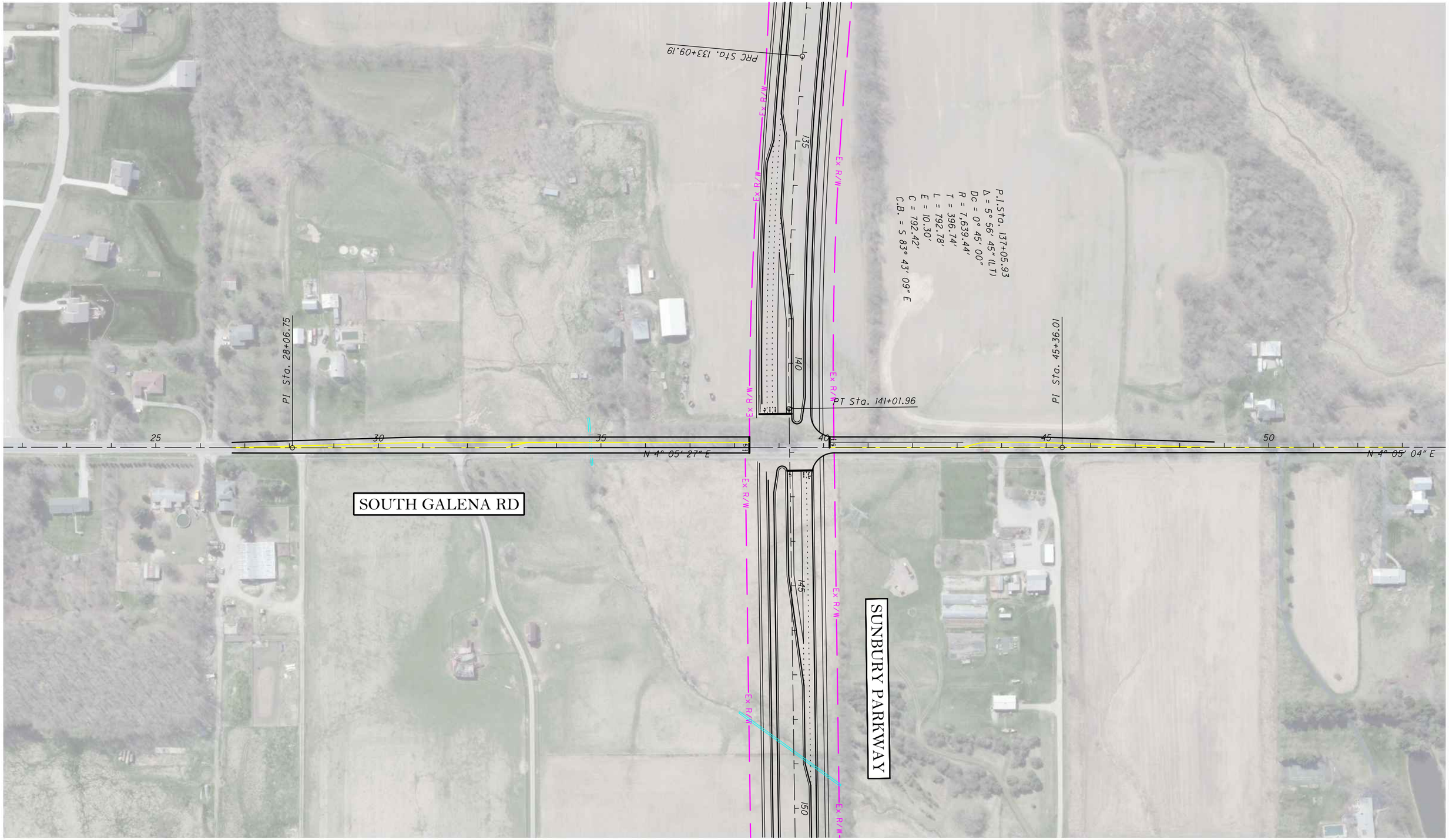
I-71 & US 36/SR 37 IMPROVEMENTS ALTERNATIVE EVALUATION REPORT

LEGEND

- Construction Limit
- Study Boundary
- Wetland
- Stream
- Archaeology Area

COMMITTED SEGMENT SHEET 5 OF 6

JULY 5, 2016
PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229



I-71 & US 36/SR 37 IMPROVEMENTS INTERCHANGE MODIFICATION STUDY

LEGEND

- Wetland
- Stream
- Archaeology Area

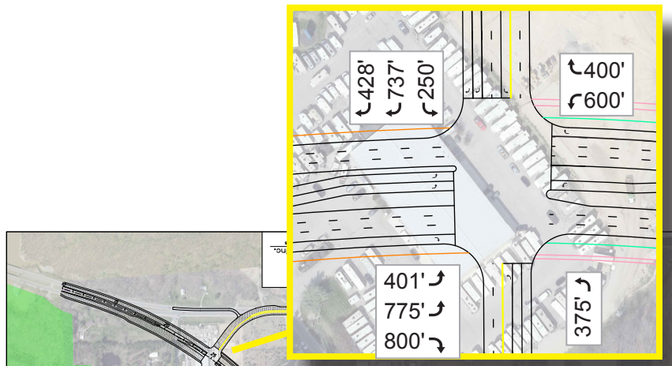
COMMITTED ROADWAY
SHEET 6 OF 6

0 25 50 100

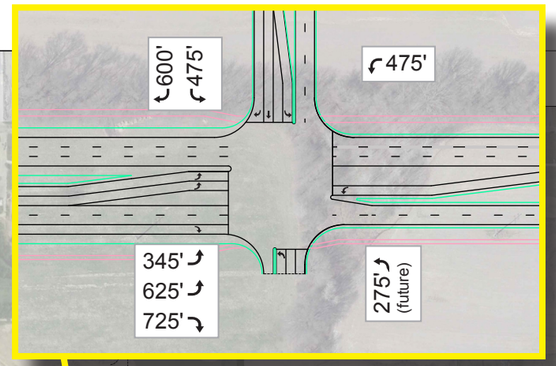
JANUARY 3, 2017
PLAN PREPARED BY:
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

Appendix F

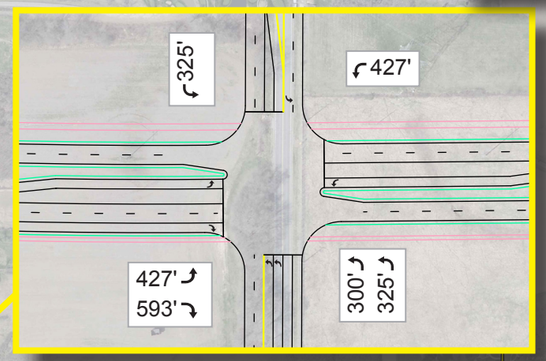
Build Condition



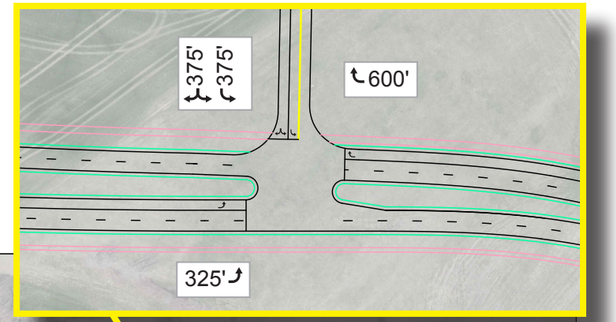
Africa Road Intersection



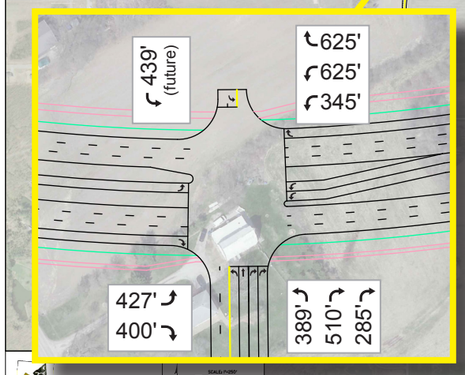
Wilson Road Intersection



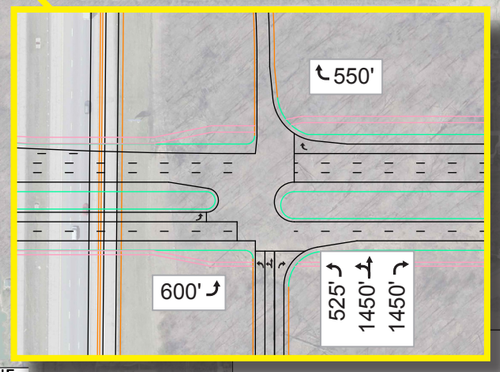
Galena Road Intersection



US 36/ SR 37 and Sunbury Parkway Intersection



Fourwinds Drive Intersection

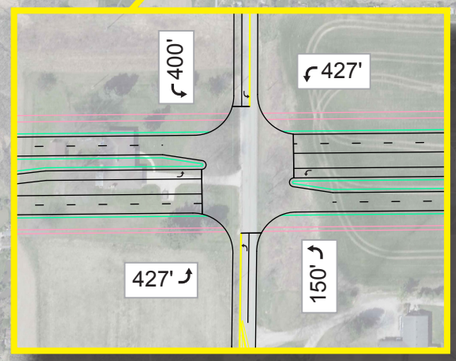


I-71 Northbound Ramps Intersection

MATCH LINE

MATCH LINE

CHESHIRE



Domigan Road Intersection

Turn lane lengths shown include storage, deceleration, and taper.

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY

BUILD CONDITION - SUNBURY PARKWAY

ms consultants, inc.
engineers, architects, planners

I-71 & US 36/SR 37 INTERCHANGE MODIFICATION STUDY

CONCEPTUAL GUIDE SIGNING PLAN

BUILD CONDITION

Proposed I-71 Northbound changes shown

(No changes are anticipated to I-71 Southbound guide signs)

Appendix G

Certified Traffic

INTER-OFFICE COMMUNICATION

TO: Steve Fellenger, District 6
Drew Hurst, District 6
Dirk Gross, District 6

FROM: Rebekah Anderson, Statewide Planning and Research

SUBJECT: DEL-71-9.67 – IR 71 at US36/SR 37 IMS – PID 90200

DATE: November 30, 2016

Design Traffic is provided and certified for use in design for the following alternatives:

- 2018 36/37 Phase 1 – ADT, AM, PM
- 2038 No Build – AM, PM
- 2038 36/37 Full Build – ADT, AM, PM
- Table of Truck Percentages

Figure 1, developed by ms consultants, shows the 36/37 interchange phasing.

Tables 1 and 2 shows the truck percentages.

Plates 1-20 show the design traffic volumes.

If you have any questions, please contact me at 614-752-5735.

RSA:rsa

c: M. Byram-OSPR, N. Gill-MORPC, H. McColeman-OES, G. Harrington-ORE, File

Figure 1 – IR 71 at US36 IMS Phasing Diagram

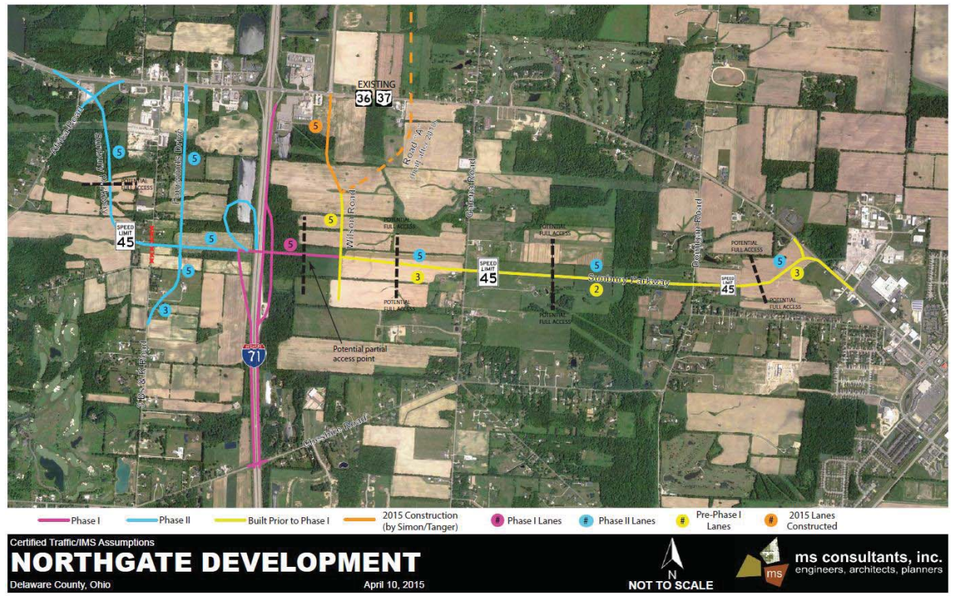


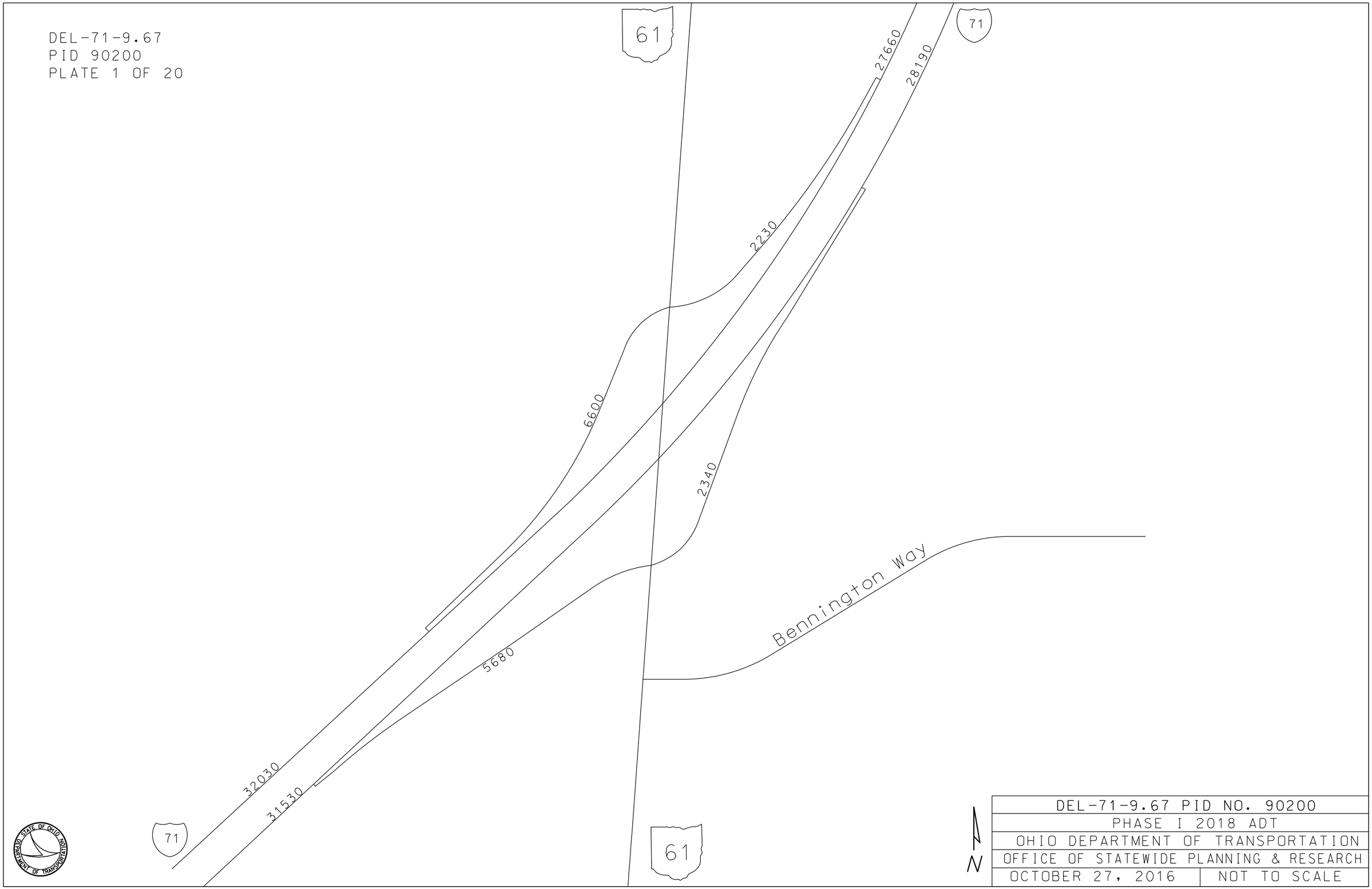
Table 1 – Truck Percentages – T24, TD

Location		T24	TDPM
IR 71			
	N of SR 61	0.21	0.08
	N of US 36	0.18	0.09
	N of Big Walnut	0.17	0.08
	N of Gemini Pkwy	0.17	0.07
	N of IR 270	0.13	0.07
Carters Corners		0.08	0.08
Domigan		0.15	0.16
Road A		0.08	0.15
McDonald's Entrance		0.02	0.02
Bob Evan's Entrance		0.05	0.13
Big Walnut		0.04	0.01
Africa N of Big Walnut		0.06	0.01
Africa S of Big Walnut		0.03	0.01

Table 2 – Truck Percentages – T24, TD

Location		2038 NO Build		2038 BUILD (NO Big Walnut)		2040 BUILD (Big Walnut Alt 2)	
		TD	T24	TD	T24	TD	T24
SR-61 Interchange							
	Ramp From IR-71 NB To SR-61	9%	16%	9%	16%	9%	16%
	Ramp From SR-61 To IR-71 NB	17%	22%	11%	16%	11%	16%
	Ramp From IR-71 SB To SR-61	21%	31%	21%	31%	21%	31%
	Ramp From SR-61 To IR-71 SB	16%	11%	16%	11%	17%	11%
US-36/ SR-37							
	Ramp From IR-71 SB To US 36-37	24%	25%	24%	25%	25%	26%
	Ramp From US 36-37 To IR-71 SB	10%	13%	6%	10%	6%	10%
	Ramp From IR-71 NB To US 36-37	5%	13%	5%	13%	5%	13%
	Ramp From US 36-37 To IR-71 NB	14%	25%	14%	25%	14%	25%
Sunbury Parkway Interchange							
	Ramp From Sunbury WB To IR-71 SB			5%	7%	4%	7%
	Ramp From Sunbury EB To IR-71 SB			6%	4%	4%	7%
	Ramp From IR-71 NB To Sunbury			4%	6%	4%	6%
	Ramp From Sunbury To IR-71 NB			4%	6%	4%	6%
Big Walnut Interchange							
	Ramp From IR-71 NB To Big Walnut					2%	2%
	Ramp To IR-71 NB From Big Walnut					8%	9%
	Ramp From IR-71 SB To Africa					8%	9%
	Ramp To IR-71 SB From Africa					3%	2%
Gemini and Polaris Interchanges							
	Ramp From Polaris EB To IR-71 SB Access Road	2%	3%	2%	3%	2%	3%
	Ramp From IR-71 NB Access Road To Polaris	2%	4%	2%	4%	2%	4%
	Ramp From Polaris WB To IR-71 SB Access Road	3%	4%	3%	4%	3%	4%
	Ramp From IR-71 NB Access Road To Gemini	2%	3%	2%	3%	2%	3%
	Ramp From Gemini To IR-71 NB	4%	5%	4%	5%	3%	3%
	Ramp From IR-71 SB To Gemini	4%	4%	4%	4%	3%	3%
	Ramp From Gemini To IR-71 SB Access Road	4%	3%	3%	3%	3%	2%
	Ramp From Polaris To IR-71 NB Access Road	5%	11%	5%	10%	4%	8%
I-270 Interchange							
	Ramp From IR-270 WB To IR-71 NB	6%	8%	6%	8%	6%	8%
	Ramp From IR-270 WB To IR-71 SB	2%	2%	2%	2%	2%	2%
	Ramp From IR-270 EB To IR-71 SB	3%	4%	3%	4%	4%	4%
	Ramp From IR-71 NB To IR-270 EB	2%	2%	2%	2%	2%	2%
	Ramp From IR-71 SB To IR-270 EB	6%	9%	6%	9%	6%	8%
	Ramp From IR-71 NB To IR-270 WB	3%	4%	3%	4%	3%	4%
	Ramp From IR-71 SB To IR-270 WB	10%	16%	10%	16%	10%	16%
	Ramp From IR-270 EB To IR-71 NB	10%	14%	10%	14%	10%	14%
US-36/SR-37							
	West of Africa	6%	9%	12%	14%	12%	14%
	Between Africa & IR 71	6%	9%	8%	11%	8%	12%
	Between IR 71 & Galena	5%	8%	12%	17%	12%	18%
	East of Galena	4%	7%	6%	12%	6%	12%
	Africa	15%	2%	15%	3%	17%	19%
	N. 3Bs & K	2%	2%	4%	2%	4%	2%
	S. 3Bs & K	3%	3%	2%	2%	2%	2%
	Fourwinds	2%	3%	2%	3%	3%	3%
	Wilson	8%	15%	8%	15%	8%	15%
	Galena North Leg	4%	6%	4%	7%	3%	7%
	Galena South Leg	4%	7%	4%	7%	3%	6%
Sunbury Parkway							
	West of I-71 interchange			12%	12%	12%	12%
	East of I-71 interchange			6%	8%	6%	8%

DEL-71-9.67
PID 90200
PLATE 1 OF 20



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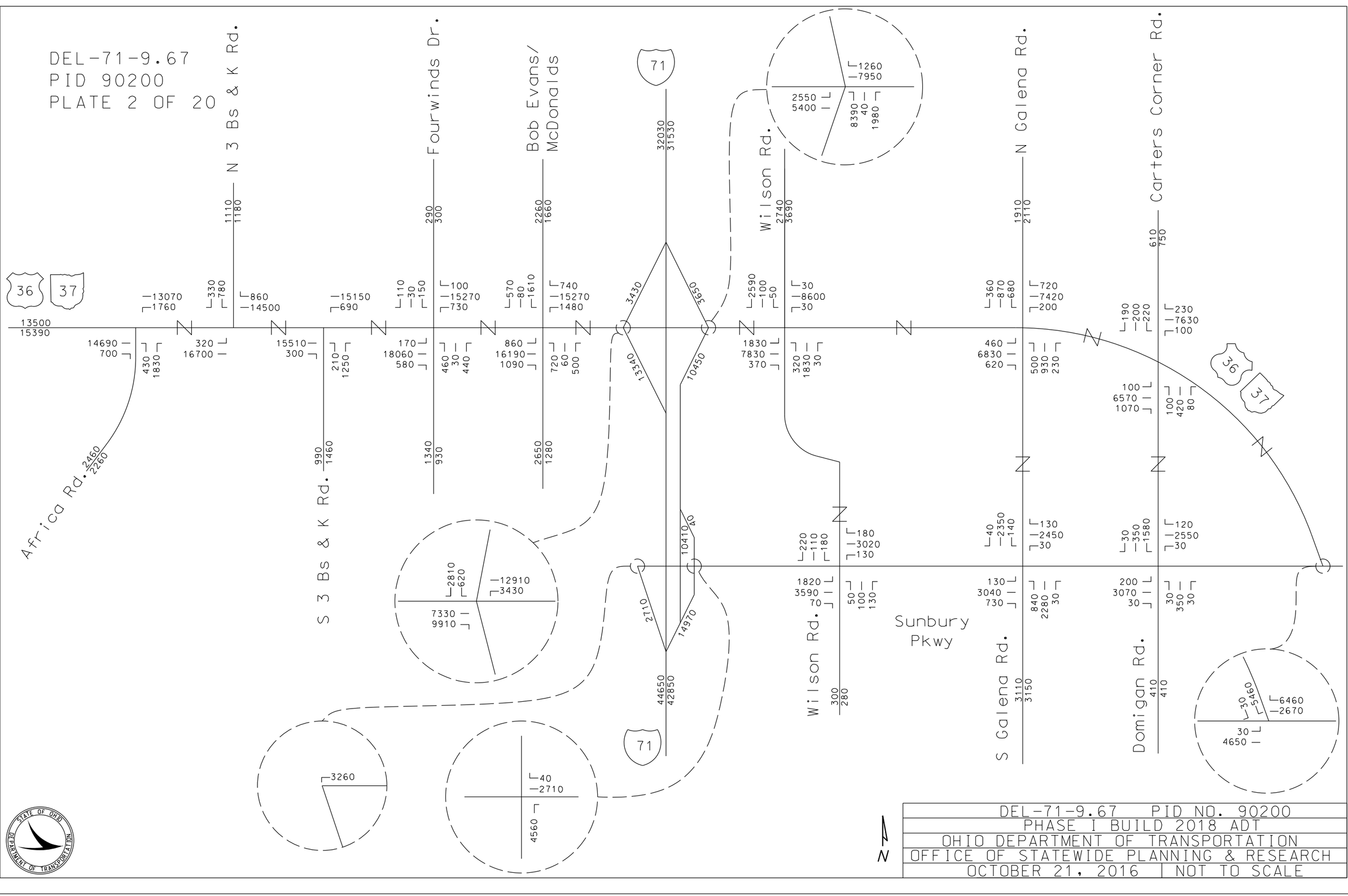
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
OCTOBER 27, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 2 OF 20



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OHIO DEPARTMENT OF TRANSPORTATION
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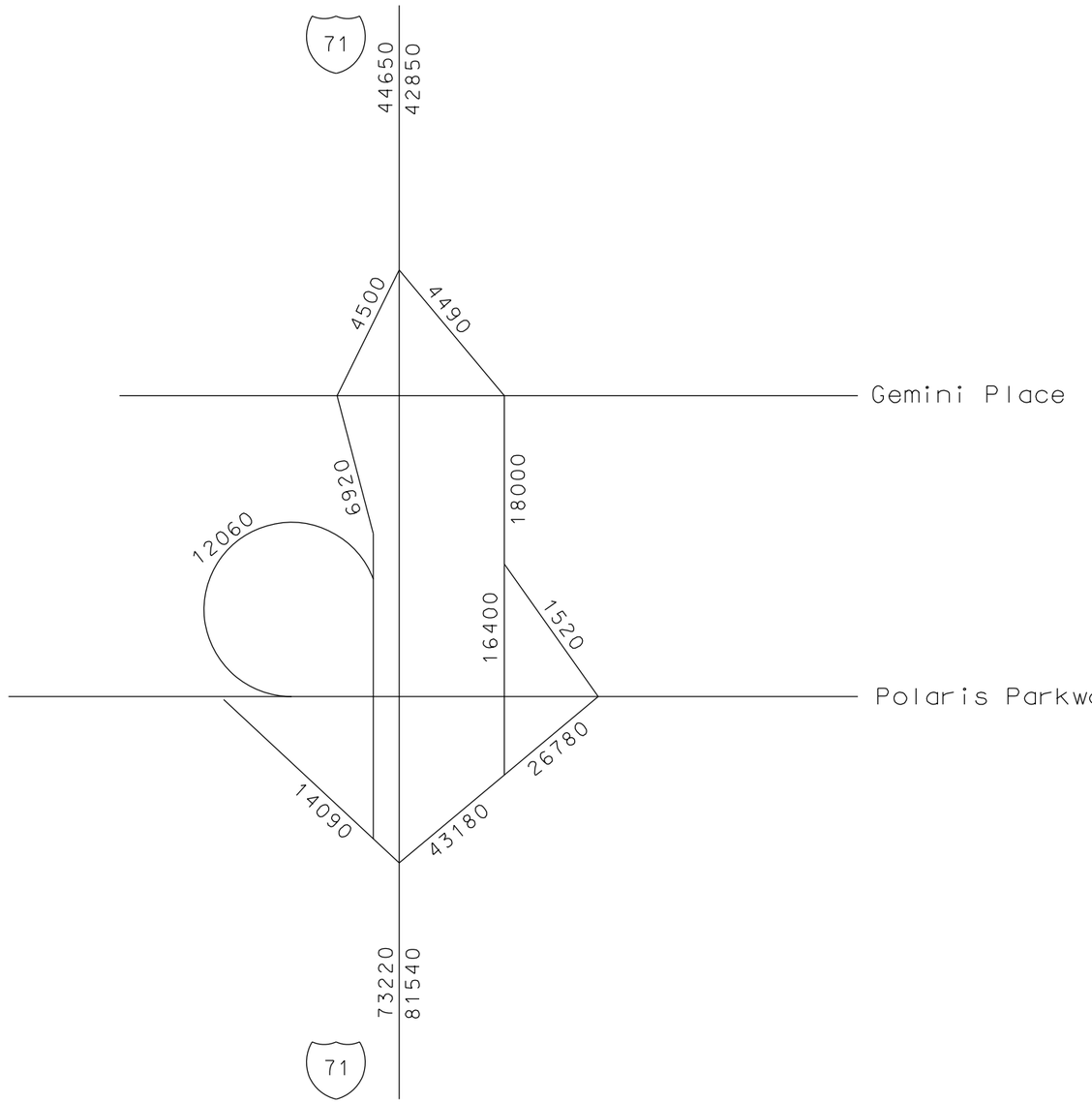
DEL-71-9.67
PID 90200
PLATE 3 OF 20



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DEL-71-9.67
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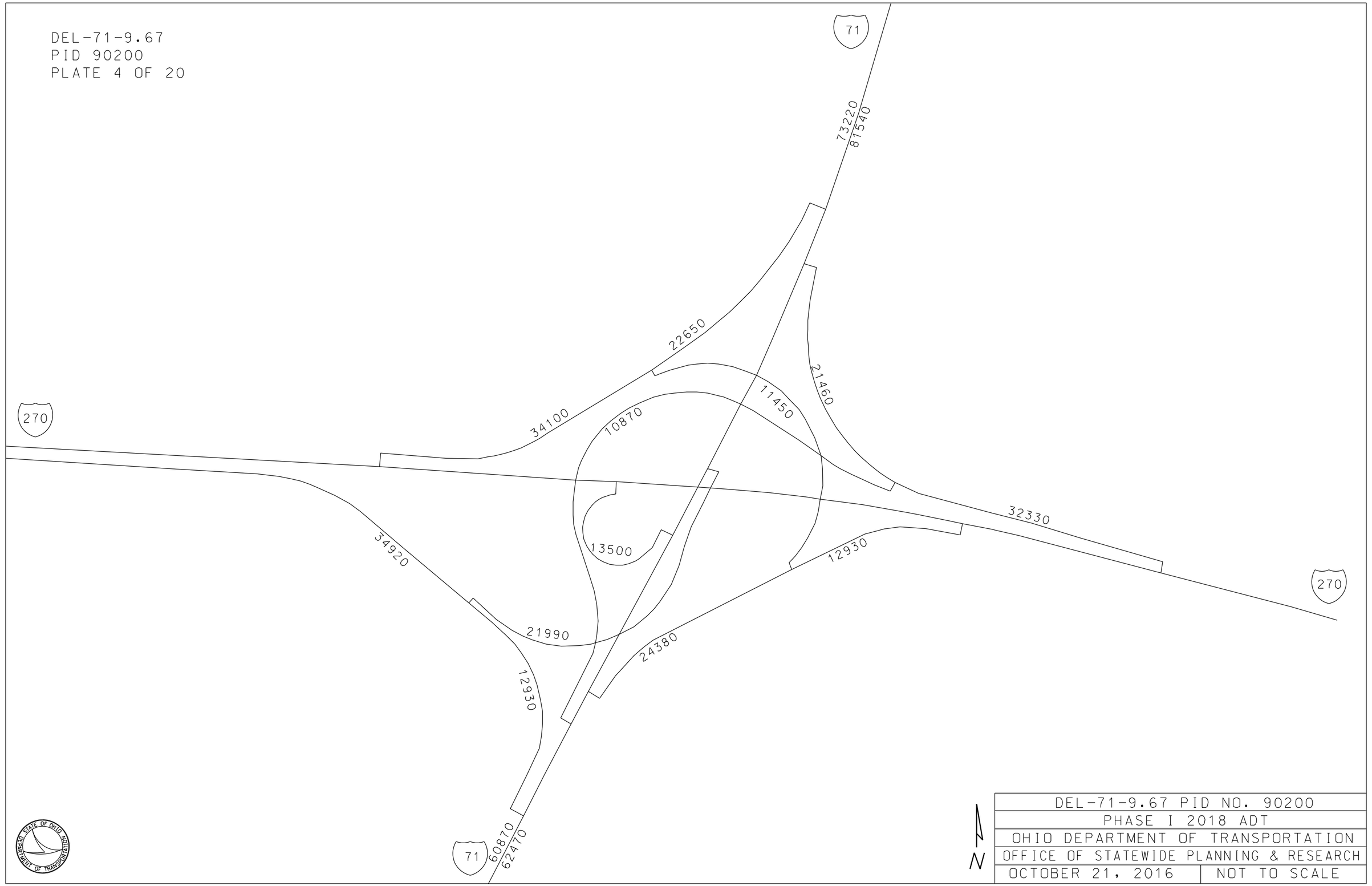
PLATE 4 OF 20



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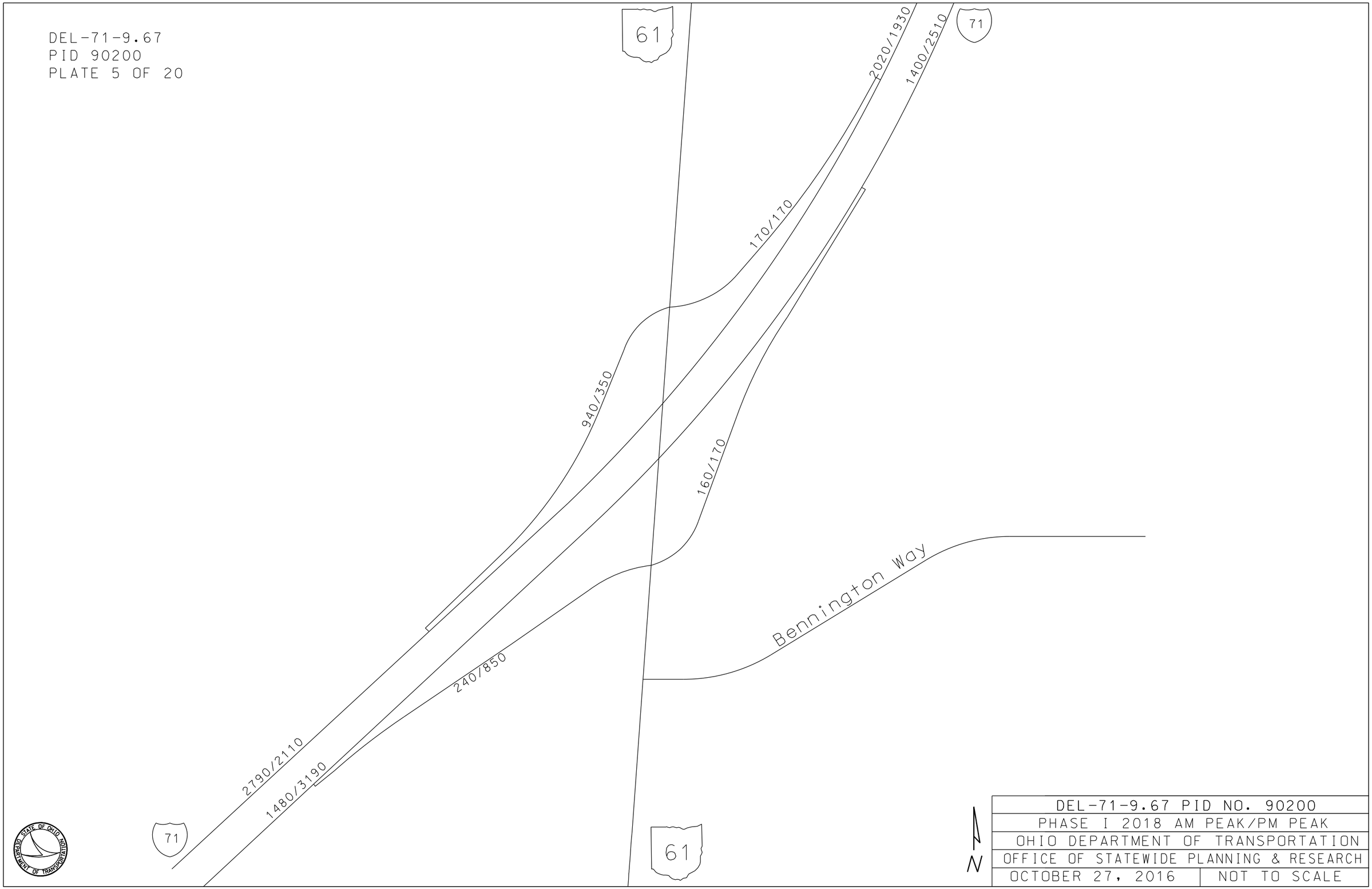
OCTOBER 21, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 5 OF 20



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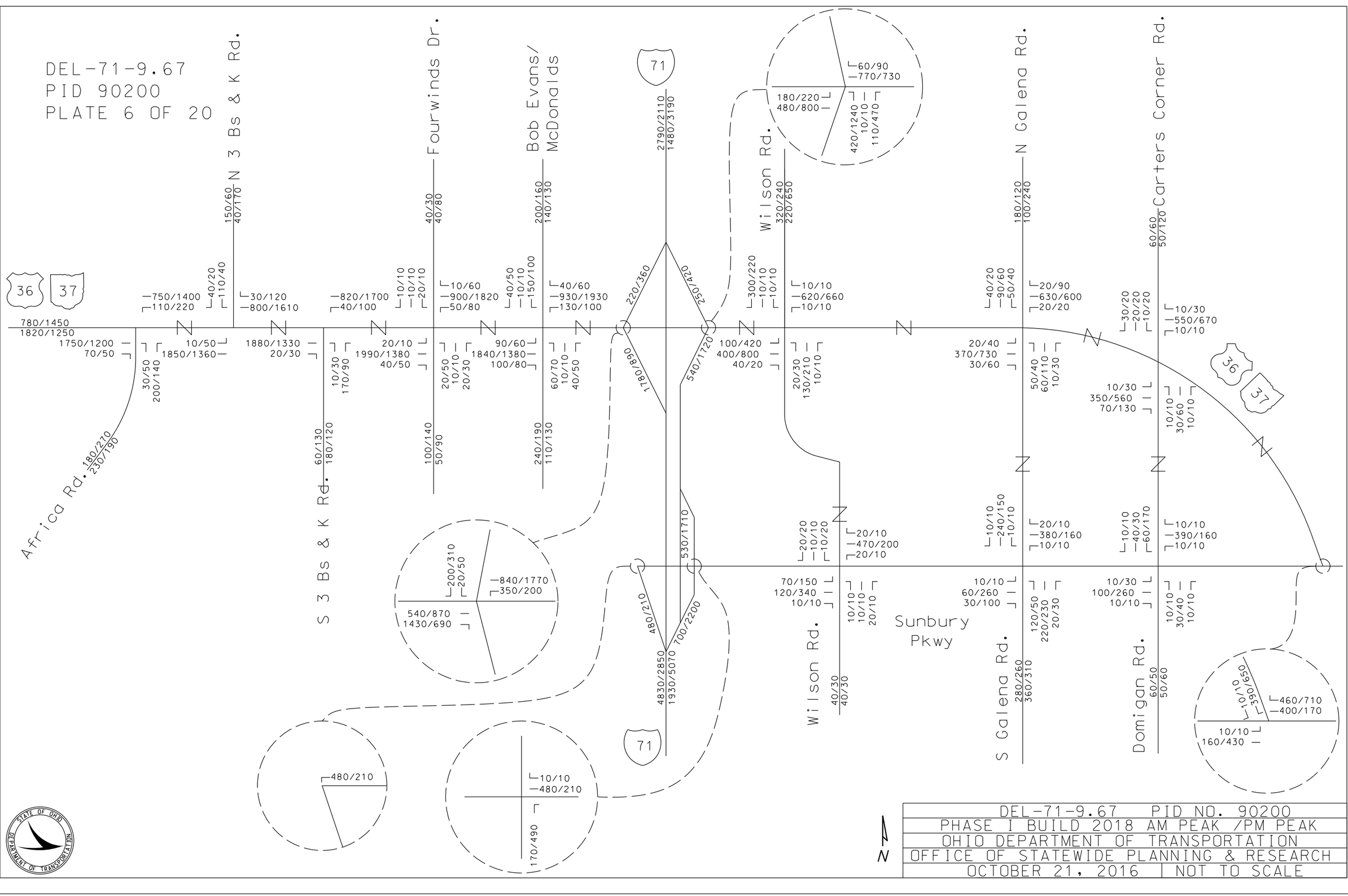
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
OCTOBER 27, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 6 OF 20



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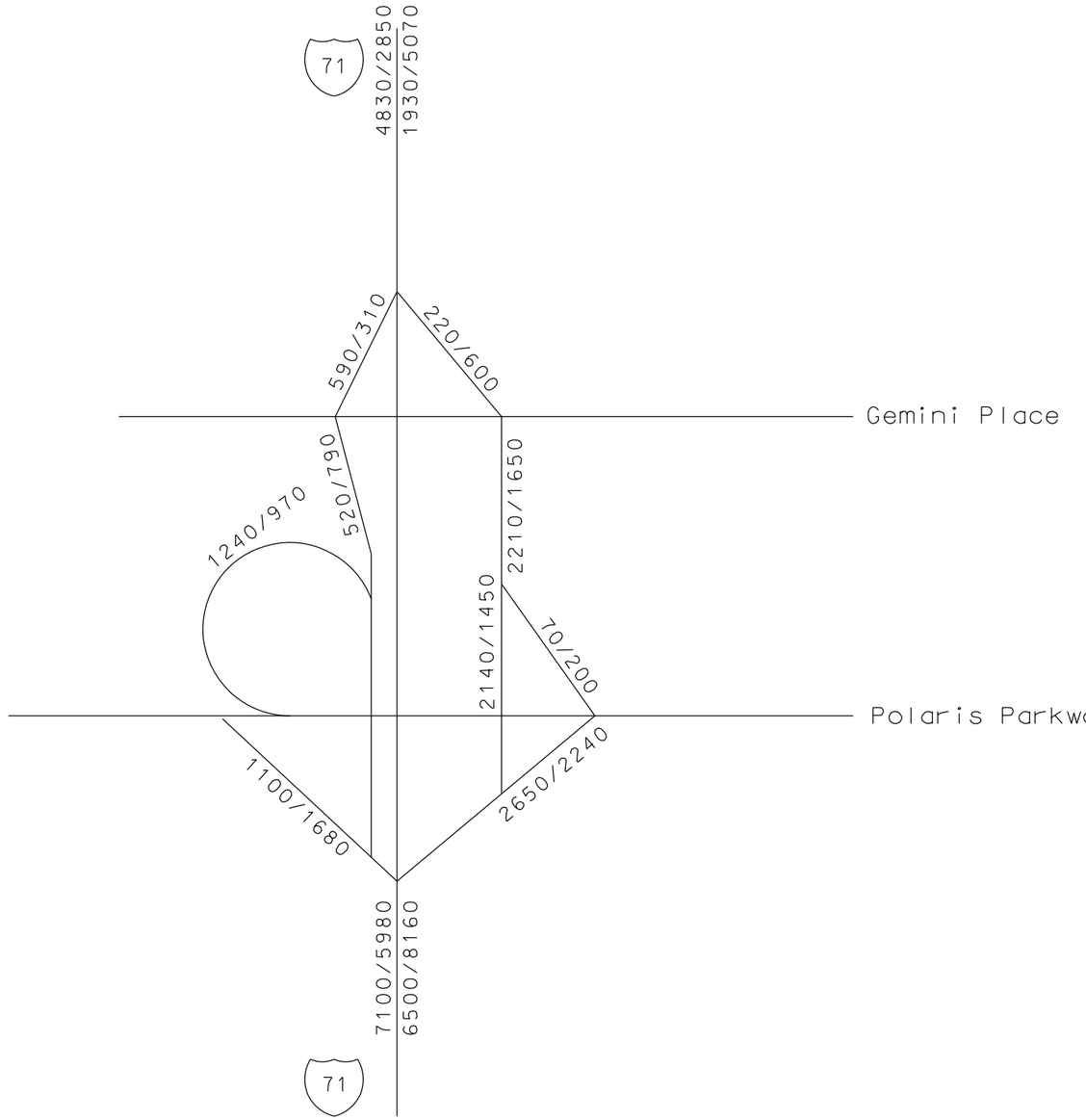
OFFICE OF STATEWIDE PLANNING & RESEARCH
OCTOBER 21, 2016 | NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 7 OF 20



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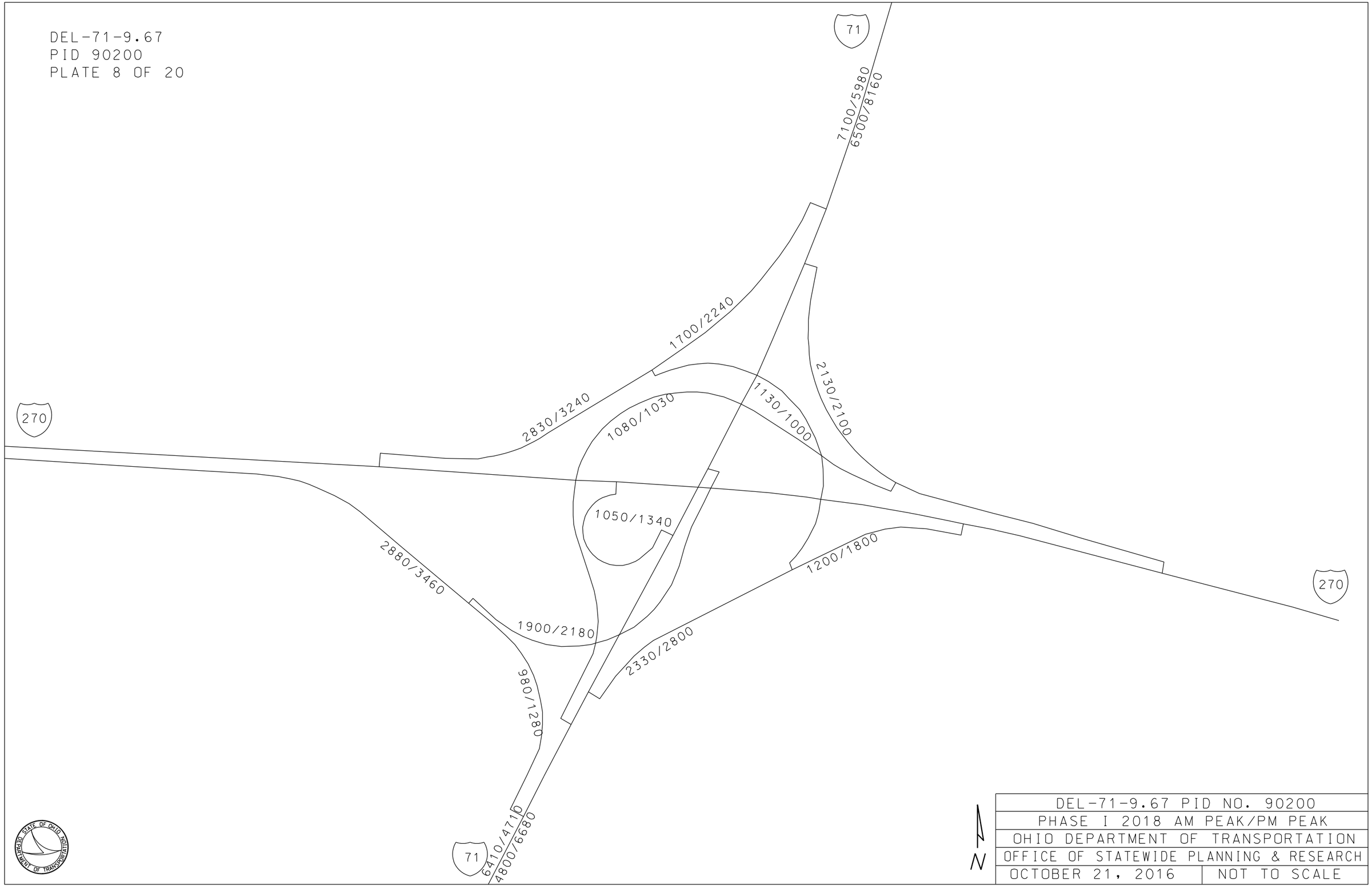
DEL-71-9.67
PID 90200
PLATE 8 OF 20



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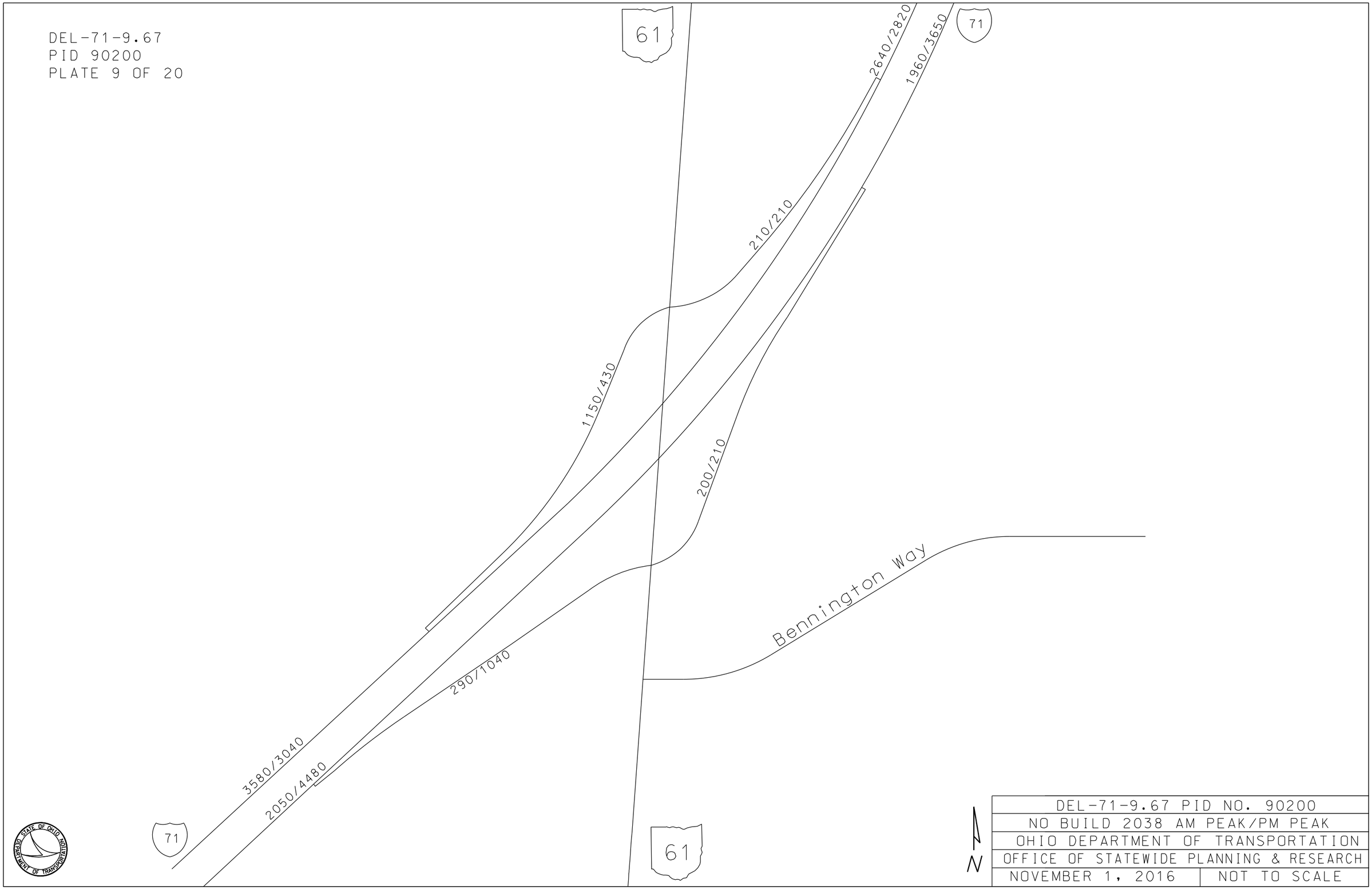
DEL-71-9.67
PID 90200
PLATE 9 OF 20



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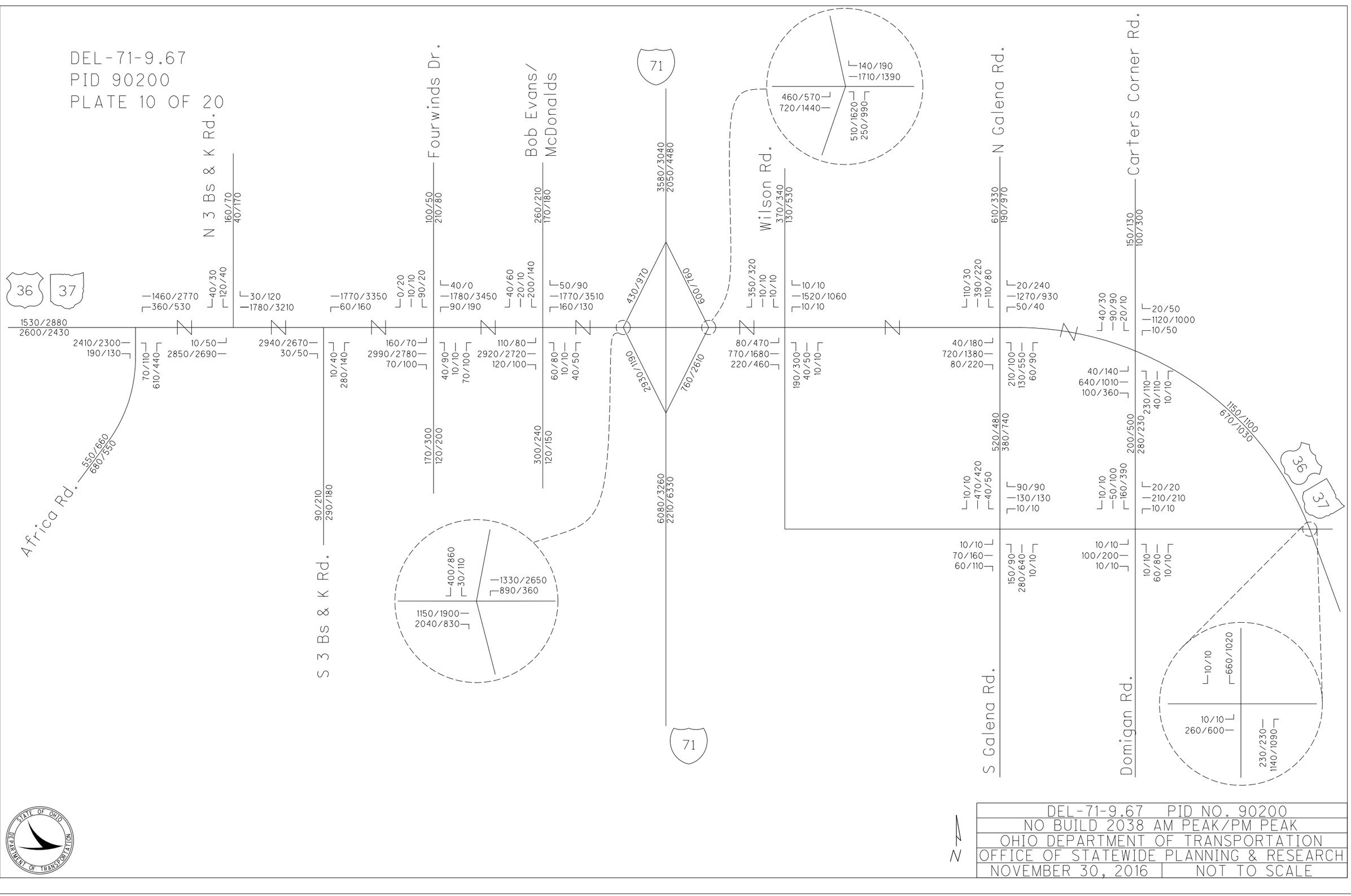
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 10 OF 20



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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF STATEWIDE PLANNING & RESEARCH
NOVEMBER 30, 2016 | NOT TO SCALE

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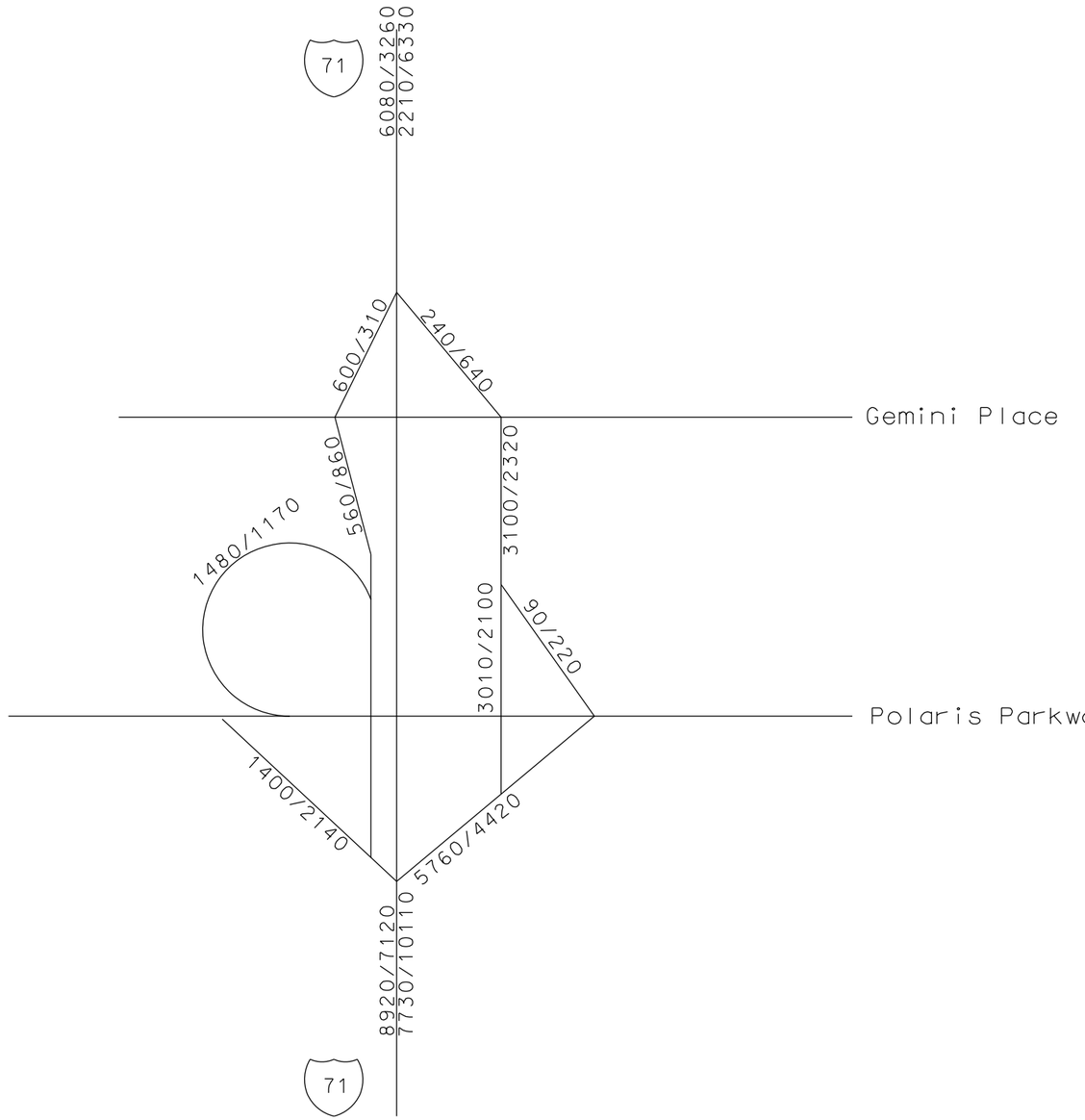
DEL-71-9.67
PID 90200
PLATE 11 OF 20



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OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

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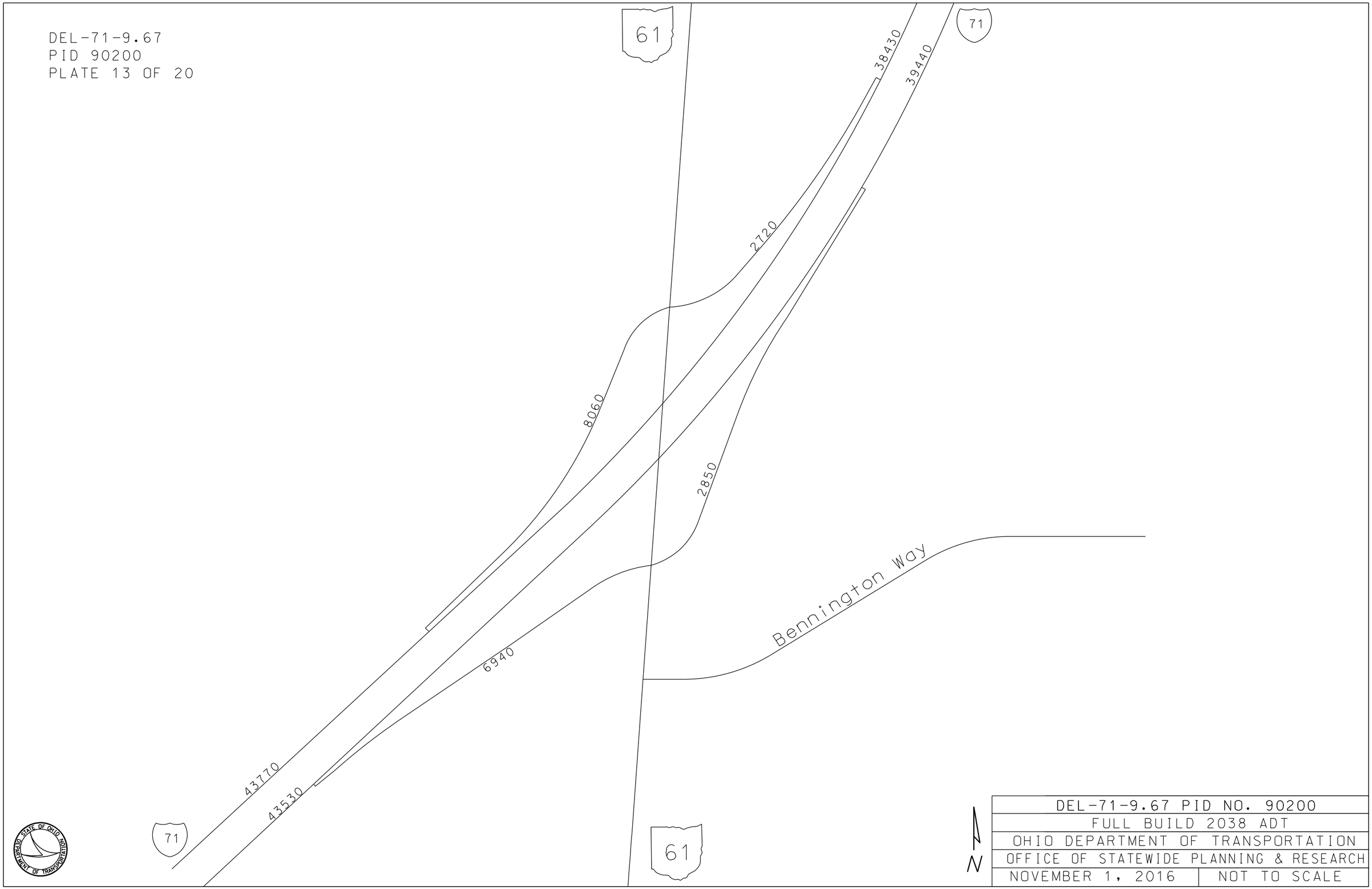
DEL-71-9.67
PID 90200
PLATE 12 OF 20

DEL-71-9.67 PID NO. 90200	
NO BUILD 2038 AM PEAK/PM PEAK	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 13 OF 20



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FULL BUILD 2038 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

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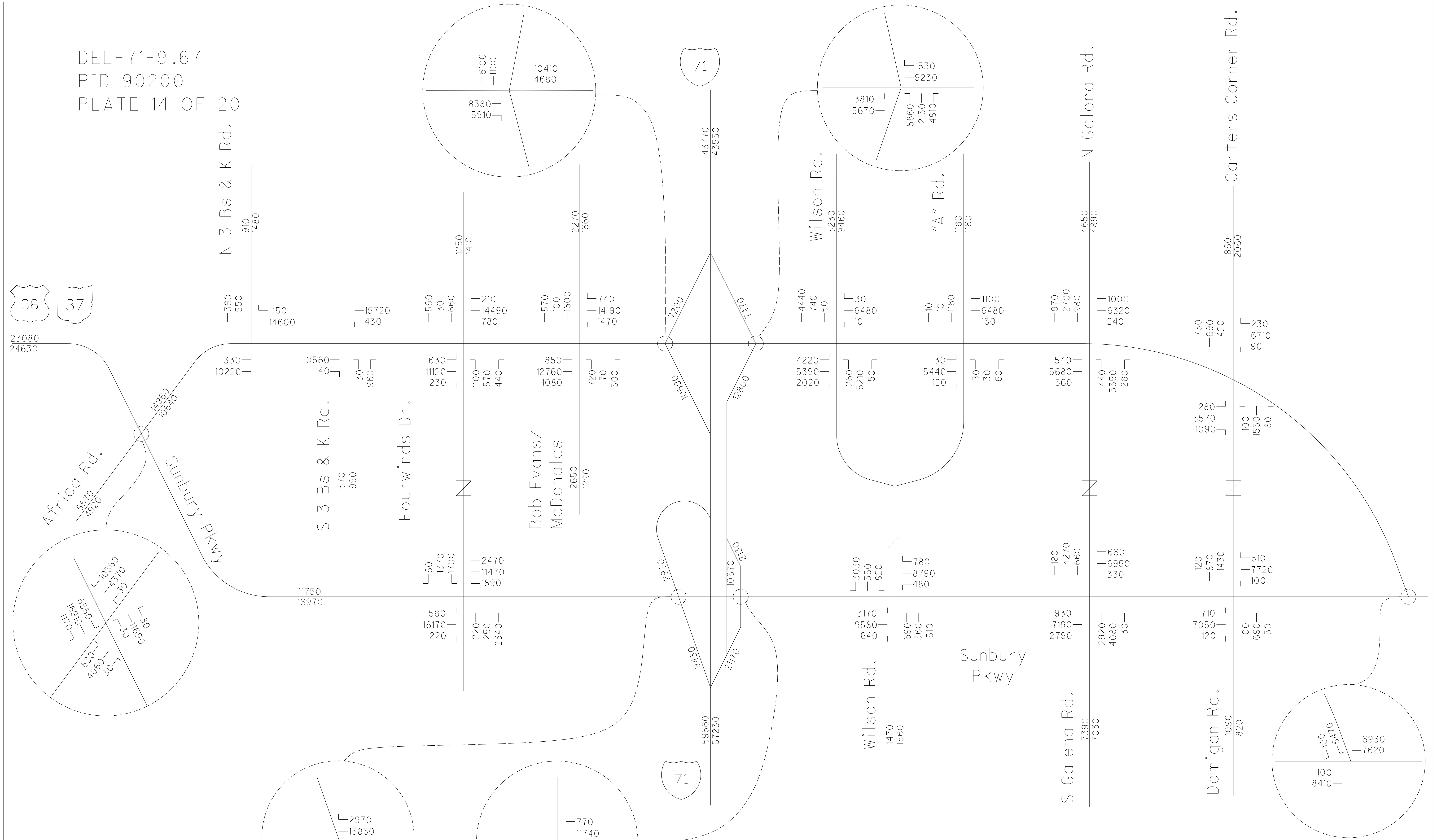
DEL-71-9.67
PID 90200
PLATE 14 OF 20



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FULL BUILD 2038 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
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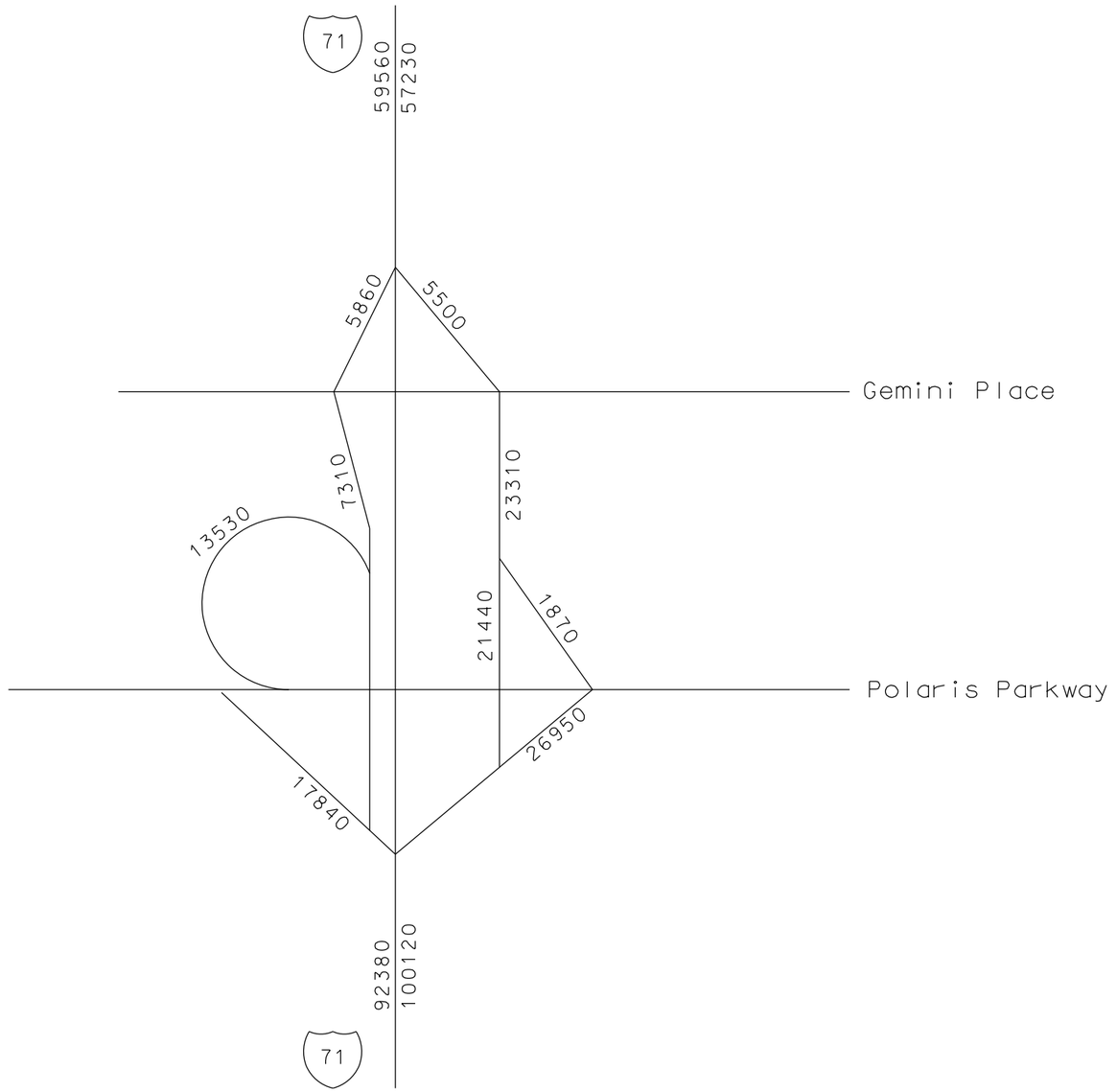
NOVEMBER 1, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 15 OF 20



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NOVEMBER 1, 2016	NOT TO SCALE

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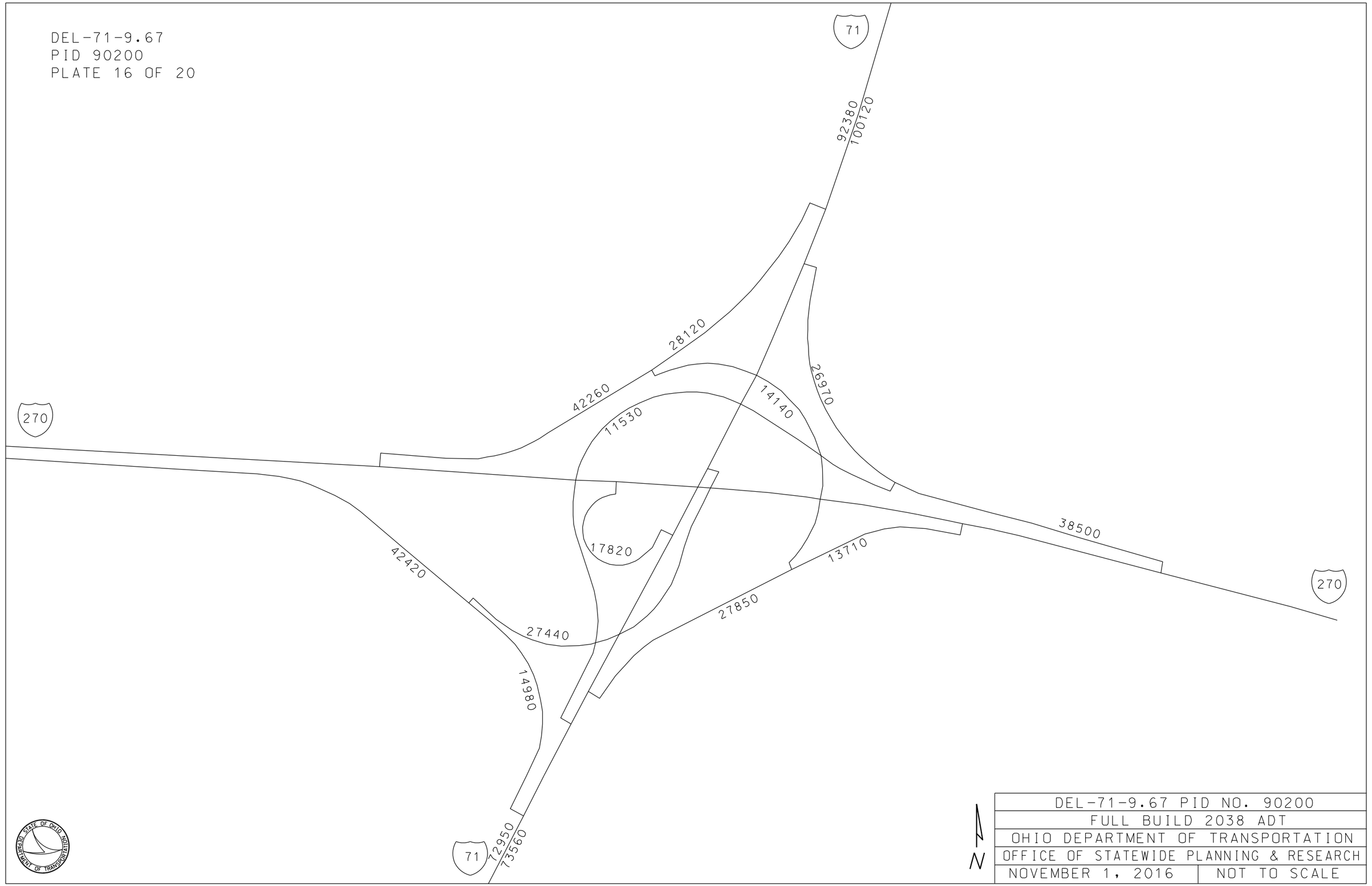
DEL-71-9.67
PID 90200
PLATE 16 OF 20



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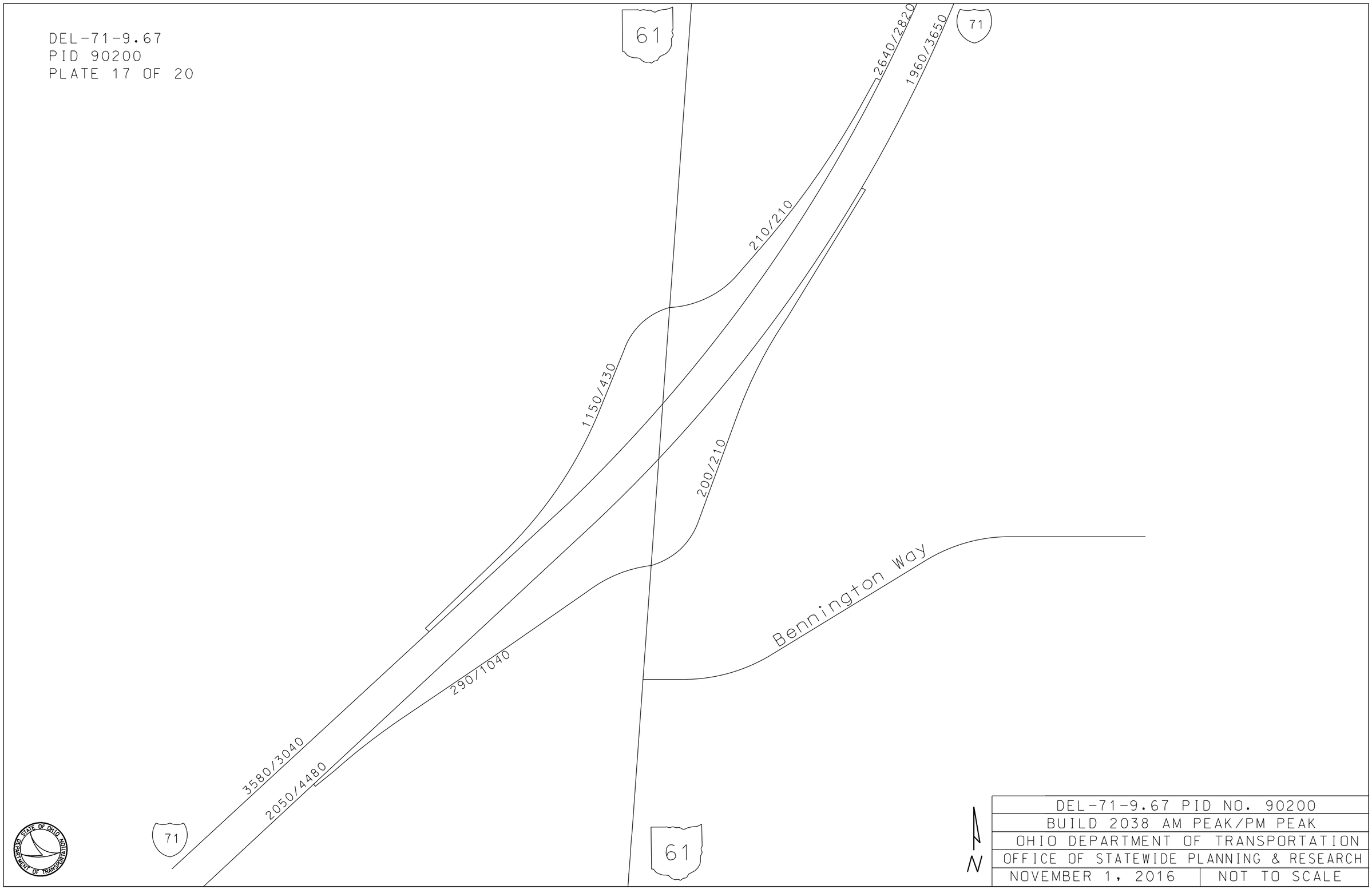
NOVEMBER 1, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 17 OF 20



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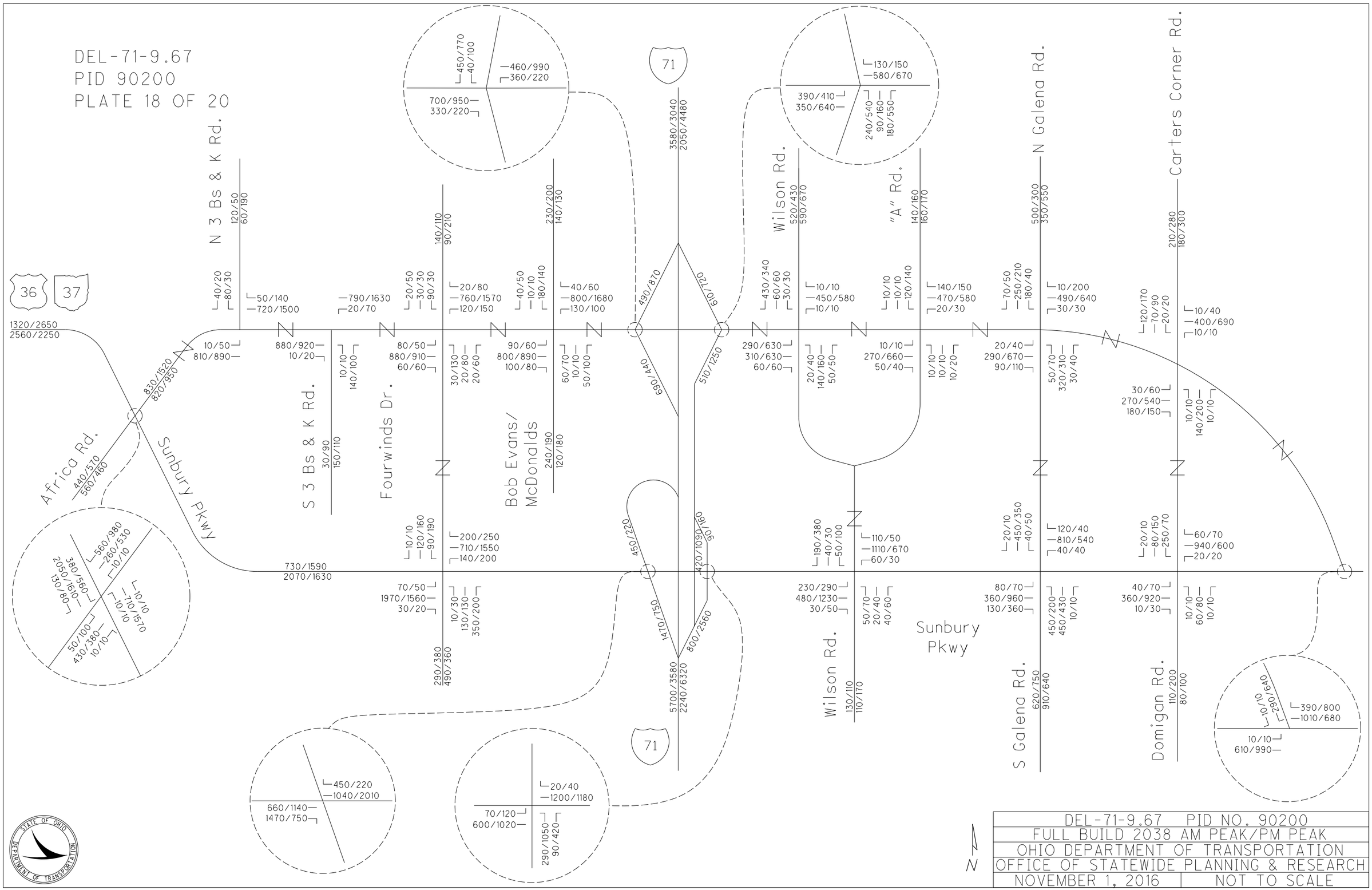
BUILD 2038 AM PEAK/PM PEAK	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

DEL-71-9.67
PID 90200
PLATE 18 OF 20



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FULL BUILD 2038 AM PEAK/PM PEAK	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

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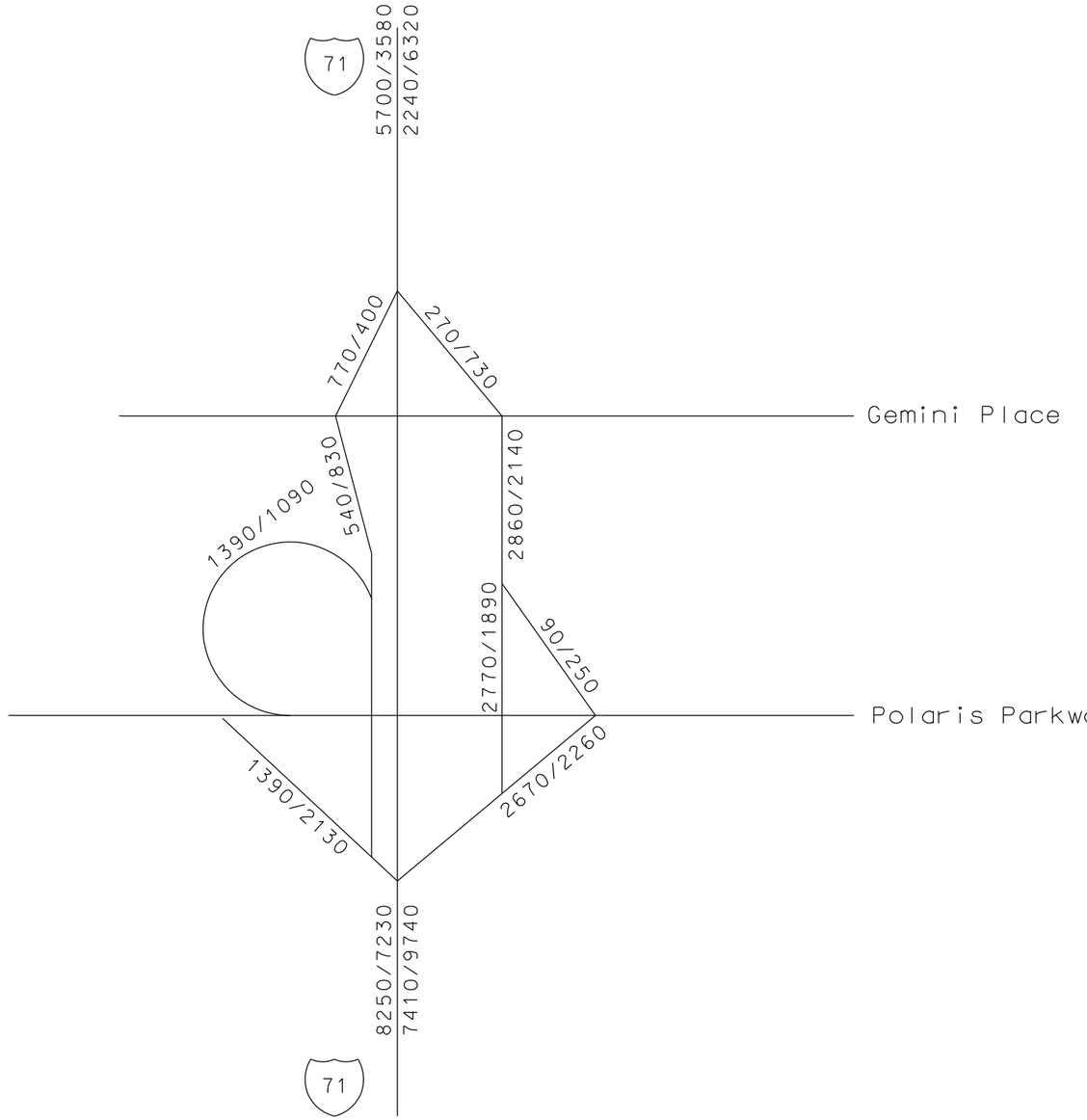
DEL-71-9.67
PID 90200
PLATE 19 OF 20



DEL-71-9.67 PID NO. 90200	
FULL BUILD 2038 AM PEAK/PM PEAK	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

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DEL-71-9.67
PID 90200
PLATE 20 OF 20

DEL-71-9.67 PID NO. 90200	
BUILD 2038 AM PEAK/PM PEAK	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF STATEWIDE PLANNING & RESEARCH	
NOVEMBER 1, 2016	NOT TO SCALE

N

STATE OF OHIO NOT FOR CONSTRUCTION
DEPARTMENT OF TRANSPORTATION

Appendix H

Capacity Analyses – No-Build Condition

ms consultants, inc.
engineers, architects, planners

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*South of Gemini On-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-1 - No-Build 2038*

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

Flow Inputs

Volume, V	*1940*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*712*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*10.2*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		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	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*South of Gemini On-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-1 - No-Build 2038*

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

Flow Inputs

Volume, V	*5690*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*2088*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*60.9*	mph	S		mph
D = v_p / S	*34.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		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	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Polaris/Gemini to 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-2 - No-Build 2038*

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

Flow Inputs

Volume, V	*2210*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*815*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*11.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Polaris/Gemini to 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-2 - No-Build 2038*

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

Flow Inputs

Volume, V	*6330*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*2334*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.1*	mph	S		mph
D = v_p / S	*42.4*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*E*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-4 - No-Build 2038*

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

Flow Inputs

Volume, V	*1450*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*535*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*7.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-4 - No-Build 2038*

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

Flow Inputs

Volume, V	*3720*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1372*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*69.7*	mph	S		mph
D = v_p / S	*19.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*36/37 to 61*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-5 - No-Build 2038*

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

Flow Inputs

Volume, V	*2050*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*760*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*10.9*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*36/37 to 61*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-5 - No-Build 2038*

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

Flow Inputs

Volume, V	*4480*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1660*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*67.5*	mph	S		mph
D = v_p / S	*24.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-6 - No-Build 2038*

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

Flow Inputs

Volume, V	*1760*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*652*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*9.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		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	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-6 - No-Build 2038*

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

Flow Inputs

Volume, V	*3440*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1275*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*69.9*	mph	S		mph
D = v_p / S	*18.2*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		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	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 Entrance Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-7 - No-Build 2038*

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

Flow Inputs

Volume, V	*2430*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*896*	pc/h/ln	Design LOS		
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*12.8*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 Entrance Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-7 - No-Build 2038*

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

Flow Inputs

Volume, V	*2610*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*963*	pc/h/ln	Design LOS		
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*13.8*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*61 to 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-8 - No-Build 2038*

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

Flow Inputs

Volume, V	*3580*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1327*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*69.8*	mph	S		mph
D = v_p / S	*19.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*61 to 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-8 - No-Build 2038*

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

Flow Inputs

Volume, V	*3040*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1127*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*16.1*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-9 - No-Build 2038*

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

Flow Inputs

Volume, V	*3150*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1167*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*16.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-9 - No-Build 2038*

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

Flow Inputs

Volume, V	*2070*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*767*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*11.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*36/37 to Gemini/Polaris*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-10 - No-Build 2038*

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

Flow Inputs

Volume, V	*6080*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*2242*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*57.4*	mph	S		mph
D = v_p / S	*39.1*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*E*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*36/37 to Gemini/Polaris*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-10 - No-Build 2038*

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

Flow Inputs

Volume, V	*3260*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1202*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*17.2*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*South of Gemini Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 - No-Build 2038*

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

Flow Inputs

Volume, V	*5480*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*2011*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*62.4*	mph	S		mph
D = v_p / S	*32.2*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*South of Gemini Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 - No-Build 2038*

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

Flow Inputs

Volume, V	*2950*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*1083*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*15.5*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

J-1 No-Build

I-71 NB at Polaris/Gemini exit ramp – AM Peak

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$
$$f_{HV} = \frac{1}{1 + 0.07(1.5 - 1) + 0}$$
$$f_{HV} = 0.966$$

$$v_F = \frac{V_F}{PHF \times f_{HV} \times f_p}$$
$$v_F = \frac{7{,}730}{0.94 \times 0.966 \times 1.00}$$

$$v_F = 8{,}513\ pc/h$$

$$D_{MD} = 0.0175\left(\frac{v_F}{N}\right)$$
$$D_{MD} = 0.0175\left(\frac{8{,}512}{6}\right)$$
$$D_{MD} = 24.8\ pc/mi/ln$$

Level of Service – C

I-71 NB at Sunbury/US 36/SR 37 – PM Peak

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$
$$f_{HV} = \frac{1}{1 + 0.08(1.5 - 1) + 0}$$
$$f_{HV} = 0.966$$

$$v_F = \frac{V_F}{PHF \times f_{HV} \times f_p}$$
$$v_F = \frac{10{,}110}{0.94 \times 0.966 \times 1.00}$$

$$v_F = 11{,}134\ pc/h$$

$$D_{MD} = 0.0175\left(\frac{v_F}{N}\right)$$
$$D_{MD} = 0.0175\left(\frac{11{,}134}{6}\right)$$
$$D_{MD} = 32.5\ pc/mi/ln$$

Level of Service – D

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	Polaris/Gemini On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-2 - No-Build 2038

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	1300	☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	1940	V_D =	veh/h
		Ramp Volume, V_R	240		
		Freeway Free-Flow Speed, S_{FF}	70.0		
		Ramp Free-Flow Speed, S_{FR}	55.0		

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	1940	0.94	Level	7	0	0.966	1.00	2136
Ramp	240	0.94	Level	4	0	0.980	1.00	260
UpStream								
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} =	(Equation 13-6 or 13-7)	L_{EQ} =	(Equation 13-12 or 13-13)
P_{FM} =	0.614 using Equation (Exhibit 13-6)	P_{FD} =	using Equation (Exhibit 13-7)
V_{12} =	1311 pc/h	V_{12} =	pc/h
V_3 or V_{av34}	825 pc/h (Equation 13-14 or 13-17)	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} > 2,700 pc/h?	☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2	☑ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2	☐ Yes ☐ No
If Yes,V_{12a} =	1311 pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2396	Exhibit 13-8		No

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 Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1571	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		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 =	9.5 (pc/mi/ln)
LOS =	A (Exhibit 13-2)

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

M_S =	0.197 (Exibit 13-11)
S_R=	64.5 mph (Exhibit 13-11)
S_0=	68.8 mph (Exhibit 13-11)
S =	65.9 mph (Exhibit 13-13)

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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	Polaris/Gemini On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-2 - No-Build 2038

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	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	5690
Ramp Volume, V_R	640
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	5690	0.94	Level	7	0	0.966	1.00	6265
Ramp	640	0.94	Level	4	0	0.980	1.00	694
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.614 using Equation (Exhibit 13-6)

V_{12} = 3846 pc/h

V_3 or V_{av34} = 2419 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} = 3846 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6959	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4540	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 = 32.4 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.543 (Exibit 13-11)

S_R = 54.8 mph (Exhibit 13-11)

S_0 = 62.8 mph (Exhibit 13-11)

S = 57.3 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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-4 - No-Build 2038

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	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	6330
Ramp Volume, V_R	2610
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	6330	0.94	Level	8	0	0.962	1.00	7003
Ramp	2610	0.94	Level	5	0	0.976	1.00	2846
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} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 4717 pc/h

V_3 or V_{av34} = 2286 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	7003	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4157	Exhibit 13-8	7200	No
V_R	2846	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4717	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 = 4.3 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.424 (Exhibit 13-12)

S_R = 58.1 mph (Exhibit 13-12)

S_0 = 71.8 mph (Exhibit 13-12)

S = 62.0 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-4 - No-Build 2038

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	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	2210
Ramp Volume, V_R	760
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2210	0.94	Level	8	0	0.962	1.00	2445
Ramp	760	0.94	Level	5	0	0.976	1.00	829
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} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 1556 pc/h

V_3 or V_{av34} = 889 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	2445	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	1616	Exhibit 13-8	7200	No
V_R	829	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1556	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 = -22.9 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.243 (Exhibit 13-12)

S_R = 63.2 mph (Exhibit 13-12)

S_0 = 76.8 mph (Exhibit 13-12)

S = 67.6 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	exit ramp to 36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-5 - No-Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	1450
Ramp Volume, V_R	600
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	1450	0.94	Level	9	0	0.957	1.00	1612
Ramp	600	0.94	Level	14	0	0.935	1.00	683
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 967 pc/h

V_3 or V_{av34} = 645 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} = 967 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2295	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1650	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 = 13.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.253 (Exibit 13-11)

S_R = 62.9 mph (Exhibit 13-11)

S_0 = 69.5 mph (Exhibit 13-11)

S = 64.6 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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	exit to 36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-5 - No-Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	3720
Ramp Volume, V_R	760
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3720	0.94	Level	9	0	0.957	1.00	4136
Ramp	760	0.94	Level	14	0	0.935	1.00	865
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 2481 pc/h

V_3 or V_{av34} = 1655 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} = 2481 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5001	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3346	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 = 26.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.344 (Exibit 13-11)

S_R = 60.4 mph (Exhibit 13-11)

S_0 = 65.8 mph (Exhibit 13-11)

S = 62.1 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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	exit to SR 61
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-6 - No-Build 2038

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	975
Freeway Volume, V_F	2050
Ramp Volume, V_R	290
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2050	0.94	Level	9	0	0.957	1.00	2279
Ramp	290	0.94	Level	9	0	0.957	1.00	322
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} = 0.688 using Equation (Exhibit 13-7)

V_{12} = 1669 pc/h

V_3 or V_{av34} = 610 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	2279	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	1957	Exhibit 13-8	7200	No
V_R	322	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1669	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 = 9.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.197 (Exhibit 13-12)

S_R = 64.5 mph (Exhibit 13-12)

S_0 = 76.8 mph (Exhibit 13-12)

S = 67.4 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	exit to SR 61
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-6 - No-Build 2038

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	975
Freeway Volume, V_F	4480
Ramp Volume, V_R	1040
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	4480	0.94	Level	9	0	0.957	1.00	4980
Ramp	1040	0.94	Level	9	0	0.957	1.00	1156
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} = 0.582 using Equation (Exhibit 13-7)

V_{12} = 3383 pc/h

V_3 or V_{av34} = 1597 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	4980	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3824	Exhibit 13-8	7200	No
V_R	1156	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3383	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 = 24.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.272 (Exhibit 13-12)

S_R = 62.4 mph (Exhibit 13-12)

S_0 = 74.5 mph (Exhibit 13-12)

S = 65.8 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	exit ramp to 36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-7 - No-Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	1760
Ramp Volume, V_R	200
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	1760	0.94	Level	9	0	0.957	1.00	1957
Ramp	200	0.94	Level	14	0	0.935	1.00	228
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 1174 pc/h

V_3 or V_{av34} = 783 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} = 1174 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2185	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1402	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 = 11.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.249 (Exibit 13-11)

S_R = 63.0 mph (Exhibit 13-11)

S_0 = 69.0 mph (Exhibit 13-11)

S = 65.0 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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	exit to SR 61
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-7 - No-Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	3440
Ramp Volume, V_R	210
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3440	0.94	Level	9	0	0.957	1.00	3824
Ramp	210	0.94	Level	14	0	0.935	1.00	239
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 2294 pc/h

V_3 or V_{av34} = 1530 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} = 2294 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4063	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2533	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 = 20.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.282 (Exibit 13-11)

S_R = 62.1 mph (Exhibit 13-11)

S_0 = 66.3 mph (Exhibit 13-11)

S = 63.6 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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	SR 61 exit ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-9 - No-Build 2038

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	900
Freeway Volume, V_F	2640
Ramp Volume, V_R	210
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2640	0.94	Level	9	0	0.957	1.00	2935
Ramp	210	0.94	Level	24	0	0.893	1.00	250
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} = 0.675 using Equation (Exhibit 13-7)

V_{12} = 2063 pc/h

V_3 or V_{av34} = 872 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	2935	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2685	Exhibit 13-8	7200	No
V_R	250	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2063	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 = 13.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.191 (Exhibit 13-12)

S_R = 64.7 mph (Exhibit 13-12)

S_0 = 76.8 mph (Exhibit 13-12)

S = 67.8 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	SR 61 exit ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-9 - No-Build 2038

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	900
Freeway Volume, V_F	2820
Ramp Volume, V_R	210
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2820	0.94	Level	9	0	0.957	1.00	3135
Ramp	210	0.94	Level	24	0	0.893	1.00	250
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} = 0.670 using Equation (Exhibit 13-7)
V_{12} = 2183 pc/h
V_3 or V_{av34} = 952 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	3135	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2885	Exhibit 13-8	7200	No
V_R	250	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2183	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 = 14.9 (pc/mi/ln)
LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.191 (Exhibit 13-12)
S_R = 64.7 mph (Exhibit 13-12)
S_0 = 76.8 mph (Exhibit 13-12)
S = 67.9 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	entrance from SR 61
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-10 - No-Build 2038

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	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	2430
Ramp Volume, V_R	1150
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2430	0.94	Level	9	0	0.957	1.00	2701
Ramp	1150	0.94	Level	16	0	0.926	1.00	1321
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = 0.608 using Equation (Exhibit 13-6)
V_{12} = 1643 pc/h
V_3 or V_{av34} = 1058 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} = 1643 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4022	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2964	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 = 21.1 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.276 (Exibit 13-11)
S_R = 62.3 mph (Exhibit 13-11)
S_0 = 68.0 mph (Exhibit 13-11)
S = 63.7 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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	entrance from SR 61
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-10 - No-Build 2038

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	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	2610
Ramp Volume, V_R	430
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2610	0.94	Level	9	0	0.957	1.00	2902
Ramp	430	0.94	Level	16	0	0.926	1.00	494
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.608 using Equation (Exhibit 13-6)

V_{12} = 1765 pc/h

V_3 or V_{av34} = 1137 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} = 1765 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3396	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2259	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 = 16.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.237 (Exibit 13-11)

S_R = 63.4 mph (Exhibit 13-11)

S_0 = 67.7 mph (Exhibit 13-11)

S = 64.7 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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	exit to 36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-11 - No-Build 2038

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	900
Freeway Volume, V_F	3580
Ramp Volume, V_R	430
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3580	0.94	Level	9	0	0.957	1.00	3980
Ramp	430	0.94	Level	24	0	0.893	1.00	512
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} = 0.637 using Equation (Exhibit 13-7)

V_{12} = 2721 pc/h

V_3 or V_{av34} = 1259 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	3980	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3468	Exhibit 13-8	7200	No
V_R	512	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2721	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 = 19.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.214 (Exhibit 13-12)

S_R = 64.0 mph (Exhibit 13-12)

S_0 = 75.8 mph (Exhibit 13-12)

S = 67.3 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	exit to US 36/SR 37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-11 - No-Build 2038

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	900
Freeway Volume, V_F	3040
Ramp Volume, V_R	940
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3040	0.94	Level	9	0	0.957	1.00	3380
Ramp	940	0.94	Level	24	0	0.893	1.00	1120
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} = 0.624 using Equation (Exhibit 13-7)

V_{12} = 2530 pc/h

V_3 or V_{av34} = 850 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	3380	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2260	Exhibit 13-8	7200	No
V_R	1120	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2530	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 = 17.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.269 (Exhibit 13-12)

S_R = 62.5 mph (Exhibit 13-12)

S_0 = 76.8 mph (Exhibit 13-12)

S = 65.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	entrance from 36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-12 - No-Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	3150
Ramp Volume, V_R	2930
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3150	0.94	Level	9	0	0.957	1.00	3502
Ramp	2930	0.94	Level	10	0	0.952	1.00	3273
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} = 2111 pc/h

V_3 or V_{av34} = 1391 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} = 2111 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6775	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5384	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 = 40.3 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 1.072 (Exibit 13-11)

S_R = 40.0 mph (Exhibit 13-11)

S_0 = 66.8 mph (Exhibit 13-11)

S = 43.6 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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	entrance from 36/37
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-12 - No-Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2070
Ramp Volume, V_R	1190
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2070	0.94	Level	9	0	0.957	1.00	2301
Ramp	1190	0.94	Level	10	0	0.952	1.00	1329
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} = 1387 pc/h

V_3 or V_{av34} = 914 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}	3630	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2716	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 = 20.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.281 (Exibit 13-11)

S_R = 62.1 mph (Exhibit 13-11)

S_0 = 68.5 mph (Exhibit 13-11)

S = 63.6 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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	exit to Gemini/Polaris
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-15 - No-Build 2038

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	6080
Ramp Volume, V_R	600
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	6080	0.94	Level	8	0	0.962	1.00	6727
Ramp	600	0.94	Level	4	0	0.980	1.00	651
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} = 0.562 using Equation (Exhibit 13-7)

V_{12} = 4065 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} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6727	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	6076	Exhibit 13-8	7200	No
V_R	651	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4065	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 = 33.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.227 (Exhibit 13-12)

S_R = 63.7 mph (Exhibit 13-12)

S_0 = 70.3 mph (Exhibit 13-12)

S = 66.1 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	exit to Gemini/Polaris
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-12 - No-Build 2038

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} =	ft
V_u =	veh/h	Freeway Volume, V_F	3260	V_D =	veh/h
		Ramp Volume, V_R	310		
		Freeway Free-Flow Speed, S_{FF}	70.0		
		Ramp Free-Flow Speed, S_{FR}	55.0		

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	3260	0.94	Level	8	0	0.962	1.00	3607
Ramp	310	0.94	Level	4	0	0.980	1.00	336
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} = 0.654 using Equation (Exhibit 13-7)

V_{12} = 2476 pc/h

V_3 or V_{av34} 1131 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	3607	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3271	Exhibit 13-8	7200	No
V_R	336	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2476	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 = 20.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.198 (Exhibit 13-12)

S_R= 64.4 mph (Exhibit 13-12)

S_0= 76.3 mph (Exhibit 13-12)

S = 67.7 mph (Exhibit 13-13)

J-16 No-Build

I-71 Southbound – at entrance ramp from Polaris/Gemini

Major merge therefore the capacities of the mainline and ramps are checked. The highest density is reported.

Location		AM		PM	
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
F-14	I-71 SB south of Gemini	32.2	D	15.5	B
F-14A	I-71 SB between Polaris/Gemini & I-270	47.5	F	31.0	D
F-14B	Entrance ramp from Polaris/Gemini	33.8	D	45.0	F

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	JRH	Highway/Direction of Travel	I-71 SB
Agency or Company	ms consultants	From/To	between Polaris/Gemini & I-270
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description F-14 (A) - No-Build 2038

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

Flow Inputs

Volume, V	8920	veh/h	Peak-Hour Factor, PHF	0.94
AADT		veh/day	%Trucks and Buses, P_T	7
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.966

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	4		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	70.0	mph	FFS	70.0	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)	2455	pc/h/ln	Design LOS		
S	51.7	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	47.5	pc/mi/ln	S		mph
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	JRH	Highway/Direction of Travel	I-71 SB
Agency or Company	ms consultants	From/To	between Polaris/Gemini & I-270
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description F-14 (A) - No-Build 2038

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

Flow Inputs

Volume, V	7120	veh/h	Peak-Hour Factor, PHF	0.94
AADT		veh/day	%Trucks and Buses, P_T	7
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.966

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	4		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	70.0	mph	FFS	70.0	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)	1960	pc/h/ln	Design LOS		
S	63.3	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	31.0	pc/mi/ln	S		mph
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB entrance ramp*
Agency or Company	*ms consultants*	From/To	*ramp from Polaris/Gemini*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 (B) - No-Build 2038*

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

Flow Inputs

Volume, V	*3440*	veh/h	Peak-Hour Factor, PHF	*0.94*
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

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		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

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1857*	pc/h/ln
S	*54.9*	mph
D = v_p / S	*33.8*	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	

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB entrance ramp*
Agency or Company	*ms consultants*	From/To	*ramp from Polaris/Gemini*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 (B) - No-Build 2038*

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

Flow Inputs

Volume, V	*4170*	veh/h	Peak-Hour Factor, PHF	*0.94*
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

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		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

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2251*	pc/h/ln
S	*50.0*	mph
D = v_p / S	*45.0*	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

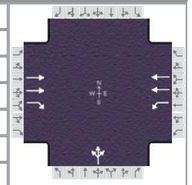
N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

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	

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	11/20/2015	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Africa Road	File Name			
Project Description	I1 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		2410	190	360	1460		70	0	610			

Signal Information			
Cycle, s	120.0	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	11.0	53.0	38.0	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0		5	6	7	8	
Red	2.0	2.0	2.0	0.0	0.0	0.0						

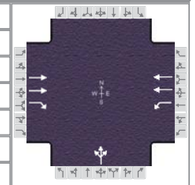
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		12.0		
Phase Duration, s		59.0	17.0	76.0		44.0		
Change Period, (*Y*+*R c*), s		6.0	6.0	6.0		6.0		
Max Allow Headway (*MAH*), s		3.0	3.1	3.0		3.3		
Queue Clearance Time (*g s*), s		55.0	13.0	45.5		40.0		
Green Extension Time (*g e*), s		0.0	0.0	19.0		0.0		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		1.00	1.00	0.70		1.00		

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		3	8	18			
Adjusted Flow Rate (*v*), veh/h		2620	207	391	1587			739				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1706	1519	1707	1706			1416				
Queue Service Time (*g s*), s		53.0	10.5	11.0	43.5			38.0				
Cycle Queue Clearance Time (*g c*), s		53.0	10.5	11.0	43.5			38.0				
Green Ratio (*g/C*)		0.44	0.44	0.55	0.58			0.32				
Capacity (*c*), veh/h		1507	671	216	1991			448				
Volume-to-Capacity Ratio (*X*)		1.738	0.308	1.808	0.797			1.648				
Available Capacity (*c a*), veh/h		1507	671	216	1991			448				
Back of Queue (*Q*), veh/ln (95 th percentile)		142.9	7.1	40.5	23.7			79.1				
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.74	13.28	0.00			0.00				
Uniform Delay (*d 1*), s/veh		33.5	21.6	38.0	19.5			41.0				
Incremental Delay (*d 2*), s/veh		334.8	1.2	381.1	3.4			301.5				
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0			0.0				
Control Delay (*d*), s/veh		368.3	22.8	419.1	22.9			342.5				
Level of Service (LOS)		F	C	F	C			F				
Approach Delay, s/veh / LOS	343.1	F		101.3	F		342.5	F		0.0		
Intersection Delay, s/veh / LOS	256.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.8	C	2.1	B	1.7	A		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Africa Road	File Name			
Project Description	I1 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		2300	130	530	2770		110	0	440			

Signal Information			
Cycle, s	120.0	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	19.0	51.9	31.1	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0		5	6	7	8	
Red	2.0	2.0	2.0	0.0	0.0	0.0						

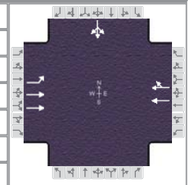
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		12.0		
Phase Duration, s		57.9	25.0	82.9		37.1		
Change Period, (*Y*+*R c*), s		6.0	6.0	6.0		6.0		
Max Allow Headway (*MAH*), s		3.0	3.1	3.0		3.3		
Queue Clearance Time (*g s*), s		53.9	21.0	78.9		33.1		
Green Extension Time (*g e*), s		0.0	0.0	0.0		0.0		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		1.00	1.00	1.00		1.00		

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		3	8	18			
Adjusted Flow Rate (*v*), veh/h		2500	141	576	3011			598				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1706	1519	1707	1706			1432				
Queue Service Time (*g s*), s		51.9	7.0	19.0	76.9			31.1				
Cycle Queue Clearance Time (*g c*), s		51.9	7.0	19.0	76.9			31.1				
Green Ratio (*g/C*)		0.43	0.43	0.61	0.64			0.26				
Capacity (*c*), veh/h		1476	657	330	2187			371				
Volume-to-Capacity Ratio (*X*)		1.694	0.215	1.744	1.377			1.611				
Available Capacity (*c a*), veh/h		1476	657	330	2187			371				
Back of Queue (*Q*), veh/ln (95 th percentile)		133.1	4.7	57.7	118.6			63.2				
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.49	18.88	0.00			0.00				
Uniform Delay (*d 1*), s/veh		34.1	21.3	40.2	21.6			44.5				
Incremental Delay (*d 2*), s/veh		315.1	0.7	347.2	172.5			287.3				
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0			0.0				
Control Delay (*d*), s/veh		349.2	22.1	387.4	194.0			331.7				
Level of Service (LOS)		F	C	F	F			F				
Approach Delay, s/veh / LOS	331.7	F		225.1	F		331.7	F		0.0		
Intersection Delay, s/veh / LOS	275.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.7	B	3.4	C	1.5	A		

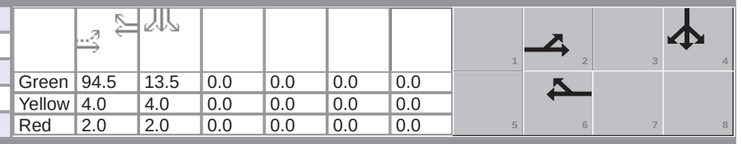
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/N 3 Bs &…	File Name	I-2_36-37_NB_AM_2038.xus		
Project Description	I-2 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	2850			1780	30				120	0	40

Signal Information			
Cycle, s	120.0	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	94.5	13.5	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

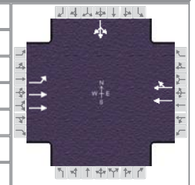
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6				4
Case Number		6.0		8.0				12.0
Phase Duration, s		100.5		100.5				19.5
Change Period, (*Y*+*R* $_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.1		3.1				3.2
Queue Clearance Time (*g* $_s$), s		96.5		34.8				14.2
Green Extension Time (*g* $_e$), s		0.0		44.4				0.0
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		1.00		0.69				1.00

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				7	4	14
Adjusted Flow Rate (*v*), veh/h	11	3098			984	984					174	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	209	1675			1759	1749					1688	
Queue Service Time (*g* $_s$), s	3.2	94.5			32.6	32.8					12.2	
Cycle Queue Clearance Time (*g* $_c$), s	36.0	94.5			32.6	32.8					12.2	
Green Ratio (*g*/*C*)	0.79	0.79			0.79	0.79					0.11	
Capacity (*c*), veh/h	168	2638			1385	1377					190	
Volume-to-Capacity Ratio (*X*)	0.065	1.174			0.710	0.714					0.916	
Available Capacity (*c* $_a$), veh/h	168	2638			1385	1377					190	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	77.2			14.5	14.5					11.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00					0.00	
Uniform Delay (*d* $_1$), s/veh	14.9	12.8			6.1	6.2					52.7	
Incremental Delay (*d* $_2$), s/veh	0.1	82.8			1.5	1.5					41.6	
Initial Queue Delay (*d* $_3$), s/veh	0.0	0.0			0.0	0.0					0.0	
Control Delay (*d*), s/veh	15.0	95.6			7.6	7.7					94.3	
Level of Service (LOS)	B	F			A	A					F	
Approach Delay, s/veh / LOS	95.3	F		7.7	A		0.0			94.3	F	
Intersection Delay, s/veh / LOS	62.4						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.8	A	2.0	B	2.8	C	2.9	C
Bicycle LOS Score / LOS	3.1	C	2.1	B			0.8	A

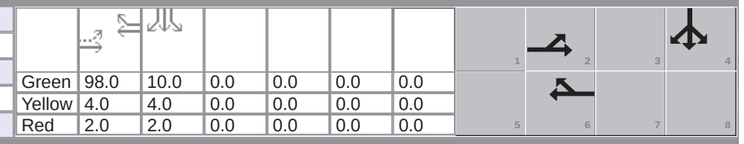
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/N 3 Bs &…	File Name	I-2_36-37_NB_PM_2038.xus		
Project Description	I-2 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	2690			3210	120				40	0	30

Signal Information			
Cycle, s	120.0	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	98.0	10.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	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		6.0		8.0				12.0
Phase Duration, s		104.0		104.0				16.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.2		3.2				3.2
Queue Clearance Time (*g* $_s$), s		100.0		122.0				7.3
Green Extension Time (*g* $_e$), s		0.0		0.0				0.0
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		1.00		1.00				1.00

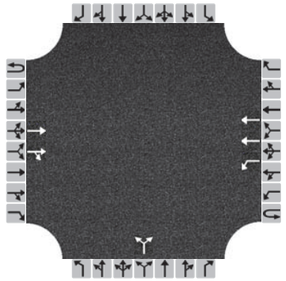
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	54	2924			1810	1810					76	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	40	1675			1759	1737					1652	
Queue Service Time (*g* $_s$), s	0.0	98.0			120.0	98.0					5.3	
Cycle Queue Clearance Time (*g* $_c$), s	98.0	98.0			120.0	98.0					5.3	
Green Ratio (*g*/*C*)	0.82	0.82			0.82	0.82					0.08	
Capacity (*c*), veh/h	60	2736			1437	1418					138	
Volume-to-Capacity Ratio (*X*)	0.906	1.069			1.260	1.276					0.553	
Available Capacity (*c* $_a$), veh/h	60	2736			1437	1418					138	
Back of Queue (*Q*), veh/ln (95 th percentile)	5.4	50.3			105.0	108.4					4.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00					0.00	
Uniform Delay (*d* $_1$), s/veh	60.0	11.0			11.0	11.0					52.9	
Incremental Delay (*d* $_2$), s/veh	81.6	39.1			122.6	129.8					2.8	
Initial Queue Delay (*d* $_3$), s/veh	0.0	0.0			0.0	0.0					0.0	
Control Delay (*d*), s/veh	141.6	50.1			133.6	140.8					55.7	
Level of Service (LOS)	F	F			F	F					E	
Approach Delay, s/veh / LOS	51.8	D		137.2	F		0.0			55.7	E	
Intersection Delay, s/veh / LOS	98.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.8	A	2.0	B	2.8	C	2.9	C
Bicycle LOS Score / LOS	2.9	C	3.5	C			0.6	A

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	JRH	Intersection	US 36/SR 37/S 3 Bs & K
Agency/Co.	ms consultants	Jurisdiction	
Date Performed	11/20/2016	East/West Street	US 36/SR 37
Analysis Year	2038	North/South Street	S 3 Bs & K
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	I-3 - No-Build 2038		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	0	0
Configuration			T	TR		L	T				LR					
Volume (veh/h)			2940	30		60	1770			10		280				
Percent Heavy Vehicles						6				3		3				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Left Only															
Median Storage	1															

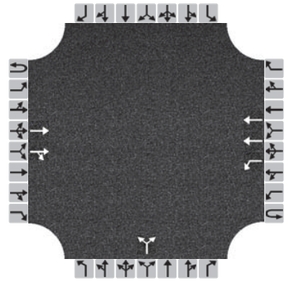
Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						65					315					
Capacity						86					51					
v/c Ratio						0.75					6.23					
95% Queue Length						3.8					36.3					
Control Delay (s/veh)						122.9					2510.5					
Level of Service (LOS)						F					F					
Approach Delay (s/veh)					4.0				2510.5							
Approach LOS					A				F							

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	JRH	Intersection	US 36/SR 37/S 3 Bs & K
Agency/Co.	ms consultants	Jurisdiction	
Date Performed	11/20/2016	East/West Street	US 36/SR 37
Analysis Year	2038	North/South Street	S 3 Bs & K
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	I-3 - No-Build 2038		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

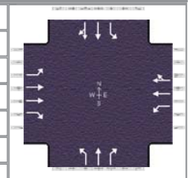
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	0	0
Configuration			T	TR		L	T				LR					
Volume (veh/h)			2670	50		160	3350			40		140				
Percent Heavy Vehicles						6				3		3				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Left Only															
Median Storage	1															

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						174					195					
Capacity						112					144					
v/c Ratio						1.56					1.35					
95% Queue Length						12.9					12.3					
Control Delay (s/veh)						359.2					255.0					
Level of Service (LOS)						F					F					
Approach Delay (s/veh)					16.4				255.0							
Approach LOS					C				F							

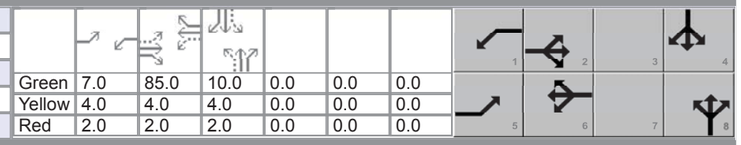
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Fourwinds	File Name	I-4_36-37_NB_AM_2038.xus		
Project Description	I-4 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160	2990	70	90	1780	40	40	10	70	90	10	10

Signal Information			
Cycle, s	120.0	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	7.0	85.0	10.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

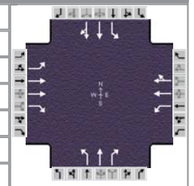
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		5.0		6.0
Phase Duration, s	13.0	91.0	13.0	91.0		16.0		16.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.2		3.2
Queue Clearance Time (*g s*), s	5.2	87.0	4.4	45.9		7.6		11.0
Green Extension Time (*g e*), s	0.1	0.0	0.0	33.3		0.1		0.0
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	1.00	1.00	0.83		1.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	174	3250	76	98	989	989	43	11	76	98	11	11
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706	1519	1707	1792	1778	1384	1863	1579	1398	1863	1579
Queue Service Time (*g s*), s	3.2	85.0	1.8	2.4	43.1	43.9	3.6	0.6	5.6	8.3	0.6	0.8
Cycle Queue Clearance Time (*g c*), s	3.2	85.0	1.8	2.4	43.1	43.9	4.4	0.6	5.6	9.0	0.6	0.8
Green Ratio (*g/C*)	0.77	0.71	0.71	0.77	0.71	0.71	0.08	0.08	0.08	0.08	0.08	0.08
Capacity (*c*), veh/h	228	2417	1076	160	1270	1260	167	155	132	169	155	132
Volume-to-Capacity Ratio (*X*)	0.762	1.344	0.071	0.613	0.779	0.785	0.261	0.070	0.578	0.579	0.070	0.083
Available Capacity (*c a*), veh/h	228	2417	1076	160	1270	1260	167	155	132	169	155	132
Back of Queue (*Q*), veh/ln (95 th percentile)	7.8	119.2	1.0	4.0	22.1	22.3	2.3	0.5	4.2	5.5	0.5	0.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.82	0.00	0.10	0.44	0.00	0.00	0.21	0.00	0.38	0.50	0.00	0.00
Uniform Delay (*d 1*), s/veh	26.0	17.5	5.4	36.4	11.4	11.5	52.8	50.7	53.0	54.8	50.7	50.8
Incremental Delay (*d 2*), s/veh	12.7	157.8	0.0	5.0	2.9	3.1	0.3	0.1	4.1	3.2	0.1	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	38.7	175.3	5.4	41.4	14.3	14.6	53.1	50.8	57.1	58.1	50.8	50.9
Level of Service (LOS)	D	F	A	D	B	B	D	D	E	E	D	D
Approach Delay, s/veh / LOS	164.9	F		15.7	B		55.2	E		56.8	E	
Intersection Delay, s/veh / LOS	107.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.4	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	3.4	C	2.2	B	0.7	A	0.6	A

2010 HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 23, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Intersection	US 36/SR 37/Fourwinds	Analysis Year	2038	Analysis Period	1> 7:00
File Name	I-4_36-37_NB_PM_2038.xus				
Project Description	I-4 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	2780	100	190	3450	10	90	10	100	20	10	20

Signal Information			
Cycle, s	120.0	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	7.0	85.0	10.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

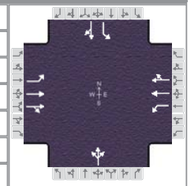
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	8	8	4	4
Case Number	1.1	3.0	1.1	4.0	5.0	5.0	6.0	6.0
Phase Duration, s	13.0	91.0	13.0	91.0	16.0	16.0	16.0	16.0
Change Period, *(Y+Rc)*, s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway *(MAH)*, s	3.1	3.0	3.1	3.0	3.2	3.2	3.2	3.2
Queue Clearance Time *(g_s)*, s	3.3	87.0	9.0	87.0	12.0	12.0	4.4	4.4
Green Extension Time *(g_e)*, s	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.43	1.00	1.00	1.00	1.00	1.00	0.14	0.14

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate *(v)*, veh/h	76	3022	109	207	1880	1880	98	11	109	22	11	22
Adjusted Saturation Flow Rate *(s)*, veh/h/ln	1707	1706	1519	1707	1792	1791	1371	1863	1579	1398	1863	1579
Queue Service time *(g_s)*, s	1.3	85.0	2.7	7.0	85.0	85.0	8.5	0.6	8.1	1.7	0.6	1.5
Cycle Queue Clearance Time *(g_c)*, s	1.3	85.0	2.7	7.0	85.0	85.0	10.0	0.6	8.1	2.4	0.6	1.5
Capacity *(c)*, veh/h	160	2417	1076	161	1270	1268	157	155	132	169	155	132
Volume-to-Capacity Ratio *(X)*	0.475	1.250	0.101	1.284	1.481	1.483	0.624	0.070	0.826	0.129	0.070	0.165
Available Capacity *(c_a)*, veh/h	160	2417	1076	161	1270	1268	157	155	132	169	155	132
Back of Queue *(Q)*, veh/ln	1.8	66.4	0.8	11.2	106.6	106.8	3.4	0.3	4.4	0.6	0.3	0.6
Overflow Queue *(Q_3)*, veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Queue Storage Ratio *(RQ)*	0.3	0.0	0.1	*1.5*	0.0	0.0	0.5	0.0	0.7	0.1	0.0	0.0
Uniform Delay *(d_1)*, s/veh	33.5	17.5	5.5	44.5	17.5	17.5	55.8	50.7	54.1	51.8	50.7	51.1
Incremental Delay *(d_2)*, s/veh	0.8	116.1	0.0	166.7	220.8	221.4	5.7	0.1	31.5	0.1	0.1	0.2
Initial Queue Delay *(d_3)*, s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay *(d)*, s/veh	34.3	133.6	5.5	211.2	238.3	238.9	61.5	50.8	85.7	51.9	50.8	51.3
Level of Service (LOS)	C	F	A	F	F	F	E	D	F	D	D	D
Approach Delay, s/veh / LOS	126.9	F		237.2	F		73.1	E		51.5	D	
Intersection Delay s/veh / LOS	183.5						F					

MultiModal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.4	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	3.1	C	3.8	D	0.8	A	0.5	A

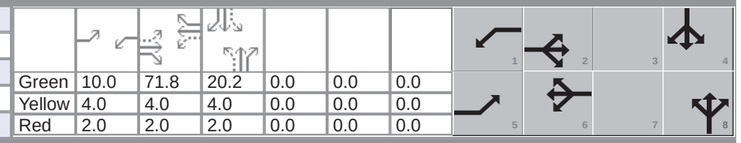
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Bob Evan…	File Name	I-5_36-37_NB_AM_2038.xus		
Project Description	I-5 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	2920	120	160	1770	50	60	10	50	200	20	40

Signal Information			
Cycle, s	120.0	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	10.0	71.8	20.2	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

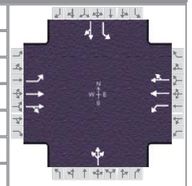
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		6.0
Phase Duration, s	16.0	77.8	16.0	77.8		26.2		26.2
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.4		3.4
Queue Clearance Time (g_s), s	4.9	73.8	9.8	62.7		14.2		22.2
Green Extension Time (g_e), s	0.1	0.0	0.0	8.8		0.6		0.0
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	0.08	1.00	1.00	0.98		0.20		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	120	1652	1652	174	989	989		130		217	65	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1792	1767	1707	1792	1775		1305		1201	1501	
Queue Service Time (g_s), s	2.9	71.8	71.8	7.8	59.3	60.7		7.6		8.0	4.5	
Cycle Queue Clearance Time (g_c), s	2.9	71.8	71.8	7.8	59.3	60.7		12.2		20.2	4.5	
Green Ratio (*g/C*)	0.68	0.60	0.60	0.68	0.60	0.60		0.17		0.17	0.17	
Capacity (*c*), veh/h	218	1072	1057	202	1072	1062		265		141	253	
Volume-to-Capacity Ratio (*X*)	0.548	1.541	1.562	0.860	0.922	0.931		0.493		1.547	0.258	
Available Capacity (c_a), veh/h	218	1072	1057	202	1072	1062		265		141	253	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.8	156.0	159.0	10.9	34.8	35.6		6.6		25.2	3.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.28	0.00	0.00	0.98	0.00	0.00		0.00		6.97	0.00	
Uniform Delay (d_1), s/veh	27.4	24.1	24.1	39.5	21.6	21.9		47.0		57.7	43.4	
Incremental Delay (d_2), s/veh	1.7	247.9	257.7	28.1	12.6	13.9		0.5		278.2	0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (*d*), s/veh	29.1	272.0	281.8	67.5	34.2	35.7		47.6		335.9	43.6	
Level of Service (LOS)	C	F	F	E	C	D		D		F	D	
Approach Delay, s/veh / LOS	268.3	F		37.6	D		47.6	D		268.4	F	
Intersection Delay, s/veh / LOS	180.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	3.3	C	2.3	B	0.7	A	1.0	A

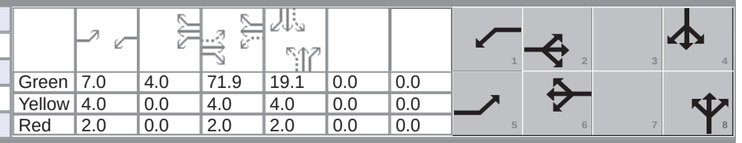
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Bob Evan…	File Name	I-5_36-37_NB_PM_2038.xus		
Project Description	I-5 - No-Build 2038				



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	2720	100	130	3510	90	80	10	60	140	10	60

Signal Information			
Cycle, s	120.0	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	7.0	4.0	71.9	19.1	0.0	0.0	
Yellow	4.0	0.0	4.0	4.0	0.0	0.0	
Red	2.0	0.0	2.0	2.0	0.0	0.0	

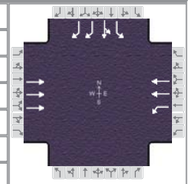
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		6.0
Phase Duration, s	13.0	77.9	17.0	81.9		25.1		25.1
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.4		3.4
Queue Clearance Time (g_s), s	4.2	73.9	7.2	77.9		19.0		21.1
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0		0.0		0.0
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	1.00	0.47	1.00		1.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	87	1533	1533	141	1957	1957		163		152	76	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1792	1770	1707	1792	1776		1164		1190	1457	
Queue Service Time (g_s), s	2.2	71.9	71.9	5.2	75.9	75.9		11.5		2.1	5.6	
Cycle Queue Clearance Time (g_c), s	2.2	71.9	71.9	5.2	75.9	75.9		17.0		19.1	5.6	
Green Ratio (*g/C*)	0.66	0.60	0.60	0.69	0.63	0.63		0.16		0.16	0.16	
Capacity (*c*), veh/h	160	1074	1060	216	1134	1124		231		81	232	
Volume-to-Capacity Ratio (*X*)	0.545	1.427	1.445	0.653	1.726	1.741		0.705		1.887	0.328	
Available Capacity (c_a), veh/h	160	1074	1060	216	1134	1124		231		81	232	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.8	130.1	132.7	7.7	210.0	212.0		9.0		21.9	3.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.21	0.00	0.00	0.70	0.00	0.00		0.00		6.04	0.00	
Uniform Delay (d_1), s/veh	29.0	24.1	24.1	35.0	22.1	22.1		50.9		59.7	44.8	
Incremental Delay (d_2), s/veh	2.2	197.6	205.7	5.5	330.3	337.3		8.0		442.1	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (*d*), s/veh	31.1	221.7	229.8	40.5	352.4	359.3		58.9		501.8	45.1	
Level of Service (LOS)	C	F	F	D	F	F		E		F	D	
Approach Delay, s/veh / LOS	220.4	F		344.9	F		58.9	E		349.6	F	
Intersection Delay, s/veh / LOS	287.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	3.1	C	3.8	D	0.8	A	0.9	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 SB ra…	File Name	I-6_36-37_NB_AM_2038.xus		
Project Description	I-6 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1150		890	1330					30	0	400

Signal Information			
Cycle, s	120.0	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	51.8	30.0	20.2	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0		5	6	7	8	
Red	2.0	2.0	2.0	0.0	0.0	0.0						

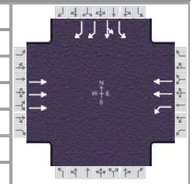
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		8.3	1.0	4.0				9.0
Phase Duration, s		36.0	57.8	93.8				26.2
Change Period, (*Y*+*R* $_c$), s		6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s		3.0	3.1	3.0				3.4
Queue Clearance Time (g_s), s		32.0	53.8	25.7				22.2
Green Extension Time (g_e), s		0.0	0.0	10.9				0.0
Phase Call Probability		1.00	1.00	1.00				1.00
Max Out Probability		1.00	1.00	0.00				1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2		1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		1250		967	1446					16	0	451
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1402		1707	1706					1459	1532	1160
Queue Service Time (g_s), s		30.0		51.8	23.7					1.1	0.0	20.2
Cycle Queue Clearance Time (g_c), s		30.0		51.8	23.7					1.1	0.0	20.2
Green Ratio (*g/C*)		0.25		0.70	0.73					0.17	0.17	0.17
Capacity (*c*), veh/h		1052		797	2497					246	258	391
Volume-to-Capacity Ratio (*X*)		1.189		1.214	0.579					0.066	0.000	1.155
Available Capacity (c_a), veh/h		1052		797	2497					246	258	391
Back of Queue (*Q*), veh/ln (95 th percentile)		29.3		62.8	12.2					0.7	0.0	17.4
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00		3.36	0.00					0.04	0.00	0.61
Uniform Delay (d_1), s/veh		45.0		29.4	7.5					42.0	0.0	49.9
Incremental Delay (d_2), s/veh		94.5		107.7	1.0					0.0	0.0	94.8
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		139.5		137.1	8.5					42.0	0.0	144.7
Level of Service (LOS)		F		F	A					D		F
Approach Delay, s/veh / LOS	139.5	F		60.1	E		0.0			141.2		F
Intersection Delay, s/veh / LOS	93.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.0	B	3.2	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	2.5	B			1.3	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 SB ra…	File Name	I-6_36-37_NB_PM_2038.xus		
Project Description	I-6 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1900		360	2650					110	0	860

Signal Information			
Cycle, s	120.0	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	23.5	41.2	37.3	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0		5	6	7	8	
Red	2.0	2.0	2.0	0.0	0.0	0.0						

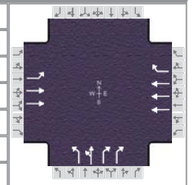
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		8.3	1.0	4.0				9.0
Phase Duration, s		47.2	29.5	76.7				43.3
Change Period, (*Y*+*R* $_c$), s		6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s		3.0	3.1	3.0				3.4
Queue Clearance Time (g_s), s		43.2	25.2	72.7				39.3
Green Extension Time (g_e), s		0.0	0.0	0.0				0.0
Phase Call Probability		1.00	1.00	1.00				1.00
Max Out Probability		1.00	1.00	1.00				1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2		1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		2065		391	2880					60	0	995
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1628		1707	1706					1459	1532	1168
Queue Service Time (g_s), s		41.2		23.2	70.7					3.5	0.0	37.3
Cycle Queue Clearance Time (g_c), s		41.2		23.2	70.7					3.5	0.0	37.3
Green Ratio (*g/C*)		0.34		0.56	0.59					0.31	0.31	0.31
Capacity (*c*), veh/h		1676		394	2011					454	476	726
Volume-to-Capacity Ratio (*X*)		1.232		0.992	1.433					0.132	0.000	1.370
Available Capacity (c_a), veh/h		1676		394	2011					454	476	726
Back of Queue (*Q*), veh/ln (95 th percentile)		48.3		17.1	122.5					2.2	0.0	43.6
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00		0.92	0.00					0.13	0.00	1.53
Uniform Delay (d_1), s/veh		39.4		38.2	24.7					29.7	0.0	41.4
Incremental Delay (d_2), s/veh		109.8		43.2	197.6					0.0	0.0	175.2
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		149.2		81.3	222.2					29.8	0.0	216.5
Level of Service (LOS)		F		F	F					C		F
Approach Delay, s/veh / LOS	149.2	F		205.4	F		0.0			205.9		F
Intersection Delay, s/veh / LOS	187.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.1	B	3.2	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	3.2	C			2.2	B

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 NB ra…	File Name	I-7_36-37_NB_AM_2038.xus		
Project Description	I-7 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	460	720			1710	140	510	0	250			

Signal Information				1	2	3	4
Cycle, s	120.0	Reference Phase	2				
Offset, s	0	Reference Point	End				
Uncoordinated	Yes	Simult. Gap E/W	On				
Force Mode	Fixed	Simult. Gap N/S	On				

								5	6	7	8
Green	26.0	56.8	19.2	0.0	0.0	0.0					
Yellow	4.0	4.0	4.0	0.0	0.0	0.0					
Red	2.0	2.0	2.0	0.0	0.0	0.0					

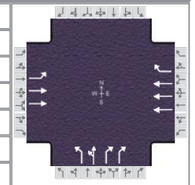
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	32.0	94.8		62.8		25.2		
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.0		3.0		3.3		
Queue Clearance Time (g_s), s	28.0	11.3		58.8		21.2		
Green Extension Time (g_e), s	0.0	11.5		0.0		0.0		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	1.00	0.01		1.00		1.00		

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	500	783			1859	152	277	0	549			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1099	1519	1723	1810	1542			
Queue Service Time (g_s), s	26.0	9.3			56.8	7.0	19.2	0.0	19.2			
Cycle Queue Clearance Time (g_c), s	26.0	9.3			56.8	7.0	19.2	0.0	19.2			
Green Ratio (*g*/*C*)	0.71	0.74			0.47	0.47	0.16	0.16	0.16			
Capacity (*c*), veh/h	430	2525			1560	719	276	290	493			
Volume-to-Capacity Ratio (*X*)	1.163	0.310			1.191	0.212	1.005	0.000	1.112			
Available Capacity (c_a), veh/h	430	2525			1560	719	276	290	493			
Back of Queue (*Q*), veh/ln (95 th percentile)	34.8	5.3			40.9	4.6	18.2	0.0	19.2			
Queue Storage Ratio (*RQ*) (95 th percentile)	1.86	0.00			0.00	0.81	0.74	0.00	0.54			
Uniform Delay (d_1), s/veh	40.3	5.3			31.6	18.5	50.4	0.0	50.4			
Incremental Delay (d_2), s/veh	96.2	0.3			92.8	0.7	55.5	0.0	74.9			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	136.5	5.6			124.4	19.2	105.9	0.0	125.3			
Level of Service (LOS)	F	A			F	B	F		F			
Approach Delay, s/veh / LOS	56.6	E		116.5	F		118.8	F		0.0		
Intersection Delay, s/veh / LOS	98.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.5	A	1.6	A	1.9	A		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 NB ra…	File Name	I-7_36-37_NB_PM_2038.xus		
Project Description	I-7 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	570	1440			1390	190	1620	0	990			

Signal Information				1	2	3	4
Cycle, s	120.0	Reference Phase	2				
Offset, s	0	Reference Point	End				
Uncoordinated	Yes	Simult. Gap E/W	On				
Force Mode	Fixed	Simult. Gap N/S	On				

								5	6	7	8
Green	25.0	25.8	51.2	0.0	0.0	0.0					
Yellow	4.0	4.0	4.0	0.0	0.0	0.0					
Red	2.0	2.0	2.0	0.0	0.0	0.0					

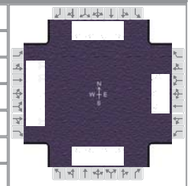
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	31.0	62.8		31.8		57.2		
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.0		3.0		3.3		
Queue Clearance Time (g_s), s	27.0	55.5		27.8		53.2		
Green Extension Time (g_e), s	0.0	1.1		0.0		0.0		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	1.00	1.00		1.00		1.00		

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	620	1565			1511	207	880	0	1957			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1628	1519	1723	1810	1522			
Queue Service Time (g_s), s	25.0	53.5			25.8	14.8	51.2	0.0	51.2			
Cycle Queue Clearance Time (g_c), s	25.0	53.5			25.8	14.8	51.2	0.0	51.2			
Green Ratio (*g*/*C*)	0.44	0.47			0.21	0.21	0.43	0.43	0.43			
Capacity (*c*), veh/h	416	1615			1050	327	735	772	1299			
Volume-to-Capacity Ratio (*X*)	1.491	0.969			1.439	0.632	1.197	0.000	1.506			
Available Capacity (c_a), veh/h	416	1615			1050	327	735	772	1299			
Back of Queue (*Q*), veh/ln (95 th percentile)	56.3	32.6			46.2	10.5	58.7	0.0	92.1			
Queue Storage Ratio (*RQ*) (95 th percentile)	3.01	0.00			0.00	1.83	2.38	0.00	2.60			
Uniform Delay (d_1), s/veh	36.0	30.7			47.1	42.8	34.4	0.0	34.4			
Incremental Delay (d_2), s/veh	233.2	16.1			203.1	9.0	101.8	0.0	232.0			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	269.2	46.9			250.2	51.8	136.2	0.0	266.4			
Level of Service (LOS)	F	D			F	D	F		F			
Approach Delay, s/veh / LOS	109.9	F		226.4	F		226.0	F		0.0		
Intersection Delay, s/veh / LOS	188.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	2.3	B	1.4	A	5.2	F		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Wilson Road	File Name	I-8_36-37_NB_AM_2038.xus		
Project Description	I-8 - No-Build 2038				



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	770	220	10	1520	10	190	40	10	10	10	350

Signal Information				1	2	3	4	5	6	7	8
Cycle, s	120.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	15.0	57.5	10.0	3.5	10.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	4.0	0.0	
				Red	2.0	2.0	2.0	0.0	2.0	0.0	

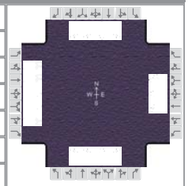
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	1.1	3.0
Phase Duration, s	21.0	63.5	21.0	63.5	19.5	19.5	16.0	16.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.3	3.1	3.3
Queue Clearance Time (g_s), s	4.8	22.1	2.3	55.3	9.4	4.8	2.7	12.0
Green Extension Time (g_e), s	0.1	8.7	0.0	1.6	0.2	0.9	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.08	0.00	1.00	0.32	0.03	0.00	1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	87	837	239	11	832	831	207	43	11	11	11	380
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1723	1464	1645	1810	1805	1597	1727	1464	1675	1759	1319
Queue Service Time (g_s), s	2.8	20.1	9.6	0.3	53.2	53.3	7.4	2.8	0.7	0.7	0.7	10.0
Cycle Queue Clearance Time (g_c), s	2.8	20.1	9.6	0.3	53.2	53.3	7.4	2.8	0.7	0.7	0.7	10.0
Green Ratio (*g/C*)	0.12	0.48	0.59	0.60	0.48	0.48	0.11	0.11	0.24	0.17	0.08	0.21
Capacity (*c*), veh/h	418	1651	866	445	867	865	359	194	348	293	147	550
Volume-to-Capacity Ratio (*X*)	0.208	0.507	0.276	0.024	0.960	0.961	0.575	0.224	0.031	0.037	0.074	0.692
Available Capacity (c_a), veh/h	418	1651	866	445	867	865	359	194	348	293	147	550
Back of Queue (*Q*), veh/ln (95 th percentile)	2.1	12.5	5.4	0.2	35.5	35.6	5.4	2.1	0.4	0.5	0.5	9.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.08	0.00	0.20	0.01	0.00	0.00	0.10	0.00	0.02	0.02	0.00	0.98
Uniform Delay (d_1), s/veh	47.2	21.5	12.0	11.5	30.1	30.2	50.5	48.5	35.1	41.9	50.7	43.9
Incremental Delay (d_2), s/veh	0.1	0.1	0.1	0.0	21.1	21.4	1.5	0.2	0.0	0.0	0.1	3.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	47.3	21.6	12.0	11.5	51.2	51.5	52.0	48.7	35.2	42.0	50.8	47.1
Level of Service (LOS)	D	C	B	B	D	D	D	D	D	D	D	D
Approach Delay, s/veh / LOS	21.6	C		51.1	D		50.7	D		47.0	D	
Intersection Delay, s/veh / LOS	40.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	2.9	C	2.9	C	3.1	C
Bicycle LOS Score / LOS	1.4	A	1.9	A	0.9	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Wilson Road	File Name	I-8_36-37_NB_PM_2038.xus		
Project Description	I-8 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	470	1680	460	10	1060	10	300	50	10	10	10	320

Signal Information				1	2	3	4	5	6	7	8
Cycle, s	120.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	23.5	44.5	7.0	5.0	10.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
				Red	2.0	2.0	2.0	2.0	2.0	0.0	

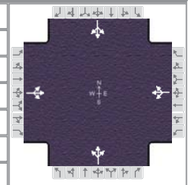
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		6.3	2.0	3.0	1.1	3.0
Phase Duration, s	29.5	80.0		50.5	24.0	27.0	13.0	16.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1		3.1	3.1	3.3	3.1	3.3
Queue Clearance Time (g_s), s	20.4	59.4		40.4	13.6	5.2	2.7	12.0
Green Extension Time (g_e), s	0.5	9.4		3.4	0.3	0.9	0.0	0.0
Phase Call Probability	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.99	0.63		0.96	0.32	0.00	0.05	1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	511	1826	500	11	582	581	326	54	11	11	11	348
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1597	1644	1464	236	1727	1721	1597	1727	1464	1675	1759	1319
Queue Service Time (g_s), s	18.4	57.4	14.5	5.0	38.4	38.4	11.6	3.2	0.7	0.7	0.7	10.0
Cycle Queue Clearance Time (g_c), s	18.4	57.4	14.5	32.9	38.4	38.4	11.6	3.2	0.7	0.7	0.7	10.0
Green Ratio (*g/C*)	0.20	0.62	0.77	0.37	0.37	0.37	0.15	0.17	0.17	0.14	0.08	0.28
Capacity (*c*), veh/h	626	2028	1122	93	641	638	479	302	256	264	147	737
Volume-to-Capacity Ratio (*X*)	0.817	0.900	0.446	0.117	0.909	0.909	0.680	0.180	0.042	0.041	0.074	0.472
Available Capacity (c_a), veh/h	626	2028	1122	93	641	638	479	302	256	264	147	737
Back of Queue (*Q*), veh/ln (95 th percentile)	12.5	29.1	6.4	0.5	25.7	25.7	8.4	2.5	0.5	0.5	0.5	7.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.48	0.00	0.23	0.03	0.00	0.00	0.16	0.00	0.02	0.02	0.00	0.81
Uniform Delay (d_1), s/veh	46.2	19.8	5.0	46.7	35.8	35.8	48.3	42.2	41.1	44.5	50.7	35.9
Incremental Delay (d_2), s/veh	7.8	5.8	0.1	0.2	16.7	16.7	3.2	0.1	0.0	0.0	0.1	0.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	53.9	25.6	5.1	46.9	52.5	52.6	51.5	42.3	41.2	44.5	50.8	36.1
Level of Service (LOS)	D	C	A	D	D	D	D	D	D	D	D	D
Approach Delay, s/veh / LOS	27.1	C		52.5	D		49.9	D		36.8	D	
Intersection Delay, s/veh / LOS	36.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	3.0	C	2.9	C	3.1	C
Bicycle LOS Score / LOS	2.8	C	1.5	A	1.1	A	1.1	A

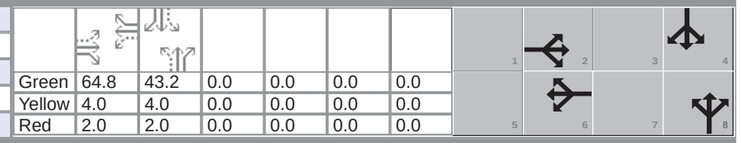
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Galena Ro…	File Name	I-9_36-37_NB_AM_2038.xus		
Project Description	I-9 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	720	80	50	1270	20	210	130	60	110	390	110

Signal Information			
Cycle, s	120.0	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	64.8	43.2	0.0	0.0	0.0	0.0		
Yellow	4.0	4.0	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		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		70.8		70.8		49.2		49.2
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.5		3.5
Queue Clearance Time (g_s), s		66.8		66.8		45.2		45.2
Green Extension Time (g_e), s		0.0		0.0		0.0		0.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		1.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		913			1457			435			663	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1420			1481			586			1587	
Queue Service Time (g_s), s		0.0			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		64.8			64.8			43.2			43.2	
Green Ratio (*g*/*C*)		0.54			0.54			0.36			0.36	
Capacity (*c*), veh/h		798			831			257			607	
Volume-to-Capacity Ratio (*X*)		1.144			1.752			1.694			1.093	
Available Capacity (c_a), veh/h		798			831			257			607	
Back of Queue (*Q*), veh/ln (95 th percentile)		54.9			162.3			51.6			39.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		26.5			27.0			42.3			39.5	
Incremental Delay (d_2), s/veh		79.4			343.6			328.7			64.4	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		105.8			370.6			371.0			103.9	
Level of Service (LOS)		F			F			F			F	
Approach Delay, s/veh / LOS	105.8	F		370.6	F		371.0	F		103.9	F	
Intersection Delay, s/veh / LOS	249.9						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	2.0	A	2.9	C	1.2	A	1.6	A

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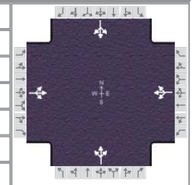
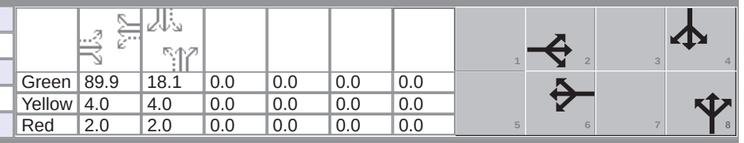
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Galena Ro…	File Name	I-9_36-37_NB_PM_2038.xus		
Project Description	I-9 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	180	1380	220	40	930	240	100	550	90	80	220	30

Signal Information			
Cycle, s	120.0	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	89.9	18.1	0.0	0.0	0.0	0.0		
Yellow	4.0	4.0	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		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		95.9		95.9		24.1		24.1
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.6		3.6		3.3		3.3
Queue Clearance Time (g_s), s		91.9		91.9		20.1		20.1
Green Extension Time (g_e), s		0.0		0.0		0.0		0.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		1.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		1935			1315			804			359	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		706			1479			1363			1103	
Queue Service Time (g_s), s		0.0			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		89.9			89.9			18.1			18.1	
Green Ratio (*g*/*C*)		0.75			0.75			0.15			0.15	
Capacity (*c*), veh/h		562			1139			240			204	
Volume-to-Capacity Ratio (*X*)		3.445			1.155			3.355			1.761	
Available Capacity (c_a), veh/h		562			1139			240			204	
Back of Queue (*Q*), veh/ln (95 th percentile)		321.4			67.7			121.2			42.6	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		15.4			14.5			52.2			52.3	
Incremental Delay (d_2), s/veh		1104.7			80.0			1070.5			361.8	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		1120.1			94.5			1122.7			414.1	
Level of Service (LOS)		F			F			F			F	
Approach Delay, s/veh / LOS	1120.1	F		94.5	F		1122.7	F		414.1	F	
Intersection Delay, s/veh / LOS	757.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	3.7	D	2.7	B	1.8	A	1.1	A

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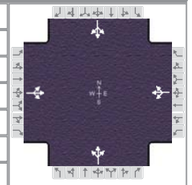
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Domigan/…	File Name			
Project Description	I10 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	640	100	10	1120	20	230	40	10	20	90	40

Signal Information			
Cycle, s	120.0	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	75.7	32.3	0.0	0.0	0.0	0.0		5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0					
Red	2.0	2.0	0.0	0.0	0.0	0.0					

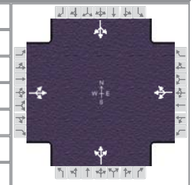
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		81.7		81.7		38.3		38.3
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.3		3.3
Queue Clearance Time (g_s), s		77.7		77.7		34.3		11.4
Green Extension Time (g_e), s		0.0		0.0		0.0		1.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		1.00		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		848			1250			304			163	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1318			1789			1046			1675	
Queue Service Time (g_s), s		0.0			0.0			22.9			0.0	
Cycle Queue Clearance Time (g_c), s		75.7			75.7			32.3			9.4	
Green Ratio (*g/C*)		0.63			0.63			0.27			0.27	
Capacity (*c*), veh/h		863			1159			336			485	
Volume-to-Capacity Ratio (*X*)		0.982			1.079			0.906			0.336	
Available Capacity (c_a), veh/h		863			1159			336			485	
Back of Queue (*Q*), veh/ln (95 th percentile)		33.4			61.2			16.8			6.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		18.8			22.7			46.2			35.5	
Incremental Delay (d_2), s/veh		26.1			50.4			26.2			0.2	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		44.9			73.2			72.4			35.6	
Level of Service (LOS)		D			F			E			D	
Approach Delay, s/veh / LOS	44.9	D		73.2	E		72.4	E		35.6	D	
Intersection Delay, s/veh / LOS	61.3						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	1.9	A	2.6	B	1.0	A	0.8	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Domigan/…	File Name			
Project Description	I10 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	1010	360	50	1000	50	110	110	10	10	90	30

Signal Information			
Cycle, s	120.0	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	98.0	10.0	0.0	0.0	0.0	0.0		5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0					
Red	2.0	2.0	0.0	0.0	0.0	0.0					

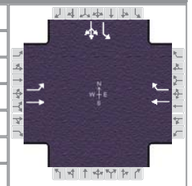
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		104.0		104.0		16.0		16.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.5		3.5		3.2		3.2
Queue Clearance Time (g_s), s		100.0		100.0		12.0		12.0
Green Extension Time (g_e), s		0.0		0.0		0.0		0.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		1.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		1641			1196			250			141	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		857			1458			930			1693	
Queue Service Time (g_s), s		0.0			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		98.0			98.0			10.0			10.0	
Green Ratio (*g/C*)		0.82			0.82			0.08			0.08	
Capacity (*c*), veh/h		733			1222			122			173	
Volume-to-Capacity Ratio (*X*)		2.240			0.979			2.052			0.815	
Available Capacity (c_a), veh/h		733			1222			122			173	
Back of Queue (*Q*), veh/ln (95 th percentile)		209.0			24.4			33.5			9.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		9.7			8.1			56.8			55.0	
Incremental Delay (d_2), s/veh		562.6			20.6			500.8			23.5	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		572.3			28.7			557.6			78.5	
Level of Service (LOS)		F			C			F			E	
Approach Delay, s/veh / LOS	572.3	F		28.7	C		557.6	F		78.5	E	
Intersection Delay, s/veh / LOS	348.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	3.2	C	2.5	B	0.9	A	0.7	A

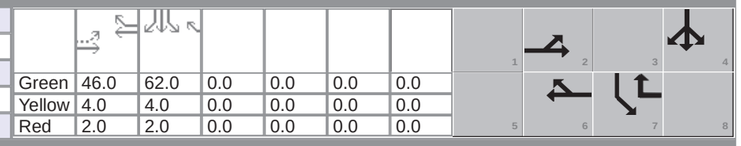
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37 @ Sunbur…	File Name			
Project Description	I11 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	260			230	1140				660	0	10

Signal Information			
Cycle, s	120.0	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	46.0	62.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

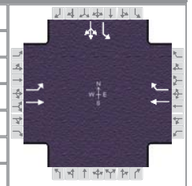
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6				4
Case Number		6.0		7.0				10.0
Phase Duration, s		52.0		52.0				68.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.3		3.3				3.2
Queue Clearance Time (g_s), s		16.5		48.0				26.2
Green Extension Time (g_e), s		6.7		0.0				1.6
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		0.06		1.00				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	5	2			6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	11	283			250	1239				395	334	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1043	1727			1727	1464				1645	1639	
Queue Service Time (g_s), s	0.9	14.5			12.5	46.0				18.3	24.2	
Cycle Queue Clearance Time (g_c), s	13.4	14.5			12.5	46.0				18.3	24.2	
Green Ratio (*g/C*)	0.38	0.38			0.38	0.90				0.52	0.52	
Capacity (*c*), veh/h	351	662			662	1317				850	847	
Volume-to-Capacity Ratio (*X*)	0.031	0.427			0.378	0.941				0.464	0.394	
Available Capacity (c_a), veh/h	351	662			662	1317				850	847	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	10.4			9.2	11.3				11.0	16.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.07	0.00			0.00	0.41				0.27	0.00	
Uniform Delay (d_1), s/veh	31.5	27.3			26.7	3.9				18.4	40.4	
Incremental Delay (d_2), s/veh	0.2	2.0			1.6	14.1				0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0	0.0	
Control Delay (*d*), s/veh	31.7	29.3			28.3	18.1				18.6	40.5	
Level of Service (LOS)	C	C			C	B				B	D	
Approach Delay, s/veh / LOS	29.4	C		19.8	B		0.0			28.6	C	
Intersection Delay, s/veh / LOS	23.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	2.9	C			1.7	A

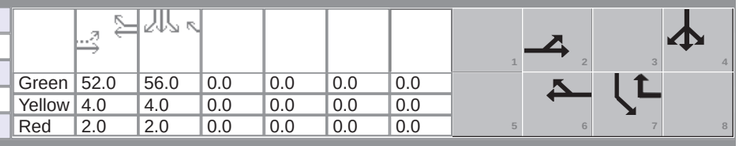
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37 @ Sunbur…	File Name			
Project Description	I11 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	600			230	1090				1020	0	10

Signal Information			
Cycle, s	120.0	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	52.0	56.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

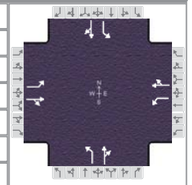
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6				4
Case Number		6.0		7.0				10.0
Phase Duration, s		58.0		58.0				62.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.2		3.2				3.2
Queue Clearance Time (g_s), s		39.8		41.1				37.1
Green Extension Time (g_e), s		5.5		5.2				2.6
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		0.44		0.50				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	5	2			6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	11	652			250	1185				610	510	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1103	1827			1827	1548				1740	1736	
Queue Service Time (g_s), s	0.8	37.8			10.8	39.1				34.5	35.1	
Cycle Queue Clearance Time (g_c), s	11.6	37.8			10.8	39.1				34.5	35.1	
Green Ratio (*g/C*)	0.43	0.43			0.43	0.90				0.47	0.47	
Capacity (*c*), veh/h	439	792			792	1393				812	810	
Volume-to-Capacity Ratio (*X*)	0.025	0.824			0.316	0.850				0.751	0.629	
Available Capacity (c_a), veh/h	439	792			792	1393				812	810	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	25.1			8.4	6.7				20.8	24.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.06	0.00			0.00	0.23				0.49	0.00	
Uniform Delay (d_1), s/veh	26.1	30.0			22.3	2.6				26.3	49.1	
Incremental Delay (d_2), s/veh	0.1	9.5			1.0	6.7				3.5	1.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0	0.0	
Control Delay (*d*), s/veh	26.2	39.5			23.4	9.2				29.8	50.3	
Level of Service (LOS)	C	D			C	A				C	D	
Approach Delay, s/veh / LOS	39.2	D		11.7	B		0.0			39.1	D	
Intersection Delay, s/veh / LOS	26.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.6	A	2.9	C			2.3	B

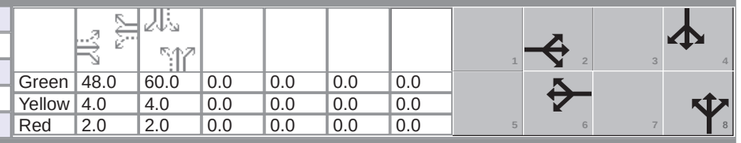
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Galen…	File Name			
Project Description	I15 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	70	60	10	130	90	150	280	10	40	470	10

Signal Information			
Cycle, s	120.0	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	48.0	60.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

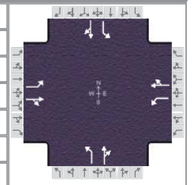
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		54.0		54.0		66.0		66.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.3		3.3
Queue Clearance Time (g_s), s		14.6		13.8		45.8		26.1
Green Extension Time (g_e), s		0.8		0.8		2.3		2.5
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	11	141		11	239		163	315		43	522	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1114	1687		1218	1702		860	1816		1040	1820	
Queue Service Time (g_s), s	0.8	6.6		0.7	11.8		19.7	12.6		3.2	24.1	
Cycle Queue Clearance Time (g_c), s	12.6	6.6		7.3	11.8		43.8	12.6		15.8	24.1	
Green Ratio (*g/C*)	0.40	0.40		0.40	0.40		0.50	0.50		0.50	0.50	
Capacity (*c*), veh/h	396	675		480	681		317	908		471	910	
Volume-to-Capacity Ratio (*X*)	0.027	0.209		0.023	0.351		0.514	0.347		0.092	0.573	
Available Capacity (c_a), veh/h	396	675		480	681		317	908		471	910	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	4.7		0.4	8.3		7.4	8.9		1.4	15.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.04	0.00		0.04	0.00		0.82	0.00		0.15	0.00	
Uniform Delay (d_1), s/veh	29.5	23.6		26.0	25.1		36.4	18.2		22.9	21.0	
Incremental Delay (d_2), s/veh	0.0	0.1		0.0	0.1		0.6	0.1		0.0	0.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	29.5	23.6		26.0	25.2		37.0	18.2		23.0	21.6	
Level of Service (LOS)	C	C		C	C		D	B		C	C	
Approach Delay, s/veh / LOS	24.1	C		25.3	C		24.6	C		21.7	C	
Intersection Delay, s/veh / LOS	23.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.7	A	0.9	A	1.3	A	1.4	A

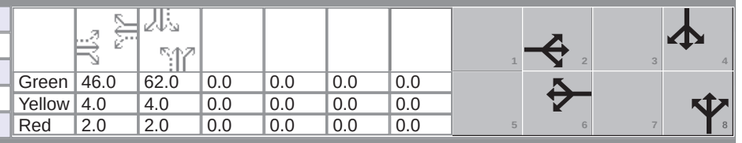
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Nov 22, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Galen…	File Name			
Project Description	I15 - No-Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	160	110	10	130	90	90	640	10	50	420	10

Signal Information			
Cycle, s	120.0	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	46.0	62.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	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		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		52.0		52.0		68.0		68.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.2		3.2
Queue Clearance Time (g_s), s		17.4		18.3		38.7		46.4
Green Extension Time (g_e), s		1.1		1.1		3.2		3.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.01		0.06

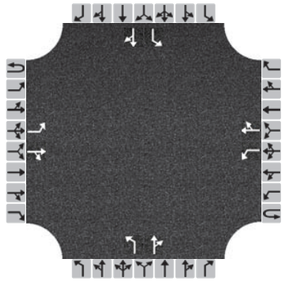
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	11	293		11	239		98	707		54	467	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1114	1702		1061	1702		904	1822		724	1819	
Queue Service Time (g_s), s	0.8	15.4		0.9	12.1		9.5	36.7		7.7	20.1	
Cycle Queue Clearance Time (g_c), s	12.9	15.4		16.3	12.1		29.5	36.7		44.4	20.1	
Green Ratio (*g/C*)	0.38	0.38		0.38	0.38		0.52	0.52		0.52	0.52	
Capacity (*c*), veh/h	375	652		330	652		376	941		212	940	
Volume-to-Capacity Ratio (*X*)	0.029	0.450		0.033	0.367		0.260	0.751		0.256	0.497	
Available Capacity (c_a), veh/h	375	652		330	652		376	941		212	940	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	10.3		0.4	8.5		3.7	22.3		2.5	12.9	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.05	0.00		0.05	0.00		0.41	0.00		0.27	0.00	
Uniform Delay (d_1), s/veh	31.2	27.6		33.7	26.5		28.5	22.9		40.4	18.9	
Incremental Delay (d_2), s/veh	0.0	0.2		0.0	0.1		0.1	3.0		0.2	0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	31.2	27.8		33.7	26.7		28.6	25.9		40.7	19.0	
Level of Service (LOS)	C	C		C	C		C	C		D	B	
Approach Delay, s/veh / LOS	27.9	C		27.0	C		26.3	C		21.3	C	
Intersection Delay, s/veh / LOS	25.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	0.9	A	1.8	A	1.3	A

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	JRH	Intersection	Sunbury Pkwy/Domigan Rd
Agency/Co.	ms consultants	Jurisdiction	
Date Performed	11/20/2016	East/West Street	Sunbury Parkway
Analysis Year	2038	North/South Street	Domigan Road
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	I-16 - No-Build 2038		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	1	1	0		1	1	0		1	1	0
Configuration		L		TR		L		TR		L		TR		L		TR
Volume (veh/h)		10	100	10		10	210	20		10	60	10		160	50	10
Percent Heavy Vehicles		16				16				16	16	16		16	16	16
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

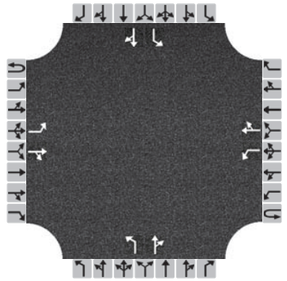
Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		11				11				11		76		174		65
Capacity		1308				1460				479		558		467		558
v/c Ratio		0.01				0.01				0.02		0.14		0.37		0.12
95% Queue Length		0.0				0.0				0.1		0.5		1.7		0.4
Control Delay (s/veh)		7.8				7.5				12.7		12.5		17.2		12.3
Level of Service (LOS)		A				A				B		B		C		B
Approach Delay (s/veh)	0.7				0.3				12.5				15.9			
Approach LOS	A				A				B				C			

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	JRH	Intersection	Sunbury Pkwy/Domigan Rd
Agency/Co.	ms consultants	Jurisdiction	
Date Performed	11/20/2016	East/West Street	Sunbury Parkway
Analysis Year	2038	North/South Street	Domigan Road
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	I-16 - No-Build 2038		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	1	1	0		1	1	0		1	1	0
Configuration		L		TR		L		TR		L		TR		L		TR
Volume (veh/h)		10	200	10		10	210	20		10	80	10		390	100	10
Percent Heavy Vehicles		16				16				16	16	16		16	16	16
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		11				11				11		98		424		120
Capacity		1240				1264				326		459		348		457
v/c Ratio		0.01				0.01				0.03		0.21		1.22		0.26
95% Queue Length		0.0				0.0				0.1		0.8		18.2		1.0
Control Delay (s/veh)		7.9				7.9				16.4		15.0		154.0		15.7
Level of Service (LOS)		A				A				C		B		F		C
Approach Delay (s/veh)	0.4				0.3				15.1				123.5			
Approach LOS	A				A				C				F			

Appendix I

Capacity Analyses – Build Condition

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*South of Gemini On-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-1 - Build 2038*

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

Flow Inputs

Volume, V	*1970*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*723*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*10.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*South of Gemini On-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-1 - Build 2038*

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

Flow Inputs

Volume, V	*5590*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*2052*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*61.6*	mph	S		mph
D = v_p / S	*33.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Polaris/Gemini to Sunbury*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-3 - Build 2038*

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

Flow Inputs

Volume, V	*2240*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*826*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*11.8*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Polaris/Gemini to Sunbury*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-3 - Build 2038*

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

Flow Inputs

Volume, V	*6320*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*2331*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.2*	mph	S		mph
D = v_p / S	*42.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*E*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-4 - Build 2038*

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

Flow Inputs

Volume, V	*1440*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*534*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*7.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-4 - Build 2038*

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

Flow Inputs

Volume, V	*3760*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1393*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*69.6*	mph	S		mph
D = v_p / S	*20.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*36/37 to 61*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-5 - Build 2038*

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

Flow Inputs

Volume, V	*2050*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*760*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*10.9*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*36/37 to 61*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-5 - Build 2038*

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

Flow Inputs

Volume, V	*4480*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1660*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*67.5*	mph	S		mph
D = v_p / S	*24.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-6 - Build 2038*

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

Flow Inputs

Volume, V	*1760*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*652*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*9.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 NB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-6 - Build 2038*

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

Flow Inputs

Volume, V	*3440*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1275*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*69.9*	mph	S		mph
D = v_p / S	*18.2*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 On-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-7 - Build 2038*

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

Flow Inputs

Volume, V	*2430*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*900*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*12.9*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		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	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*North of SR 61 On-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-7 - Build 2038*

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

Flow Inputs

Volume, V	*2610*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*967*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*13.8*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		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	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*61 to 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-8 - Build 2038*

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

Flow Inputs

Volume, V	*3580*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1327*	pc/h/ln	Design LOS		
S	*69.8*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*19.0*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*61 to 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-8 - Build 2038*

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

Flow Inputs

Volume, V	*3040*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1127*	pc/h/ln	Design LOS		
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*16.1*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2015*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-9 - Build 2038*

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

Flow Inputs

Volume, V	*3090*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1145*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*16.4*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Under 36/37*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-9 - Build 2038*

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

Flow Inputs

Volume, V	*2170*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*804*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*11.5*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	JRH	Highway/Direction of Travel	I-71 SB
Agency or Company	ms consultants	From/To	36/37 Ramp to WB Sunbury Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description F-11 - Build 2038

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

Flow Inputs

Volume, V	3780	veh/h	Peak-Hour Factor, PHF	0.94
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			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)	70.0	mph	FFS	70.0	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)	1401	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	69.5	mph	S		mph
D = v_p / S	20.1	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	C		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	JRH	Highway/Direction of Travel	I-71 SB
Agency or Company	ms consultants	From/To	36/37 Ramp to WB Sunbury Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description F-11 - Build 2038

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

Flow Inputs

Volume, V	2610	veh/h	Peak-Hour Factor, PHF	0.94
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			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)	70.0	mph	FFS	70.0	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)	967	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	70.0	mph	S		mph
D = v_p / S	13.8	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	B		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Sunbury EB/WB On-Ramps*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-12 - Build 2038*

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

Flow Inputs

Volume, V	*4230*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1568*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*68.4*	mph	S		mph
D = v_p / S	*22.9*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*Sunbury EB/WB On-Ramps*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-12 - Build 2038*

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

Flow Inputs

Volume, V	*2830*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			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)	*70.0*	mph	FFS	*70.0*	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)	*1049*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*15.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	JRH	Highway/Direction of Travel	I-71 SB
Agency or Company	ms consultants	From/To	EB Sunbury On-Ramp to Gem/Pol
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description F-13 - Build 2038

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

Flow Inputs

Volume, V	5700	veh/h	Peak-Hour Factor, PHF	0.94
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	3	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	70.0	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	70.0	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2102	pc/h/ln
S	60.6	mph
D = v_p / S	34.7	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		Site Information	
Analyst	JRH	Highway/Direction of Travel	I-71 SB
Agency or Company	ms consultants	From/To	EB Sunbury On-Ramp to Gem/Pol
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description F-13 - Build 2038

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

Flow Inputs

Volume, V	3580	veh/h	Peak-Hour Factor, PHF	0.94
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	3	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	70.0	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	70.0	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1320	pc/h/ln
S	69.8	mph
D = v_p / S	18.9	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	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*South of Gemini Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 - Build 2038*

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

Flow Inputs

Volume, V	*4930*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*1809*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*65.7*	mph	S		mph
D = v_p / S	*27.5*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*South of Gemini Off-Ramp*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 - Build 2038*

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

Flow Inputs

Volume, V	*3180*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

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)	*70.0*	mph	FFS	*70.0*	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)	*1167*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*16.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*between Polaris/Gemini & I-270*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 (A) - Build 2038*

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

Flow Inputs

Volume, V	*8250*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	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)	*2271*	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*56.7*	mph	S		mph
D = v_p / S	*40.1*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*E*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB*
Agency or Company	*ms consultants*	From/To	*between Polaris/Gemini & I-270*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 (A) - Build 2038*

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

Flow Inputs

Volume, V	*7230*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*7*
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	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	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)	*1990*	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*62.8*	mph	S		mph
D = v_p / S	*31.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*I-71 SB entrance ramp*
Agency or Company	*ms consultants*	From/To	*ramp from Polaris/Gemini*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 (B) - Build 2038*

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

Flow Inputs

Volume, V	*3320*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		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)	*1792*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.0*	mph	S		mph
D = v_p / S	*32.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		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	*JRH*	Highway/Direction of Travel	*I-71 SB entrance ramp*
Agency or Company	*ms consultants*	From/To	*ramp from Polaris/Gemini*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-14 (B) - Build 2038*

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

Flow Inputs

Volume, V	*4050*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		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)	*2187*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*51.3*	mph	S		mph
D = v_p / S	*42.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*E*		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	*JRH*	Highway/Direction of Travel	*NBCD*
Agency or Company	*ms consultants*	From/To	*Under Sunbury*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *F-15 - Build 2038 [1-lane, Volume x 2]*

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

Flow Inputs

Volume, V	*840*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	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)	*467*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*6.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		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	*JRH*	Highway/Direction of Travel	*NBCD*
Agency or Company	*ms consultants*	From/To	*Under Sunbury*
Date Performed	*11/20/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2038*

Project Description *F-15 - Build 2038 [1-lane, Volume x 2]*

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

Flow Inputs

Volume, V	*2180*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	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)	*1212*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*17.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		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	

J-1 Build Major Diverge Analyses

I-71 NB at Polaris/Gemini exit ramp – AM Peak

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$
$$f_{HV} = \frac{1}{1 + 0.07(1.5 - 1) + 0}$$
$$f_{HV} = 0.966$$

$$v_F = \frac{V_F}{PHF \times f_{HV} \times f_p}$$
$$v_F = \frac{7410}{0.94 \times 0.966 \times 1.00}$$

$$v_F = 8{,}160\ pc/h$$

$$D_{MD} = 0.0175\left(\frac{v_F}{N}\right)$$
$$D_{MD} = 0.0175\left(\frac{8{,}160}{6}\right)$$
$$D_{MD} = 23.8\ pc/mi/ln$$

Level of Service – C

I-71 NB at Polaris/Gemini exit ramp – PM Peak

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$
$$f_{HV} = \frac{1}{1 + 0.08(1.5 - 1) + 0}$$
$$f_{HV} = 0.966$$

$$v_F = \frac{V_F}{PHF \times f_{HV} \times f_p}$$
$$v_F = \frac{9{,}740}{0.94 \times 0.966 \times 1.00}$$

$$v_F = 10{,}726\ pc/h$$

$$D_{MD} = 0.0175\left(\frac{v_F}{N}\right)$$
$$D_{MD} = 0.0175\left(\frac{10{,}726}{6}\right)$$
$$D_{MD} = 31.3 pc/mi/ln$$

Level of Service – D

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	Polaris/Gemini On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-2 - Build 2038

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	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	1970
Ramp Volume, V_R	270
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	1970	0.94	Level	7	0	0.966	1.00	2169
Ramp	270	0.94	Level	4	0	0.980	1.00	293
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.614 using Equation (Exhibit 13-6)

V_{12} = 1332 pc/h

V_3 or V_{av34} = 837 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} = 1332 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2462	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1625	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 = 9.9 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.198 (Exibit 13-11)

S_R = 64.5 mph (Exhibit 13-11)

S_0 = 68.8 mph (Exhibit 13-11)

S = 65.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	Polaris/Gemini On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-2 - Build 2038

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	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	5590
Ramp Volume, V_R	730
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	5590	0.94	Level	7	0	0.966	1.00	6155
Ramp	730	0.94	Level	4	0	0.980	1.00	792
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.614 using Equation (Exhibit 13-6)

V_{12} = 3779 pc/h

V_3 or V_{av34} = 2376 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} = 3779 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6947	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4571	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 = 32.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.555 (Exibit 13-11)

S_R = 54.5 mph (Exhibit 13-11)

S_0 = 63.0 mph (Exhibit 13-11)

S = 57.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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)

J-3 Build Major Diverge Analyses

I-71 NB at Sunbury/US 36/SR 37 – AM Peak

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$
$$f_{HV} = \frac{1}{1 + 0.08(1.5 - 1) + 0}$$
$$f_{HV} = 0.962$$

$$v_F = \frac{V_F}{PHF \times f_{HV} \times f_p}$$
$$v_F = \frac{2240}{0.94 \times 0.962 \times 1.00}$$
$$v_F = 2{,}477\ pc/h$$

$$D_{MD} = 0.0175\left(\frac{v_F}{N}\right)$$
$$D_{MD} = 0.0175\left(\frac{2477}{4}\right)$$
$$D_{MD} = 10.8\ pc/mi/ln$$

Level of Service – B

I-71 NB at Sunbury/US 36/SR 37 – PM Peak

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$
$$f_{HV} = \frac{1}{1 + 0.08(1.5 - 1) + 0}$$
$$f_{HV} = 0.962$$

$$v_F = \frac{V_F}{PHF \times f_{HV} \times f_p}$$
$$v_F = \frac{6320}{0.94 \times 0.962 \times 1.00}$$
$$v_F = 6{,}989\ pc/h$$

$$D_{MD} = 0.0175\left(\frac{v_F}{N}\right)$$
$$D_{MD} = 0.0175\left(\frac{6{,}989}{4}\right)$$
$$D_{MD} = 30.5 pc/mi/ln$$

Level of Service – D

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	36/37 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-5 - Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	1440
Ramp Volume, V_R	610
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	1440	0.94	Level	9	0	0.957	1.00	1601
Ramp	610	0.94	Level	14	0	0.935	1.00	694
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 960 pc/h

V_3 or V_{av34} = 641 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} = 960 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2295	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1654	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 = 13.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.253 (Exibit 13-11)

S_R = 62.9 mph (Exhibit 13-11)

S_0 = 69.5 mph (Exhibit 13-11)

S = 64.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	36/37 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-5 - Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	3760
Ramp Volume, V_R	720
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3760	0.94	Level	9	0	0.957	1.00	4180
Ramp	720	0.94	Level	14	0	0.935	1.00	820
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 2508 pc/h

V_3 or V_{av34} = 1672 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} = 2508 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5000	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3328	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 = 26.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.342 (Exibit 13-11)

S_R = 60.4 mph (Exhibit 13-11)

S_0 = 65.8 mph (Exhibit 13-11)

S = 62.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	SR 61 Off-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-6 - Build 2038

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	975
Freeway Volume, V_F	2050
Ramp Volume, V_R	290
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2050	0.94	Level	9	0	0.957	1.00	2279
Ramp	290	0.94	Level	9	0	0.957	1.00	322
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} = 0.688 using Equation (Exhibit 13-7)

V_{12} = 1669 pc/h

V_3 or V_{av34} 610 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	2279	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	1957	Exhibit 13-8	7200	No
V_R	322	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1669	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 = 9.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.197 (Exhibit 13-12)

S_R= 64.5 mph (Exhibit 13-12)

S_0= 76.8 mph (Exhibit 13-12)

S = 67.4 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	SR 61 Off-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-6 - Build 2038

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	975
Freeway Volume, V_F	4480
Ramp Volume, V_R	1040
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	4480	0.94	Level	9	0	0.957	1.00	4980
Ramp	1040	0.94	Level	9	0	0.957	1.00	1156
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} = 0.582 using Equation (Exhibit 13-7)

V_{12} = 3383 pc/h

V_3 or V_{av34} 1597 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	4980	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3824	Exhibit 13-8	7200	No
V_R	1156	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3383	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 = 24.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.272 (Exhibit 13-12)

S_R= 62.4 mph (Exhibit 13-12)

S_0= 74.5 mph (Exhibit 13-12)

S = 65.8 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	SR 61 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-7 - Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	1760
Ramp Volume, V_R	200
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	1760	0.94	Level	9	0	0.957	1.00	1957
Ramp	200	0.94	Level	14	0	0.935	1.00	228
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 1174 pc/h

V_3 or V_{av34} = 783 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} = 1174 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2185	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1402	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 = 11.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.249 (Exibit 13-11)

S_R = 63.0 mph (Exhibit 13-11)

S_0 = 69.0 mph (Exhibit 13-11)

S = 65.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 NB
Agency or Company	ms consultants	Junction	SR 61 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-7 - Build 2038

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	800
Deceleration Lane Length L_D	
Freeway Volume, V_F	3440
Ramp Volume, V_R	210
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3440	0.94	Level	9	0	0.957	1.00	3824
Ramp	210	0.94	Level	14	0	0.935	1.00	239
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.600 using Equation (Exhibit 13-6)

V_{12} = 2294 pc/h

V_3 or V_{av34} = 1530 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} = 2294 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4063	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2533	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 = 20.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.282 (Exibit 13-11)

S_R = 62.1 mph (Exhibit 13-11)

S_0 = 66.3 mph (Exhibit 13-11)

S = 63.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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)

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*NBCD*
Agency or Company	*ms consultants*	From/To	*NBCD to 36/37*
Date Performed	*11/30/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *J-8 - Build 2038*

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

Flow Inputs

Volume, V	*840*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		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)	*458*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.0*	mph	S		mph
D = v_p / S	*8.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JRH*	Highway/Direction of Travel	*NBCD*
Agency or Company	*ms consultants*	From/To	*NBCD to 36/37*
Date Performed	*11/30/2016*	Jurisdiction	*ODOT*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2038*

Project Description *J-8 - Build 2038*

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

Flow Inputs

Volume, V	*2180*	veh/h	Peak-Hour Factor, PHF	*0.94*
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			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		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)	*1189*	pc/h/ln	Design LOS v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.0*	mph	S		mph
D = v_p / S	*21.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 10-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	SR 61 exit ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-9 - Build 2038

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	900
Freeway Volume, V_F	2640
Ramp Volume, V_R	210
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2640	0.94	Level	9	0	0.957	1.00	2935
Ramp	210	0.94	Level	24	0	0.893	1.00	250
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} = 0.675 using Equation (Exhibit 13-7)

V_{12} = 2063 pc/h

V_3 or V_{av34} 872 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	2935	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2685	Exhibit 13-8	7200	No
V_R	250	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2063	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 = 13.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.191 (Exhibit 13-12)

S_R= 64.7 mph (Exhibit 13-12)

S_0= 76.8 mph (Exhibit 13-12)

S = 67.8 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	SR 61 exit ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-9 - Build 2038

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	900
Freeway Volume, V_F	2820
Ramp Volume, V_R	210
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2820	0.94	Level	9	0	0.957	1.00	3135
Ramp	210	0.94	Level	24	0	0.893	1.00	250
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} = 0.670 using Equation (Exhibit 13-7)

V_{12} = 2183 pc/h

V_3 or V_{av34} 952 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	3135	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2885	Exhibit 13-8	7200	No
V_R	250	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2183	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 = 14.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.191 (Exhibit 13-12)

S_R= 64.7 mph (Exhibit 13-12)

S_0= 76.8 mph (Exhibit 13-12)

S = 67.9 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	SR 61 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-10 - Build 2038

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	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	2430
Ramp Volume, V_R	1150
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2430	0.94	Level	9	0	0.957	1.00	2701
Ramp	1150	0.94	Level	16	0	0.926	1.00	1321
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.608 using Equation (Exhibit 13-6)

V_{12} = 1643 pc/h

V_3 or V_{av34} = 1058 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} = 1643 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4022	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2964	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 = 21.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.276 (Exibit 13-11)

S_R = 62.3 mph (Exhibit 13-11)

S_0 = 68.0 mph (Exhibit 13-11)

S = 63.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	SR 61 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-10 - Build 2038

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	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	2610
Ramp Volume, V_R	430
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2610	0.94	Level	9	0	0.957	1.00	2902
Ramp	430	0.94	Level	16	0	0.926	1.00	494
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.608 using Equation (Exhibit 13-6)

V_{12} = 1765 pc/h

V_3 or V_{av34} = 1137 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} = 1765 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3396	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2259	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 = 16.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.237 (Exibit 13-11)

S_R = 63.4 mph (Exhibit 13-11)

S_0 = 67.7 mph (Exhibit 13-11)

S = 64.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	36/37 Off-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-11 - Build 2038

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	900
Freeway Volume, V_F	3580
Ramp Volume, V_R	490
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3580	0.94	Level	9	0	0.957	1.00	3980
Ramp	490	0.94	Level	24	0	0.893	1.00	584
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} = 0.634 using Equation (Exhibit 13-7)

V_{12} = 2736 pc/h

V_3 or V_{av34} 1244 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	3980	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3396	Exhibit 13-8	7200	No
V_R	584	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2736	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 = 19.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.221 (Exhibit 13-12)

S_R = 63.8 mph (Exhibit 13-12)

S_0 = 75.8 mph (Exhibit 13-12)

S = 67.1 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	36/37 Off-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-11 - Build 2038

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	900
Freeway Volume, V_F	3040
Ramp Volume, V_R	870
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3040	0.94	Level	9	0	0.957	1.00	3380
Ramp	870	0.94	Level	24	0	0.893	1.00	1037
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} = 0.628 using Equation (Exhibit 13-7)

V_{12} = 2508 pc/h

V_3 or V_{av34} 872 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	3380	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2343	Exhibit 13-8	7200	No
V_R	1037	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2508	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 = 17.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.261 (Exhibit 13-12)

S_R = 62.7 mph (Exhibit 13-12)

S_0 = 76.8 mph (Exhibit 13-12)

S = 65.8 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	36/37 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-12 - Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	3090
Ramp Volume, V_R	690
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	3090	0.94	Level	9	0	0.957	1.00	3435
Ramp	690	0.94	Level	6	0	0.971	1.00	756
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.603 using Equation (Exhibit 13-6)

V_{12} = 2070 pc/h

V_3 or V_{av34} = 1365 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}	4191	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2826	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 = 21.5 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.288 (Exibit 13-11)

S_R = 61.9 mph (Exhibit 13-11)

S_0 = 66.9 mph (Exhibit 13-11)

S = 63.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	36/37 On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-12 - Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2170
Ramp Volume, V_R	440
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2170	0.94	Level	9	0	0.957	1.00	2412
Ramp	440	0.94	Level	6	0	0.971	1.00	482
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.603 using Equation (Exhibit 13-6)

V_{12} = 1454 pc/h

V_3 or V_{av34} = 958 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} = 1454 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2894	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1936	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 = 14.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.249 (Exibit 13-11)

S_R = 63.0 mph (Exhibit 13-11)

S_0 = 68.4 mph (Exhibit 13-11)

S = 64.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	WB Sunbury On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-13 - Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	3780
Ramp Volume, V_R	450
Freeway Free-Flow Speed, S_{FF}	70.0
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	3780	0.94	Level	9	0	0.957	1.00	4202
Ramp	450	0.94	Level	5	0	0.976	1.00	491
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.603 using Equation (Exhibit 13-6)

V_{12} = 2533 pc/h

V_3 or V_{av34} = 1669 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} = 2533 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4693	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3024	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 = 23.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.338 (Exibit 13-11)

S_R = 60.5 mph (Exhibit 13-11)

S_0 = 65.8 mph (Exhibit 13-11)

S = 62.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	WB Sunbury On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-13 - Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2610
Ramp Volume, V_R	220
Freeway Free-Flow Speed, S_{FF}	70.0
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	2610	0.94	Level	9	0	0.957	1.00	2902
Ramp	220	0.94	Level	6	0	0.971	1.00	241
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.603 using Equation (Exhibit 13-6)

V_{12} = 1749 pc/h

V_3 or V_{av34} = 1153 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} = 1749 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3143	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1990	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 = 15.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.287 (Exibit 13-11)

S_R = 62.0 mph (Exhibit 13-11)

S_0 = 67.6 mph (Exhibit 13-11)

S = 63.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	EB Sunbury On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-14 - Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	4230
Ramp Volume, V_R	1470
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	4230	0.94	Level	9	0	0.957	1.00	4703
Ramp	1470	0.94	Level	6	0	0.971	1.00	1611
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.603 using Equation (Exhibit 13-6)

V_{12} = 2834 pc/h

V_3 or V_{av34} = 1869 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} = 2834 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6314	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4445	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 = 33.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.554 (Exibit 13-11)

S_R = 54.5 mph (Exhibit 13-11)

S_0 = 65.1 mph (Exhibit 13-11)

S = 57.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	EB Sunbury On-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-14 - Build 2038

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	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2830
Ramp Volume, V_R	750
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	2830	0.94	Level	9	0	0.957	1.00	3146
Ramp	750	0.94	Level	6	0	0.971	1.00	822
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.603 using Equation (Exhibit 13-6)

V_{12} = 1896 pc/h

V_3 or V_{av34} = 1250 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} = 1896 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3968	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2718	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 = 20.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.281 (Exibit 13-11)

S_R = 62.1 mph (Exhibit 13-11)

S_0 = 67.3 mph (Exhibit 13-11)

S = 63.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)

L_{EQ} =

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	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	Gemini/Polaris Off-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	AM Peak Hour	Analysis Year	2038

Project Description J-15 - Build 2038

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	5700
Ramp Volume, V_R	770
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5700	0.94	Level	7	0	0.966	1.00	6276
Ramp	770	0.94	Level	4	0	0.980	1.00	836
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} = 0.565 using Equation (Exhibit 13-7)

V_{12} = 3908 pc/h

V_3 or V_{av34} 2368 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	6276	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5440	Exhibit 13-8	7200	No
V_R	836	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3908	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 = 32.5 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.243 (Exhibit 13-12)

S_R = 63.2 mph (Exhibit 13-12)

S_0 = 71.5 mph (Exhibit 13-12)

S = 66.1 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JRH	Freeway/Dir of Travel	I-71 SB
Agency or Company	ms consultants	Junction	Gemini/Polaris Off-Ramp
Date Performed	11/20/2016	Jurisdiction	ODOT
Analysis Time Period	PM Peak Hour	Analysis Year	2038

Project Description J-15 - Build 2038

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	3580
Ramp Volume, V_R	400
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	55.0

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3580	0.94	Level	7	0	0.966	1.00	3942
Ramp	400	0.94	Level	4	0	0.980	1.00	434
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} = 0.641 using Equation (Exhibit 13-7)

V_{12} = 2684 pc/h

V_3 or V_{av34} 1258 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	3942	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3508	Exhibit 13-8	7200	No
V_R	434	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2684	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 = 21.9 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.207 (Exhibit 13-12)

S_R = 64.2 mph (Exhibit 13-12)

S_0 = 75.8 mph (Exhibit 13-12)

S = 67.5 mph (Exhibit 13-13)

J-16 Build

I-71 Southbound – at entrance ramp from Polaris/Gemini

Major merge therefore the capacities of the mainline and ramps are checked. The highest density is reported.

Location		AM		PM	
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
F-14	I-71 SB south of Gemini	27.5	D	16.7	B
F-14A	I-71 SB between Polaris/Gemini & I-270	40.1	E	31.7	D
F-14B	Entrance ramp from Polaris/Gemini	32.6	D	42.6	E

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	JRH	Freeway/Dir of Travel	I-71 NBCD
Agency/Company	ms consultants	Weaving Segment Location	Sunbury Parkway & US 36/SR 37
Date Performed	6/29/2016	Analysis Year	2038
Analysis Time Period	AM Peak Hour		

Project Description W-1 - Build 2038

Inputs

Weaving configuration	One-Sided	Segment type	C-D Roadway/ Multilane Highways
Weaving number of lanes, N	2		
Weaving segment length, L_S	1920ft	Freeway minimum speed, S_{MIN}	15
Freeway free-flow speed, FFS	55 mph	Freeway maximum capacity, C_{IFL}	2250
		Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	0	0.94	0	0	1.5	1.2	1.000	1.00	0
V_{RF}	90	0.94	4	0	1.5	1.2	0.980	1.00	98
V_{FR}	420	0.94	5	0	1.5	1.2	0.976	1.00	458
V_{RR}	0	0.94	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	0							V =	556
V_W	556								
VR	1.000								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	556 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	665 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	655 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1320 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	543 veh/h	Weaving intensity factor, W	0.168
Weaving segment capacity, c_w	2400 veh/h	Weaving segment speed, S	49.2 mph
Weaving segment v/c ratio	0.226	Average weaving speed, S_W	49.2 mph
Weaving segment density, D	5.6 pc/mi/ln	Average non-weaving speed, S_{NW}	49.7 mph
Level of Service, LOS	A	Maximum weaving length, L_{MAX}	14232 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		Site Information	
Analyst	JRH	Freeway/Dir of Travel	I-71 NBCD
Agency/Company	ms consultants	Weaving Segment Location	Sunbury Parkway & US 36/SR 37
Date Performed	6/29/2016	Analysis Year	2038
Analysis Time Period	PM Peak Hour		

Project Description W-1 - Build 2038

Inputs

Weaving configuration	One-Sided	Segment type	C-D Roadway/ Multilane Highways
Weaving number of lanes, N	2		
Weaving segment length, L_S	1920ft	Freeway minimum speed, S_{MIN}	15
Freeway free-flow speed, FFS	55 mph	Freeway maximum capacity, C_{IFL}	2250
		Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	0	0.94	0	0	1.5	1.2	1.000	1.00	0
V_{RF}	200	0.94	4	0	1.5	1.2	0.980	1.00	217
V_{FR}	1370	0.94	5	0	1.5	1.2	0.976	1.00	1494
V_{RR}	0	0.94	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	0							V =	1711
V_W	1711								
VR	1.000								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1711 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1820 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	655 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2475 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

Weaving Segment Speed, Density, Level of Service, and Capacity

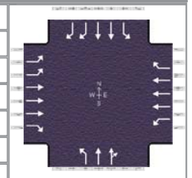
Weaving segment flow rate, v	1671 veh/h	Weaving intensity factor, W	0.276
Weaving segment capacity, c_w	2400 veh/h	Weaving segment speed, S	46.3 mph
Weaving segment v/c ratio	0.696	Average weaving speed, S_W	46.3 mph
Weaving segment density, D	18.5 pc/mi/ln	Average non-weaving speed, S_{NW}	38.6 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	14232 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".

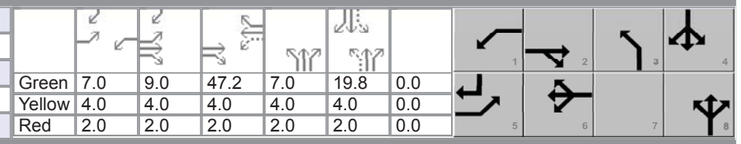
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37/Sunbury P…	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Africa Road	File Name			
Project Description	I1 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	380	2050	130	10	710	10	50	430	10	10	260	560

Signal Information			
Cycle, s	120.0	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	7.0	9.0	47.2	7.0	19.8	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	

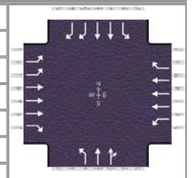
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8		4
Case Number	2.0	3.0	1.1	3.0	1.0	4.0		5.3
Phase Duration, s	28.0	68.2	13.0	53.2	13.0	38.8		25.8
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0	3.1	3.2		3.2
Queue Clearance Time (*g s*), s	16.9	55.8	2.4	16.6	5.3	16.8		21.8
Green Extension Time (*g e*), s	0.5	4.9	0.0	13.3	0.0	3.3		0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Max Out Probability	0.21	0.82	0.03	0.19	1.00	0.04		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	413	2228	141	11	772	11	54	240	238	11	283	609
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1569	1540	1438	1616	1540	1438	1573	1652	1639	862	1675	1319
Queue Service Time (*g s*), s	14.9	53.8	6.3	0.4	14.6	0.6	3.3	14.8	14.8	1.3	9.2	19.8
Cycle Queue Clearance Time (*g c*), s	14.9	53.8	6.3	0.4	14.6	0.6	3.3	14.8	14.8	3.1	9.2	19.8
Green Ratio (*g/C*)	0.18	0.52	0.52	0.45	0.39	0.39	0.24	0.27	0.27	0.16	0.16	0.35
Capacity (*c*), veh/h	575	2395	745	163	1818	565	237	452	448	189	553	919
Volume-to-Capacity Ratio (*X*)	0.718	0.930	0.190	0.067	0.425	0.019	0.229	0.531	0.532	0.058	0.511	0.662
Available Capacity (*c a*), veh/h	575	2395	745	163	1818	565	237	452	448	189	553	919
Back of Queue (*Q*), veh/ln (95 th percentile)	10.1	27.8	3.9	0.3	9.2	0.4	2.3	10.0	10.0	0.5	6.9	12.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.42	0.00	0.14	0.02	0.00	0.02	0.20	0.86	0.86	0.04	0.00	0.25
Uniform Delay (*d 1*), s/veh	46.1	26.9	15.4	25.6	26.5	22.3	36.5	37.1	37.1	43.9	45.7	33.1
Incremental Delay (*d 2*), s/veh	3.7	8.0	0.6	0.1	0.7	0.1	0.2	0.6	0.6	0.0	0.3	1.4
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	49.8	34.9	16.0	25.7	27.2	22.3	36.6	37.7	37.7	44.0	46.0	34.6
Level of Service (LOS)	D	C	B	C	C	C	D	D	D	D	D	C
Approach Delay, s/veh / LOS	36.1	D		27.1	C		37.6	D		38.3	D	
Intersection Delay, s/veh / LOS	35.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.1	C	3.4	C	3.5	C
Bicycle LOS Score / LOS	2.0	B	0.9	A	0.9	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37/Sunbury P…	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Africa Road	File Name			
Project Description	I1 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	560	1610	80	10	1570	10	100	380	10	10	530	980

Signal Information			
Cycle, s	120.0	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	7.0	11.0	47.0	31.0	0.0	0.0	
Yellow	4.0	4.0	4.0	4.0	0.0	0.0	
Red	2.0	2.0	2.0	2.0	0.0	0.0	

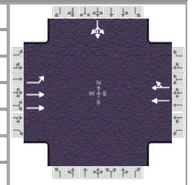
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		6.0		5.0
Phase Duration, s	30.0	70.0	13.0	53.0		37.0		37.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	2.9	2.8	2.9	2.8		3.3		3.3
Queue Clearance Time (*g s*), s	25.1	36.1	2.8	44.7		33.0		33.0
Green Extension Time (*g e*), s	0.0	12.6	0.0	1.9		0.0		0.0
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.22	0.03	1.00		1.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	609	1750	87	11	1707	11	109	213	211	11	576	1065
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1569	1540	1438	1616	1540	1438	739	1652	1637	906	1675	1319
Queue Service Time (*g s*), s	23.1	34.1	3.6	0.8	42.7	0.6	12.5	13.1	13.2	1.2	18.5	31.0
Cycle Queue Clearance Time (*g c*), s	23.1	34.1	3.6	0.8	42.7	0.6	31.0	13.1	13.2	14.4	18.5	31.0
Green Ratio (*g/C*)	0.20	0.53	0.53	0.06	0.39	0.39	0.26	0.26	0.26	0.26	0.26	0.46
Capacity (*c*), veh/h	628	2465	767	94	1810	563	137	427	423	194	865	1209
Volume-to-Capacity Ratio (*X*)	0.970	0.710	0.113	0.115	0.943	0.019	0.793	0.498	0.500	0.056	0.666	0.881
Available Capacity (*c a*), veh/h	628	2465	767	94	1810	563	137	427	423	194	865	1209
Back of Queue (*Q*), veh/ln (95 th percentile)	16.4	16.5	2.0	0.5	23.0	0.3	7.6	9.1	9.1	0.5	12.3	20.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.69	0.00	0.07	0.03	0.00	0.01	0.65	0.78	0.78	0.04	0.00	0.43
Uniform Delay (*d 1*), s/veh	47.6	21.0	13.9	53.6	35.2	22.4	55.6	37.9	37.9	44.0	39.9	29.5
Incremental Delay (*d 2*), s/veh	28.3	1.8	0.3	0.2	11.4	0.1	24.6	0.3	0.3	0.0	1.6	7.5
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	75.9	22.8	14.2	53.8	46.6	22.4	80.2	38.2	38.2	44.1	41.4	37.0
Level of Service (LOS)	E	C	B	D	D	C	F	D	D	D	D	D
Approach Delay, s/veh / LOS	35.7	D		46.5	D		46.8	D		38.6	D	
Intersection Delay, s/veh / LOS	40.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.1	C	3.4	C	3.5	C
Bicycle LOS Score / LOS	1.8	A	1.4	A	0.9	A	1.9	A

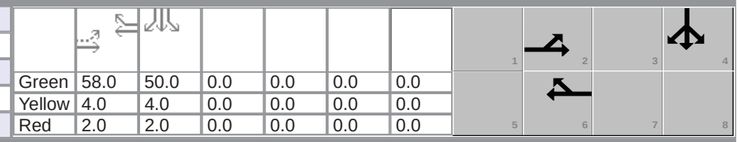
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/N 3 Bs &…	File Name	I-2_36-37_B_AM_2038.xus		
Project Description	I-2 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	810			720	50				80	0	40

Signal Information			
Cycle, s	120.0	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	58.0	50.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

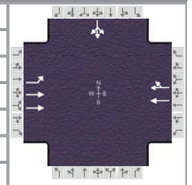
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6				4
Case Number		6.0		8.0				12.0
Phase Duration, s		64.0		64.0				56.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.1		3.1				3.2
Queue Clearance Time (g_s), s		24.1		21.7				7.9
Green Extension Time (g_e), s		4.3		4.3				0.2
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	5	2			6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	11	880			423	414					130	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	618	1675			1759	1719					1671	
Queue Service Time (g_s), s	1.5	22.1			19.6	19.7					5.9	
Cycle Queue Clearance Time (g_c), s	21.1	22.1			19.6	19.7					5.9	
Green Ratio (*g*/*C*)	0.48	0.48			0.48	0.48					0.42	
Capacity (*c*), veh/h	257	1619			850	831					696	
Volume-to-Capacity Ratio (*X*)	0.042	0.544			0.498	0.498					0.187	
Available Capacity (c_a), veh/h	257	1619			850	831					696	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	13.2			12.5	12.3					4.2	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00					0.00	
Uniform Delay (d_1), s/veh	28.3	21.7			21.1	21.1					22.1	
Incremental Delay (d_2), s/veh	0.0	0.2			0.2	0.2					0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0					0.0	
Control Delay (*d*), s/veh	28.3	21.9			21.3	21.3					22.2	
Level of Service (LOS)	C	C			C	C					C	
Approach Delay, s/veh / LOS	22.0	C		21.3	C		0.0			22.2	C	
Intersection Delay, s/veh / LOS	21.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.1	B	2.8	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.2	A			0.7	A

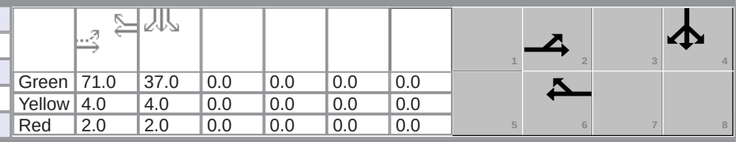
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/N 3 Bs &…	File Name	I-2_36-37_B_PM_2038.xus		
Project Description	I-2 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	890			1500	140				30	0	20

Signal Information			
Cycle, s	120.0	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	71.0	37.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	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		6.0		8.0				12.0
Phase Duration, s		77.0		77.0				43.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.2		3.2				3.2
Queue Clearance Time (g_s), s		73.0		55.0				4.8
Green Extension Time (g_e), s		0.0		8.3				0.1
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		1.00		0.48				0.00

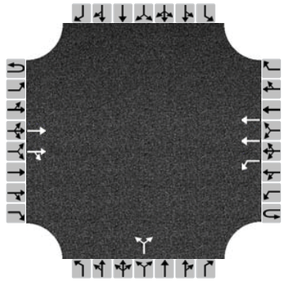
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	54	967			896	887					54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	250	1675			1759	1707					1658	
Queue Service Time (g_s), s	18.0	19.9			51.7	53.0					2.8	
Cycle Queue Clearance Time (g_c), s	71.0	19.9			51.7	53.0					2.8	
Green Ratio (*g*/*C*)	0.59	0.59			0.59	0.59					0.31	
Capacity (*c*), veh/h	97	1982			1041	1010					511	
Volume-to-Capacity Ratio (*X*)	0.558	0.488			0.860	0.879					0.106	
Available Capacity (c_a), veh/h	97	1982			1041	1010					511	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.2	11.5			28.7	29.5					2.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00					0.00	
Uniform Delay (d_1), s/veh	53.8	14.1			20.4	20.8					29.7	
Incremental Delay (d_2), s/veh	4.2	0.1			7.1	8.6					0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0					0.0	
Control Delay (*d*), s/veh	58.1	14.1			27.5	29.5					29.7	
Level of Service (LOS)	E	B			C	C					C	
Approach Delay, s/veh / LOS	16.5	B		28.5	C		0.0			29.7	C	
Intersection Delay, s/veh / LOS	24.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.1	B	2.8	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	2.0	A			0.6	A

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	JRH	Intersection	US 36/SR 37/S 3 Bs & K
Agency/Co.	ms consultants	Jurisdiction	Delaware County, OH
Date Performed	11/20/2016	East/West Street	US 36/SR 37
Analysis Year	2038	North/South Street	S 3 Bs & K
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	I-3 - Build 2038		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	0	0
Configuration			T	TR		L	T				LR					
Volume (veh/h)			880	10		20	790			10		140				
Percent Heavy Vehicles						8				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Left Only															
Median Storage	1															

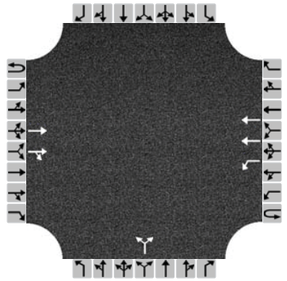
Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						22					163					
Capacity						689					486					
v/c Ratio						0.03					0.34					
95% Queue Length						0.1					1.5					
Control Delay (s/veh)						10.4					16.1					
Level of Service (LOS)						B					C					
Approach Delay (s/veh)					0.3				16.1							
Approach LOS					A				C							

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	JRH	Intersection	US 36/SR 37/S 3 Bs & K
Agency/Co.	ms consultants	Jurisdiction	Delaware County, OH
Date Performed	11/20/2016	East/West Street	US 36/SR 37
Analysis Year	2038	North/South Street	S 3 Bs & K
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	I-3 - Build 2038		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

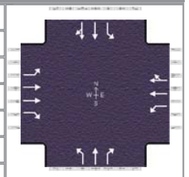
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	0	0
Configuration			T	TR		L	T				LR					
Volume (veh/h)			920	20		70	1630			10		100				
Percent Heavy Vehicles						8				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Left Only															
Median Storage	1															

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						76					120					
Capacity						657					400					
v/c Ratio						0.12					0.30					
95% Queue Length						0.4					1.2					
Control Delay (s/veh)						11.2					17.8					
Level of Service (LOS)						B					C					
Approach Delay (s/veh)					0.5				17.8							
Approach LOS					A				C							

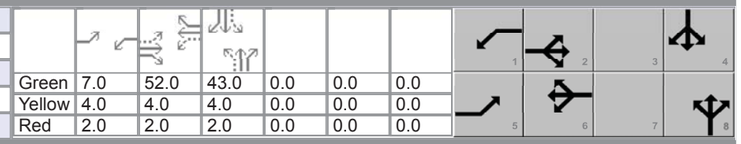
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Fourwinds	File Name	I-4_36-37_B_AM_2038.xus		
Project Description	I-4 - Build 2038				



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	880	60	120	760	20	30	20	20	90	30	20

Signal Information			
Cycle, s	120.0	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	7.0	52.0	43.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

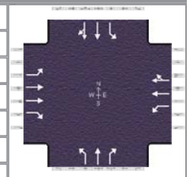
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		5.0		6.0
Phase Duration, s	13.0	58.0	13.0	58.0		49.0		49.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.2		3.2
Queue Clearance Time (*g s*), s	5.3	29.2	7.1	23.7		5.2		8.8
Green Extension Time (*g e*), s	0.0	4.6	0.0	4.7		0.4		0.4
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.03	1.00	0.01		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	87	957	65	130	426	422	33	22	22	98	27	27
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1675	1491	1675	1759	1743	1344	1863	1579	1384	1863	1627
Queue Service Time (*g s*), s	3.3	27.2	3.1	5.1	21.7	21.7	1.9	0.9	1.1	5.9	1.1	1.3
Cycle Queue Clearance Time (*g c*), s	3.3	27.2	3.1	5.1	21.7	21.7	3.2	0.9	1.1	6.8	1.1	1.3
Green Ratio (*g/C*)	0.49	0.43	0.43	0.49	0.43	0.43	0.36	0.36	0.36	0.36	0.36	0.36
Capacity (*c*), veh/h	302	1452	646	263	762	755	527	667	566	546	667	583
Volume-to-Capacity Ratio (*X*)	0.288	0.659	0.101	0.496	0.559	0.559	0.062	0.033	0.038	0.179	0.041	0.046
Available Capacity (*c a*), veh/h	302	1452	646	263	762	755	527	667	566	546	667	583
Back of Queue (*Q*), veh/ln (95 th percentile)	2.3	16.1	1.9	3.6	13.9	13.8	1.1	0.7	0.7	3.5	0.9	0.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.25	0.00	0.21	0.40	0.00	0.00	0.10	0.00	0.07	0.32	0.00	0.00
Uniform Delay (*d 1*), s/veh	19.1	27.0	20.1	21.5	25.4	25.4	26.2	25.0	25.0	27.2	25.1	25.1
Incremental Delay (*d 2*), s/veh	0.2	0.9	0.0	0.5	0.6	0.6	0.0	0.0	0.0	0.1	0.0	0.0
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	19.3	27.9	20.2	22.0	26.0	26.0	26.2	25.0	25.1	27.3	25.1	25.1
Level of Service (LOS)	B	C	C	C	C	C	C	C	C	C	C	C
Approach Delay, s/veh / LOS	26.7	C		25.5	C		25.5	C		26.5	C	
Intersection Delay, s/veh / LOS	26.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.4	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	1.3	A	0.6	A	0.6	A

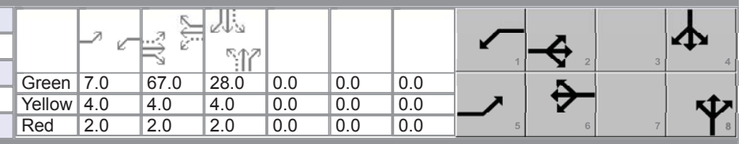
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Fourwinds	File Name	I-4_36-37_B_PM_2038.xus		
Project Description	I-4 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	910	60	150	1570	80	130	80	60	30	30	50

Signal Information			
Cycle, s	120.0	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	7.0	67.0	28.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

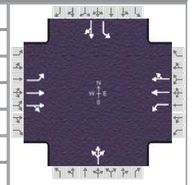
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		5.0		6.0
Phase Duration, s	13.0	73.0	13.0	73.0		34.0		34.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.2		3.2
Queue Clearance Time (*g s*), s	3.5	24.2	7.0	58.8		16.9		9.0
Green Extension Time (*g e*), s	0.0	9.9	0.0	5.1		0.7		0.8
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	0.58	0.07	1.00	0.70		0.01		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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	989	65	163	899	894	141	87	65	33	33	54
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1675	1491	1675	1759	1729	1305	1863	1579	1305	1863	1579
Queue Service Time (*g s*), s	1.5	22.2	2.4	5.0	55.4	56.8	11.6	4.5	4.0	2.5	1.6	3.3
Cycle Queue Clearance Time (*g c*), s	1.5	22.2	2.4	5.0	55.4	56.8	14.9	4.5	4.0	7.0	1.6	3.3
Green Ratio (*g/C*)	0.62	0.56	0.56	0.62	0.56	0.56	0.23	0.23	0.23	0.23	0.23	0.23
Capacity (*c*), veh/h	175	1870	832	349	982	965	329	435	368	316	435	368
Volume-to-Capacity Ratio (*X*)	0.311	0.529	0.078	0.468	0.915	0.927	0.430	0.200	0.177	0.103	0.075	0.148
Available Capacity (*c a*), veh/h	175	1870	832	349	982	965	329	435	368	316	435	368
Back of Queue (*Q*), veh/ln (95 th percentile)	1.5	13.2	1.5	3.2	33.5	34.1	6.7	3.7	2.8	1.4	1.3	2.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.16	0.00	0.16	0.35	0.00	0.00	0.61	0.00	0.25	0.13	0.00	0.00
Uniform Delay (*d 1*), s/veh	26.5	16.6	12.2	13.3	23.9	24.2	42.4	37.0	36.8	39.8	35.9	36.5
Incremental Delay (*d 2*), s/veh	0.4	1.1	0.2	0.4	14.4	15.9	0.3	0.1	0.1	0.1	0.0	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	26.9	17.7	12.4	13.6	38.3	40.1	42.8	37.1	36.9	39.9	35.9	36.6
Level of Service (LOS)	C	B	B	B	D	D	D	D	D	D	D	D
Approach Delay, s/veh / LOS	17.8	B		37.1	D		39.8	D		37.3	D	
Intersection Delay, s/veh / LOS	31.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.4	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	2.1	B	1.0	A	0.6	A

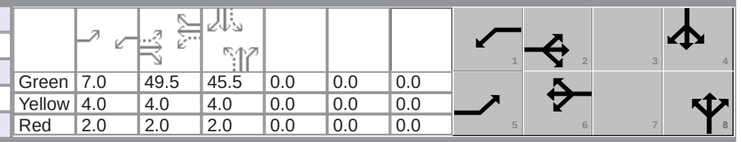
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Bob Evan…	File Name	I-5_36-37_B_AM_2038.xus		
Project Description	I-5 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	90	800	100	130	800	40	60	10	50	180	10	40

Signal Information			
Cycle, s	120.0	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	7.0	49.5	45.5	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						

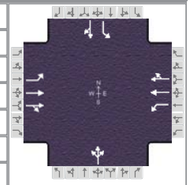
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		6.0
Phase Duration, s	13.0	55.5	13.0	55.5		51.5		51.5
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1		3.4		3.4
Queue Clearance Time (g_s), s	5.9	29.9	7.8	27.0		9.8		25.8
Green Extension Time (g_e), s	0.0	4.0	0.0	4.1		0.9		0.8
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.07	1.00	0.05		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	98	499	479	141	460	453		130		196	54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1759	1690	1675	1759	1729		1453		1201	1470	
Queue Service Time (g_s), s	3.9	27.9	27.9	5.8	25.0	25.0		4.9		16.0	2.9	
Cycle Queue Clearance Time (g_c), s	3.9	27.9	27.9	5.8	25.0	25.0		7.8		23.8	2.9	
Green Ratio (*g*/*C*)	0.47	0.41	0.41	0.47	0.41	0.41		0.38		0.38	0.38	
Capacity (*c*), veh/h	266	726	697	246	726	713		596		437	557	
Volume-to-Capacity Ratio (*X*)	0.368	0.687	0.687	0.574	0.634	0.634		0.219		0.447	0.098	
Available Capacity (c_a), veh/h	266	726	697	246	726	713		596		437	557	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7	17.6	17.0	4.3	15.9	15.7		4.6		8.2	1.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.21	0.00	0.00	0.39	0.00	0.00		0.00		2.26	0.00	
Uniform Delay (d_1), s/veh	21.5	28.9	28.9	23.4	28.1	28.1		25.6		33.7	24.0	
Incremental Delay (d_2), s/veh	0.3	2.3	2.4	2.1	1.4	1.4		0.1		0.3	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (*d*), s/veh	21.8	31.2	31.3	25.5	29.4	29.5		25.6		34.0	24.0	
Level of Service (LOS)	C	C	C	C	C	C		C		C	C	
Approach Delay, s/veh / LOS	30.4	C		28.9	C		25.6	C		31.8	C	
Intersection Delay, s/veh / LOS	29.7	C										

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.3	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.4	A	1.4	A	0.7	A	0.9	A

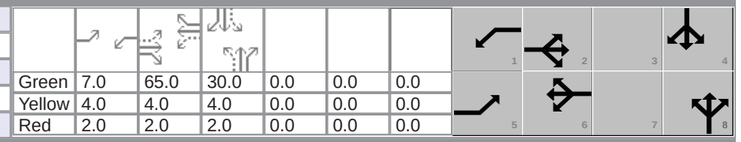
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Bob Evan…	File Name	I-5_36-37_B_PM_2038.xus		
Project Description	I-5 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	890	80	100	1680	60	70	10	100	140	10	50

Signal Information			
Cycle, s	120.0	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	7.0	65.0	30.0	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						

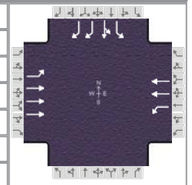
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		6.0
Phase Duration, s	13.0	71.0	13.0	71.0		36.0		36.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0		3.4		3.4
Queue Clearance Time (g_s), s	3.9	26.0	5.3	67.0		16.4		32.0
Green Extension Time (g_e), s	0.0	9.5	0.0	0.0		0.8		0.0
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.11	1.00	1.00		0.00		1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	65	535	519	109	946	945		196		152	65	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1675	1759	1708	1675	1759	1738		1453		1144	1462	
Queue Service Time (g_s), s	1.9	24.0	24.0	3.3	64.0	65.0		10.2		15.6	4.2	
Cycle Queue Clearance Time (g_c), s	1.9	24.0	24.0	3.3	64.0	65.0		14.4		30.0	4.2	
Green Ratio (*g*/*C*)	0.60	0.54	0.54	0.60	0.54	0.54		0.25		0.25	0.25	
Capacity (*c*), veh/h	158	953	925	321	953	941		405		209	366	
Volume-to-Capacity Ratio (*X*)	0.413	0.561	0.561	0.338	0.993	1.004		0.483		0.729	0.178	
Available Capacity (c_a), veh/h	158	953	925	321	953	941		405		209	366	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.8	14.5	14.2	2.2	41.4	42.4		8.7		8.9	2.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14	0.00	0.00	0.20	0.00	0.00		0.00		2.45	0.00	
Uniform Delay (d_1), s/veh	27.6	18.1	18.1	13.9	27.3	27.5		39.2		52.4	35.3	
Incremental Delay (d_2), s/veh	0.6	0.5	0.5	0.2	27.3	30.3		0.3		10.7	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (*d*), s/veh	28.2	18.6	18.6	14.1	54.6	57.8		39.6		63.0	35.4	
Level of Service (LOS)	C	B	B	B	D	F		D		E	D	
Approach Delay, s/veh / LOS	19.1	B		53.9	D		39.6	D		54.7	D	
Intersection Delay, s/veh / LOS	42.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.3	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.4	A	2.1	B	0.8	A	0.8	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 SB ra…	File Name	I-6_36-37_B_AM_2038.xus		
Project Description	I-6 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	700		360	460					40	0	450

Signal Information					1	2	3	4	5	6	7	8
Cycle, s	120.0	Reference Phase	2	Green	17.0	13.0	43.0	23.0	0.0	0.0		
Offset, s	0	Reference Point	End	Yellow	4.0	4.0	4.0	4.0	0.0	0.0		
Uncoordinated	Yes	Simult. Gap E/W	On	Red	2.0	2.0	2.0	2.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On									

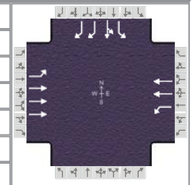
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6				4
Case Number	2.0	4.0	1.1	4.0				9.0
Phase Duration, s	23.0	49.0	42.0	68.0				29.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0				3.4
Queue Clearance Time (g_s), s	2.1	26.4	13.9	12.2				24.4
Green Extension Time (g_e), s	0.0	2.4	0.7	3.3				0.0
Phase Call Probability	1.00	1.00	1.00	1.00				1.00
Max Out Probability	0.00	0.17	0.00	0.00				1.00

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		1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h	1	761		391	500					24	0	509
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645	1053		1675	1675					1459	1532	1161
Queue Service Time (g_s), s	0.1	24.4		11.9	10.2					1.6	0.0	22.4
Cycle Queue Clearance Time (g_c), s	0.1	24.4		11.9	10.2					1.6	0.0	22.4
Green Ratio (*g*/*C*)	0.14	0.36		0.67	0.52					0.19	0.19	0.33
Capacity (*c*), veh/h	233	1131		665	1731					280	294	771
Volume-to-Capacity Ratio (*X*)	0.005	0.672		0.588	0.289					0.085	0.000	0.660
Available Capacity (c_a), veh/h	233	1131		665	1731					280	294	771
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	10.6		7.4	7.1					1.0	0.0	10.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.40	0.00					0.06	0.00	0.37
Uniform Delay (d_1), s/veh	44.2	32.5		14.3	16.5					39.9	0.0	34.1
Incremental Delay (d_2), s/veh	0.0	3.2		0.9	0.4					0.0	0.0	1.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh	44.2	35.7		15.2	16.9					39.9	0.0	35.8
Level of Service (LOS)	D	D		B	B					D		D
Approach Delay, s/veh / LOS	35.8	D		16.2	B		0.0			36.0	D	
Intersection Delay, s/veh / LOS	27.8			C								

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.6	B	3.2	C	3.0	C
Bicycle LOS Score / LOS	0.9	A	1.2	A			1.4	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 SB ra…	File Name	I-6_36-37_B_PM_2038.xus		
Project Description	I-6 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	950		220	990					100	0	770

Signal Information					1	2	3	4	5	6	7	8
Cycle, s	120.0	Reference Phase	2	Green	16.0	48.0	38.0	0.0	0.0	0.0		
Offset, s	0	Reference Point	End	Yellow	4.0	4.0	4.0	0.0	0.0	0.0		
Uncoordinated	Yes	Simult. Gap E/W	On	Red	2.0	2.0	2.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On									

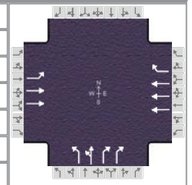
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6				4
Case Number	2.0	4.0	1.1	4.0				9.0
Phase Duration, s	22.0	54.0	22.0	54.0				44.0
Change Period, (*Y*+*R* $_c$), s	6.0	6.0	6.0	6.0				6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0				3.4
Queue Clearance Time (g_s), s	2.1	26.4	11.3	36.1				40.0
Green Extension Time (g_e), s	0.0	6.2	0.2	5.0				0.0
Phase Call Probability	1.00	1.00	1.00	1.00				1.00
Max Out Probability	0.00	0.06	0.24	0.26				1.00

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		1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h	1	1033		239	1076					60	0	886
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645	1359		1675	1675					1459	1727	1166
Queue Service Time (g_s), s	0.1	24.4		9.3	34.1					3.5	0.0	38.0
Cycle Queue Clearance Time (g_c), s	0.1	24.4		9.3	34.1					3.5	0.0	38.0
Green Ratio (*g*/*C*)	0.13	0.40		0.53	0.40					0.32	0.32	0.45
Capacity (*c*), veh/h	219	1631		376	1340					462	547	1045
Volume-to-Capacity Ratio (*X*)	0.005	0.633		0.636	0.803					0.129	0.000	0.848
Available Capacity (c_a), veh/h	219	1631		376	1340					462	547	1045
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	12.7		6.7	20.6					2.2	0.0	17.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.37	0.00					0.13	0.00	0.61
Uniform Delay (d_1), s/veh	45.1	28.9		20.7	31.8					29.2	0.0	29.3
Incremental Delay (d_2), s/veh	0.0	1.9		2.7	5.2					0.0	0.0	6.3
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh	45.1	30.8		23.4	37.0					29.3	0.0	35.6
Level of Service (LOS)	D	C		C	D					C		D
Approach Delay, s/veh / LOS	30.8	C		34.5	C		0.0			35.2	D	
Intersection Delay, s/veh / LOS	33.6			C								

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.6	B	3.2	C	3.0	C
Bicycle LOS Score / LOS	1.1	A	1.6	A			2.0	B

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 NB ra…	File Name	I-7_36-37_B_AM_2038.xus		
Project Description	I-7 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	390	350			580	130	240	90	180			

Signal Information					1	2	3	4
Cycle, s	120.0	Reference Phase	2					
Offset, s	0	Reference Point	End	Green	23.0	44.0	35.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0

	5	6	7	8
Green	0.0	0.0		
Yellow	0.0	0.0		
Red	0.0	0.0		

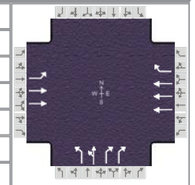
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	29.0	79.0		50.0		41.0		
Change Period, (*Y*+*R c*), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.1		3.1		3.2		
Queue Clearance Time (*g s*), s	18.8	7.9		23.2		12.2		
Green Extension Time (*g e*), s	0.4	2.9		2.8		1.2		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	0.51	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	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	424	380			630	141	170	189	196			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			963	1519	1723	1768	1357			
Queue Service Time (*g s*), s	16.8	5.9			21.2	7.8	9.3	10.2	6.6			
Cycle Queue Clearance Time (*g c*), s	16.8	5.9			21.2	7.8	9.3	10.2	6.6			
Green Ratio (*g/C*)	0.57	0.61			0.37	0.37	0.29	0.29	0.29			
Capacity (*c*), veh/h	532	2076			1059	557	503	516	792			
Volume-to-Capacity Ratio (*X*)	0.797	0.183			0.595	0.254	0.337	0.367	0.247			
Available Capacity (*c a*), veh/h	532	2076			1059	557	503	516	792			
Back of Queue (*Q*), veh/ln (95 th percentile)	11.8	3.9			8.8	5.3	7.0	7.8	3.9			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.63	0.00			0.00	0.93	0.28	0.00	0.11			
Uniform Delay (*d 1*), s/veh	19.3	10.4			30.8	26.5	33.4	33.7	32.4			
Incremental Delay (*d 2*), s/veh	7.7	0.2			2.5	1.1	0.1	0.2	0.1			
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	27.0	10.6			33.3	27.6	33.5	33.9	32.5			
Level of Service (LOS)	C	B			C	C	C	C	C			
Approach Delay, s/veh / LOS	19.2	B		32.2	C		33.3	C		0.0		
Intersection Delay, s/veh / LOS	27.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.2	A	0.9	A	1.4	A		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/I-71 NB ra…	File Name	I-7_36-37_B_PM_2038.xus		
Project Description	I-7 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	410	640			670	150	540	160	550			

Signal Information					1	2	3	4
Cycle, s	120.0	Reference Phase	2					
Offset, s	0	Reference Point	End	Green	29.0	34.0	39.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0

	5	6	7	8
Green	0.0	0.0		
Yellow	0.0	0.0		
Red	0.0	0.0		

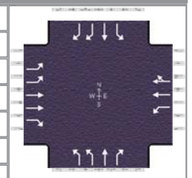
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	35.0	75.0		40.0		45.0		
Change Period, (*Y*+*R c*), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.1		3.1		3.2		
Queue Clearance Time (*g s*), s	21.4	15.1		17.1		25.0		
Green Extension Time (*g e*), s	0.6	4.4		4.0		3.1		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	0.06	0.00		0.04		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	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	446	696			728	163	382	379	598			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1628	1519	1723	1763	1357			
Queue Service Time (*g s*), s	19.4	13.1			15.1	10.3	23.0	22.2	22.9			
Cycle Queue Clearance Time (*g c*), s	19.4	13.1			15.1	10.3	23.0	22.2	22.9			
Green Ratio (*g/C*)	0.54	0.57			0.28	0.28	0.32	0.32	0.32			
Capacity (*c*), veh/h	582	1962			1383	430	560	573	882			
Volume-to-Capacity Ratio (*X*)	0.765	0.354			0.526	0.379	0.681	0.662	0.678			
Available Capacity (*c a*), veh/h	582	1962			1383	430	560	573	882			
Back of Queue (*Q*), veh/ln (95 th percentile)	12.9	8.6			10.2	7.4	15.1	14.8	12.2			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.69	0.00			0.00	1.29	0.61	0.00	0.34			
Uniform Delay (*d 1*), s/veh	20.1	13.6			36.2	34.5	35.1	34.8	35.1			
Incremental Delay (*d 2*), s/veh	5.4	0.5			1.4	2.5	2.8	2.3	1.7			
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	25.6	14.1			37.7	37.0	37.9	37.1	36.8			
Level of Service (LOS)	C	B			D	D	D	D	D			
Approach Delay, s/veh / LOS	18.6	B		37.5	D		37.2	D		0.0		
Intersection Delay, s/veh / LOS	31.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.4	A	1.0	A	2.7	B		

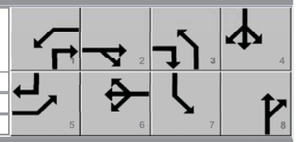
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Wilson Road	File Name	I-8_36-37_B_AM_2038.xus		
Project Description	I-8 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	290	310	60	10	450	10	20	140	50	30	60	430

Signal Information													
Cycle, s	120.0	Reference Phase	2										
Offset, s	0	Reference Point	End										
Uncoordinated	Yes	Simult. Gap E/W	On	Green	18.0	42.0	7.0	29.0	0.0	0.0			
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	0.0	0.0			
				Red	2.0	2.0	2.0	2.0	0.0	0.0			



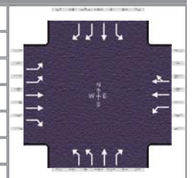
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	1.1	3.0
Phase Duration, s	24.0	48.0	24.0	48.0	13.0	35.0	13.0	35.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.3	3.1	3.3
Queue Clearance Time (*g s*), s	12.7	10.5	2.4	14.7	2.8	11.0	3.7	17.7
Green Extension Time (*g e*), s	0.4	1.8	0.0	1.8	0.0	1.8	0.0	1.6
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.14	0.00	0.00	0.00	0.07	0.00	0.67	0.03

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	315	337	65	11	251	249	22	152	54	33	65	467
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1778	1569	1696	1464	1675	1759	1319
Queue Service Time (*g s*), s	10.7	8.5	3.2	0.4	12.7	12.7	0.8	9.0	2.8	1.7	3.5	15.7
Cycle Queue Clearance Time (*g c*), s	10.7	8.5	3.2	0.4	12.7	12.7	0.8	9.0	2.8	1.7	3.5	15.7
Green Ratio (*g/C*)	0.15	0.35	0.41	0.50	0.35	0.35	0.06	0.24	0.39	0.30	0.24	0.39
Capacity (*c*), veh/h	497	1194	620	578	627	622	183	410	573	332	425	1034
Volume-to-Capacity Ratio (*X*)	0.634	0.282	0.105	0.019	0.400	0.400	0.119	0.371	0.095	0.098	0.153	0.452
Available Capacity (*c a*), veh/h	497	1194	620	578	627	622	183	410	573	332	425	1034
Back of Queue (*Q*), veh/ln (95 th percentile)	8.0	6.3	2.0	0.3	9.3	9.2	0.6	6.7	1.7	1.2	2.7	8.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.30	0.00	0.07	0.02	0.00	0.00	0.01	0.00	0.07	0.05	0.00	0.91
Uniform Delay (*d 1*), s/veh	47.9	28.1	21.9	15.6	29.5	29.5	53.6	37.9	23.1	30.5	35.8	27.0
Incremental Delay (*d 2*), s/veh	2.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.0	0.0	0.1	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	49.9	28.2	22.0	15.6	29.6	29.6	53.7	38.1	23.1	30.5	35.9	27.1
Level of Service (LOS)	D	C	C	B	C	C	D	D	C	C	D	C
Approach Delay, s/veh / LOS	37.2	D		29.3	C		36.0	D		28.3	C	
Intersection Delay, s/veh / LOS	32.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	2.8	C	3.1	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	0.9	A	1.4	A

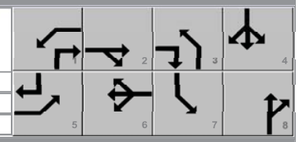
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Wilson Road	File Name	I-8_36-37_B_PM_2038.xus		
Project Description	I-8 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	630	630	60	10	580	10	40	160	50	30	60	340

Signal Information													
Cycle, s	120.0	Reference Phase	2										
Offset, s	0	Reference Point	End										
Uncoordinated	Yes	Simult. Gap E/W	On	Green	19.0	7.0	32.0	7.0	25.0	0.0			
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	4.0	0.0			
				Red	2.0	2.0	2.0	2.0	2.0	0.0			



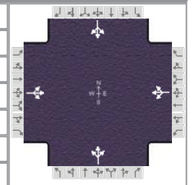
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	1.1	3.0
Phase Duration, s	38.0	51.0	25.0	38.0	13.0	31.0	13.0	31.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0	3.1	3.2	3.1	3.2
Queue Clearance Time (*g s*), s	24.9	20.8	2.4	21.3	3.6	12.9	3.7	12.3
Green Extension Time (*g e*), s	1.2	3.1	0.0	2.6	0.0	1.4	0.0	1.4
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.12	0.00	0.00	0.13	0.56	0.01	0.78	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	685	685	65	11	322	320	43	174	54	33	65	370
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1782	1569	1696	1438	1675	1759	1319
Queue Service Time (*g s*), s	22.9	18.8	3.1	0.4	19.2	19.3	1.6	10.9	3.0	1.7	3.7	10.3
Cycle Queue Clearance Time (*g c*), s	22.9	18.8	3.1	0.4	19.2	19.3	1.6	10.9	3.0	1.7	3.7	10.3
Green Ratio (*g/C*)	0.27	0.38	0.43	0.42	0.27	0.27	0.06	0.21	0.37	0.27	0.21	0.48
Capacity (*c*), veh/h	884	1280	658	476	478	475	183	353	527	273	367	1253
Volume-to-Capacity Ratio (*X*)	0.775	0.535	0.099	0.023	0.673	0.673	0.238	0.492	0.103	0.119	0.178	0.295
Available Capacity (*c a*), veh/h	884	1280	658	476	478	475	183	353	527	273	367	1253
Back of Queue (*Q*), veh/ln (95 th percentile)	14.8	12.2	1.9	0.3	13.6	13.6	1.1	8.0	1.8	1.3	2.9	5.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.55	0.00	0.07	0.02	0.00	0.00	0.02	0.00	0.07	0.05	0.00	0.59
Uniform Delay (*d 1*), s/veh	40.7	29.3	20.1	20.2	39.3	39.3	54.0	41.9	25.0	33.6	39.1	19.2
Incremental Delay (*d 2*), s/veh	3.9	0.2	0.0	0.0	3.0	3.0	0.2	0.4	0.0	0.1	0.1	0.0
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	44.6	29.6	20.2	20.2	42.3	42.4	54.2	42.3	25.0	33.7	39.1	19.3
Level of Service (LOS)	D	C	C	C	D	D	D	D	C	C	D	B
Approach Delay, s/veh / LOS	36.3	D		42.0	D		40.7	D		23.1	C	
Intersection Delay, s/veh / LOS	35.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	2.9	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	1.0	A	0.9	A	1.3	A

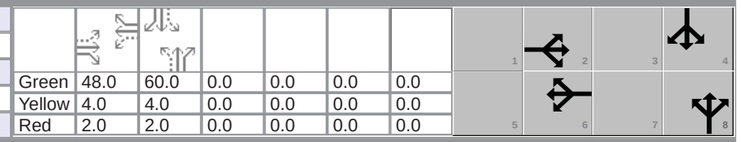
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Galena	File Name	I-9_36-37_B_AM_2038.xus		
Project Description	I-9 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	290	90	30	490	10	50	320	30	180	250	70

Signal Information			
Cycle, s	120.0	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	48.0	60.0	0.0	0.0	0.0	0.0		
Yellow	4.0	4.0	0.0	0.0	0.0	0.0		
Red	2.0	2.0	0.0	0.0	0.0	0.0		

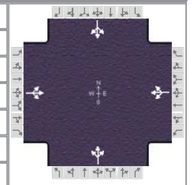
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		54.0		54.0		66.0		66.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.1		3.1		3.3		3.3
Queue Clearance Time (g_s), s		27.1		50.0		22.6		52.1
Green Extension Time (g_e), s		2.1		0.0		2.5		1.8
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		1.00		0.00		0.26

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		435			576			435			543	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1561			1729			1592			1222	
Queue Service Time (g_s), s		0.0			10.6			0.0			29.6	
Cycle Queue Clearance Time (g_c), s		25.1			35.7			20.6			50.1	
Green Ratio (*g*/*C*)		0.40			0.40			0.50			0.50	
Capacity (*c*), veh/h		656			723			830			652	
Volume-to-Capacity Ratio (*X*)		0.663			0.797			0.524			0.834	
Available Capacity (c_a), veh/h		656			723			830			652	
Back of Queue (*Q*), veh/ln (95 th percentile)		15.4			22.1			12.5			21.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		28.9			32.1			19.9			29.3	
Incremental Delay (d_2), s/veh		2.0			5.7			0.3			8.6	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		30.9			37.8			20.2			37.9	
Level of Service (LOS)		C			D			C			D	
Approach Delay, s/veh / LOS	30.9	C		37.8	D		20.2	C		37.9	D	
Intersection Delay, s/veh / LOS	32.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	1.2	A	1.4	A	1.2	A	1.4	A

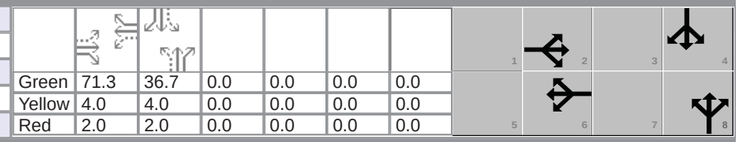
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Galena	File Name	I-9_36-37_B_PM_2038.xus		
Project Description	I-9 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	670	110	30	640	200	70	310	40	40	210	50

Signal Information			
Cycle, s	120.0	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	71.3	36.7	0.0	0.0	0.0	0.0		
Yellow	4.0	4.0	0.0	0.0	0.0	0.0		
Red	2.0	2.0	0.0	0.0	0.0	0.0		

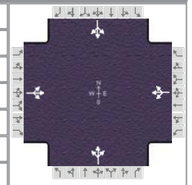
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		77.3		77.3		42.7		42.7
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.2		3.2
Queue Clearance Time (g_s), s		73.3		73.3		38.7		25.4
Green Extension Time (g_e), s		0.0		0.0		0.0		1.4
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		1.00		0.04

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		891			946			457			326	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1372			1513			1466			1402	
Queue Service Time (g_s), s		0.0			0.0			13.3			0.0	
Cycle Queue Clearance Time (g_c), s		71.3			71.3			36.7			23.4	
Green Ratio (*g*/*C*)		0.59			0.59			0.31			0.31	
Capacity (*c*), veh/h		847			930			483			463	
Volume-to-Capacity Ratio (*X*)		1.053			1.017			0.944			0.705	
Available Capacity (c_a), veh/h		847			930			483			463	
Back of Queue (*Q*), veh/ln (95 th percentile)		43.8			43.1			23.7			13.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		22.7			23.8			42.1			36.1	
Incremental Delay (d_2), s/veh		45.8			33.8			27.2			4.1	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		68.5			57.5			69.3			40.3	
Level of Service (LOS)		F			F			E			D	
Approach Delay, s/veh / LOS	68.5	E		57.5	E		69.3	E		40.3	D	
Intersection Delay, s/veh / LOS	61.2						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	2.0	A	2.0	B	1.2	A	1.0	A

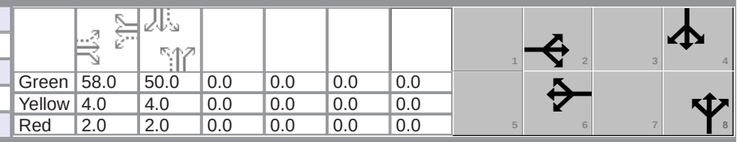
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Domigan/…	File Name			
Project Description	I10 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	270	180	10	400	10	10	140	10	20	70	120

Signal Information			
Cycle, s	120.0	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	58.0	50.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

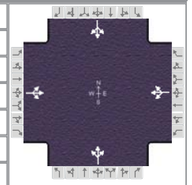
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		64.0		64.0		56.0		56.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.2		3.2
Queue Clearance Time (g_s), s		30.5		23.3		10.4		13.7
Green Extension Time (g_e), s		2.1		2.1		0.8		0.8
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		522			457			174			228	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1622			1767			1590			1550	
Queue Service Time (g_s), s		7.1			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		28.5			21.3			8.4			11.7	
Green Ratio (*g*/*C*)		0.48			0.48			0.42			0.42	
Capacity (*c*), veh/h		816			885			694			679	
Volume-to-Capacity Ratio (*X*)		0.640			0.516			0.250			0.336	
Available Capacity (c_a), veh/h		816			885			694			679	
Back of Queue (*Q*), veh/ln (95 th percentile)		16.4			13.5			5.7			7.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		23.3			21.5			22.9			23.8	
Incremental Delay (d_2), s/veh		1.3			0.2			0.1			0.1	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		24.6			21.8			22.9			23.9	
Level of Service (LOS)		C			C			C			C	
Approach Delay, s/veh / LOS	24.6	C		21.8	C		22.9	C		23.9	C	
Intersection Delay, s/veh / LOS	23.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	1.3	A	1.2	A	0.8	A	0.9	A

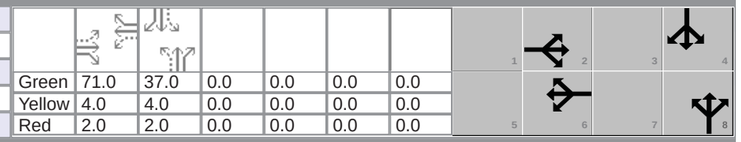
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Domigan/…	File Name			
Project Description	I10 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	540	150	10	690	40	10	200	10	20	90	170

Signal Information			
Cycle, s	120.0	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	71.0	37.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

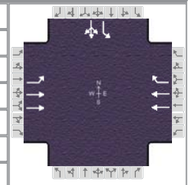
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		77.0		77.0		43.0		43.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.2		3.2
Queue Clearance Time (g_s), s		64.2		42.6		16.3		21.9
Green Extension Time (g_e), s		2.8		4.6		1.1		1.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.56		0.02		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		815			804			239			304	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1466			1754			1604			1552	
Queue Service Time (g_s), s		21.6			0.0			0.0			3.5	
Cycle Queue Clearance Time (g_c), s		62.2			40.6			14.3			19.9	
Green Ratio (*g*/*C*)		0.59			0.59			0.31			0.31	
Capacity (*c*), veh/h		900			1068			526			511	
Volume-to-Capacity Ratio (*X*)		0.906			0.753			0.455			0.596	
Available Capacity (c_a), veh/h		900			1068			526			511	
Back of Queue (*Q*), veh/ln (95 th percentile)		30.6			22.9			9.5			12.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		22.2			18.3			33.7			35.5	
Incremental Delay (d_2), s/veh		12.4			2.7			0.2			1.3	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		34.5			21.0			33.9			36.9	
Level of Service (LOS)		C			C			C			D	
Approach Delay, s/veh / LOS	34.5	C		21.0	C		33.9	C		36.9	D	
Intersection Delay, s/veh / LOS	29.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	1.8	A	1.8	A	0.9	A	1.0	A

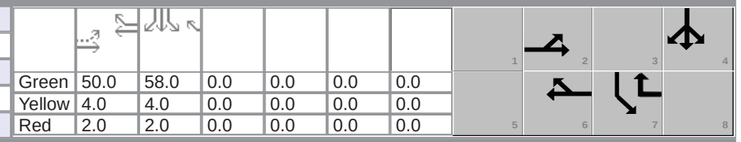
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Sunbury P…	File Name			
Project Description	I11 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	610			1010	390				290	0	10

Signal Information			
Cycle, s	120.0	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	50.0	58.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

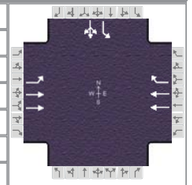
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6				4
Case Number		6.0		7.0				10.0
Phase Duration, s		56.0		56.0				64.0
Change Period, ($Y+R_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.1		3.1				3.2
Queue Clearance Time (g_s), s		37.5		35.2				13.6
Green Extension Time (g_e), s		5.3		5.7				0.7
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		0.30		0.22				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				7	4	14
Adjusted Flow Rate (*v*), veh/h	11	663			1098	424				158	168	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	492	1706			1706	1519				1707	1695	
Queue Service Time (g_s), s	2.3	16.9			33.2	4.6				6.3	11.6	
Cycle Queue Clearance Time (g_c), s	35.5	16.9			33.2	4.6				6.3	11.6	
Green Ratio (*g/C*)	0.42	0.42			0.42	0.90				0.48	0.48	
Capacity (*c*), veh/h	129	1422			1422	1367				825	819	
Volume-to-Capacity Ratio (*X*)	0.084	0.466			0.772	0.310				0.191	0.206	
Available Capacity (c_a), veh/h	129	1422			1422	1367				825	819	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.6	11.2			20.2	0.6				4.4	9.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.03	0.00			0.00	0.02				0.31	0.00	
Uniform Delay (d_1), s/veh	45.4	25.3			30.1	0.8				17.6	35.7	
Incremental Delay (d_2), s/veh	1.3	1.1			4.1	0.6				0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0	0.0	
Control Delay (*d*), s/veh	46.7	26.4			34.2	1.4				17.7	35.7	
Level of Service (LOS)	D	C			C	A				B	D	
Approach Delay, s/veh / LOS	26.8	C		25.1	C		0.0			27.0	C	
Intersection Delay, s/veh / LOS	25.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.3	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.0	A	1.7	A			1.0	A

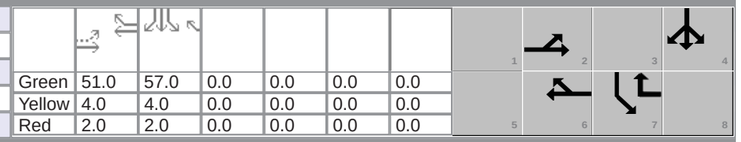
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	US 36/SR 37	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	US 36/SR 37/Sunbury P…	File Name			
Project Description	I11 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	990			680	800				640	0	10

Signal Information			
Cycle, s	120.0	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	51.0	57.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

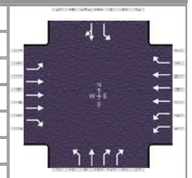
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6				4
Case Number		6.0		7.0				10.0
Phase Duration, s		57.0		57.0				63.0
Change Period, ($Y+R_c$), s		6.0		6.0				6.0
Max Allow Headway (*MAH*), s		3.2		3.2				3.2
Queue Clearance Time (g_s), s		33.8		21.1				27.1
Green Extension Time (g_e), s		8.0		9.8				1.5
Phase Call Probability		1.00		1.00				1.00
Max Out Probability		0.35		0.13				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				7	4	14
Adjusted Flow Rate (*v*), veh/h	11	1076			739	870				348	359	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	689	1706			1706	1519				1707	1701	
Queue Service Time (g_s), s	1.4	31.8			19.1	16.1				16.1	25.1	
Cycle Queue Clearance Time (g_c), s	20.5	31.8			19.1	16.1				16.1	25.1	
Green Ratio (*g/C*)	0.42	0.42			0.42	0.90				0.48	0.48	
Capacity (*c*), veh/h	243	1450			1450	1367				811	808	
Volume-to-Capacity Ratio (*X*)	0.045	0.742			0.510	0.636				0.429	0.444	
Available Capacity (c_a), veh/h	243	1450			1450	1367				811	808	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.5	19.3			12.4	2.3				10.4	17.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.02	0.00			0.00	0.08				0.73	0.00	
Uniform Delay (d_1), s/veh	32.8	29.0			25.3	1.4				20.8	43.4	
Incremental Delay (d_2), s/veh	0.3	3.5			1.3	2.3				0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0	0.0	
Control Delay (*d*), s/veh	33.2	32.4			26.6	3.7				20.9	43.6	
Level of Service (LOS)	C	C			C	A				C	D	
Approach Delay, s/veh / LOS	32.4	C		14.2	B		0.0			32.4	C	
Intersection Delay, s/veh / LOS	23.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.3	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	1.8	A			1.7	A

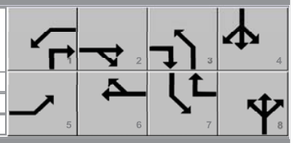
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Fourw…	File Name			
Project Description	I12 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	1970	30	140	710	200	10	130	350	90	120	10

Signal Information			
Cycle, s	120.0	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	11.0	56.0	7.0	22.0	0.0	0.0	
Yellow	4.0	4.0	4.0	4.0	0.0	0.0	
Red	2.0	2.0	2.0	2.0	0.0	0.0	

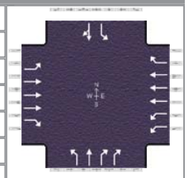
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	1.1	3.0	1.1	4.0
Phase Duration, s	17.0	62.0	17.0	62.0	13.0	28.0	13.0	28.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.2	3.1	3.2
Queue Clearance Time (*g s*), s	7.4	51.4	7.6	14.8	2.6	15.7	7.3	10.2
Green Extension Time (*g e*), s	0.0	3.7	0.1	14.3	0.0	1.0	0.0	1.3
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.49	0.91	0.66	0.10	0.04	0.21	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	2141	33	152	772	217	11	141	380	98	141	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1616	1638	1438	1569	1540	1438	1774	1863	1397	1774	1837	
Queue Service Time (*g s*), s	5.4	49.4	1.3	5.6	12.8	10.2	0.6	8.0	13.7	5.3	8.2	
Cycle Queue Clearance Time (*g c*), s	5.4	49.4	1.3	5.6	12.8	10.2	0.6	8.0	13.7	5.3	8.2	
Green Ratio (*g/C*)	0.09	0.47	0.53	0.09	0.47	0.53	0.24	0.18	0.28	0.24	0.18	
Capacity (*c*), veh/h	148	2294	755	288	2157	755	286	342	768	287	337	
Volume-to-Capacity Ratio (*X*)	0.514	0.934	0.043	0.529	0.358	0.288	0.038	0.414	0.495	0.341	0.419	
Available Capacity (*c a*), veh/h	148	2294	755	288	2157	755	286	342	768	287	337	
Back of Queue (*Q*), veh/ln (95 th percentile)	4.0	27.8	0.8	4.0	8.1	6.2	0.4	6.7	8.2	4.2	6.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00	0.03	0.18	0.00	0.27	0.05	0.00	0.46	0.27	0.00	
Uniform Delay (*d 1*), s/veh	52.0	30.2	13.9	52.0	20.5	15.9	35.2	43.3	36.5	37.0	43.4	
Incremental Delay (*d 2*), s/veh	1.3	8.6	0.1	0.9	0.5	1.0	0.0	0.3	0.2	0.3	0.3	
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	53.3	38.8	14.0	53.0	21.0	16.9	35.2	43.6	36.7	37.2	43.7	
Level of Service (LOS)	D	D	B	D	C	B	D	D	D	D	D	
Approach Delay, s/veh / LOS	39.0	D		24.5	C		38.5	D		41.0	D	
Intersection Delay, s/veh / LOS	35.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	C	3.4	C
Bicycle LOS Score / LOS	1.7	A	1.1	A	1.4	A	0.9	A

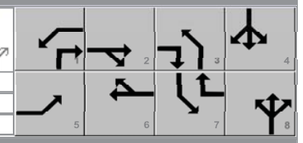
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Fourw…	File Name			
Project Description	I12 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1560	20	200	1550	250	30	130	200	190	160	10

Signal Information			
Cycle, s	120.0	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	9.0	5.0	49.0	7.0	3.0	23.0	
Yellow	4.0	0.0	4.0	4.0	0.0	4.0	
Red	2.0	0.0	2.0	2.0	0.0	2.0	

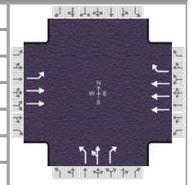
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	1.1	3.0	1.1	4.0
Phase Duration, s	15.0	55.0	20.0	60.0	13.0	29.0	16.0	32.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.2	3.1	3.2
Queue Clearance Time (*g s*), s	5.9	43.2	9.9	39.9	3.7	10.0	12.0	12.5
Green Extension Time (*g e*), s	0.0	4.8	0.2	9.9	0.0	1.0	0.0	1.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.98	0.89	0.34	0.63	0.70	0.00	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	1696	22	217	1685	272	33	141	217	207	185	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1616	1540	1438	1569	1540	1438	1774	1863	1397	1774	1843	
Queue Service Time (*g s*), s	3.9	41.2	1.0	7.9	37.9	13.1	1.7	8.0	7.0	10.0	10.5	
Cycle Queue Clearance Time (*g c*), s	3.9	41.2	1.0	7.9	37.9	13.1	1.7	8.0	7.0	10.0	10.5	
Green Ratio (*g/C*)	0.08	0.41	0.47	0.12	0.45	0.53	0.25	0.19	0.31	0.28	0.22	
Capacity (*c*), veh/h	121	1887	671	366	2079	767	298	357	862	364	399	
Volume-to-Capacity Ratio (*X*)	0.449	0.899	0.032	0.594	0.810	0.354	0.109	0.396	0.252	0.568	0.463	
Available Capacity (*c a*), veh/h	121	1887	671	366	2079	767	298	357	862	364	399	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.9	22.7	0.6	5.7	20.3	7.9	1.3	6.6	4.2	8.7	8.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14	0.00	0.02	0.26	0.00	0.35	0.14	0.00	0.24	0.57	0.00	
Uniform Delay (*d 1*), s/veh	53.1	33.2	17.3	50.3	28.6	16.1	34.8	42.4	31.1	36.9	40.9	
Incremental Delay (*d 2*), s/veh	1.0	7.3	0.1	1.8	3.5	1.3	0.1	0.3	0.1	1.3	0.3	
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	54.1	40.5	17.4	52.1	32.1	17.4	34.8	42.7	31.2	38.3	41.2	
Level of Service (LOS)	D	D	B	D	C	B	C	D	C	D	D	
Approach Delay, s/veh / LOS	40.6	D		32.3	C		35.6	D		39.7	D	
Intersection Delay, s/veh / LOS	36.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	C	3.4	C
Bicycle LOS Score / LOS	1.5	A	1.7	A	1.1	A	1.1	A

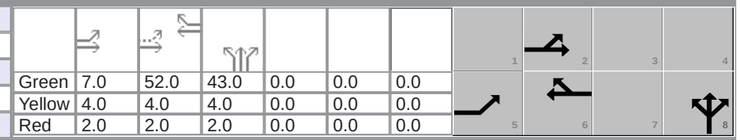
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/I-71 N…	File Name			
Project Description	I13 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	600			1200	20	290	5	90			

Signal Information			
Cycle, s	120.0	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	7.0	52.0	43.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

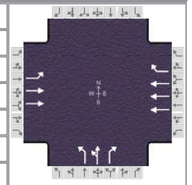
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	13.0	71.0		58.0		49.0		
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.0		3.0		3.1		
Queue Clearance Time (g_s), s	4.8	15.0		27.5		9.9		
Green Extension Time (g_e), s	0.0	6.2		5.9		0.8		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	1.00	0.00		0.03		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	76	652			1304	22	158	163	98			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1593	1519	1740	1743	1548			
Queue Service Time (g_s), s	2.8	13.0			25.5	1.0	7.7	7.9	5.2			
Cycle Queue Clearance Time (g_c), s	2.8	13.0			25.5	1.0	7.7	7.9	5.2			
Green Ratio (*g*/*C*)	0.51	0.54			0.43	0.43	0.36	0.36	0.36			
Capacity (*c*), veh/h	249	1849			2071	658	623	625	555			
Volume-to-Capacity Ratio (*X*)	0.306	0.353			0.630	0.033	0.253	0.261	0.176			
Available Capacity (c_a), veh/h	249	1849			2071	658	623	625	555			
Back of Queue (*Q*), veh/ln (95 th percentile)	1.9	8.5			14.6	0.6	5.7	5.9	3.4			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.09	0.00			0.00	0.02	0.12	0.00	0.12			
Uniform Delay (d_1), s/veh	19.1	15.6			26.5	19.5	27.2	27.3	26.4			
Incremental Delay (d_2), s/veh	0.3	0.0			0.5	0.0	0.1	0.1	0.1			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	19.3	15.6			27.0	19.6	27.2	27.3	26.4			
Level of Service (LOS)	B	B			C	B	C	C	C			
Approach Delay, s/veh / LOS	16.0	B		26.8	C		27.1	C		0.0		
Intersection Delay, s/veh / LOS	23.7			C								

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.1	A	1.2	A	1.2	A		

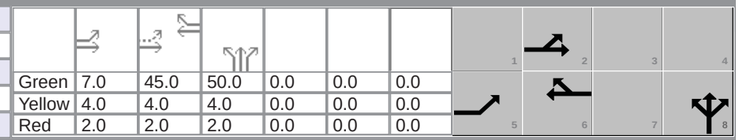
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/I-71 N…	File Name			
Project Description	I13 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	120	1020			1180	40	1050	5	420			

Signal Information			
Cycle, s	120.0	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	7.0	45.0	50.0	0.0	0.0	0.0	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
Red	2.0	2.0	2.0	0.0	0.0	0.0	

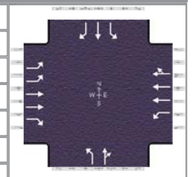
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	13.0	64.0		51.0		56.0		
Change Period, (*Y*+*R* $_c$), s	6.0	6.0		6.0		6.0		
Max Allow Headway (*MAH*), s	3.1	3.0		3.0		3.2		
Queue Clearance Time (g_s), s	7.5	31.8		28.7		36.6		
Green Extension Time (g_e), s	0.0	8.0		6.8		3.4		
Phase Call Probability	1.00	1.00		1.00		1.00		
Max Out Probability	1.00	0.07		0.22		0.15		

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	130	1109			1283	43	571	576	457			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706			1628	1519	1740	1741	1548			
Queue Service Time (g_s), s	5.5	29.8			26.7	2.2	34.2	34.6	29.3			
Cycle Queue Clearance Time (g_c), s	5.5	29.8			26.7	2.2	34.2	34.6	29.3			
Green Ratio (*g*/*C*)	0.45	0.48			0.38	0.38	0.42	0.42	0.42			
Capacity (*c*), veh/h	222	1650			1831	570	725	725	645			
Volume-to-Capacity Ratio (*X*)	0.586	0.672			0.700	0.076	0.787	0.794	0.708			
Available Capacity (c_a), veh/h	222	1650			1831	570	725	725	645			
Back of Queue (*Q*), veh/ln (95 th percentile)	4.2	17.4			15.7	1.4	21.3	21.6	16.6			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00			0.00	0.06	0.43	0.00	0.57			
Uniform Delay (d_1), s/veh	24.7	23.7			31.8	24.1	30.4	30.5	29.0			
Incremental Delay (d_2), s/veh	2.7	0.9			1.0	0.0	5.3	5.6	3.1			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	27.4	24.6			32.8	24.1	35.7	36.1	32.0			
Level of Service (LOS)	C	C			C	C	D	D	C			
Approach Delay, s/veh / LOS	24.9	C		32.5	C		34.8	C		0.0		
Intersection Delay, s/veh / LOS	31.1			C								

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.5	A	1.2	A	3.1	C		

HCS 2010 Signalized Intersection Results Summary

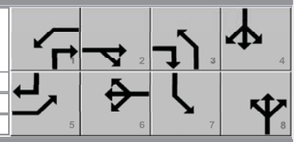
General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Wilso…	File Name			
Project Description	I14 - Build 2038				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	230	480	30	60	1110	110	50	20	40	50	40	190

Signal Information			
Cycle, s	120.0	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	7.0	11.0	41.0	7.0	24.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	



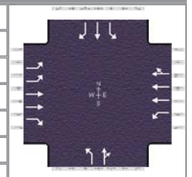
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	1.1	4.0	1.1	3.0
Phase Duration, s	30.0	64.0	13.0	47.0	13.0	30.0	13.0	30.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.3	3.1	3.3
Queue Clearance Time (*g s*), s	9.8	13.2	4.9	28.4	5.0	6.2	5.0	13.6
Green Extension Time (*g e*), s	0.5	5.2	0.0	4.2	0.0	0.6	0.0	0.5
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.00	1.00	0.19	1.00	0.00	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	250	522	33	65	898	428	54	65		54	43	207
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1707	1675	1571		1675	1759	1491
Queue Service Time (*g s*), s	7.8	11.2	1.2	2.9	26.4	26.4	3.0	4.2		3.0	2.4	11.6
Cycle Queue Clearance Time (*g c*), s	7.8	11.2	1.2	2.9	26.4	26.4	3.0	4.2		3.0	2.4	11.6
Green Ratio (*g/C*)	0.20	0.48	0.54	0.40	0.34	0.34	0.26	0.20		0.26	0.20	0.40
Capacity (*c*), veh/h	663	1650	823	448	1225	583	367	314		345	352	596
Volume-to-Capacity Ratio (*X*)	0.377	0.316	0.040	0.146	0.733	0.734	0.148	0.208		0.158	0.124	0.346
Available Capacity (*c a*), veh/h	663	1650	823	448	1225	583	367	314		345	352	596
Back of Queue (*Q*), veh/ln (95 th percentile)	5.8	7.8	0.7	2.1	17.2	17.0	2.2	2.9		2.2	1.9	7.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.21	0.00	0.03	0.11	0.95	0.94	0.26	0.00		0.23	0.00	0.35
Uniform Delay (*d 1*), s/veh	41.5	18.9	12.9	22.5	34.7	34.7	34.2	40.1		34.3	39.4	25.1
Incremental Delay (*d 2*), s/veh	0.1	0.0	0.0	0.1	2.0	4.2	0.1	0.1		0.1	0.1	0.1
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	41.7	18.9	12.9	22.5	36.7	38.9	34.3	40.2		34.4	39.4	25.2
Level of Service (LOS)	D	B	B	C	D	D	C	D		C	D	C
Approach Delay, s/veh / LOS	25.8	C		36.7	D		37.5	D		28.9	C	
Intersection Delay, s/veh / LOS	32.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.8	C	3.0	C	3.4	C
Bicycle LOS Score / LOS	1.2	A	1.3	A	0.7	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

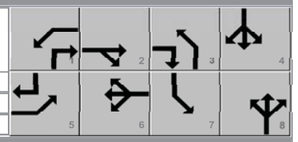
General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Wilso…	File Name			
Project Description	**I-14 - Build 2038**				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	290	1230	50	30	670	50	70	40	60	100	30	380

Signal Information			
Cycle, s	120.0	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	10.0	11.0	36.0	8.0	25.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	



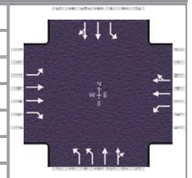
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	1.1	4.0	1.1	3.0
Phase Duration, s	33.0	59.0	16.0	42.0	14.0	31.0	14.0	31.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.0	3.1	3.0	3.1	3.3	3.1	3.3
Queue Clearance Time (*g s*), s	11.8	45.2	3.4	16.6	6.1	8.8	7.9	27.0
Green Extension Time (*g e*), s	0.7	4.0	0.0	6.1	0.0	1.2	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.52	0.00	0.11	1.00	0.00	1.00	1.00

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	315	1337	54	33	527	256	76	109		109	33	413
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1658	1706	1519	1707	1792	1726	1707	1618		1707	1792	1519
Queue Service Time (*g s*), s	9.8	43.2	2.2	1.4	14.5	14.6	4.1	6.8		5.9	1.8	25.0
Cycle Queue Clearance Time (*g c*), s	9.8	43.2	2.2	1.4	14.5	14.6	4.1	6.8		5.9	1.8	25.0
Green Ratio (*g/C*)	0.22	0.44	0.51	0.38	0.30	0.30	0.28	0.21		0.28	0.21	0.43
Capacity (*c*), veh/h	746	1507	772	228	1075	518	407	337		340	373	658
Volume-to-Capacity Ratio (*X*)	0.423	0.887	0.070	0.143	0.490	0.494	0.187	0.323		0.320	0.087	0.627
Available Capacity (*c a*), veh/h	746	1507	772	228	1075	518	407	337		340	373	658
Back of Queue (*Q*), veh/ln (95 th percentile)	7.1	25.4	1.4	1.1	10.4	10.2	3.0	4.9		4.4	1.4	14.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.26	0.00	0.05	0.06	0.57	0.56	0.35	0.00		0.46	0.00	0.68
Uniform Delay (*d 1*), s/veh	39.8	30.8	15.0	26.9	34.5	34.5	33.1	40.3		34.0	38.3	26.5
Incremental Delay (*d 2*), s/veh	0.1	6.6	0.0	0.1	0.1	0.3	0.1	0.2		0.2	0.0	1.4
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	40.0	37.3	15.1	27.0	34.6	34.8	33.2	40.5		34.2	38.3	27.9
Level of Service (LOS)	D	D	B	C	C	C	C	D		C	D	C
Approach Delay, s/veh / LOS	37.1	D		34.3	C		37.5	D		29.8	C	
Intersection Delay, s/veh / LOS	35.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.8	C	3.0	C	3.4	C
Bicycle LOS Score / LOS	1.9	A	0.9	A	0.8	A	1.4	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Galen…	File Name			
Project Description	**I-15 - Build 2038**				



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	360	130	40	810	120	450	450	10	40	450	20

Signal Information			
Cycle, s	120.0	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	7.0	27.0	7.0	22.0	27.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	

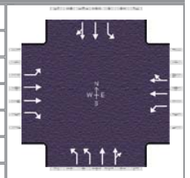
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.2	3.0	1.3	4.0	2.0	4.0	1.1	4.0
Phase Duration, s	13.0	46.0	13.0	46.0	28.0	33.0	28.0	33.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.0	3.1	3.0
Queue Clearance Time (*g s*), s	6.5	12.4	2.0	34.4	18.6	16.8	3.8	17.3
Green Extension Time (*g e*), s	0.0	1.2	1.3	1.4	0.5	1.6	0.0	1.6
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	0.00	0.54	0.45	0.82	0.08	0.00	0.09

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	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	87	391	141	43	517	494	489	251	249	43	257	254
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706	1519	1707	1792	1711	1689	1827	1813	1740	1827	1799
Queue Service Time (*g s*), s	4.5	10.4	8.2	0.0	32.4	32.4	16.6	14.8	14.8	1.8	15.2	15.3
Cycle Queue Clearance Time (*g c*), s	4.5	10.4	8.2	0.0	32.4	32.4	16.6	14.8	14.8	1.8	15.2	15.3
Green Ratio (*g/C*)	0.30	0.33	0.33	0.27	0.33	0.33	0.18	0.22	0.22	0.41	0.22	0.22
Capacity (*c*), veh/h	160	1138	506	358	597	570	619	411	408	453	411	405
Volume-to-Capacity Ratio (*X*)	0.545	0.344	0.279	0.122	0.866	0.866	0.790	0.610	0.611	0.096	0.625	0.627
Available Capacity (*c a*), veh/h	160	1138	506	358	597	570	619	411	408	453	411	405
Back of Queue (*Q*), veh/ln (95 th percentile)	3.5	7.6	5.1	1.8	22.4	21.7	11.9	11.1	11.1	1.3	11.4	11.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.17	0.00	0.24	0.08	0.00	0.00	0.51	0.00	0.00	0.10	0.00	0.00
Uniform Delay (*d 1*), s/veh	34.5	30.1	7.7	33.8	37.5	37.5	46.8	41.8	41.8	22.8	41.9	42.0
Incremental Delay (*d 2*), s/veh	2.2	0.1	0.1	0.1	12.2	12.7	6.3	1.9	2.0	0.0	2.2	2.3
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	36.7	30.2	7.8	33.9	49.6	50.1	53.1	43.7	43.7	22.8	44.2	44.3
Level of Service (LOS)	D	C	A	C	D	D	D	D	D	C	D	D
Approach Delay, s/veh / LOS	26.0	C		49.2	D		48.3	D		42.5	D	
Intersection Delay, s/veh / LOS	43.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.8	C	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.0	A	1.4	A	1.3	A	0.9	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Galen…	File Name			
Project Description	**I-15 - Build 2038**				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	960	360	40	540	40	200	430	10	50	350	10

Signal Information			
Cycle, s	120.0	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	7.0	27.0	7.0	15.0	34.0	0.0	
Yellow	4.0	4.0	4.0	4.0	4.0	0.0	
Red	2.0	2.0	2.0	2.0	2.0	0.0	

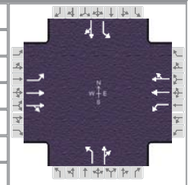
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.2	3.0	1.3	4.0	2.0	4.0	1.1	4.0
Phase Duration, s	13.0	46.0	13.0	46.0	21.0	40.0	21.0	40.0
Change Period, (*Y+R c*), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	3.0	3.1	3.0
Queue Clearance Time (*g s*), s	5.9	37.2	2.0	19.4	9.2	15.0	4.3	12.4
Green Extension Time (*g e*), s	0.0	1.3	0.7	1.2	0.2	1.5	0.0	1.5
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	1.00	0.38	0.00	0.05	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	1043	391	43	319	312	217	240	238	54	196	195
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1707	1706	1464	1707	1792	1749	1689	1827	1812	1740	1827	1809
Queue Service Time (*g s*), s	3.9	35.2	29.2	0.0	17.3	17.4	7.2	13.0	13.0	2.3	10.4	10.4
Cycle Queue Clearance Time (*g c*), s	3.9	35.2	29.2	0.0	17.3	17.4	7.2	13.0	13.0	2.3	10.4	10.4
Green Ratio (*g/C*)	0.30	0.33	0.33	0.27	0.33	0.33	0.12	0.28	0.28	0.41	0.28	0.28
Capacity (*c*), veh/h	221	1138	488	172	597	583	422	518	513	419	518	512
Volume-to-Capacity Ratio (*X*)	0.345	0.917	0.802	0.253	0.533	0.535	0.515	0.463	0.464	0.130	0.379	0.381
Available Capacity (*c a*), veh/h	221	1138	488	172	597	583	422	518	513	419	518	512
Back of Queue (*Q*), veh/ln (95 th percentile)	2.9	22.8	8.1	2.2	12.0	11.8	5.5	9.7	9.7	1.7	8.1	8.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14	0.00	0.40	0.11	0.00	0.00	0.24	0.00	0.00	0.12	0.00	0.00
Uniform Delay (*d 1*), s/veh	32.5	38.4	6.6	52.8	32.4	32.5	49.1	35.5	35.5	22.7	34.5	34.5
Incremental Delay (*d 2*), s/veh	0.3	11.4	8.7	0.3	0.5	0.5	0.5	0.2	0.2	0.1	0.2	0.2
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.8	49.8	15.2	53.1	32.9	33.0	49.6	35.7	35.7	22.7	34.7	34.7
Level of Service (LOS)	C	D	B	D	C	C	D	D	D	C	C	C
Approach Delay, s/veh / LOS	40.0	D		34.2	C		40.1	D		33.2	C	
Intersection Delay, s/veh / LOS	37.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.8	C	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.7	A	1.0	A	1.1	A	0.9	A

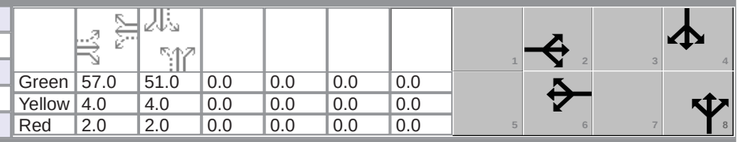
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Domi…	File Name			
Project Description	**I-16 - Build 2038**				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	360	10	20	940	60	10	60	10	250	80	20

Signal Information			
Cycle, s	120.0	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	57.0	51.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	

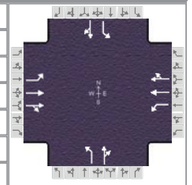
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		63.0		63.0		57.0		57.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.4		3.4
Queue Clearance Time (g_s), s		38.5		29.8		7.8		27.6
Green Extension Time (g_e), s		3.5		3.6		1.1		1.1
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.05		0.01		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	43	202	200	22	549	538	11	76		272	109	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	497	1792	1775	942	1792	1754	1125	1597		1159	1581	
Queue Service Time (g_s), s	8.7	8.0	8.0	1.7	27.8	27.8	0.7	3.5		22.2	5.1	
Cycle Queue Clearance Time (g_c), s	36.5	8.0	8.0	9.7	27.8	27.8	5.8	3.5		25.6	5.1	
Green Ratio (*g*/*C*)	0.48	0.48	0.48	0.48	0.48	0.48	0.42	0.42		0.42	0.42	
Capacity (*c*), veh/h	181	851	843	444	851	833	490	679		519	672	
Volume-to-Capacity Ratio (*X*)	0.240	0.237	0.238	0.049	0.645	0.645	0.022	0.112		0.523	0.162	
Available Capacity (c_a), veh/h	181	851	843	444	851	833	490	679		519	672	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.9	5.9	5.9	0.7	17.3	17.0	0.3	2.3		10.2	3.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.09	0.00	0.00	0.03	0.00	0.00	0.04	0.00		0.62	0.00	
Uniform Delay (d_1), s/veh	37.7	18.6	18.6	21.5	23.8	23.8	23.1	20.8		28.6	21.3	
Incremental Delay (d_2), s/veh	0.3	0.1	0.1	0.0	1.3	1.4	0.0	0.0		0.5	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	37.9	18.7	18.7	21.5	25.2	25.2	23.1	20.9		29.0	21.3	
Level of Service (LOS)	D	B	B	C	C	C	C	C		C	C	
Approach Delay, s/veh / LOS	20.6	C		25.1	C		21.1	C		26.8	C	
Intersection Delay, s/veh / LOS	24.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	0.9	A	1.4	A	0.6	A	1.1	A

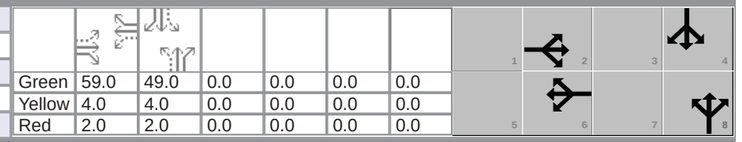
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ms consultants			Duration, h	0.25
Analyst	JRH	Analysis Date	Dec 3, 2016	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.92
Urban Street	Sunbury Parkway	Analysis Year	2038	Analysis Period	1> 7:00
Intersection	Sunbury Parkway/Domi…	File Name			
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	920	30	20	600	70	10	80	10	70	150	10

Signal Information			
Cycle, s	120.0	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	59.0	49.0	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	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		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		65.0		65.0		55.0		55.0
Change Period, (*Y*+*R* $_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.2		3.2
Queue Clearance Time (g_s), s		27.4		30.6		11.4		12.0
Green Extension Time (g_e), s		4.6		4.6		0.7		0.7
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.02		0.02		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	519	513	22	371	358	11	98		76	174	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	696	1792	1772	524	1792	1726	1060	1606		1136	1620	
Queue Service Time (g_s), s	9.4	24.9	24.9	3.7	15.9	15.9	0.8	4.6		5.4	8.5	
Cycle Queue Clearance Time (g_c), s	25.4	24.9	24.9	28.6	15.9	15.9	9.4	4.6		10.0	8.5	
Green Ratio (*g*/*C*)	0.49	0.49	0.49	0.49	0.49	0.49	0.41	0.41		0.41	0.41	
Capacity (*c*), veh/h	310	881	871	209	881	849	418	656		480	661	
Volume-to-Capacity Ratio (*X*)	0.246	0.589	0.589	0.104	0.420	0.421	0.026	0.149		0.158	0.263	
Available Capacity (c_a), veh/h	310	881	871	209	881	849	418	656		480	661	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.8	15.5	15.4	0.9	10.7	10.4	0.4	3.1		2.6	5.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.13	0.00	0.00	0.04	0.00	0.00	0.05	0.00		0.16	0.00	
Uniform Delay (d_1), s/veh	27.7	21.8	21.8	32.1	19.5	19.6	26.6	22.4		25.5	23.5	
Incremental Delay (d_2), s/veh	0.2	0.7	0.7	0.1	0.1	0.1	0.0	0.0		0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	27.8	22.5	22.5	32.1	19.7	19.7	26.6	22.4		25.6	23.6	
Level of Service (LOS)	C	C	C	C	B	B	C	C		C	C	
Approach Delay, s/veh / LOS	22.9	C		20.0	C		22.8	C		24.2	C	
Intersection Delay, s/veh / LOS	22.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.4	A	1.1	A	0.7	A	0.9	A

Appendix J

SimTraffic Queuing Reports

ms consultants, inc.
engineers, architects, planners

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	4:50	4:50	4:50	4:50	4:50	4:50	4:50
End Time	6:00	6:00	6:00	6:00	6:00	6:00	6:00
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	10435	10310	10270	10381	10306	10426	10523
Vehs Exited	10323	10133	10208	10330	10293	10323	10422
Starting Vehs	757	684	758	704	730	736	723
Ending Vehs	869	861	820	755	743	839	824
Travel Distance (mi)	20706	20772	20365	20611	20716	20694	21214
Travel Time (hr)	794.8	790.8	770.5	782.3	777.2	827.7	814.5
Total Delay (hr)	308.3	304.8	292.2	298.8	290.9	340.5	317.0
Total Stops	18810	17848	17821	18127	18053	18709	18903
Fuel Used (gal)	766.6	764.2	750.3	760.7	758.9	770.8	780.8

Summary of All Intervals

Run Number	8	16_AMpeak_9	MS_PID90200	Avg
Start Time	4:50	4:50	4:50	4:50
End Time	6:00	6:00	6:00	6:00
Total Time (min)	70	70	70	70
Time Recorded (min)	60	60	60	60
# of Intervals	2	2	2	2
# of Recorded Intervals	1	1	1	1
Vehs Entered	10379	10345	10413	10374
Vehs Exited	10242	10183	10361	10280
Starting Vehs	670	696	717	709
Ending Vehs	807	858	769	808
Travel Distance (mi)	20491	20761	20505	20683
Travel Time (hr)	814.2	781.4	777.3	793.1
Total Delay (hr)	332.5	295.5	296.9	307.7
Total Stops	18109	18004	17623	18196
Fuel Used (gal)	762.9	761.1	756.6	763.3

Interval #0 Information Seeding

Start Time	4:50
End Time	5:00
Total Time (min)	10
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	5:00
End Time	6:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	6	7
Vehs Entered	10435	10310	10270	10381	10306	10426	10523
Vehs Exited	10323	10133	10208	10330	10293	10323	10422
Starting Vehs	757	684	758	704	730	736	723
Ending Vehs	869	861	820	755	743	839	824
Travel Distance (mi)	20706	20772	20365	20611	20716	20694	21214
Travel Time (hr)	794.8	790.8	770.5	782.3	777.2	827.7	814.5
Total Delay (hr)	308.3	304.8	292.2	298.8	290.9	340.5	317.0
Total Stops	18810	17848	17821	18127	18053	18709	18903
Fuel Used (gal)	766.6	764.2	750.3	760.7	758.9	770.8	780.8

Interval #1 Information Recording

Start Time	5:00
End Time	6:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	8	16_AMpeak_9	MS_PID90200	Avg
Vehs Entered	10379	10345	10413	10374
Vehs Exited	10242	10183	10361	10280
Starting Vehs	670	696	717	709
Ending Vehs	807	858	769	808
Travel Distance (mi)	20491	20761	20505	20683
Travel Time (hr)	814.2	781.4	777.3	793.1
Total Delay (hr)	332.5	295.5	296.9	307.7
Total Stops	18109	18004	17623	18196
Fuel Used (gal)	762.9	761.1	756.6	763.3

1: Wilson Road & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.3	0.0	0.3	0.0	0.0	0.1	2.1	0.1	0.2	2.1	0.1	0.1
Total Del/Veh (s)	53.6	12.0	5.8	58.9	24.0	13.4	54.6	47.6	10.4	60.0	52.5	15.8
Stop/Veh	0.84	0.33	0.40	0.93	0.44	0.44	0.90	0.81	0.84	0.90	0.83	0.85

1: Wilson Road & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	25.9
Stop/Veh	0.54

4: Sunbury Pkwy & Africa Road/US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	3.3	0.6	2.9	0.2	0.0	0.4	0.0	0.0	0.0	1.3	0.3	1.1
Total Del/Veh (s)	40.3	38.3	23.2	56.1	44.6	10.4	28.1	16.4	5.1	46.1	16.6	4.1
Stop/Veh	0.88	0.72	0.58	0.90	0.69	0.43	1.00	0.37	0.30	0.81	0.40	0.35

4: Sunbury Pkwy & Africa Road/US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.4
Total Del/Veh (s)	21.9
Stop/Veh	0.49

5: Galena Road & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.5
Total Del/Veh (s)	46.0	39.4	31.8	55.1	59.1	49.7	26.0	15.4	19.9	66.6	70.1	64.0
Stop/Veh	1.15	0.71	0.78	1.06	0.84	0.80	0.87	0.35	0.64	1.16	1.05	1.07

5: Galena Road & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	44.1
Stop/Veh	0.75

8: Fourwinds Dr & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.2	0.3	0.5	0.0	0.0
Total Del/Veh (s)	28.8	32.7	11.9	54.1	17.5	7.3	35.3	44.9	34.3	31.6	27.2	15.5
Stop/Veh	0.90	0.44	0.40	0.94	0.41	0.42	0.75	0.75	0.83	0.79	0.54	0.70

8: Fourwinds Dr & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	29.6
Stop/Veh	0.52

9: Galena Road & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	18.5	17.6	16.8	1.0	0.1	1.2
Total Del/Veh (s)	28.0	20.3	9.5	24.6	36.6	34.0	348.8	92.9	52.1	30.1	45.1	29.7
Stop/Veh	0.84	0.39	0.49	0.71	0.58	0.62	1.84	1.31	0.82	0.84	0.76	0.75

9: Galena Road & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	5.6
Total Del/Veh (s)	91.1
Stop/Veh	0.90

10: US 36/SR 37 & N 3B's & K Rd. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	0.2	0.0
Total Del/Veh (s)	7.4	4.8	1.3	0.5	31.1	17.9	4.8
Stop/Veh	0.45	0.00	0.00	0.00	0.99	1.00	0.07

11: SB 71 & Sunbury Pkwy Performance by movement

Movement	EBT	EBR	WBT	WBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	10.3	16.0	5.1	11.1	11.2
Stop/Veh	0.01	0.01	0.00	0.02	0.01

17: Domigan Road & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.2	0.2	1.1	0.1	0.1
Total Del/Veh (s)	26.2	11.5	9.5	16.1	16.6	14.3	33.6	32.7	11.3	56.3	34.1	18.6
Stop/Veh	0.83	0.26	0.36	0.50	0.28	0.34	0.80	0.72	0.82	1.00	0.72	0.76

17: Domigan Road & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	22.2
Stop/Veh	0.43

22: I-71 NB ramps & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBT	NBR	All
Denied Del/Veh (s)	0.1	0.0	0.0	0.1	0.6	0.3	0.2	0.1
Total Del/Veh (s)	14.7	7.9	21.2	13.8	47.5	52.9	6.0	20.5
Stop/Veh	0.72	0.26	0.45	0.38	0.86	0.80	0.76	0.47

28: Sunbury Pkwy & US 36/SR 37 Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.3	0.8	0.0	0.0	0.3
Total Del/Veh (s)	28.4	9.8	7.3	6.2	49.1	41.4	13.2
Stop/Veh	0.88	0.19	0.16	0.19	0.86	0.82	0.26

31: Fourwinds Dr & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.4	4.1
Total Del/Veh (s)	13.0	3.4	2.2	18.7	3.9	3.0	43.6	4.3	9.0	57.3	45.1	7.8
Stop/Veh	0.80	0.09	0.12	0.86	0.08	0.13	0.88	0.05	0.85	0.92	0.79	0.81

31: Fourwinds Dr & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	7.7
Stop/Veh	0.20

35: Domigan Road & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.2
Total Del/Veh (s)	18.2	16.4	11.7	15.2	11.7	7.3	32.1	33.1	18.7	35.3	36.7	19.2
Stop/Veh	0.59	0.21	0.26	0.67	0.25	0.20	0.88	0.73	0.82	0.83	0.81	0.82

35: Domigan Road & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.0
Total Del/Veh (s)	17.8
Stop/Veh	0.40

37: S. 3B's & K Rd. & US 36/SR 37 Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.1	0.2	0.0
Total Del/Veh (s)	1.3	0.4	5.5	2.1	24.1	11.0	2.5
Stop/Veh	0.00	0.00	0.47	0.00	1.00	0.99	0.08

902: Bob Evans/McDonald's & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.5	0.0	0.1	0.2	0.3	0.2	3.1	0.4	0.5
Total Del/Veh (s)	18.3	12.9	10.2	18.7	7.8	6.0	43.0	48.5	22.6	45.9	41.1	12.4
Stop/Veh	0.82	0.33	0.39	0.78	0.22	0.30	0.82	0.88	0.87	0.90	0.90	0.83

902: Bob Evans/McDonald's & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	15.1
Stop/Veh	0.42

903: SB 71 & US 36/SR 37 Performance by movement

Movement	EBT	EBR	WBL	WBT	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	1.7	3.5	0.7
Total Del/Veh (s)	13.6	5.6	37.6	5.9	44.3	12.2	14.9
Stop/Veh	0.35	0.37	0.74	0.13	0.78	0.83	0.47

904: NB 71 & US 36/SR 37 Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBT	NBR	All
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	1.1	0.5	1.5	0.3
Total Del/Veh (s)	42.0	8.5	17.1	6.9	53.1	49.8	8.7	23.9
Stop/Veh	0.85	0.30	0.34	0.49	0.92	0.83	0.75	0.55

906: Wilson Road/Wilson & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	3.3	0.3	0.8
Total Del/Veh (s)	44.4	7.9	2.9	19.4	20.3	15.0	41.3	16.2	17.9	59.3	47.9	9.4
Stop/Veh	0.81	0.23	0.23	0.70	0.37	0.36	0.94	0.40	0.84	0.93	0.78	0.61

906: Wilson Road/Wilson & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	19.9
Stop/Veh	0.49

Total Network Performance

Denied Del/Veh (s)	2.4
Total Del/Veh (s)	97.7
Stop/Veh	1.64

Intersection: 1: Wilson Road & Sunbury Pkwy

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB
Directions Served	L	L	T	T	R	L	T	T	T	R	L	TR
Maximum Queue (ft)	183	195	139	164	50	138	223	250	296	92	114	82
Average Queue (ft)	79	101	58	78	9	45	99	128	164	28	37	26
95th Queue (ft)	152	166	123	144	34	100	186	221	272	65	84	64
Link Distance (ft)			1583	1583			3191	3191				2560
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	250	250			250	250			750	750	250	
Storage Blk Time (%)	0	0					0					
Queuing Penalty (veh)	0	0					0					

Intersection: 1: Wilson Road & Sunbury Pkwy

Movement	SB	SB	SB
Directions Served	L	T	R
Maximum Queue (ft)	96	98	146
Average Queue (ft)	40	32	69
95th Queue (ft)	84	76	125
Link Distance (ft)		2816	2816
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	250		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Sunbury Pkwy & Africa Road/US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	TR	L	T	T	R	R	L	T	T	T
Maximum Queue (ft)	183	312	250	56	160	162	160	146	38	195	194	211
Average Queue (ft)	42	173	134	10	82	84	64	66	7	82	88	100
95th Queue (ft)	106	264	233	37	141	144	123	120	27	167	176	192
Link Distance (ft)		1186			1851	1851				2388	2388	2388
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	250		250	250			500	500	250			
Storage Blk Time (%)	0	1	0		0					0		
Queuing Penalty (veh)	0	2	0		0					0		

Intersection: 4: Sunbury Pkwy & Africa Road/US 36/SR 37

Movement	NB	SB	SB	SB	SB	SB	SB
Directions Served	R	L	L	T	T	T	R
Maximum Queue (ft)	28	209	317	420	418	395	67
Average Queue (ft)	2	109	137	214	219	200	14
95th Queue (ft)	15	187	240	345	353	335	45
Link Distance (ft)				1815	1815	1815	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)	725	400	400				725
Storage Blk Time (%)				0			
Queuing Penalty (veh)				1			

Intersection: 5: Galena Road & US 36/SR 37

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	475	638	324	646
Average Queue (ft)	194	288	154	342
95th Queue (ft)	372	589	285	639
Link Distance (ft)	3513	5896	1585	1551
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 8: Fourwinds Dr & Sunbury Pkwy

Movement	EB	EB	EB	EB	EB	B2	B2	B2	WB	WB	WB	WB
Directions Served	L	T	T	T	R	T	T	T	L	L	T	T
Maximum Queue (ft)	194	499	526	538	245	240	237	237	114	123	189	201
Average Queue (ft)	49	230	252	250	17	8	8	8	56	75	86	102
95th Queue (ft)	161	422	445	448	108	237	233	233	103	113	154	171
Link Distance (ft)		1898	1898	1898		2388	2388	2388			1900	1900
Upstream Blk Time (%)						0						
Queuing Penalty (veh)						0						
Storage Bay Dist (ft)	400				400				400	400		
Storage Blk Time (%)		2		3	0							
Queuing Penalty (veh)		1		1	0							

Intersection: 8: Fourwinds Dr & Sunbury Pkwy

Movement	WB	WB	NB	NB	NB	SB	SB
Directions Served	T	R	L	T	R	L	TR
Maximum Queue (ft)	213	94	30	160	322	123	146
Average Queue (ft)	108	41	5	70	170	45	56
95th Queue (ft)	181	76	20	140	286	95	118
Link Distance (ft)	1900			1140	1140		2843
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		400	400			400	
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 9: Galena Road & Sunbury Pkwy

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	TR	L	L	T	TR	L
Maximum Queue (ft)	116	144	154	97	147	396	415	262	275	1466	1436	89
Average Queue (ft)	45	58	70	34	25	213	251	259	273	1071	988	30
95th Queue (ft)	90	118	126	74	89	355	385	278	287	1741	1686	67
Link Distance (ft)		3191	3191			5895	5895			1426	1426	
Upstream Blk Time (%)										26	4	
Queuing Penalty (veh)										0	0	
Storage Bay Dist (ft)	400			400	400			250	250			250
Storage Blk Time (%)						0		20	70	2		
Queuing Penalty (veh)						0		44	158	8		

Intersection: 9: Galena Road & Sunbury Pkwy

Movement	SB	SB
Directions Served	T	TR
Maximum Queue (ft)	256	259
Average Queue (ft)	144	140
95th Queue (ft)	222	222
Link Distance (ft)	1222	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		600
Storage Blk Time (%)	0	
Queuing Penalty (veh)	1	

Intersection: 10: US 36/SR 37 & N 3B's & K Rd.

Movement	EB	WB	SB
Directions Served	L	TR	LR
Maximum Queue (ft)	28	4	147
Average Queue (ft)	5	0	61
95th Queue (ft)	21	4	117
Link Distance (ft)		426	854
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	250		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 11: SB 71 & Sunbury Pkwy

Movement	EB	EB	EB	WB	WB
Directions Served	T	TR	R	T	TR
Maximum Queue (ft)	345	596	385	16	47
Average Queue (ft)	11	32	13	1	2
95th Queue (ft)	244	418	268	11	18
Link Distance (ft)	1900	1900	1900	722	722
Upstream Blk Time (%)	0	0	0		
Queuing Penalty (veh)	0	0	0		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 17: Domigan Road & Sunbury Pkwy

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	81	122	111	40	239	247	45	113	269	312
Average Queue (ft)	26	35	42	9	104	118	9	45	165	79
95th Queue (ft)	63	98	99	32	212	222	32	96	258	230
Link Distance (ft)		5895	5895		6024	6024		1432		2472
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	400			400			250		250	
Storage Blk Time (%)									5	0
Queuing Penalty (veh)									5	0

Intersection: 22: I-71 NB ramps & Sunbury Pkwy

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB
Directions Served	L	T	T	T	T	T	R	L	LT	R
Maximum Queue (ft)	99	182	147	236	340	386	172	205	238	69
Average Queue (ft)	32	81	61	94	147	201	10	112	155	32
95th Queue (ft)	73	152	129	193	274	337	82	188	214	58
Link Distance (ft)		722	722	1583	1583	1583			1210	1210
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	200						250	500		
Storage Blk Time (%)		0				4	0			
Queuing Penalty (veh)		0				1	0			

Intersection: 28: Sunbury Pkwy & US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	SB	SB
Directions Served	L	T	T	T	T	R	L	LR
Maximum Queue (ft)	44	145	152	141	168	95	204	212
Average Queue (ft)	8	49	54	63	74	40	103	115
95th Queue (ft)	30	116	120	120	143	78	175	181
Link Distance (ft)		6024	6024	3679	3679			932
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	250					600	300	
Storage Blk Time (%)							0	
Queuing Penalty (veh)							0	

Intersection: 31: Fourwinds Dr & US 36/SR 37

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	R	L	T
Maximum Queue (ft)	93	144	148	43	121	68	101	80	60	46	153	87
Average Queue (ft)	39	35	41	7	54	15	32	24	12	9	75	23
95th Queue (ft)	76	96	106	29	101	48	79	65	39	30	136	64
Link Distance (ft)		1141	1141			858	858		2843			594
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400			250	300			300		250	300	
Storage Blk Time (%)												
Queuing Penalty (veh)												

Intersection: 31: Fourwinds Dr & US 36/SR 37

Movement	SB
Directions Served	R
Maximum Queue (ft)	53
Average Queue (ft)	14
95th Queue (ft)	41
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	250
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 35: Domigan Road & US 36/SR 37

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	180	191	199	220
Average Queue (ft)	69	69	91	97
95th Queue (ft)	143	153	168	180
Link Distance (ft)	5896	5965	2472	1938
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 37: S. 3B's & K Rd. & US 36/SR 37

Movement	EB	WB	NB
Directions Served	T	L	LR
Maximum Queue (ft)	5	40	123
Average Queue (ft)	0	7	52
95th Queue (ft)	5	28	97
Link Distance (ft)	426		696
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		250	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 902: Bob Evans/McDonald's & US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	LTR	L	TR
Maximum Queue (ft)	142	254	263	128	214	238	183	124	301
Average Queue (ft)	47	111	131	58	84	98	79	105	93
95th Queue (ft)	100	213	235	107	170	192	147	143	244
Link Distance (ft)		858	858		774	774	402		1136
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	200			380				100	
Storage Blk Time (%)		1						27	0
Queuing Penalty (veh)		1						14	0

Intersection: 903: SB 71 & US 36/SR 37

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	T	T	T	R	L	T	T	L	LT	R	R
Maximum Queue (ft)	260	216	160	137	388	113	115	66	154	235	213
Average Queue (ft)	94	59	41	42	174	22	33	15	31	119	69
95th Queue (ft)	213	155	114	99	322	71	87	49	92	203	160
Link Distance (ft)		774	774		630	630	630		669		
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	350			400				250		250	250
Storage Blk Time (%)										0	0
Queuing Penalty (veh)										0	0

Intersection: 904: NB 71 & US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	T	T	T	R	L	LT	R	R
Maximum Queue (ft)	474	210	174	224	165	120	101	239	292	89	59
Average Queue (ft)	272	52	59	102	53	33	17	97	157	25	22
95th Queue (ft)	430	141	137	201	127	91	58	203	249	63	45
Link Distance (ft)	630	630	630		1078	1078			568	568	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)				300			200	400			400
Storage Blk Time (%)					0						
Queuing Penalty (veh)					0						

Intersection: 906: Wilson Road/Wilson & US 36/SR 37

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	TR	L	L	T	TR	L
Maximum Queue (ft)	199	233	218	56	46	213	222	34	39	115	149	91
Average Queue (ft)	96	125	62	12	7	100	100	6	5	36	64	32
95th Queue (ft)	172	196	149	39	30	192	197	23	22	88	125	74
Link Distance (ft)		1078	1078			3513				2816	2816	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400			600	300		600	250	250			575
Storage Blk Time (%)						0						
Queuing Penalty (veh)						0						

Intersection: 906: Wilson Road/Wilson & US 36/SR 37

Movement	SB	SB	SB
Directions Served	T	R	R
Maximum Queue (ft)	121	176	141
Average Queue (ft)	50	85	49
95th Queue (ft)	101	145	102
Link Distance (ft)	1135	1135	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			575
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 238

Summary of All Intervals

Run Number	1	2	3	4	5	6	7
Start Time	4:50	4:50	4:50	4:50	4:50	4:50	4:50
End Time	6:00	6:00	6:00	6:00	6:00	6:00	6:00
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1	1
Vehs Entered	12452	12504	12328	12308	12405	12500	12451
Vehs Exited	12072	12347	12082	12076	12120	12133	12358
Starting Vehs	972	994	975	948	908	928	959
Ending Vehs	1352	1151	1221	1180	1193	1295	1052
Travel Distance (mi)	26570	26756	26682	26326	26480	26420	26918
Travel Time (hr)	1174.5	1108.3	1121.2	1109.7	1068.8	1212.5	1147.4
Total Delay (hr)	555.0	485.5	501.3	497.4	451.4	596.3	519.3
Total Stops	28561	28529	27618	27364	26748	29013	28875
Fuel Used (gal)	1009.8	1005.1	1002.4	992.3	982.4	1015.1	1016.3

Summary of All Intervals

Run Number	8	16_PMpeak_9MS_PID90200	Avg
Start Time	4:50	4:50	4:50	4:50
End Time	6:00	6:00	6:00	6:00
Total Time (min)	70	70	70	70
Time Recorded (min)	60	60	60	60
# of Intervals	2	2	2	2
# of Recorded Intervals	1	1	1	1
Vehs Entered	12491	12636	12434	12449
Vehs Exited	12155	12181	12058	12158
Starting Vehs	957	928	931	946
Ending Vehs	1293	1383	1307	1233
Travel Distance (mi)	26829	26849	26568	26640
Travel Time (hr)	1143.5	1184.2	1144.2	1141.4
Total Delay (hr)	518.7	557.9	525.9	520.9
Total Stops	28199	29242	28323	28241
Fuel Used (gal)	1009.3	1025.3	1004.8	1006.3

Interval #0 Information Seeding

Start Time	4:50
End Time	5:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

I-71 & US 36/SR 37 IMS
Build Condition
DEL-71-9.71 (PID 90200)
PM Peak

Interval #1 Information Recording

Start Time	5:00
End Time	6:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	6	7
Vehs Entered	12452	12504	12328	12308	12405	12500	12451
Vehs Exited	12072	12347	12082	12076	12120	12133	12358
Starting Vehs	972	994	975	948	908	928	959
Ending Vehs	1352	1151	1221	1180	1193	1295	1052
Travel Distance (mi)	26570	26756	26682	26326	26480	26420	26918
Travel Time (hr)	1174.5	1108.3	1121.2	1109.7	1068.8	1212.5	1147.4
Total Delay (hr)	555.0	485.5	501.3	497.4	451.4	596.3	519.3
Total Stops	28561	28529	27618	27364	26748	29013	28875
Fuel Used (gal)	1009.8	1005.1	1002.4	992.3	982.4	1015.1	1016.3

Interval #1 Information Recording

Start Time	5:00
End Time	6:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	8	16_PMpeak_9MS_PID90200	Avg
Vehs Entered	12491	12636	12434	12449
Vehs Exited	12155	12181	12058	12158
Starting Vehs	957	928	931	946
Ending Vehs	1293	1383	1307	1233
Travel Distance (mi)	26829	26849	26568	26640
Travel Time (hr)	1143.5	1184.2	1144.2	1141.4
Total Delay (hr)	518.7	557.9	525.9	520.9
Total Stops	28199	29242	28323	28241
Fuel Used (gal)	1009.3	1025.3	1004.8	1006.3

1: Wilson Road & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.4	0.0	0.3	0.0	0.0	0.0	2.0	0.2	0.2	2.5	0.3	0.2
Total Del/Veh (s)	66.6	13.2	8.8	52.8	24.1	10.7	47.6	43.5	25.6	54.5	44.3	16.0
Stop/Veh	0.91	0.15	0.15	0.94	0.46	0.56	0.84	0.76	0.79	0.90	0.71	0.82

1: Wilson Road & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	24.5
Stop/Veh	0.46

4: Sunbury Pkwy & Africa Road/US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	3.4	0.7	3.4	0.1	0.0	0.3	0.0	0.0	0.1	1.4	0.3	1.2
Total Del/Veh (s)	43.0	34.2	18.1	62.4	55.0	29.9	81.3	30.6	9.2	97.4	18.7	5.5
Stop/Veh	0.95	0.67	0.64	1.00	0.77	0.62	1.00	0.54	0.25	1.20	0.46	0.41

4: Sunbury Pkwy & Africa Road/US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.4
Total Del/Veh (s)	36.1
Stop/Veh	0.63

5: Galena Road & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	12.8	17.0	24.6	0.3	0.0	0.1	0.0	0.0	0.0	0.3	0.3	0.3
Total Del/Veh (s)	184.3	174.0	170.0	164.5	153.6	147.6	250.9	199.5	239.5	65.6	70.7	58.4
Stop/Veh	1.92	1.49	1.48	1.94	1.54	1.55	1.25	0.99	1.26	1.10	1.00	1.00

5: Galena Road & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	5.9
Total Del/Veh (s)	161.3
Stop/Veh	1.37

8: Fourwinds Dr & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.3	0.2	1.5	0.2	0.1
Total Del/Veh (s)	33.3	27.5	7.3	51.0	15.1	8.6	36.1	51.1	20.2	58.1	37.7	26.8
Stop/Veh	0.96	0.38	0.43	0.82	0.33	0.32	0.87	0.81	0.80	1.01	0.62	0.70

8: Fourwinds Dr & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	25.1
Stop/Veh	0.46

9: Galena Road & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.4	0.3	0.6	0.1	0.6
Total Del/Veh (s)	26.1	32.9	19.8	28.1	27.6	23.5	57.4	40.4	19.9	34.4	44.5	25.3
Stop/Veh	0.78	0.59	0.63	0.85	0.53	0.56	0.93	0.71	0.70	0.90	0.78	0.80

9: Galena Road & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	34.0
Stop/Veh	0.66

10: US 36/SR 37 & N 3B's & K Rd. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.1	0.1	0.0
Total Del/Veh (s)	39.1	4.8	3.6	2.4	332.0	247.2	10.3
Stop/Veh	0.87	0.00	0.00	0.04	0.97	1.00	0.04

11: SB 71 & Sunbury Pkwy Performance by movement

Movement	EBT	EBR	WBT	WBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	11.0	9.3	4.7	10.0	7.6
Stop/Veh	0.01	0.01	0.00	0.01	0.01

17: Domigan Road & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.2	0.2	0.1	0.0	0.0
Total Del/Veh (s)	24.4	18.5	17.3	24.5	12.8	11.0	47.6	34.2	22.7	42.9	31.8	23.3
Stop/Veh	0.74	0.23	0.29	0.75	0.21	0.30	0.91	0.74	0.82	0.88	0.63	0.80

17: Domigan Road & Sunbury Pkwy Performance by movement

Movement	All
Denied Del/Veh (s)	0.0
Total Del/Veh (s)	19.5
Stop/Veh	0.33

22: I-71 NB ramps & Sunbury Pkwy Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBT	NBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.4	0.8	0.7	0.6	0.3
Total Del/Veh (s)	38.4	27.8	41.0	12.9	43.7	46.1	20.1	35.6
Stop/Veh	1.02	0.51	0.75	0.76	0.81	0.75	0.59	0.69

28: Sunbury Pkwy & US 36/SR 37 Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.4	0.9	0.1	0.3	0.3
Total Del/Veh (s)	71.2	20.0	10.8	14.9	46.9	42.0	21.9
Stop/Veh	0.92	0.35	0.25	0.33	0.81	0.80	0.41

31: Fourwinds Dr & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	4.0	0.3	4.0
Total Del/Veh (s)	34.4	7.5	3.1	26.5	16.4	17.1	51.4	31.1	14.6	55.0	43.0	22.3
Stop/Veh	0.96	0.17	0.25	0.91	0.26	0.32	0.93	0.57	0.80	0.93	0.79	0.76

31: Fourwinds Dr & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	16.8
Stop/Veh	0.37

35: Domigan Road & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3
Total Del/Veh (s)	82.4	78.8	71.3	37.6	24.7	22.4	73.5	54.7	46.8	65.4	65.5	54.4
Stop/Veh	1.16	0.83	0.85	0.80	0.37	0.45	1.12	0.87	0.91	0.95	0.89	0.92

35: Domigan Road & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.0
Total Del/Veh (s)	50.9
Stop/Veh	0.67

37: S. 3B's & K Rd. & US 36/SR 37 Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	0.2	0.0
Total Del/Veh (s)	1.4	0.4	10.4	6.8	112.8	38.4	6.6
Stop/Veh	0.00	0.00	0.53	0.00	1.00	0.99	0.05

902: Bob Evans/McDonald's & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.7	0.2	0.3	0.2	0.3	0.2	3.2	0.4	0.4
Total Del/Veh (s)	44.3	11.3	10.1	20.1	16.4	16.8	44.6	52.1	28.3	50.1	37.3	28.6
Stop/Veh	0.98	0.31	0.42	0.80	0.36	0.43	0.86	0.90	0.88	0.92	0.80	0.84

902: Bob Evans/McDonald's & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	18.0
Stop/Veh	0.43

903: SB 71 & US 36/SR 37 Performance by movement

Movement	EBT	EBR	WBL	WBT	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	2.5	2.4	3.6	1.0
Total Del/Veh (s)	42.7	6.2	69.3	20.6	35.3	40.8	28.5	31.7
Stop/Veh	0.80	0.70	0.89	0.37	0.70	0.70	0.80	0.67

904: NB 71 & US 36/SR 37 Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBT	NBR	All
Denied Del/Veh (s)	0.6	0.0	0.0	0.0	1.1	0.9	1.5	0.6
Total Del/Veh (s)	61.7	26.8	33.4	15.9	44.7	45.6	11.6	33.6
Stop/Veh	1.00	0.75	0.50	0.68	0.91	0.80	0.60	0.72

906: Wilson Road/Wilson & US 36/SR 37 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.3	0.8
Total Del/Veh (s)	37.0	21.6	5.5	25.1	30.1	32.9	37.6	18.2	18.6	56.9	51.1	8.8
Stop/Veh	0.78	0.51	0.43	0.80	0.51	0.70	0.85	0.44	0.76	0.94	0.80	0.51

906: Wilson Road/Wilson & US 36/SR 37 Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	26.1
Stop/Veh	0.58

Total Network Performance

Denied Del/Veh (s)	2.3
Total Del/Veh (s)	137.9
Stop/Veh	2.11

Intersection: 1: Wilson Road & Sunbury Pkwy

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB
Directions Served	L	L	T	T	R	L	T	T	T	R	L	TR
Maximum Queue (ft)	217	224	356	229	65	94	168	203	246	65	128	136
Average Queue (ft)	105	124	75	89	8	23	78	92	113	19	45	51
95th Queue (ft)	179	193	243	188	40	62	151	172	212	51	100	110
Link Distance (ft)			1583	1583			3191	3191				2560
Upstream Blk Time (%)			0									
Queuing Penalty (veh)			0									
Storage Bay Dist (ft)	250	250			250	250			750	750	250	
Storage Blk Time (%)	0	0	0	0	0		0					
Queuing Penalty (veh)	0	1	0	0	0		0					

Intersection: 1: Wilson Road & Sunbury Pkwy

Movement	SB	SB	SB
Directions Served	L	T	R
Maximum Queue (ft)	174	74	228
Average Queue (ft)	72	20	110
95th Queue (ft)	139	55	186
Link Distance (ft)		2816	2816
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	250		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Sunbury Pkwy & Africa Road/US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	TR	L	T	T	R	R	L	T	T	T
Maximum Queue (ft)	212	282	242	68	340	322	299	294	93	395	407	409
Average Queue (ft)	70	149	103	11	187	184	191	188	11	249	252	256
95th Queue (ft)	149	242	209	47	298	288	279	270	54	356	370	369
Link Distance (ft)		1186			1851	1851				2388	2388	2388
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	250		250	250			500	500	250			
Storage Blk Time (%)	0	0	0		4					4		
Queuing Penalty (veh)	0	1	0		0					0		

Intersection: 4: Sunbury Pkwy & Africa Road/US 36/SR 37

Movement	NB	SB	SB	SB	SB	SB	SB
Directions Served	R	L	L	T	T	T	R
Maximum Queue (ft)	24	371	383	640	614	514	61
Average Queue (ft)	2	249	267	279	265	191	10
95th Queue (ft)	12	420	431	654	593	381	37
Link Distance (ft)				1815	1815	1815	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)	725	400	400				725
Storage Blk Time (%)		1	7	0			
Queuing Penalty (veh)		5	40	0			

Intersection: 5: Galena Road & US 36/SR 37

Movement	EB	WB	NB	B39	B39	SB
Directions Served	LTR	LTR	LTR	T		LTR
Maximum Queue (ft)	2077	2119	1503	358	161	441
Average Queue (ft)	1215	1140	864	65	8	218
95th Queue (ft)	2449	2391	1678	398	116	429
Link Distance (ft)	3513	5896	1585	1222	1222	1551
Upstream Blk Time (%)			12			
Queuing Penalty (veh)			64			
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 8: Fourwinds Dr & Sunbury Pkwy

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	WB	NB
Directions Served	L	T	T	T	R	L	L	T	T	T	R	L
Maximum Queue (ft)	92	355	378	339	34	142	158	285	294	300	94	64
Average Queue (ft)	38	188	203	181	8	68	92	141	152	166	45	19
95th Queue (ft)	75	309	322	296	28	121	140	247	262	270	83	51
Link Distance (ft)		1898	1898	1898				1900	1900	1900		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400				400	400	400				400	400
Storage Blk Time (%)		0		0								
Queuing Penalty (veh)		0		0								

Intersection: 8: Fourwinds Dr & Sunbury Pkwy

Movement	NB	NB	SB	SB
Directions Served	T	R	L	TR
Maximum Queue (ft)	173	180	259	186
Average Queue (ft)	83	68	124	83
95th Queue (ft)	153	139	225	164
Link Distance (ft)	1140	1140		2843
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			400	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 9: Galena Road & Sunbury Pkwy

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	TR	L	L	T	TR	L
Maximum Queue (ft)	136	398	394	311	85	240	259	174	227	256	218	97
Average Queue (ft)	42	234	243	106	27	121	148	63	113	155	112	38
95th Queue (ft)	101	363	362	212	64	220	247	140	182	230	206	79
Link Distance (ft)		3191	3191			5895	5895			1426	1426	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400			400	400			250	250			250
Storage Blk Time (%)		0	0	0					0	0		
Queuing Penalty (veh)		0	1	0					0	1		

Intersection: 9: Galena Road & Sunbury Pkwy

Movement	SB	SB
Directions Served	T	TR
Maximum Queue (ft)	205	225
Average Queue (ft)	111	114
95th Queue (ft)	180	190
Link Distance (ft)	1222	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		600
Storage Blk Time (%)	0	
Queuing Penalty (veh)	0	

Intersection: 10: US 36/SR 37 & N 3B's & K Rd.

Movement	EB	WB	WB	SB
Directions Served	L	T	TR	LR
Maximum Queue (ft)	100	5	35	265
Average Queue (ft)	37	0	5	125
95th Queue (ft)	84	5	23	286
Link Distance (ft)		426	426	854
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)	250			
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 11: SB 71 & Sunbury Pkwy

Movement	EB	EB	WB	WB	WB
Directions Served	T	TR	T	T	TR
Maximum Queue (ft)	21	55	35	53	42
Average Queue (ft)	1	3	1	2	2
95th Queue (ft)	13	24	35	39	20
Link Distance (ft)	1900	1900	722	722	722
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 17: Domigan Road & Sunbury Pkwy

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	107	231	238	52	141	164	58	157	128	209
Average Queue (ft)	37	74	87	15	51	67	10	64	50	98
95th Queue (ft)	85	192	210	44	123	148	37	126	99	173
Link Distance (ft)		5895	5895		6024	6024		1432		2472
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	400			400			250		250	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 22: I-71 NB ramps & Sunbury Pkwy

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB
Directions Served	L	T	T	T	T	T	R	L	LT	R
Maximum Queue (ft)	224	398	372	298	400	443	251	491	664	419
Average Queue (ft)	93	213	211	187	228	253	37	326	378	179
95th Queue (ft)	206	337	328	286	340	378	175	449	545	328
Link Distance (ft)		722	722	1583	1583	1583			1210	1210
Upstream Blk Time (%)									0	0
Queuing Penalty (veh)									0	0
Storage Bay Dist (ft)	200						250	500		
Storage Blk Time (%)	0	14				10	0	0	0	
Queuing Penalty (veh)	1	16				4	0	0	2	

Intersection: 28: Sunbury Pkwy & US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	SB	SB
Directions Served	L	T	T	T	T	R	L	LR
Maximum Queue (ft)	80	317	318	148	168	270	318	435
Average Queue (ft)	15	166	168	78	88	132	188	205
95th Queue (ft)	54	288	287	136	154	234	305	347
Link Distance (ft)		6024	6024	3679	3679			932
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	250					600	300	
Storage Blk Time (%)		1					0	2
Queuing Penalty (veh)		0					1	5

Intersection: 31: Fourwinds Dr & US 36/SR 37

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	R	L	T
Maximum Queue (ft)	115	151	161	57	183	372	408	208	136	156	80	72
Average Queue (ft)	37	70	77	11	67	158	196	96	51	69	27	23
95th Queue (ft)	87	138	139	40	133	314	352	175	106	129	68	58
Link Distance (ft)		1141	1141			858	858		2843			594
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400			250	300			300		250	300	
Storage Blk Time (%)					0	1				0		
Queuing Penalty (veh)					0	1				0		

Intersection: 31: Fourwinds Dr & US 36/SR 37

Movement	SB
Directions Served	R
Maximum Queue (ft)	96
Average Queue (ft)	31
95th Queue (ft)	72
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	250
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 35: Domigan Road & US 36/SR 37

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	1152	648	369	450
Average Queue (ft)	462	201	155	189
95th Queue (ft)	1192	474	303	376
Link Distance (ft)	5896	5965	2472	1938
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 37: S. 3B's & K Rd. & US 36/SR 37

Movement	EB	WB	NB
Directions Served	TR	L	LR
Maximum Queue (ft)	8	68	229
Average Queue (ft)	0	24	73
95th Queue (ft)	5	56	184
Link Distance (ft)	426		696
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		250	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 902: Bob Evans/McDonald's & US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	LTR	L	TR
Maximum Queue (ft)	128	257	245	262	541	581	248	124	259
Average Queue (ft)	48	146	145	57	259	296	111	93	73
95th Queue (ft)	100	226	220	155	482	513	200	139	191
Link Distance (ft)		858	858		774	774	402		1136
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	200			380				100	
Storage Blk Time (%)	0	2		0	2			20	1
Queuing Penalty (veh)	0	1		0	2			12	2

Intersection: 903: SB 71 & US 36/SR 37

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	T	T	T	R	L	T	T	L	LT	R	R
Maximum Queue (ft)	349	413	348	103	311	299	303	241	564	275	262
Average Queue (ft)	226	211	182	39	146	153	166	46	178	241	215
95th Queue (ft)	349	346	302	76	269	274	284	139	463	306	304
Link Distance (ft)		774	774		630	630	630		669		
Upstream Blk Time (%)									0		
Queuing Penalty (veh)									0		
Storage Bay Dist (ft)	350			400				250		250	250
Storage Blk Time (%)	1	1							0	7	1
Queuing Penalty (veh)	3	2							1	8	1

Intersection: 904: NB 71 & US 36/SR 37

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	T	T	T	R	L	LT	R	R
Maximum Queue (ft)	522	342	351	221	222	223	147	413	500	131	127
Average Queue (ft)	376	242	244	110	115	117	38	227	292	60	52
95th Queue (ft)	502	346	342	195	199	201	103	360	435	110	99
Link Distance (ft)	630	630	630		1078	1078			568	568	
Upstream Blk Time (%)	0								0		
Queuing Penalty (veh)	1								0		
Storage Bay Dist (ft)				300			200	400			400
Storage Blk Time (%)				0	0	1	0	0	1		
Queuing Penalty (veh)				0	0	1	0	0	3		

Intersection: 906: Wilson Road/Wilson & US 36/SR 37

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	TR	L	L	T	TR	L
Maximum Queue (ft)	362	380	492	61	79	287	319	52	64	130	168	84
Average Queue (ft)	196	217	253	19	10	158	174	10	17	40	69	33
95th Queue (ft)	307	324	431	50	58	265	287	33	50	95	137	70
Link Distance (ft)		1078	1078			3513				2816	2816	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400			600	300		600	250	250			575
Storage Blk Time (%)	0	0	0			0						
Queuing Penalty (veh)	0	1	0			1						

Intersection: 906: Wilson Road/Wilson & US 36/SR 37

Movement	SB	SB	SB
Directions Served	T	R	R
Maximum Queue (ft)	140	146	109
Average Queue (ft)	54	71	40
95th Queue (ft)	106	125	85
Link Distance (ft)	1135	1135	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			575
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 184

Appendix K

Turn Lane Sizing Calculations

ms consultants, inc.
engineers, architects, planners

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	60 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	380 veh.		**Cols. job?**	N
Approach Volume	2560		**other job?**	N
Vol. in Adj. Thru Lane	683 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**12.67**			50
Veh./Cycle Analyzed	13			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	295	0	345	
Method C (Mod. Speed Decel./Storage)	50	131	475	656	*

* - indicates highest of Methods B and C

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 775

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	60 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	560 veh.		**Cols. job?**	N
Approach Volume	2250		**other job?**	N
Vol. in Adj. Thru Lane	537 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**18.67**			50
Veh./Cycle Analyzed	19			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	295	0	345	
Method C (Mod. Speed Decel./Storage)	50	131	650	831	*

* - indicates highest of Methods B and C

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	60 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	130 veh.		**Cols. job?**	N
Approach Volume	2560		**other job?**	N
Vol. in Adj. Thru Lane	683 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.33**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	295	0	345	
Method C (Mod. Speed Decel./Storage)	50	131	200	381	*

* - indicates highest of Methods B and C

No-Block Storage Length 775

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	60 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	80 veh.		**Cols. job?**	N
Approach Volume	2250		**other job?**	N
Vol. in Adj. Thru Lane	603 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.67**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	295	0	345	*
Method C (Mod. Speed Decel./Storage)	50	131	150	331	

* - indicates highest of Methods B and C

No-Block Storage Length 725

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	730		**other job?**	N
Vol. in Adj. Thru Lane	237 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	1590		**other job?**	N
Vol. in Adj. Thru Lane	523 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	WB Right - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	730		**other job?**	N
Vol. in Adj. Thru Lane	237 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	WB Right - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	1590		**other job?**	N
Vol. in Adj. Thru Lane	523 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	490		**other job?**	N
Vol. in Adj. Thru Lane	220 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	100	264	

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	100 veh.		**Cols. job?**	N
Approach Volume	490		**other job?**	N
Vol. in Adj. Thru Lane	195 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.33**			50
Veh./Cycle Analyzed	4			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	
Method C (Mod. Speed Decel./Storage)	50	114	175	339	*

* - indicates highest of Methods B and C

No-Block Storage Length 275

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	830		**other job?**	N
Vol. in Adj. Thru Lane	130 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	1520		**other job?**	N
Vol. in Adj. Thru Lane	265 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 350

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	SB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	560 veh.		**Cols. job?**	N
Approach Volume	930		**other job?**	N
Vol. in Adj. Thru Lane	130 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**18.67**			50
Veh./Cycle Analyzed	19			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	650	700
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Africa Road			
Movement --	SB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	980 veh.		**Cols. job?**	N
Approach Volume	1520		**other job?**	N
Vol. in Adj. Thru Lane	265 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**32.67**			50
Veh./Cycle Analyzed	33			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	1065	1115
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 350

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ N. 3 B's & K Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	820		**other job?**	N
Vol. in Adj. Thru Lane	410 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 500

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ N. 3 B's & K Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	890		**other job?**	N
Vol. in Adj. Thru Lane	495 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ S. 3 B's & K Road			
Movement --	WB Left - AM Peak			
Approach Type	Unsignalized Through			
Design Speed	35 mph		**Offset?**	N
Cycle Length	60 sec			
Cycles/Hour	**60.0**		**ODOT job?**	Y
Turn Lane Volume	20 veh.		**Cols. job?**	N
Approach Volume	810		**other job?**	N
Vol. in Adj. Thru Lane	395 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length N/A

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ S. 3 B's & K Road			
Movement --	WB Left - PM Peak			
Approach Type	Unsignalized Through			
Design Speed	35 mph		**Offset?**	N
Cycle Length	60 sec			
Cycles/Hour	**60.0**		**ODOT job?**	Y
Turn Lane Volume	70 veh.		**Cols. job?**	N
Approach Volume	1700		**other job?**	N
Vol. in Adj. Thru Lane	815 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.17**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length N/A

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	80 veh.		**Cols. job?**	N
Approach Volume	1020		**other job?**	N
Vol. in Adj. Thru Lane	440 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.67**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	150	200
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 525

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	1020		**other job?**	N
Vol. in Adj. Thru Lane	455 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 550

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	1020		**other job?**	N
Vol. in Adj. Thru Lane	440 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 525

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	1020		**other job?**	N
Vol. in Adj. Thru Lane	455 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 550

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	120 veh.		**Cols. job?**	N
Approach Volume	900		**other job?**	N
Vol. in Adj. Thru Lane	390 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.00**			50
Veh./Cycle Analyzed	4			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	175	225
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 475

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	150 veh.		**Cols. job?**	N
Approach Volume	1800		**other job?**	N
Vol. in Adj. Thru Lane	825 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**5.00**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	200	250
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 915

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	70		**other job?**	N
Vol. in Adj. Thru Lane	20 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 50

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	130 veh.		**Cols. job?**	N
Approach Volume	270		**other job?**	N
Vol. in Adj. Thru Lane	80 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.33**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	200	250
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	NB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	20 veh.		**Cols. job?**	N
Approach Volume	70		**other job?**	N
Vol. in Adj. Thru Lane	20 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 50

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	NB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	270		**other job?**	N
Vol. in Adj. Thru Lane	80 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	90 veh.		**Cols. job?**	N
Approach Volume	140		**other job?**	N
Vol. in Adj. Thru Lane	30 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.00**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	150	200
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 50

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Fourwinds Drive			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	110		**other job?**	N
Vol. in Adj. Thru Lane	30 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 50

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Bob Evans/McDonald's signal			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	90 veh.		**Cols. job?**	N
Approach Volume	990		**other job?**	N
Vol. in Adj. Thru Lane	450 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.00**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	150	200
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 525

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Bob Evans/McDonald's signal			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	1030		**other job?**	N
Vol. in Adj. Thru Lane	485 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Bob Evans/McDonald's signal			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	130 veh.		**Cols. job?**	N
Approach Volume	970		**other job?**	N
Vol. in Adj. Thru Lane	420 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.33**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	200	250
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 500

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Bob Evans/McDonald's signal			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	100 veh.		**Cols. job?**	N
Approach Volume	1840		**other job?**	N
Vol. in Adj. Thru Lane	870 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.33**			50
Veh./Cycle Analyzed	4			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	175	225
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 945

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Bob Evans/McDonald's signal			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	25 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	180 veh.		**Cols. job?**	N
Approach Volume	230		**other job?**	N
Vol. in Adj. Thru Lane	50 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.00**			50
Veh./Cycle Analyzed	6			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	250	300
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

Note: Design speeds under 30mph are designed at 30 mph

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Bob Evans/McDonald's signal			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	25 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	140 veh.		**Cols. job?**	N
Approach Volume	200		**other job?**	N
Vol. in Adj. Thru Lane	60 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.67**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	200	250
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

Note: Design speeds under 30mph are designed at 30 mph

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	330 veh.		**Cols. job?**	N
Approach Volume	1030		**other job?**	N
Vol. in Adj. Thru Lane	233 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**11.00**			50
Veh./Cycle Analyzed	11			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	400	450
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	220 veh.		**Cols. job?**	N
Approach Volume	1070		**other job?**	N
Vol. in Adj. Thru Lane	317 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**7.33**			50
Veh./Cycle Analyzed	8			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	325	375
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 400

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	360 veh.		**Cols. job?**	N
Approach Volume	820		**other job?**	N
Vol. in Adj. Thru Lane	230 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**12.00**			50
Veh./Cycle Analyzed	12			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	450	500
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	220 veh.		**Cols. job?**	N
Approach Volume	1210		**other job?**	N
Vol. in Adj. Thru Lane	495 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**7.33**			50
Veh./Cycle Analyzed	8			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	325	375
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	490		**other job?**	N
Vol. in Adj. Thru Lane	225 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	100 veh.		**Cols. job?**	N
Approach Volume	870		**other job?**	N
Vol. in Adj. Thru Lane	385 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.33**			50
Veh./Cycle Analyzed	4			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	175	225
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 475

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	SB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	450 veh.		**Cols. job?**	N
Approach Volume	490		**other job?**	N
Vol. in Adj. Thru Lane	20 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**15.00**			50
Veh./Cycle Analyzed	15			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	525	575
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 50

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 SB ramps			
Movement --	SB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	770 veh.		**Cols. job?**	N
Approach Volume	870		**other job?**	N
Vol. in Adj. Thru Lane	50 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**25.67**			50
Veh./Cycle Analyzed	26			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	855	905
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	390 veh.		**Cols. job?**	N
Approach Volume	740		**other job?**	N
Vol. in Adj. Thru Lane	175 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**13.00**			50
Veh./Cycle Analyzed	13			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	475	525
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	410 veh.		**Cols. job?**	N
Approach Volume	1050		**other job?**	N
Vol. in Adj. Thru Lane	320 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**13.67**			50
Veh./Cycle Analyzed	14			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	500	550
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 400

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	WB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	130 veh.		**Cols. job?**	N
Approach Volume	710		**other job?**	N
Vol. in Adj. Thru Lane	193 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.33**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	200	250
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 275

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	WB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	150 veh.		**Cols. job?**	N
Approach Volume	385		**other job?**	N
Vol. in Adj. Thru Lane	223 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**5.00**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	200	250
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	330 veh.		**Cols. job?**	N
Approach Volume	510		**other job?**	N
Vol. in Adj. Thru Lane	90 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**11.00**			50
Veh./Cycle Analyzed	11			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	400	450
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	700 veh.		**Cols. job?**	N
Approach Volume	1250		**other job?**	N
Vol. in Adj. Thru Lane	275 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**23.33**			50
Veh./Cycle Analyzed	24			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	800	850
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 375

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	NB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	180 veh.		**Cols. job?**	N
Approach Volume	510		**other job?**	N
Vol. in Adj. Thru Lane	165 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.00**			50
Veh./Cycle Analyzed	6			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	250	300
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ I-71 NB ramps			
Movement --	NB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	550 veh.		**Cols. job?**	N
Approach Volume	1250		**other job?**	N
Vol. in Adj. Thru Lane	350 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**18.33**			50
Veh./Cycle Analyzed	19			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	650	700
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 450

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	290 veh.		**Cols. job?**	N
Approach Volume	660		**other job?**	N
Vol. in Adj. Thru Lane	155 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**9.67**			50
Veh./Cycle Analyzed	10			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	375	425
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	630 veh.		**Cols. job?**	N
Approach Volume	1320		**other job?**	N
Vol. in Adj. Thru Lane	315 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**21.00**			50
Veh./Cycle Analyzed	21			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	725	775
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 400

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	660		**other job?**	N
Vol. in Adj. Thru Lane	155 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	132		**other job?**	N
Vol. in Adj. Thru Lane	315 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 400

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	470		**other job?**	N
Vol. in Adj. Thru Lane	235 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	600		**other job?**	N
Vol. in Adj. Thru Lane	295 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 375

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	20 veh.		**Cols. job?**	N
Approach Volume	210		**other job?**	N
Vol. in Adj. Thru Lane	140 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	250		**other job?**	N
Vol. in Adj. Thru Lane	160 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	NB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	210		**other job?**	N
Vol. in Adj. Thru Lane	140 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	NB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	250		**other job?**	N
Vol. in Adj. Thru Lane	160 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	520		**other job?**	N
Vol. in Adj. Thru Lane	60 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	430		**other job?**	N
Vol. in Adj. Thru Lane	60 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	SB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	430 veh.		**Cols. job?**	N
Approach Volume	520		**other job?**	N
Vol. in Adj. Thru Lane	60 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**14.33**			50
Veh./Cycle Analyzed	15			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	525	575
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Wilson Road			
Movement --	SB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	340 veh.		**Cols. job?**	N
Approach Volume	430		**other job?**	N
Vol. in Adj. Thru Lane	60 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**11.33**			50
Veh./Cycle Analyzed	12			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	450	500
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Galena Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	20 veh.		**Cols. job?**	N
Approach Volume	400		**other job?**	N
Vol. in Adj. Thru Lane	380 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 475

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Galena Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	820		**other job?**	N
Vol. in Adj. Thru Lane	780 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	100	264	

* - indicates highest of Methods B and C

No-Block Storage Length 855

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Galena Road			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	530		**other job?**	N
Vol. in Adj. Thru Lane	490 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Galena Road			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	870		**other job?**	N
Vol. in Adj. Thru Lane	640 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 750

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Galena Road			
Movement --	WB Right - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	530		**other job?**	N
Vol. in Adj. Thru Lane	490 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Galena Road			
Movement --	WB Right - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	200 veh.		**Cols. job?**	N
Approach Volume	870		**other job?**	N
Vol. in Adj. Thru Lane	640 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.67**			50
Veh./Cycle Analyzed	7			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	
Method C (Mod. Speed Decel./Storage)	50	114	275	439	*

* - indicates highest of Methods B and C

No-Block Storage Length 750

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Sunbury Parkway			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	620		**other job?**	N
Vol. in Adj. Thru Lane	305 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 400

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Sunbury Parkway			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	1000		**other job?**	N
Vol. in Adj. Thru Lane	495 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Sunbury Parkway			
Movement --	WB Right - AM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	390 veh.		**Cols. job?**	N
Approach Volume	1400		**other job?**	N
Vol. in Adj. Thru Lane	505 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**13.00**			50
Veh./Cycle Analyzed	13			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	475	600	*

* - indicates highest of Methods B and C

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Sunbury Parkway			
Movement --	WB Right - PM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	800 veh.		**Cols. job?**	N
Approach Volume	1480		**other job?**	N
Vol. in Adj. Thru Lane	340 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**26.67**			50
Veh./Cycle Analyzed	27			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	885	1010	*

* - indicates highest of Methods B and C

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 450

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Sunbury Parkway			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	290 veh.		**Cols. job?**	N
Approach Volume	300		**other job?**	N
Vol. in Adj. Thru Lane	150 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**9.67**			50
Veh./Cycle Analyzed	10			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	375	500	*

* - indicates highest of Methods B and C

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	US36/SR 37 @ Sunbury Parkway			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	640 veh.		**Cols. job?**	N
Approach Volume	650		**other job?**	N
Vol. in Adj. Thru Lane	320 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**21.33**			50
Veh./Cycle Analyzed	22			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	750	875	*

* - indicates highest of Methods B and C

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 400

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	70 veh.		**Cols. job?**	N
Approach Volume	2070		**other job?**	N
Vol. in Adj. Thru Lane	657 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.33**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	150	293	*

* - indicates highest of Methods B and C

No-Block Storage Length 750

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	1630		**other job?**	N
Vol. in Adj. Thru Lane	520 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 625

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	2070		**other job?**	N
Vol. in Adj. Thru Lane	657 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 750

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	20 veh.		**Cols. job?**	N
Approach Volume	1630		**other job?**	N
Vol. in Adj. Thru Lane	520 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph	**Offset?**	Y	
Cycle Length	120 sec	**Offset Distance (ft)**	19.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	140 veh.	**Cols. job?**	N	
Approach Volume	1050	**other job?**	N	
Vol. in Adj. Thru Lane	237 veh.			
No. of Turn Lanes	2 (1 or 2)			
Actual Veh./Cycle	**4.67**		50	
Veh./Cycle Analyzed	5			

Output Data:

	Taper	L	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	202	427	
Method C (Mod. Speed Decel./Storage)	50	175	202	427	*

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph	**Offset?**	Y	
Cycle Length	120 sec	**Offset Distance (ft)**	19.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	200 veh.	**Cols. job?**	N	
Approach Volume	2000	**other job?**	N	
Vol. in Adj. Thru Lane	513 veh.			
No. of Turn Lanes	2 (1 or 2)			
Actual Veh./Cycle	**6.67**		50	
Veh./Cycle Analyzed	7			

Output Data:

	Taper	L	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	202	427	
Method C (Mod. Speed Decel./Storage)	50	175	202	427	*

* - indicates highest of Methods B and C

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	WB Right - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	200 veh.		**Cols. job?**	N
Approach Volume	1050		**other job?**	N
Vol. in Adj. Thru Lane	237 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.67**			50
Veh./Cycle Analyzed	7			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	275	418	*

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	WB Right - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	250 veh.		**Cols. job?**	N
Approach Volume	2000		**other job?**	N
Vol. in Adj. Thru Lane	513 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**8.33**			50
Veh./Cycle Analyzed	9			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	350	493	*

* - indicates highest of Methods B and C

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	490		**other job?**	N
Vol. in Adj. Thru Lane	130 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	460		**other job?**	N
Vol. in Adj. Thru Lane	130 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	*
Method C (Mod. Speed Decel./Storage)	50	114	50	214	

* - indicates highest of Methods B and C

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	NB Right - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	350 veh.		**Cols. job?**	N
Approach Volume	490		**other job?**	N
Vol. in Adj. Thru Lane	130 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**11.67**			50
Veh./Cycle Analyzed	12			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	
Method C (Mod. Speed Decel./Storage)	50	114	450	614	*

* - indicates highest of Methods B and C

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	NB Right - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	200 veh.		**Cols. job?**	N
Approach Volume	460		**other job?**	N
Vol. in Adj. Thru Lane	130 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.67**			50
Veh./Cycle Analyzed	7			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	
Method C (Mod. Speed Decel./Storage)	50	114	275	439	*

* - indicates highest of Methods B and C

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	90 veh.		**Cols. job?**	N
Approach Volume	220		**other job?**	N
Vol. in Adj. Thru Lane	65 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.00**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	
Method C (Mod. Speed Decel./Storage)	50	114	150	314	*

* - indicates highest of Methods B and C

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Fourwinds Drive			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	55 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	190 veh.		**Cols. job?**	N
Approach Volume	360		**other job?**	N
Vol. in Adj. Thru Lane	85 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.33**			50
Veh./Cycle Analyzed	7			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	235	0	285	
Method C (Mod. Speed Decel./Storage)	50	114	275	439	*

* - indicates highest of Methods B and C

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	70 veh.		**Cols. job?**	N
Approach Volume	670		**other job?**	N
Vol. in Adj. Thru Lane	300 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.33**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	150	293	*

* - indicates highest of Methods B and C

No-Block Storage Length 375

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	120 veh.		**Cols. job?**	N
Approach Volume	1140		**other job?**	N
Vol. in Adj. Thru Lane	510 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.00**			50
Veh./Cycle Analyzed	4			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	175	318	*

* - indicates highest of Methods B and C

No-Block Storage Length 600

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	WB Right - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	20 veh.		**Cols. job?**	N
Approach Volume	1220		**other job?**	N
Vol. in Adj. Thru Lane	400 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 500

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	WB Right - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	1220		**other job?**	N
Vol. in Adj. Thru Lane	393 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 500

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	290 veh.		**Cols. job?**	N
Approach Volume	380		**other job?**	N
Vol. in Adj. Thru Lane	90 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**9.67**			50
Veh./Cycle Analyzed	10			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	375	425
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	1050 veh.		**Cols. job?**	N
Approach Volume	1470		**other job?**	N
Vol. in Adj. Thru Lane	420 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**35.00**			50
Veh./Cycle Analyzed	35			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	1125	1175
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

600 ft. is maximum recommended length for left turn lanes.

(800 ft. max. for right turn lanes.)

No-Block Storage Length 500

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	NB Right - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	90 veh.		**Cols. job?**	N
Approach Volume	380		**other job?**	N
Vol. in Adj. Thru Lane	145 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.00**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	150	200
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 200

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ I-71 NB ramps			
Movement --	NB Right - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	420 veh.		**Cols. job?**	N
Approach Volume	1470		**other job?**	N
Vol. in Adj. Thru Lane	525 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**14.00**			50
Veh./Cycle Analyzed	14			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	500	550
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 625

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	230 veh.		**Cols. job?**	N
Approach Volume	740		**other job?**	N
Vol. in Adj. Thru Lane	240 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**7.67**			50
Veh./Cycle Analyzed	8			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	325	468	*

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	290 veh.		**Cols. job?**	N
Approach Volume	1570		**other job?**	N
Vol. in Adj. Thru Lane	615 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**9.67**			50
Veh./Cycle Analyzed	10			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	375	518	*

* - indicates highest of Methods B and C

No-Block Storage Length 725

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	740		**other job?**	N
Vol. in Adj. Thru Lane	240 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	1570		**other job?**	N
Vol. in Adj. Thru Lane	615 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 725

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	60 veh.		**Cols. job?**	N
Approach Volume	1280		**other job?**	N
Vol. in Adj. Thru Lane	370 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.00**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 475

Comments: Offset turn lane length (as per L&D 401-8E)
250' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	30 veh.		**Cols. job?**	N
Approach Volume	750		**other job?**	N
Vol. in Adj. Thru Lane	240 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.00**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 325

Comments: Offset turn lane length (as per L&D 401-8E)
250' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	110		**other job?**	N
Vol. in Adj. Thru Lane	60 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	100	225	*

* - indicates highest of Methods B and C

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	70 veh.		**Cols. job?**	N
Approach Volume	170		**other job?**	N
Vol. in Adj. Thru Lane	100 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.33**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	150	275	*

* - indicates highest of Methods B and C

No-Block Storage Length 175

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	45 mph	**Offset?**	Y	
Cycle Length	120 sec	**Offset Distance (ft)**	12.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	50 veh.	**Cols. job?**	N	
Approach Volume	280	**other job?**	N	
Vol. in Adj. Thru Lane	40 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	L	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	146	321	
Method C (Mod. Speed Decel./Storage)	50	125	146	321	*

* - indicates highest of Methods B and C

No-Block Storage Length 100

Comments: Offset turn lane length (as per L&D 401-8E)
250' storage + 175' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	45 mph	**Offset?**	Y	
Cycle Length	120 sec	**Offset Distance (ft)**	12.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	100 veh.	**Cols. job?**	N	
Approach Volume	510	**other job?**	N	
Vol. in Adj. Thru Lane	30 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**3.33**			50
Veh./Cycle Analyzed	4			

Output Data:

	Taper	L	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	146	321	
Method C (Mod. Speed Decel./Storage)	50	125	175	350	*

* - indicates highest of Methods B and C

No-Block Storage Length 50

Comments: Offset turn lane length (as per L&D 401-8E)
250' storage + 175' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	SB Right - AM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	190 veh.		**Cols. job?**	N
Approach Volume	280		**other job?**	N
Vol. in Adj. Thru Lane	40 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.33**			50
Veh./Cycle Analyzed	7			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	275	400	*

* - indicates highest of Methods B and C

No-Block Storage Length 100

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Wilson Road			
Movement --	SB Right - PM Peak			
Approach Type	Signalized			
Design Speed	45 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	380 veh.		**Cols. job?**	N
Approach Volume	510		**other job?**	N
Vol. in Adj. Thru Lane	30 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**12.67**			50
Veh./Cycle Analyzed	13			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	125	0	175	
Method C (Mod. Speed Decel./Storage)	50	75	475	600	*

* - indicates highest of Methods B and C

No-Block Storage Length 50

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph	**Offset?**	N	
Cycle Length	120 sec		19.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	80 veh.	**Cols. job?**	N	
Approach Volume	570	**other job?**	N	
Vol. in Adj. Thru Lane	180 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.67**		50	
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	150	293	*

* - indicates highest of Methods B and C

No-Block Storage Length 250

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph	**Offset?**	N	
Cycle Length	120 sec		19.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	70 veh.	**Cols. job?**	N	
Approach Volume	1390	**other job?**	N	
Vol. in Adj. Thru Lane	480 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.33**		50	
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	150	293	*

* - indicates highest of Methods B and C

No-Block Storage Length 550

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	EB Right - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	130 veh.		**Cols. job?**	N
Approach Volume	570		**other job?**	N
Vol. in Adj. Thru Lane	180 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**4.33**			50
Veh./Cycle Analyzed	5			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	200	343	*

* - indicates highest of Methods B and C

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	EB Right - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	360 veh.		**Cols. job?**	N
Approach Volume	1390		**other job?**	N
Vol. in Adj. Thru Lane	480 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**12.00**			50
Veh./Cycle Analyzed	12			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	450	593	*

* - indicates highest of Methods B and C

No-Block Storage Length 550

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	970		**other job?**	N
Vol. in Adj. Thru Lane	465 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 550

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	620		**other job?**	N
Vol. in Adj. Thru Lane	300 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 375

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	450 veh.		**Cols. job?**	N
Approach Volume	910		**other job?**	N
Vol. in Adj. Thru Lane	230 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**15.00**			50
Veh./Cycle Analyzed	15			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	525	575
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	200 veh.		**Cols. job?**	N
Approach Volume	640		**other job?**	N
Vol. in Adj. Thru Lane	220 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**6.67**			50
Veh./Cycle Analyzed	7			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	275	325
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	510		**other job?**	N
Vol. in Adj. Thru Lane	235 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 325

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Galena Road			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	50 veh.		**Cols. job?**	N
Approach Volume	410		**other job?**	N
Vol. in Adj. Thru Lane	180 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.67**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	100	150
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	EB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			19.0
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	40 veh.		**Cols. job?**	N
Approach Volume	410		**other job?**	N
Vol. in Adj. Thru Lane	185 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**1.33**			50
Veh./Cycle Analyzed	2			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	100	243	*

* - indicates highest of Methods B and C

No-Block Storage Length 275

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	EB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph		**Offset?**	N
Cycle Length	120 sec			19.0
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	70 veh.		**Cols. job?**	N
Approach Volume	1020		**other job?**	N
Vol. in Adj. Thru Lane	475 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.33**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	
Method C (Mod. Speed Decel./Storage)	50	93	150	293	*

* - indicates highest of Methods B and C

No-Block Storage Length 550

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	WB Left - AM Peak			
Approach Type	Signalized			
Design Speed	50 mph	**Offset?**	N	
Cycle Length	120 sec		19.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	20 veh.	**Cols. job?**	N	
Approach Volume	1020	**other job?**	N	
Vol. in Adj. Thru Lane	500 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**		50	
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 600

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	WB Left - PM Peak			
Approach Type	Signalized			
Design Speed	50 mph	**Offset?**	N	
Cycle Length	120 sec		19.0	
Cycles/Hour	**30.0**	**ODOT job?**	Y	
Turn Lane Volume	20 veh.	**Cols. job?**	N	
Approach Volume	690	**other job?**	N	
Vol. in Adj. Thru Lane	335 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.67**		50	
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total	
Method A (Storage only)	N/A	N/A	N/A	N/A	
Method B (High Speed Decel. Only)	50	175	0	225	*
Method C (Mod. Speed Decel./Storage)	50	93	50	193	

* - indicates highest of Methods B and C

No-Block Storage Length 450

Comments: Offset turn lane length (as per L&D 401-8E)
202' storage + 225' decel

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	NB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	80		**other job?**	N
Vol. in Adj. Thru Lane	70 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	NB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	10 veh.		**Cols. job?**	N
Approach Volume	100		**other job?**	N
Vol. in Adj. Thru Lane	90 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**0.33**			50
Veh./Cycle Analyzed	1			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	50	100
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 150

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	SB Left - AM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	250 veh.		**Cols. job?**	N
Approach Volume	350		**other job?**	N
Vol. in Adj. Thru Lane	100 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**8.33**			50
Veh./Cycle Analyzed	9			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	350	400
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 175

Comments:

ODOT L&D Manual Lane Sizing Calculation Worksheet (updated May 2010)

Input Data:

Intersection --	Sunbury Parkway @ Domigan Road			
Movement --	SB Left - PM Peak			
Approach Type	Signalized			
Design Speed	35 mph		**Offset?**	N
Cycle Length	120 sec			
Cycles/Hour	**30.0**		**ODOT job?**	Y
Turn Lane Volume	70 veh.		**Cols. job?**	N
Approach Volume	230		**other job?**	N
Vol. in Adj. Thru Lane	160 veh.			
No. of Turn Lanes	1 (1 or 2)			
Actual Veh./Cycle	**2.33**			50
Veh./Cycle Analyzed	3			

Output Data:

	Taper	Decel	Storage	Total
Method A (Storage only)	50	0	150	200
Method B (High Speed Decel. Only)	N/A	N/A	N/A	N/A
Method C (Mod. Speed Decel./Storage)	N/A	N/A	N/A	N/A

No-Block Storage Length 250

Comments: