

#### **Ohio Division**

January 27, 2016

200 North High Street, Rm 328 Columbus, Ohio 43215 614-280-6896 614-280-6876

> In Reply Refer To: HDA-OH

Jerry Wray Director Ohio Department of Transportation 1980 West Broad Street Columbus, OH 43223

Dear Director Wray:

This letter is in response to your request for FHWA Ohio Division to review the January 26, 2016, submittal for the January 4<sup>th</sup>, 2016 CUY-82-2.93(I-71/SR-82/Shurmer Rd.) PID 96987Interchange Justification Study (IJS).

This IJS proposes the following modifications:

- Construct a new I-71 SB exit ramp that originates just south of the SR 82 to I-71 SB entrance ramp and terminates at the Howe Rd./Shurmer Rd. intersection.
- Widen Howe Rd. to five lanes (about 2000') from the current five lane section just north of Pomeroy Boulevard to the Howe Rd./Shurmer Rd. intersection.
- Widen the southern and western intersection approaches of the Howe Rd./Shurmer Rd. intersection.
- Optimize signal timings and coordination.

FHWA has reviewed the IJS and understands that this concept will provide for a safe and operationally acceptable design in the future. The modifications will not have a significant adverse impact on the operation of the Interstate facility based on current and future traffic.

The access approval is a two-step process and based on the data provided in the Interchange Justification Study dated January 4<sup>th</sup>, 2016 FHWA is making a determination that the first step, engineering and operational acceptability is approved. The second step is the final FHWA approval which constitutes a Federal Action and requires that the NEPA procedures are followed. Upon your completion of the NEPA process, submit a request for final approval of the IJS that includes confirmation of completion of the NEPA process and if there were any changes required to the proposed design in the IJS.

If you have any questions or comments, please contact Naureen Dar, Transportation Engineer, at (614) 280-6846, or Naureen.Dar@dot.gov.

Sincerely,

Laura S. Leffler

Division Administrator

e-cc: A. Blalock

N. Dar

Brenton Bogard, ODOT ORES Brian Blayney, ODOT District 12

File: CUY-96987/Design



# OHIO DEPARTMENT OF TRANSPORTATION

CENTRAL OFFICE • 1980 WEST BROAD STREET • COLUMBUS, OH 43223 JOHN R. KASICH, GOVERNOR • JERRY WRAY, DIRECTOR

January 4th, 2016

Ms. Laura S. Leffler
Division Administrator
Federal Highway Administration
200 North High Street
Columbus, Ohio 43215

Re: Ohio Department of Transportation Interchange Justification Study CUY-82-2.93 (I-71/SR-82/Shurmer Rd.) PID 96987, IJS dated December 2015

Dear Ms. Leffler:

Enclosed for your review and approval is the CUY-82-2.93 PID 96987 Interchange Justification Study (IJS).

## Improvements include:

- Construct a new I-71 SB exit ramp that originates just south of the SR 82 to I-71 SB entrance ramp and terminates at the Howe Rd./Shurmer Rd. intersection.
- Widen Howe Road to five lanes (about 2000') from the current five lane section just north of Pomeroy Boulevard to the Howe Rd./Shurmer Rd. intersection.
- Widen the southern and western intersection approaches of the Howe Road/Shurmer Rd. intersection.
- Add an additional right turn lane to SR-82 EB to access I-71 NB (as part of a separate project to be constructed in 2017, PID 99435).
- Optimize signal timings and coordination.

The IJS meets the requirements of the ODOT and FHWA. The State recommends the study be approved and your concurrence is requested. If you require any additional information please contact Brenton Bogard at 614-752-5575.

Respectfully.

Jerry Wra

Enclosure JW:DLH:blb

c: N. Dar, D. Holstein, R. Bruce, M. Cronebach, L. Hazapis, B. Blayney, File w/ enclosure, Reading File

# I-71 at SR 82 Interchange Justification Study

December 28, 2015



# Prepared for:

The Ohio Department of Transportation District 12 5500 Transportation Boulevard Garfield Heights, OH 44125

The City of Strongsville 16099 Foltz Parkway Strongsville, OH 44149

Prepared by:



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# I. Executive Summary

The City of Strongsville commissioned Hatch Mott MacDonald (HMM) to provide documentation to justify a new access point at the Interstate 71 (I-71)/SR 82 interchange (CUY-71-2.57) located in the City of Strongsville, Cuyahoga County, Ohio. The City of Strongsville is looking for a long-term solution to reduce congestion and decrease crashes in the study area. Several short to medium term countermeasures have been implemented or studied with little improvement to congestion or crashes.

HMM evaluated the Build Condition for traffic operations, safety, and to determine any impacts to the existing freeway network. The Build Condition includes adding an additional exit ramp to the I-71/SR 82 interchange from I-71 SB terminating at the Howe Road/Shurmer Road intersection. Additionally, the Build Condition includes widening Howe Road from Shurmer Road to the north and adding an additional SR 82 EB right turn lane to access I-71 NB (currently under design as a separate project).

Based on the analyses presented in this report, the Build Condition does not degrade or otherwise negatively affect freeway operations on I-71. In fact, the Build Condition is expected to improve the efficiency of the SR 82 coordinated signal system (US 42 to I-71 Interchange) and thus reduce travel times, fuel consumption, emissions, and crashes as well as eliminate queues that currently extend onto the I-71 mainline during periods of high traffic volumes.

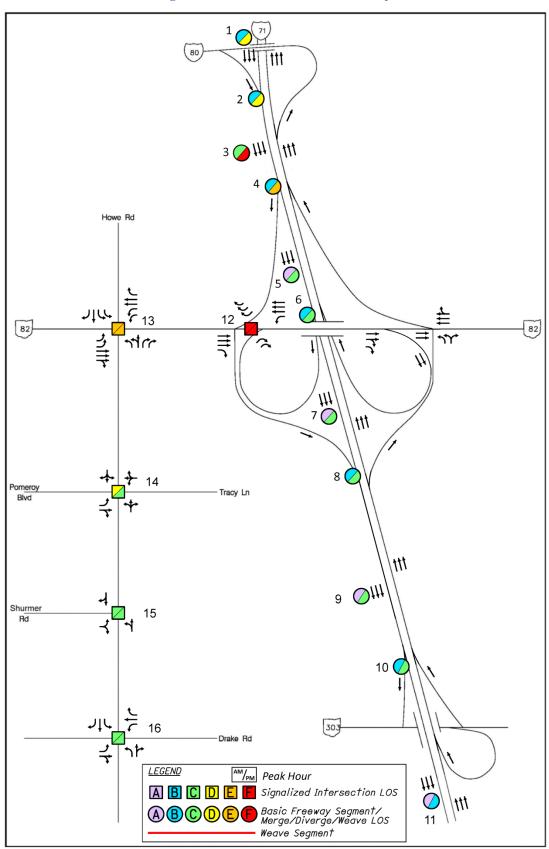


Figure 1 - No Build LOS Summary



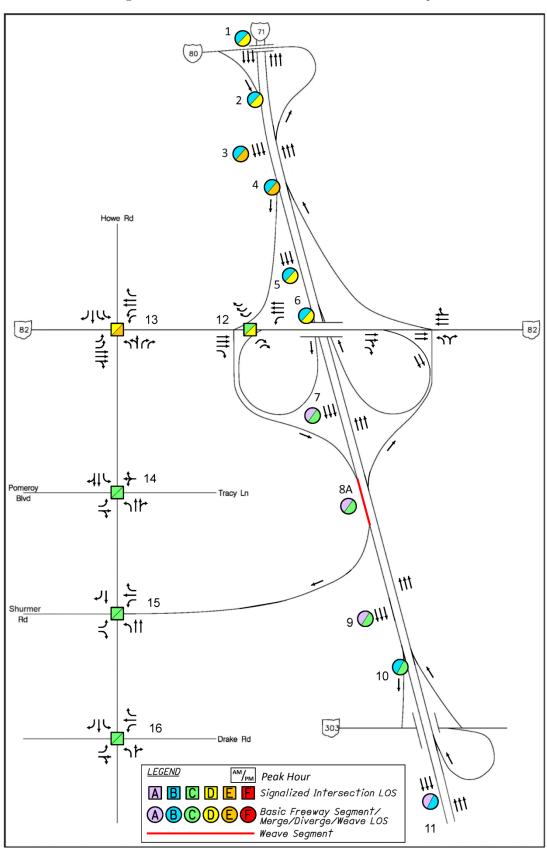


Figure 2 - 2035 Build Condition LOS Summary



# II. Background

The City of Strongsville commissioned Hatch Mott MacDonald (HMM) to provide documentation to justify a new access point at the Interstate 71 (I-71) / SR 82 interchange (CUY-71-2.57) located in the City of Strongsville, Cuyahoga County, Ohio. This Interchange Justification Study (IJS) expands upon the preparation of the "I-71 at SR 82 Interchange Operations Analysis" completed by HMM on April 15, 2013 and incorporates ODOT comments and initial feedback from the "I-71 at SR 82 Interchange Modification Study" completed by HMM on July 18, 2013. This IJS follows ODOT procedures for an IJS as stated in the Location and Design Manual (L&D), Volume 1, Section 550.5 and in the IJS Traffic Academy Manual.

A formal safety study was also completed by ODOT District 12 in July of 2012. The study focused on approximately one mile of SR 82 centered at the SR 82/Howe intersection, including the I-71/SR 82 interchange. The safety study focused on short and medium term countermeasures. Several of the short-term countermeasures from the study have already been implemented by the City of Strongsville. Recently implemented short-term improvements include:

- All noted non-functioning loop detectors were repaired.
- All noted non-functioning pedestrian crossings were repaired.
- Made signal displays on Howe Road northbound OMUTCD compliant.
- Intersection dotted lines were re-positioned from the Howe Road northbound right turn lane to SR 82 and Southpark Center Road to SR 82.
- Additional left turn storage length was provided and a second left turn lane added to SR 82 eastbound at Howe Road.
- A signal progression study was performed and timings were improved to reduce queuing onto I-71 southbound to the extent possible. As part of this study, weekend and holiday timing plans were also evaluated and optimized (PID 94550).

In addition, Parsons Brinkerhoff (through District 12) prepared the "Further Evaluation of Safety Improvements and Congestion Mitigation for the SR 82 Corridor near the I-71 Interchange" (PID 96987, dated November 2014). This report provided an analysis of additional alternatives on SR 82 to alleviate congestion.

# III. Purpose & Need

Congestion on SR 82 at the I-71 interchange and adjacent areas caused by high travel demand is pushing the limits of the existing transportation network. Howe Road from Drake Road to the south mall entrance is identified on NOACA's Long Range Transportation Plan (Connections 2035) as a regional congestion priority. This segment of Howe is ranked #1 in the NOACA region for existing congestion and in the top 10 for forecasted congestion. The congestion has also brought safety concerns as this area is high on ODOT's Highway Safety Program (HSP) Priority List (see Figure 5). The purpose of this study is to examine a long term countermeasure to improve safety by reducing congestion on SR 82 and eliminating queues from the I-71 exit ramps onto mainline I-71.



# IV. Study Area

The study area consists of I-71 from the SR 303 interchange to the I-80 (Ohio Turnpike) interchange, SR 82 from west of Howe Road through the I-71 interchange (MP 3.1 through 3.7), and Howe Road from Drake Road to SR 82. See Figure 3 and Figure 4. Figure 3 – Study Area







Figure 4 - I-71/SR 82 Interchange with Signal Spacing



# V. Existing Conditions

## a. Road Geometry & Access Locations

The existing I-71 / SR 82 interchange is a full-access, partial cloverleaf interchange. SR 82 is the major east-west roadway through the area and is heavily commerical from US 42 to I-71 with large retail centers on both the north and south sides of the roadway including Southpark Mall to the south. US 42 is a heavily commercial, major north-south arterial located about one mile to the west of I-71. Shurmer Road and areas to the south are largely residential.

Table 1 - Functional Classification

	Functional Class	Legal Speed Limit
I-71	Urban Interstate	60
SR 82	Urban Principal Arterial	35
Howe Rd	Urban Collector	35
Shurmer Rd	Urban Local	25

Current ADT on SR 82 in the project area is approximately 45,000 vehicles per day. The SR 82/Howe intersection averages approximately 60,000 vehicles per day. Signalized intersections along with distances between each are shown on Figure 4. SR 82 traffic signals are part of a coordinated, closed loop system.

#### b. Physical Conditions - Terrain

The terrain is relatively flat is this area. I-71 passes under SR 82.

#### c. Crash Data

Based on the Formal Safety Study completed in July of 2012, an analysis of traffic crashes from 2008 - 2010 revealed that 289 crashes occurred along the SR 82 corridor from MP 2.7 to 3.7 with about 25% of all crashes resulting in an injury. This included 113 crashes directly related to the SR 82/Howe intersection. Rear end crashes account for over 70% of all crashes. Crash frequency is highest during the weekday PM peak hours (4:00 - 7:00 PM), on Saturdays and during the months of November and December. The high crash frequency periods directly correlate with the highest traffic volume periods.



Figure 5 shows the number of ODOT Highway Safety Program safety priority locations that are within the project area.



Figure 5 - 2014 ODOT HSP Priority Rankings

Green = Urban Intersection Safety Priority Location and Rank
Blue = Urban Non-Freeway Safety Priority Location and Rank
Red = Urban Freeway Safety Priority Location and Rank

- SR 82 / Howe Rd Urban Intersection, HSP Priority Ranking #12 (2012), #99 (2013)
- \*\* SR 82 3.26-3.36 Urban Non-Freeway Segment, HSP Priority Ranking #27 (2012), #32 (2013)



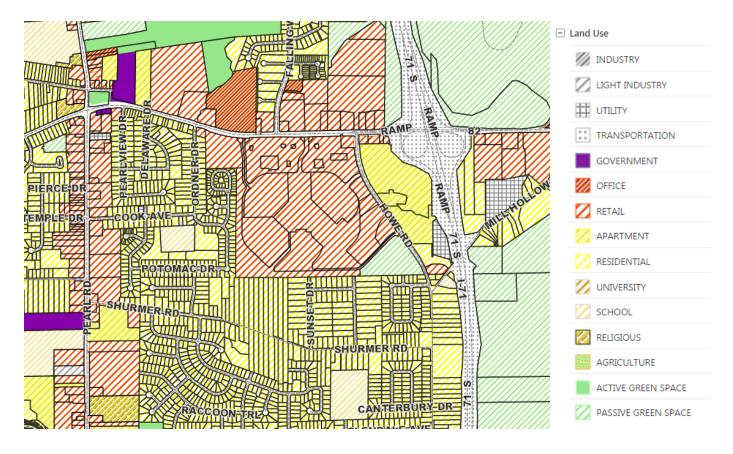
#### d. Demographics

Per 2013 Census data, The City of Strongsville has a total population of approximately 45,000 people while Cuyahoga County has approximately 1.26 million people. Refer to Appendix A for more detailed information.

#### e. Land Use

The land use along SR 82 and US 42 is largely commercial. The land use adjacent to these commercial areas is mostly single family residential. See Figure 6 for land use data retrieved from the Cuyahoga County GIS.

Figure 6 - Land Use Map





# VI. Analysis Years

The current year traffic used for analysis is considered 2015 while the design year is established as 2035. Traffic analysis within this IJS uses 2035 design year volumes provided by ODOT's Office of Statewide Planning & Research. The No Build condition is defined as the existing geometry and lane use with revised traffic signal timing and coordination. The Build Condition is defined as the proposed improvements as presented in Figure 8. This includes an additional exit ramp from I-71 SB to the Howe Road/Shurmer Road intersection, widening Howe Road to five lanes from Shurmer Road to the existing five lane section north of Pomeroy Boulevard, and widening the SR 82 EB to I-71 NB loop ramp to provide two SR 82 EB right turn lanes. The I-71 NB loop widening is a separate project slated for 2017 construction (PID 99435) and is therefore included in the design year analysis. The proposed signing plan for I-71 SB is shown in Figure 9.

# VII. Alternatives Considered

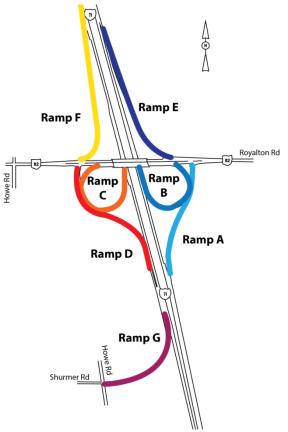
The following alternatives have been considered as part of this or prior studies:

- 1. No Build The No Build condition is defined as the existing geometry and lane use.
- 2. Short-term several short term improvements have been implemented, are in the process of being implemented, or have been previously studied. They are as follows.
  - a. Pavement marking changes based on the formal safety study from July of 2012, several pavement marking changes have occurred on SR 82 between I-71 and the mall entrances to improve turn lane use and efficiency (ex: the SR 82 EB left turn lane approaching Howe Road was extended based on updated traffic count information).
  - b. Widening HMM has explored widening Howe Road from south of Shurmer Road to the southern mall entrance. This widening is included in the Build condition.
  - c. Signal timing / coordination optimization ODOT completed a signal optimization study and implemented optimized timings for the SR 82 closed loop system which runs from US 42 through the I-71 interchange intersections. In addition, the City of Strongsville is sponsoring a city-wide traffic signal coordination and upgrade project which will include central monitoring and adaptive signal control.
  - d. Intersection improvements the City of Strongsville has studied improvements to the Howe Road/Shurmer Road intersection independent of the Build condition from this IJS.
- 3. Ramp Metering ramp metering was dismissed as a viable option at this interchange because the congestion and crash problem is more prevalent on SR 82 and on the I-71 SB to SR 82 WB exit ramp and ramp storage would likely degrade operations of SR 82. In addition, metering is typically applied on a corridor-wide basis and at this ramp metering does not exist in this area. Ramp metering was tried at this interchange in the past for the SR 82 WB to I-71 NB ramp. The ramp metering signal was removed not long after installation.
- 4. SR 82/Howe Road Intersection Reconstruction Parsons Brinckerhoff, through ODOT District 12, evaluated alternative intersection designs at the SR 82/Howe intersection such as a roundabout, Continuous Flow Intersection (CFI), and median U-turns in an alternatives study dated November 2014. The close proximately of the I-71 interchange, physical site constraints, major disruption of traffic, and high construction/ROW costs prohibited these options as being viable at this time.
- 5. New I-71 Interchange Several studies have been conducted in the past to explore the feasibility of constructing a new interchange on I-71 between SR 303 and SR 82. Based on a teleconference



- on March 2, 2015 between HMM, District 12, and the Office of Roadway Engineering, this alternative has been dismissed due to high costs, ROW needs, and a lack of support by local municipalities and ODOT.
- 6. Collector-Distributor Road HMM explored a C-D road along I-71 southbound that would begin just south of the SR 82 eastbound exit ramp and tie back into I-71 south of the Howe Road ramp. This alternative was dismissed based on right of way costs, major utility impacts, and negligible operational improvements over the Build Condition.
- 7. Howe Road/Shurmer Road Entrance Ramp to I-71 HMM explored adding an entrance ramp to I-71 from the Howe/Shurmer intersection but dismissed this alternative based on negligible operational improvements and the cost of the
- 8. Build The Build condition studied in this report will represent the following proposed conditions:
  - a. Construct a new I-71 SB exit ramp that originates just south of the SR 82 to I-71 SB entrance ramp and terminates at the Howe Road/Shurmer Road intersection.
  - b. Widen Howe Road to five lanes (about 2000') from the current five lane section just north of Pomeroy Boulevard to the Howe Road/Shurmer Road intersection.
  - c. Widen the southern and western intersection approaches of the Howe Road/Shurmer Road intersection.
  - d. Add an additional right turn lane to SR 82 EB to access I-71 NB (as part of a separate project to be constructed in 2017, PID 99435).
  - e. Optimize signal timings and coordination.

Figure 7 - Build Interchange Ramp Configuration



#### **Build Condition Design Standards**

The proposed Build condition improvements meet ODOT design standards pertaining to roadway geometrics and interchange elements.

#### **Build Condition Limits of L/A ROW**

Given the Build conditions of an additional I-71 SB exit ramp that terminates at the Howe Road / Shurmer Road intersection, the intent would be to permit all residential driveways to remain while not allowing commercial driveways to be constructed within 600 feet of the ramp terminus. This restricts future commercial growth without the need to acquire residential properties.





Figure 8 - Build Condition



Royalton Rd 80 28 Howe Rd Royalton Rd Strongsville SCALE 1000 EXIL A ONLY Howe Rd EXIT 230 EXIT ONLY **Exit Ramp to Howe/Shurmer** Howe Rd **Road Intersection** EXIT 230 er-Rd-Proposed Signing Plan Hatch Mott MacDonald  $\overline{71}$ 

Figure 9 - Proposed I-71 SB Signing Plan



# VIII. Traffic Volumes

ODOT's Office of Statewide Planning & Research provided certified traffic forecasts on June 19, 2013. Certified traffic was provided for AM/PM peaks, ADT's, and truck factors for 2015 (current year) and 2035 (design year). See Appendix B for certified traffic.

To assist in the development of certified traffic forecasts, HMM completed an Origin-Destination (O-D) Study in 2013 to determine traffic patterns in the area and in particular to help determine proposed volumes on the new I-71 SB to Howe Road exit ramp. The results of this study are available in the *I-71* at SR 82 Origin-Destination Study dated April 5, 2013.

# IX. Traffic Analyses

#### **Level of Service**

Per the Highway Capacity Manual, a Level of Service (LOS) C is desired for the interstate/freeway system and interchange components of the Build condition. The Northeast Ohio Areawide Coordinating Agency (NOACA) accepts LOS D or better within their MPO boundaries. Regardless of delay, any intersection which has a volume-to-capacity (v/c) ratio over 1.0 is considered failing and will be labeled LOS F. Analysis was based on a cycle length of 150 seconds (AM and PM) for all intersections on SR 82 and 110 seconds (AM and PM) for all intersections on Howe Road. The SR 82/Howe Road intersection was analyzed at 150 second cycles. Full capacity reports are available in Appendix C.

#### Intersections

Traffic analysis was completed for intersection locations in Figure 10 for AM and PM peaks for the No Build and Build Alternatives. All intersections were analyzed using *Highway Capacity Software (HCS) 2010* to determine LOS for existing conditions (No Build) and to appropriately size the intersections for proposed conditions (Build). No Build analyses followed ODOT balancing procedures where the worst east-west approach was balanced within three seconds of the worst north-south approach where possible. In addition, the signals along SR 82 were analyzed in *Synchro 8* to measure coordination parameters and the interaction between signals within the SR 82 closed loop system (see Figure 11).

HCS Results for No Build and Build design year traffic are presented on the following page. Note that the intersection of I-71 SB and SR 82 was not analyzed in HCS because the existing signal phasing and intersection geometrics exceeds the capabilities of HCS and therefore any analysis in HCS would not be reliable. This intersection was analyzed in Synchro as an isolated intersection (presented on the following page) as well as part of the SR 82 coordinated system.

#### **HCS/Isolated Intersection Build Analysis**

- All intersections operate at an acceptable LOS D or better in the AM Build condition.
- The SR 82/Howe intersection operates at a LOS E in the PM Build condition.
- All other intersections operate at an acceptable LOS D or better in the PM Build condition.

#### **Synchro Coordination Analysis**

All intersections operate at a LOS D or better for both AM and PM in the Build condition.



Figure 10 – Intersection LOS Summary

	AM No E	Build v	's Build				PM No E	<u>Build</u> v	s Build	<u> </u>	
ıD		2035 N	lo Build	2035	2035 Build		Lasatian	2035 N	lo Build	2035 Build	
ID	Location	LOS	Delay	LOS	Delay	ID	Location	LOS	Delay	LOS	Delay
12	SR 82 & I-71 SB <sup>1</sup>	F	85.2	С	26.7	12	SR 82 & I-71 SB <sup>1</sup>	F	104.2	D	41.6
	EB Approach	F	111.6	С	23.6		EB Approach	F	145.7	D	41.8
	WB Approach	С	29.8	С	22.9		WB Approach	F*	54.9	D	39.9
	NB Approach	E	60.1	С	33.1		NB Approach	F	145.1	D	42.9
	SB Approach	F	110.0	D	43.1		SB Approach	F*	70.3	D	43.0
13	SR 82 & Howe	E	61.1	D	54.6	13	SR 82 & Howe	E	73.2	Е	61.9
	EB Approach	D	43.9	D	54.5		EB Approach	F*	79.0	Е	57.8
	WB Approach	F*	70.1	D	54.5		WB Approach	F*	73.7	F*	63.2
	NB Approach	E	67.8	D	54.8		NB Approach	E	55.7	Е	64.7
	SB Approach	E	56.2	D	54.7		SB Approach	E	78.6	E	65.6
14	Howe & Pomeroy/Tracy	D	37.7	С	34.7	14	Howe & Pomeroy/Tracy	С	33.9	С	31.3
	EB Approach	D	46.1	С	34.4		EB Approach	D	45.1	С	33.6
	WB Approach	D	46.6	D	35.1		WB Approach	D	46.0	С	33.7
	NB Approach	D	45.0	D	35.0		NB Approach	В	15.9	С	33.8
	SB Approach	Α	8.7	С	29.4		SB Approach	D	45.7	С	26.0
15	Howe & Shurmer	С	30.5	С	25.2	15	Howe & Shurmer	С	27.5	С	27.7
	EB Approach	С	30.5	С	25.5		EB Approach	С	34.9	С	28.6
	WB Approach	-	-	С	26.7		WB Approach	-	-	С	28.2
	NB Approach	С	33.1	С	24.6		NB Approach	В	14.3	С	26.6
	SB Approach	С	20.2	С	27.6		SB Approach	D	35.2	С	28.2
16	Howe & Drake	С	27.9	(same as	No Build)	16	Howe & Drake	С	26.4	(same as	No Build
	EB Approach	С	22.1				EB Approach	С	24.8		
	WB Approach	С	32.5				WB Approach	С	33.1		
	NB Approach	С	31.5				NB Approach	С	32.9		
		С	23.4				SB Approach	С	21.7		

Figure 11 - SR 82 Coordinated System LOS Summary

	AM No Build vs Build							PM No Build vs Build						
15	l ti	2035 N	Io Build	2035	Build		10	1	2035 N	lo Build	2035 Build			
ID	Location	LOS	Delay	LOS	Delay		ID	Location	LOS	Delay	LOS	Delay		
	SR 82 & I-71 NB	В	17.9	В	12.9			SR 82 & I-71 NB	В	16.5	В	10.7		
	EB Approach	Α	4.7	В	12.2			EB Approach	Α	7.2	Α	6.9		
	WB Approach	В	11.1	Α	8.8			WB Approach	Α	9.6	Α	6.8		
	NB Approach	Е	61.8	С	31.7			NB Approach	Е	63.7	D	40.6		
12	SR 82 & I-71 SB	Е	57.7	С	29.3		12	SR 82 & I-71 SB	F	105.5	D	47.3		
	EB Approach	F	80.2	С	25.0			EB Approach	F	137.4	D	50.9		
	WB Approach	С	28.3	С	23.8			WB Approach	D	54.3	D	42.2		
	NB Approach	E	58.8	D	35.4			NB Approach	F	139.7	D	50.4		
	SB Approach	D	43.9	D	51.4			SB Approach	F	91.0	D	45.4		
13	SR 82 & Howe	F	125.4	D	36.4		13	SR 82 & Howe	F	130.4	D	46.3		
	EB Approach	F	221.4	D	42.9			EB Approach	F	204.8	D	43.0		
	WB Approach	С	34.4	В	19.7			WB Approach	F	117.5	D	35.9		
	NB Approach	F	174.2	D	53.3			NB Approach	D	53.5	Е	65.1		
	SB Approach	D	51.9	D	51.9			SB Approach	E	69.1	Е	67.7		



#### **Freeway Segment Analysis**

HMM analyzed freeway segments on I-71 SB following ODOT methodology using *HCS 2010*. Segments were analyzed between interchanges and within interchanges between merge and diverge points.

Note that the segment from I-80 to SR 82 (ID 3) cannot be accurately modeled in HCS using basic freeway segment analysis due to downstream congestion and rolling queues from the SR 82 interchange, largely stemming from the SR 82 WB Exit. HCS cannot factor preferential lane use of Lane 3 (the outside, western-most lane). To account for this, HMM calculated capacity for Lanes 1 and 2 separately from Lane 3. Lane 3 volume was assumed to be all of SR 82 WB exiting traffic plus half of SR 82 EB exiting traffic. This methodology produces a density and LOS that is more reflective of observed conditions. The Build Condition is expected to improve this condition by rebalancing the lane distribution given the additional exit ramp to Howe Road. A summary of the segment analysis is below.

- In the PM, the SB segment of I-71 SB from the I-80 to the SR 82 WB Exit is LOS F for the No Build Condition and LOS E for the Build Condition.
- The proposed Build conditions do not degrade freeway segment operations as defined in the IJS Traffic Academy Manual.

	AM No Build vs Build						PM No Build vs Build						
ID	I-71 Southbound	Lanos	2035	No Build	203	5 Build		I-71 Southbound	Lance	2035	No Build	203	5 Build
ID	1-71 300111000110	Lanes	LOS	Density	LOS	Density	ID	1-71 300111000110	Lanes	LOS	Density	LOS	Density
	@ I-80							@ I-80					
1	@ I-80	3	В	12.3	ʻsame d	ıs No Build)	1	@ I-80	3	D	32.6	'same d	ıs No Build)
3	I-80 to SR 82	3	С	19.0	В	15.0	3	I-80 to SR 82	3	F	49.7	E	37.9
	@ SR 82							@ SR 82					
5	SR 82 WB Exit to EB Exit	3	Α	9.7	В	11.2	5	SR 82 WB Exit to EB Exit	3	С	23.0	D	26.9
7	SR 82 EB Exit to SR 82 Enter	3	Α	7.7	Α	9.2	7	SR 82 EB Exit to SR 82 Enter	3	С	18.4	С	21.8
	@ Howe							@ Howe					
9	Howe to SR 303	3	Α	9.8	'same a	ıs No Build)	9	Howe to SR 303	3	С	21.4	'same d	ıs No Build)
11	@ SR 303	3	Α	6.2	same d	ıs No Build)	11	@ SR 303	3	В	13.6	same d	ıs No Build)

Figure 12 - Freeway Segment LOS Summary







# Merge / Diverge Analysis

HMM analyzed LOS at merge and diverge points along I-71 SB within the project area following ODOT methodology using *HCS 2010*. Note that the SR 82 entrance ramp merge to I-71 SB is a weave in the Build condition and is discussed in the subsequent section.

- In the PM, the I-71 SB diverge to SR 82 WB operates at LOS E for the No Build & Build conditions.
- The proposed Build conditions do not degrade freeway operations for merge and diverge points.

Figure 14 - Merge/Diverge LOS Summary

	AM No Build vs Build						PM No Build vs Build						
ID	. 74 6	2035 No Build		2035 Build		10	D 1.746 111 1	2035 No Build		2035 Build			
ID	I-71 Southbound	LOS	Density	LOS	Density	ID	I-71 Southbound	LOS	Density	LOS	Density		
@ I-80						@ I-80							
2	Merge - from I-80	В	16.3	(same as No Build)		2	Merge - from I-80	D	32.9	(same a	s No Build)		
	@ SR 82				@ SR 82								
4	Diverge - to SR 82 WB	В	19.5	В	18.8	4	Diverge - to SR 82 WB	Е	38.7	Е	36.2		
6	Diverge - to SR 82 EB	В	13.4	В	15.1	6	Diverge - to SR 82 EB	С	27.5	D	30.3		
8	Merge - from SR 82	В	10.8	-	-	8	Merge - from SR 82	С	21.9	-	-		
	@ SR 303				@ SR 303								
10	Diverge - to SR 303	В	14.2	(same as	(same as No Build)		Diverge - to SR 303	С	27.6	(same a	s No Build)		



#### **Weave Analysis**

HMM analyzed the weave segment on I-71 SB between the SR 82 entrance ramp and the Howe Road exit ramp following ODOT methodology using *HCS 2010*. The analysis only accounted for the Build condition as the No Build condition is a merge.

The Build Condition does not degrade freeway operations at the weave segment.

AM Build PM Build 2035 Build 2035 Build ID I-71 Southbound ID I-71 Southbound LOS LOS Density Density SR 82 Entrance **SR 82 Entrance** to Howe Exit to Howe Exit Weave - I-71 9.9 Weave - I-71 8A Α 8A С 24.1

Figure 15 - Weave LOS Summary

#### **Turn Lane Storage Length Recommendations**

HMM calculated turn lane storage lengths based on 2035 Build condition turning movement traffic volumes as per the ODOT L&D Volume 1 using the same cycle lengths as the capacity analysis. Below is a summary of calculated and recommended turn lane lengths at locations with proposed changes. Full calculations are provided in Appendix D.

Volume (vph) L&D Length (ft)\* Thru Backup Recommend Length (ft)\* **Build Intersection** Reason LT THRU RT LT THRU RT RT RT (cycle length in sec) LT (ft) LT Howe & Shurmer (110) EB Shurmer ٨ 225 150 150 225 100 50 1 1 WB I-71 Exit Ramp 600 520 90 210 1 1 325 150 600 600 form both lanes at same pt. NB Howe 50 660 2 150 365 150 limit ROW impacts, low turn vol 1 SB Howe 440 50 150 525 rt lane will form from thru lane Howe & Pomeroy/Tracy (110) lack of turn traffic, presence of NB Howe 10 1210 10 1 2 100 600 150 TWLTL, & drives lack of turn traffic & presence 100 625 150 SB Howe 20 590 20 1 1 of TWLTL SR 82 & I-71 SB (150) 310 1190 1 3 -517 constrained by existing bridge WB SR 82 525 300

Figure 16 - Turn Lane Calculation Summary



^shared thru/right lane



# X. Cost Estimates

The cost estimates provided below breakdown the improvements for the Build Condition. A detailed cost estimate is provided in Appendix E.

Table 2 - Build Condition Cost Estimate

Summary of I71_SR82 Interchange Improvements Probable Costs Build Condition								
Section		Cost						
Howe Road Off Ramp and Intersection Improvements	\$	4,700,000						
Howe Road Widening (5 lanes) North of Shurmer	\$	3,000,000						
Total	\$	7,700,000						

# XI. Environmental Overview

At this time the full scope of the environmental impacts is unknown until more detailed environmental analysis is completed. Preliminarily, the Build Condition will have permanent right of way impacts but no major utility impacts. Noise walls will likely be needed. The CE document level will be determined with further development of the Build Condition.



#### XII. Conclusion and Recommendations

The I-71/SR 82 interchange is heavily congested due traffic demand from commercial areas adjacent to the interchange as well as the large residential population surrounding the commercial areas. Travel delays are high due to the congestion and a number of closely spaced signalized intersections. In addition, crash frequency is high within the study area as many locations fall under ODOT's Highway Safety Program Priority List.

The Build Condition is expected to reduce delay at the SR 82/Howe and SR 82/I-71 SB intersections, particularly in the PM peak (which is similar to Saturday and holiday season volumes per recent ODOT traffic counts and studies). This delay reduction is based on redirecting vehicles currently utilizing the I-71 SB to SR 82 exit ramp as well as the SR 82 corridor and redirecting them to the Howe Road exit ramp. Nearly 7,000 vehicles a day are expected to utilize to the Howe Road exit ramp in the Build Conditions with nearly 400 vehicles in the AM peak and over 800 in the PM peak. Removing these vehicles from the SR 82/Howe Road intersection allows the existing roadway system to work better.

The Build Condition does not degrade freeway operations. All intersections, freeway segments, merge, diverge, and weave segments operate with equal or improved LOS between No Build and Build conditions.

The Build Condition is expected to operate with similar levels of service for freeway segments and merge/diverge conditions. The weave between the SR 82 to I-71 SB entrance ramp and the Howe Road exit ramp is expected to operate at a LOS C or better.

The Build Condition is expected to improve traffic operations at the I-71/SR 82 interchange and the SR 82 corridor within and adjacent to the interchange without degrading freeway operations.



# Appendix A

**2013 Census Data** 

# OH - Cuyahoga County

# OH - Strongsville city

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# **Housing Status**

( in housing units unless noted )	
Total	621,763
Occupied	545,056
Owner-occupied	331,876
Population in owner-occupied	804,136
( number of individuals )	
Renter-occupied	213,180
Population in renter-occupied	446,735
( number of individuals )	
Households with individuals under 18	154,582
Vacant	76,707
Vacant: for rent	32,522
Vacant: for sale	9,679

# Population by Sex/Age

607,362
672,760
290,262
989,860
78,335
157,986
254,121
266,049
198,541

# Population by Ethnicity

Н	Hispanic or Latino	61,270
N	Non Hispanic or Latino	1,218,852

#### Population by Race

White	814,103
African American	380,198
Asian	32,883
American Indian and Alaska Native	2,578
Native Hawaiian and Pacific Islander	285
Other	23,339
Identified by two or more	26,73

# Population

Total Population 44,7	50
-----------------------	----

# Housing Status

( in housing units unless noted )	
Total	18,476
Occupied	17,659
Owner-occupied	14,270
Population in owner-occupied	37,978
( number of individuals )	
Renter-occupied	3,389
Population in renter-occupied	6,468
( number of individuals )	
Households with individuals under 18	5,571
Vacant	817
Vacant: for rent	316
Vacant: for sale	205

# Population by Sex/Age

21,766
22,984
10,405
34,345
1,951
4,014
9,567
10,686
7,189

# Population by Ethnicity

Hispanic or Latino	912
Non Hispanic or Latino	43,838

#### Population by Race

1 opulation by reade	
White	41,185
African American	845
Asian	1,833
American Indian and Alaska Native	42
Native Hawaiian and Pacific Islander	14
Other	190
Identified by two or more	641

#### **OH - Medina County**

# OH - Brunswick city

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# **Housing Status**

( in housing units unless noted )	
Total	69,181
Occupied	65,143
Owner-occupied	52,536
Population in owner-occupied	143,720
( number of individuals )	
Renter-occupied	12,607
Population in renter-occupied	27,414
( number of individuals )	
Households with individuals under 18	22,966
Vacant	4,038
Vacant: for rent	1,400
Vacant: for sale	880

# Population by Sex/Age

84,941
87,391
43,741
128,591
7,801
17,926
39,633
36,696
22,601

# Population by Ethnicity

Hispanic or Latino	2,747
Non Hispanic or Latino	169,585

#### Population by Race

· opulation by reacc	
White	165,642
African American	2,027
Asian	1,660
American Indian and Alaska Native	247
Native Hawaiian and Pacific Islander	18
Other	652
Identified by two or more	2,086

# Population

Total Population 34,25	5
------------------------	---

# Housing Status

( in housing units unless noted )	
Total	13,600
Occupied	12,967
Owner-occupied	10,190
Population in owner-occupied	27,816
( number of individuals )	
Renter-occupied	2,777
Population in renter-occupied	6,239
( number of individuals )	
Households with individuals under 18	4,695
Vacant	633
Vacant: for rent	322
Vacant: for sale	135

# Population by Sex/Age

Male	16,830
Female	17,425
Under 18	8,644
18 & over	25,611
20 - 24	1,738
25 - 34	3,983
35 - 49	8,040
50 - 64	6,949
65 & over	4,079

# Population by Ethnicity

Hispanic or Latino	790
Non Hispanic or Latino	33,465

# Population by Race

White	32,706
African American	422
Asian	420
American Indian and Alaska Native	51
Native Hawaiian and Pacific Islander	6
Other	204
Identified by two or more	44

# Appendix B

**Certified Traffic** 

# INTER-OFFICE COMMUNICATION

TO: Brian Blayney, P.E., Traffic Planning Engineer, District 12

**FROM:** Becky Salak, Transportation Planner, Office of Statewide Planning and Research

SUBJECT: CUY-71-2.57, No PID Revised

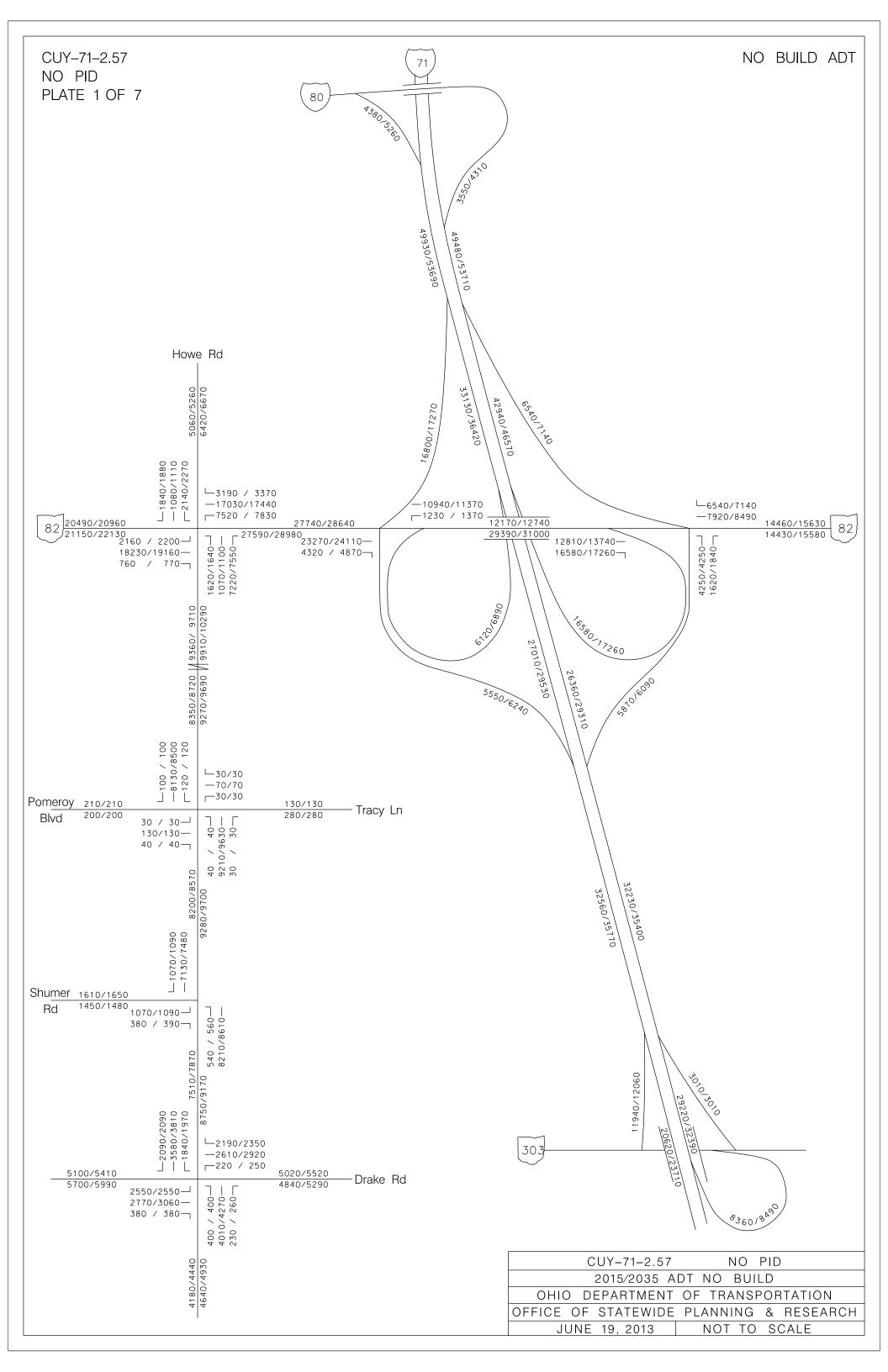
**DATE:** June 19, 2013

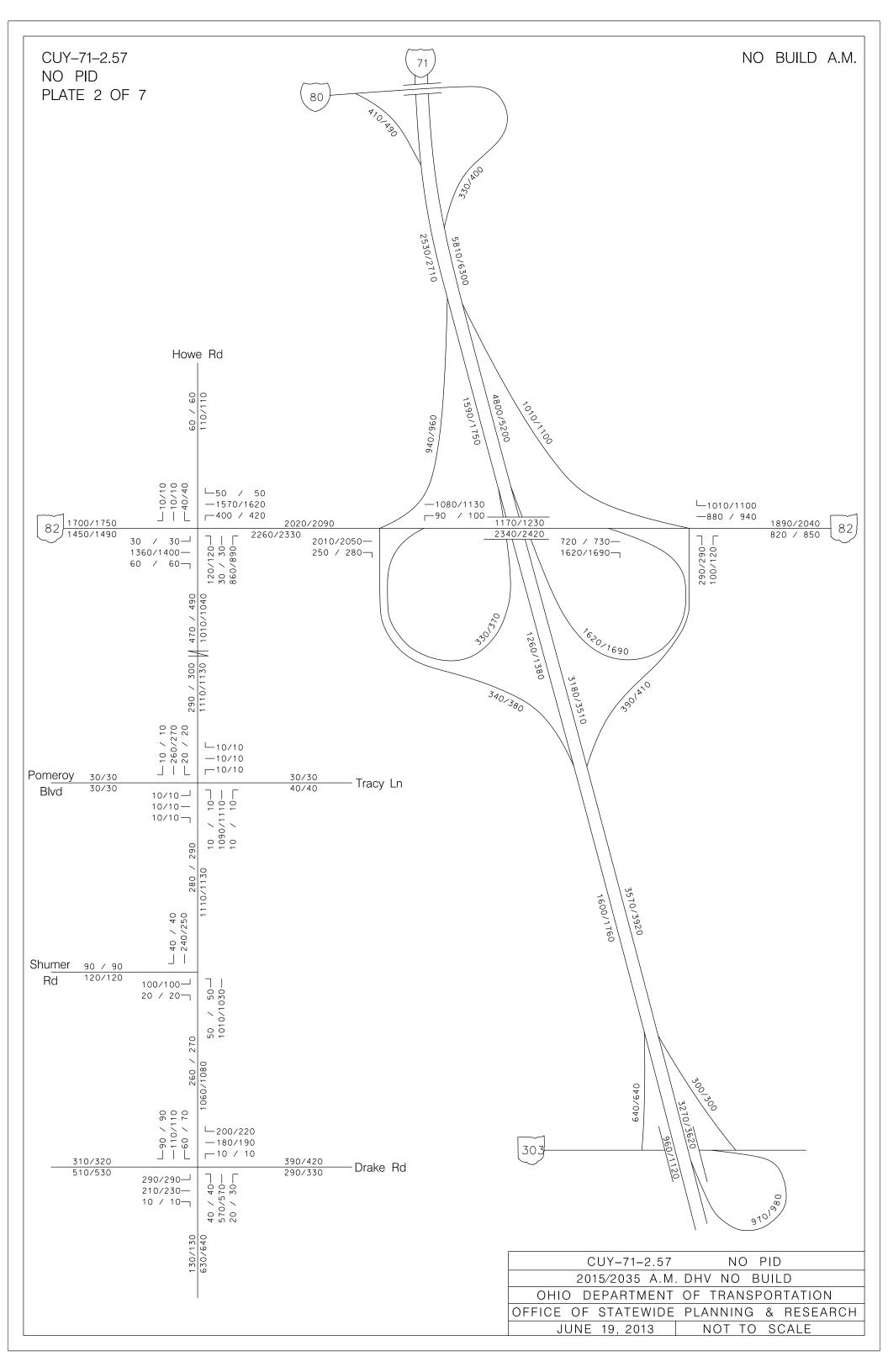
The attached plates have been revised, and replace the plates sent with the June 14, 2013 IOC.

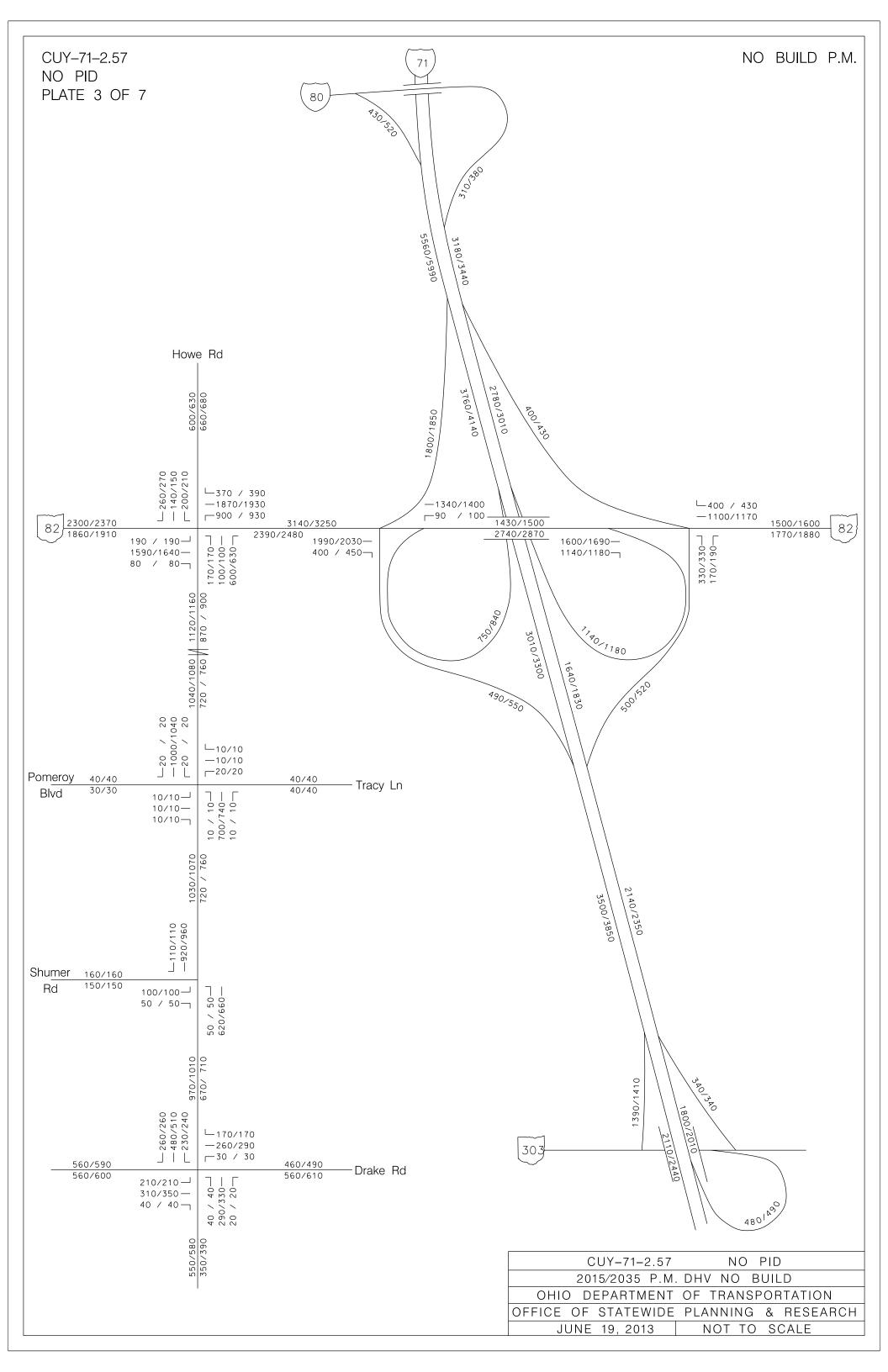
In reply to a request received May 24, 2013, plates are attached showing 2015/2035 ADT, A.M. DHV, and P.M. DHV turning movement forecasts for the no build and build scenarios. K & D factors can be calculated as needed. Truck factors are shown on a separate plate.

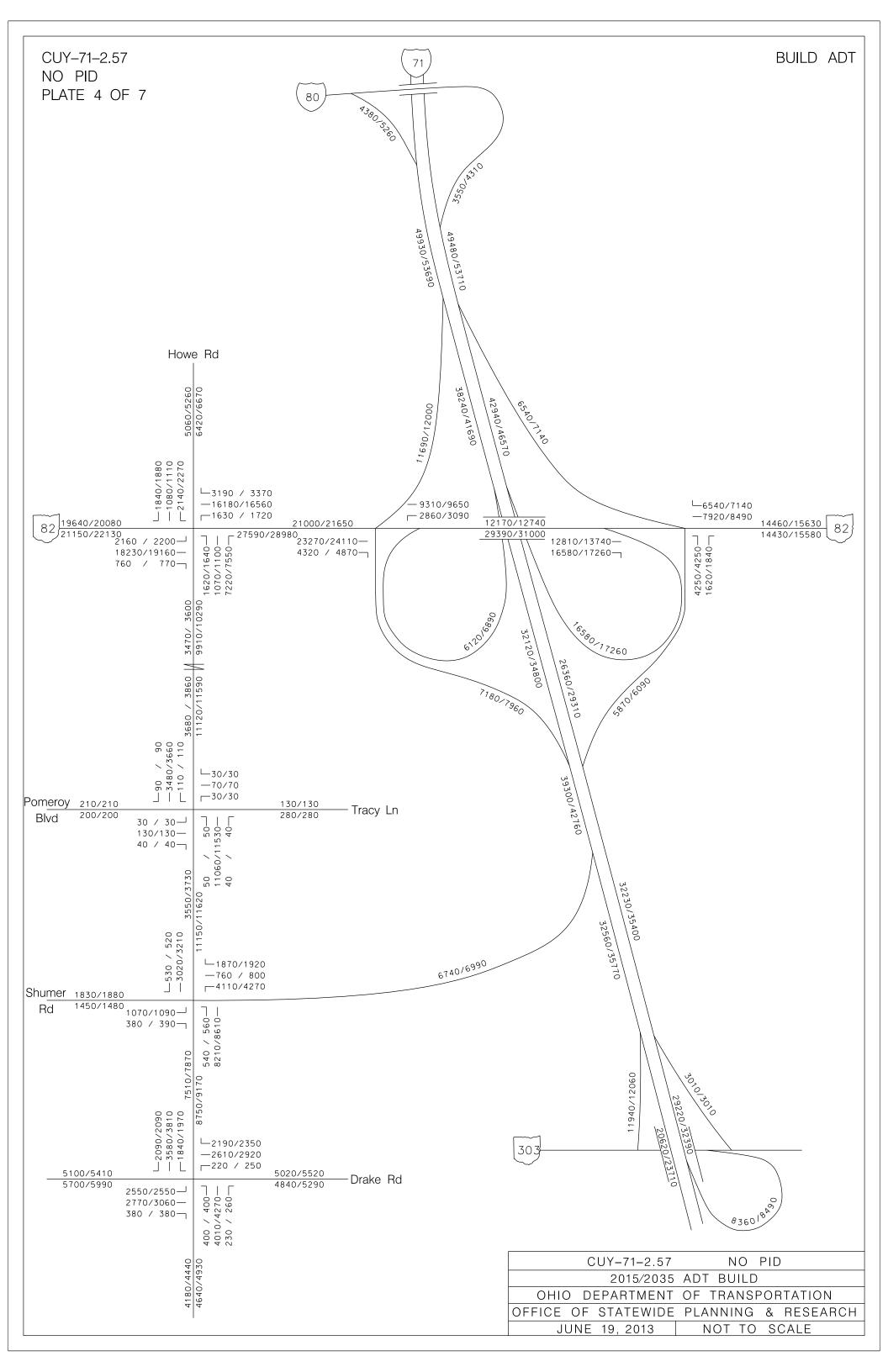
If you have any questions, please contact me at (614) 644-8195.

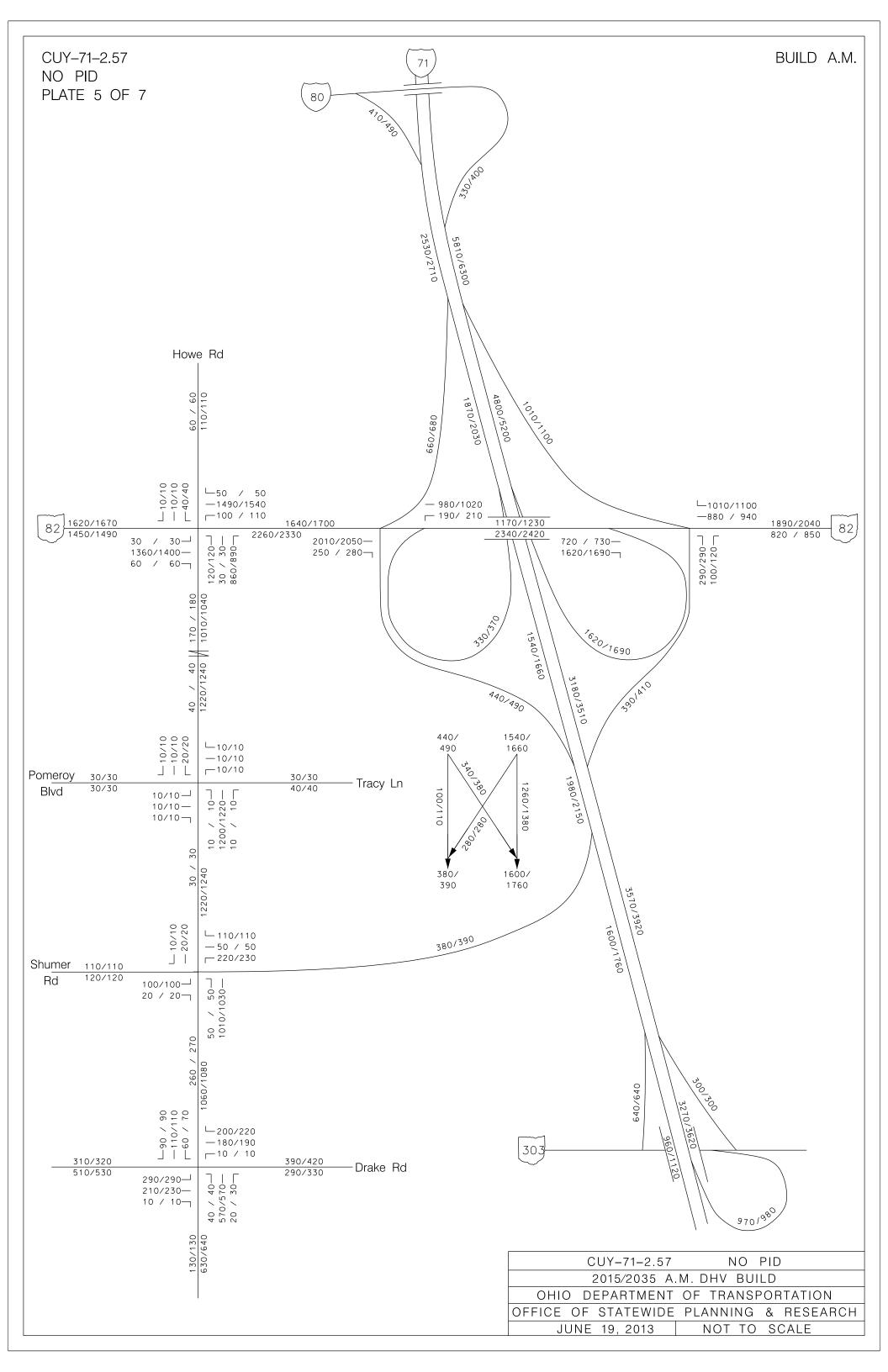
c: M. Byram, OSPR – G. Giaimo, OSPR – File

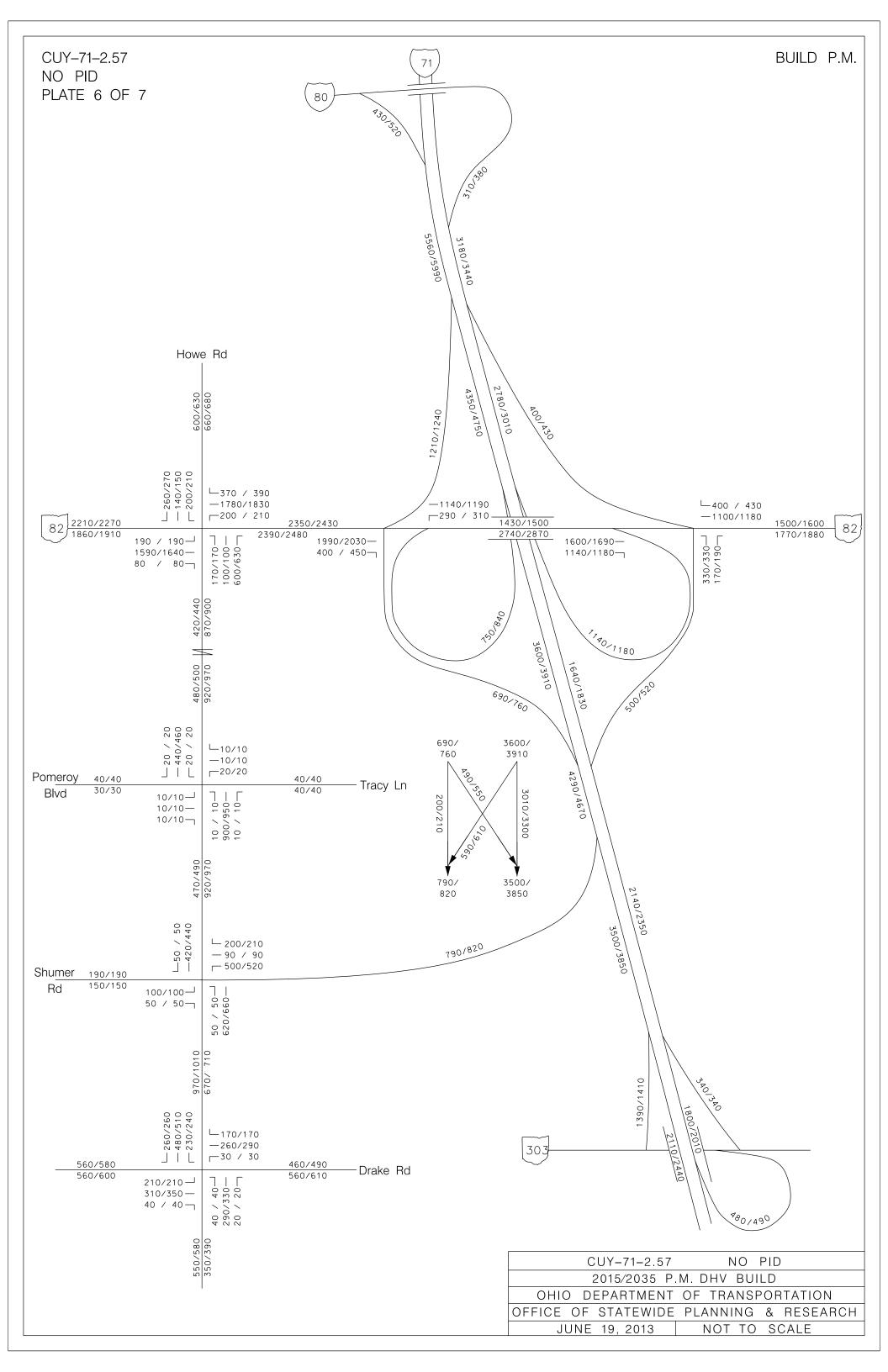


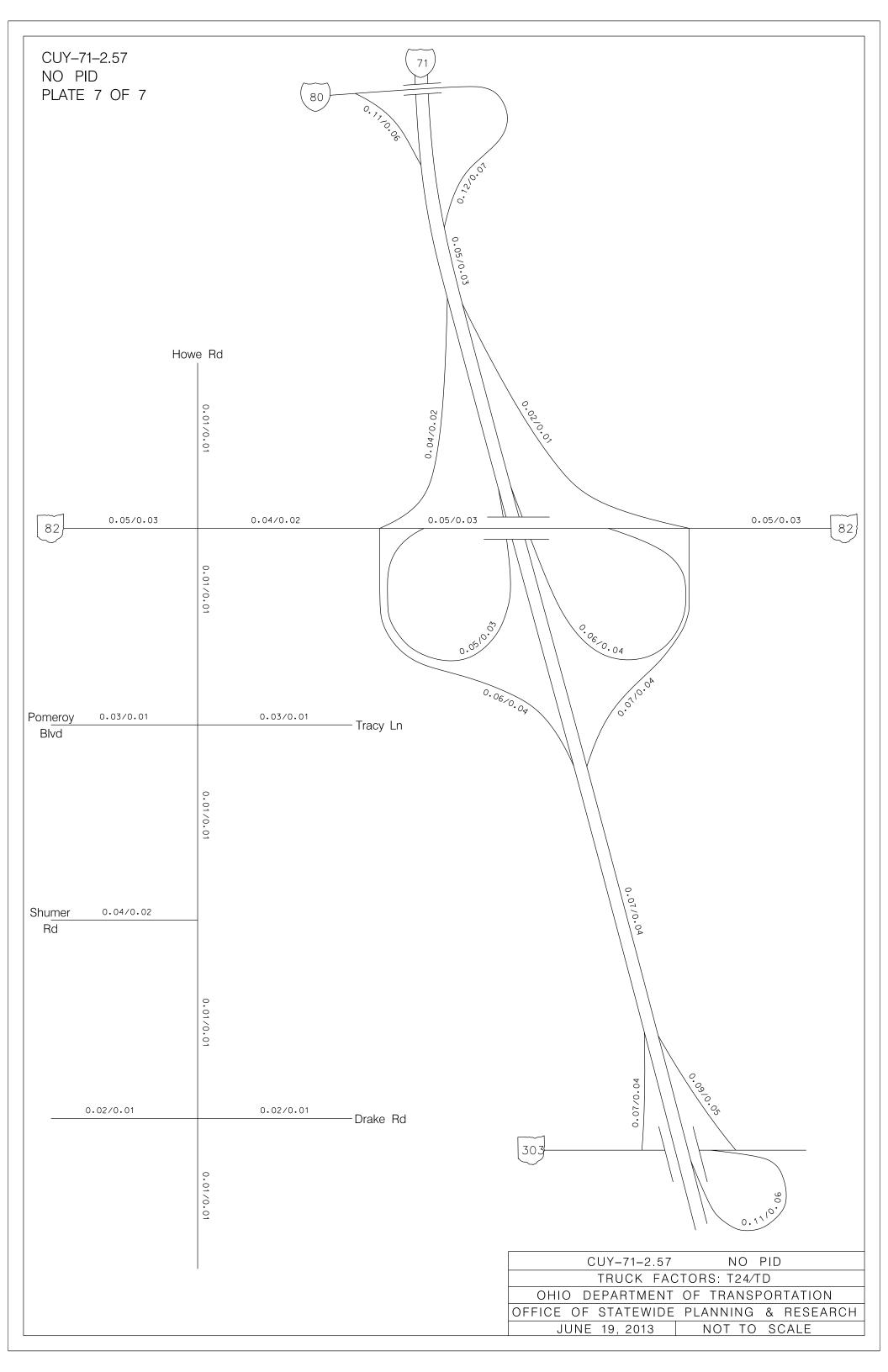












# Appendix C

**Capacity Analysis** 

# Intersections

# **2035 No Build Condition**

 $\mathbf{AM}$ 

	<b>→</b>	•	•	←	/	1		
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR	ø1	ø4
Lane Configurations	ተተተ	7	ሻ	ተተተ	77	777		
Volume (vph)	2050	280	100	1130	370	960		
Turn Type	NA	Perm	Prot	NA	pt+ov	custom		
Protected Phases	6		5	2	4 5	14	1	4
Permitted Phases	6	6		2		14		
Detector Phase	6	6	5	2	4 5	14		
Switch Phase								
Minimum Initial (s)	25.0	25.0	10.0	25.0			1.0	7.0
Minimum Split (s)	32.0	32.0	17.0	32.0			20.0	20.0
Total Split (s)	111.0	111.0	25.0	105.0			31.0	14.0
Total Split (%)	74.0%	74.0%	16.7%	70.0%			21%	9%
Yellow Time (s)	5.0	5.0	5.0	5.0			5.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0			2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0				
Total Lost Time (s)	7.0	7.0	7.0	7.0				
Lead/Lag	Lead	Lead	Lag	Lag			Lead	
Lead-Lag Optimize?	Yes	Yes						
Recall Mode	None	None	None	None			None	Max
Act Effct Green (s)	104.0	104.0	18.0	98.0	33.0	38.0		
Actuated g/C Ratio	0.69	0.69	0.12	0.65	0.22	0.25		
v/c Ratio	1.22	0.27	1.03	0.40	0.68	1.09		
Control Delay	126.6	1.3	133.5	12.6	60.1	110.0		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	126.6	1.3	133.5	12.6	60.1	110.0		
LOS	F	Α	F	В	Ε	F		
Approach Delay	111.6			29.8				
Approach LOS	F			С				
Intersection Summary								

#### Intersection Summary

Cycle Length: 150

Actuated Cycle Length: 150

Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.22

Intersection Signal Delay: 85.2 Intersection LOS: F
Intersection Capacity Utilization Err% ICU Level of Service H

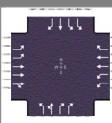
Analysis Period (min) 15

Splits and Phases: 2: I-71 SB Ramp & SR 82 Royalton Rd



No Build | 13

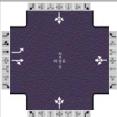
General Information				Intersection Info	rmation
Agency		Duration, h	0.25		
Analyst	SJB	Analysis Date	Mar 25, 2013	Area Type	Other
Jurisdiction	Strongsville	Time Period	AM	PHF	0.92
Intersection	SR 82 @ Howe Rd	Analysis Year	2035	Analysis Period	1> 7:00
File Name	16_SR82 & Howe 2035 AM	l No Build.xus			
Project Description	NO BUILD				



File Name Project Description	16_SR82 & Howe 2	2035 41/	I Na Dui	9.4										
Project Description			i ivo Bu	ııa.xus									1111	
	NO BUILD													_
Demand Information				EB		T	WB		T	NB		T	SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand (v), veh/h			30	1400	60	420	1620	50	120	30	890	40	10	10
Signal Information						. 2	T	211						
Cycle, s 150.0	Reference Phase	2	1	2	₹	B I soal					_	į.	<b>4</b>	
Offset, s 0	Reference Point	End		7	<u></u>							2	3	4
Uncoordinated Yes	Simult. Gap E/W	On	Green Yellow		33.5 4.0	4.0	21.0 4.0	18.0 4.0	0.0		, l	<b>←</b>		-4-
Force Mode Fixed	_	On	Red	1.5	1.5	1.5	1.5	1.5	0.0		5	6	7	Y
	- Constant Cop Cons				1									
Timer Results			EBL	_	EBT	WB	L ,	WBT	NBI		NBT	SBI		SBT
Assigned Phase			5		2	1		6		$\neg$	8		$\neg$	4
Case Number			2.0		4.0	2.0		3.0			9.0			9.0
Phase Duration, s			23.5	5	62.5	37.5		76.5			26.5			23.5
change Period, ( <i>Y+R₀</i> ), s			5.5		5.5	5.5		5.5			5.5			5.5
lax Allow Headway ( <i>MAH</i> ), s			3.0	$\neg$	3.0	3.1		3.0		$\neg$	3.3		$\neg$	3.3
Queue Clearance Time $(g_s)$ , s			3.3	_	39.9	20.0		73.0			23.0			3.7
Green Extension Time ( $g_e$ ), s			3.8		0.0	0.9		0.0		$\neg$	0.0		$\neg$	0.1
Phase Call Probability			1.00		1.00	1.00	)	1.00			1.00			1.00
Max Out Probability			0.08 1.00		1.00			1.00		$\neg$	1.00		$\neg$	0.00
Movement Group Re	sults		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	·		33	1069	518	457	1761	54	130	33	967	43	11	11
Adjusted Saturation F	, ,	1	1706	1845	1789	1723	1773	1577	1792	1881	1411	1740	1881	1586
Queue Service Time (	<del>- ·</del>		1.3	37.9	37.9	18.0	71.0	2.8	10.1	2.3	21.0	1.7	0.8	0.8
Cycle Queue Clearan	ce Time (gc), s		1.3	37.9	37.9	18.0	71.0	2.8	10.1	2.3	21.0	1.7	0.8	0.8
Green Ratio (g/C)			0.12	0.38	0.38	0.21	0.47	0.47	0.14	0.14	0.35	0.12	0.12	0.24
Capacity (c), veh/h			409	1402	680	735	1679	746	251	263	997	418	226	382
Volume-to-Capacity R	. ,		0.080	0.762		0.621	1.049	0.073	0.520	0.124	0.970	0.104	0.048	0.028
Available Capacity (ca			409	1402	680	735	1679	746	251	263	997	418	226	382
Back of Queue (Q), ve			0.6	17.5	17.5	7.9	38.4	1.1	4.7	1.1	20.5	0.8	0.4	0.3
Queue Storage Ratio		:)	0.04	0.00	0.00	0.35	0.00	0.11	0.39	0.00	0.00	0.17	0.00	0.00
Uniform Delay (d1), s/			58.6	40.6	40.6	53.5	39.5	21.5	59.8	56.4	47.7	58.8	58.4	43.6
Incremental Delay (d2	<u></u>		0.0	2.3	4.6	1.2	36.0	0.0	0.9	0.1	21.4	0.0	0.0	0.0
Initial Queue Delay (d	*		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/ve			58.7	42.9	45.2	54.7	75.5	21.6	60.7	56.5	69.1	58.9	58.4	43.6
Level of Service (LOS	<u>,                                      </u>		E 40.6	D	D	D 70.4	F	С	E 07.0	E	E	E	E	_ D
Approach Delay, s/veh			43.9	,	D	70.1		E	67.8	5	Е	56.2	<u> </u>	Е
Intersection Delay, s/v	ren / LOS				61	1.1						E		
microcollon Delay, 5/1	Multimodal Results													
Multimodal Results				EB			WB			NB			SB	
	e/LOS			EB			WB			NB			SB	

No Build | 14

General Information					Intersection	on Info	rmation	T
Agency	Hatch Mott MacDonald				Duration, h	ı	0.25	],
Analyst	SJB	Analysis Date	Mar 25,	2013	Other			
Jurisdiction	Strongsville	Time Period	AM		PHF		0.92	
Intersection	Howe Rd & Pomeroy Blvd/	Analysis Year	2035		Analysis P	eriod	1> 7:00	
File Name	17_Howe & Pomeroy-Tracy	/ 2035 AM No B	uild.xus					
Project Description	NO BUILD							
<b>Demand Information</b>		EB		W	/B		NB	

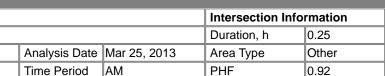


Intersection		Howe Rd & Pomero	y Biva/	Anaiys	is yea	r 2035		A	naiysis	Period	1> /:	00	_		,	
File Name		17_Howe & Pomero	oy-Trac	y 2035 A	AM No	Build.xu	S							*		
Project Descrip	tion	NO BUILD											T	11147	17	
							, I			1			4			
Demand Inform					EB			WB	1 -		NB		+	SB	T -	
Approach Move				L	Т	R	<u> </u>	Т	R	L	T	R	<u> </u>	T	R	
Demand (v), ve	eh/h			10	10	10	10	10	10	10	1110	10	20	270	10	
Signal Informa	ation				IJĿ.		15									
Cycle, s	110.0	Reference Phase	2	1	E.V.	a ≥3	2	╡					<b>*</b>			
Offset, s	0	Reference Point	End				100					1	2	3	<b>Y</b> 4	
Uncoordinated		Simult. Gap E/W	On	Green Yellow		4.0	4.0	0.0	0.0	0.0	_		L		<b>\( \rightarrow \)</b>	
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.5	2.5	2.5	0.0	0.0	0.0		5	6	7	8	
	1			,												
Timer Results				EBI	-	EBT	WBI	_ \	WBT	NB	L	NBT	SB	L	SBT	
Assigned Phas	<u> </u>					4			8			2	<u> </u>		6	
Case Number						10.0			12.0			8.0	<u> </u>		8.0	
	hase Duration, s					16.5			16.5			77.0	—	$-\!\!\!\!-\!$	77.0	
	Change Period, (Y+Rc), s				_	6.5		_	6.5		_	6.5	-		6.5	
	Max Allow Headway ( <i>MAH</i> ), s				_	3.3	_		3.3		_	3.1	—	-	3.1	
Queue Clearan					_	3.3	_	_	3.9		_	72.5	-		10.3	
Green Extension		( <i>g</i> e), S				0.0	0.0			0.0				5.0		
Phase Call Pro				1.00		1.00			1.00			-		1.00		
Max Out Proba	Dility			0.00		0.01			1.00					0.00		
Movement Gro	oup Res	sults			EB			WB			NB			SB		
Approach Move	ement			L	Т	R	L	Т	R	L	Т	R	L	T	R	
Assigned Move	ment			7	4	14	3	8	18	5	2	12	1	6	16	
Adjusted Flow I	Rate (v)	, veh/h		11	22			33			1228			326		
		ow Rate (s), veh/h/ln		1792	1716			1740			1874			1195		
Queue Service				0.6	1.3		$oxed{oxed}$	1.9			26.6		ــــــ	0.0		
Cycle Queue C		e Time $(g_c)$ , s		0.6	1.3			1.9			70.5		—	8.3		
Green Ratio (g				0.09	0.09		$\vdash$	0.09			0.64		—	0.64		
Capacity (c), ve				163	156			158			1234		-	801		
Volume-to-Cap				0.067				0.206			0.996		—	0.407		
Available Capa	<b>,</b> ,	,		163	156			158		_	1234		-	801		
	· /·	h/ln (50th percentile)		0.3	0.6			0.8			36.3		₩	3.1		
Uniform Delay		RQ) (50th percentile	)	0.00 45.7	0.00 46.0			0.00 46.3			20.5		_	0.00 8.6		
Incremental De				0.1	0.1			0.2			24.5			0.0		
Initial Queue D	- ' '			0.0	0.0			0.2			0.0			0.1		
Control Delay (		•		45.8	46.2			46.6			45.0			8.7		
Level of Service				D	D			D			D			A		
Approach Dela				46.1		D	46.6		D	45.0		D	8.7		Α	
Intersection De							7.7						D			
Multimodal Re	sults				EB			WB			NB			SB		
Pedestrian LOS	S Score	/ LOS														

Bicycle LOS Score / LOS

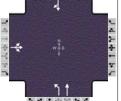
# HCS 2010 Signalized Intersection Results Summary No Build | 15 General Information Intersection Information

Analysis Year 2035



Analysis Period

1> 7:00



File Name 18\_Howe & Shurmer 2035 AM No Build.xus
Project Description NO BUILD

SJB

Strongsville

Hatch Mott MacDonald

Howe Rd @ Shurmer Rd

Agency

Analyst

Jurisdiction

Intersection

Demand Information	EB			WB			NB		SB			
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand (v), veh/h	100	0	20				50	1030			250	40

Signal Informa	tion					21	Ι							
Cycle, s	110.0	Reference Phase	2		54	5.A	Ħ					<b>1</b>		<b>→</b>
Offset, s	0	Reference Point	End			- 1					1	2	2 3	<b>Y</b> 4
	-			Green	14.0	49.5	30.0	0.0	0.0	0.0				
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	<b>\</b>	4		
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	1.5	0.0	0.0	0.0	5	6	7	8

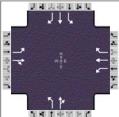
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		12.0			1.0	4.0		8.3
Phase Duration, s		35.5			19.5	74.5		55.0
Change Period, (Y+Rc), s		5.5			5.5	5.5		5.5
Max Allow Headway (MAH), s		3.3			3.1	3.0		3.0
Queue Clearance Time (gs), s		8.5			3.4	62.3		14.5
Green Extension Time $(g_e)$ , s		0.2			0.0	2.4		3.9
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.00			0.00	0.48		0.00

Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement	7	4	14				5	2			6	16
Adjusted Flow Rate (v), veh/h		130					54	1120			315	
Adjusted Saturation Flow Rate (s), veh/h/ln		1737					1792	1881			1835	
Queue Service Time (gs), s		6.5					1.4	60.3			12.5	
Cycle Queue Clearance Time (gc), s		6.5					1.4	60.3			12.5	
Green Ratio (g/C)		0.27					0.60	0.63			0.45	
Capacity (c), veh/h		474					653	1180			826	
Volume-to-Capacity Ratio (X)		0.275					0.083	0.949			0.382	
Available Capacity (ca), veh/h		474					653	1180			826	
Back of Queue (Q), veh/ln (50th percentile)		2.8					0.5	27.9			5.2	
Queue Storage Ratio (RQ) (50th percentile)		0.00					0.26	0.00			0.00	
Uniform Delay (d1), s/veh		31.5					10.3	18.9			20.1	
Incremental Delay (d2), s/veh		0.1					0.0	15.4			0.1	
Initial Queue Delay (d3), s/veh		0.0					0.0	0.0			0.0	
Control Delay (d), s/veh		31.6					10.3	34.2			20.2	
Level of Service (LOS)		С					В	С			С	
Approach Delay, s/veh / LOS	31.6 C		0.0			33.1 C			20.2	2	С	
Intersection Delay, s/veh / LOS			30	).5						С		

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

No Build | 16

General Information		Intersection Info	rmation		
Agency		Duration, h	0.25		
Analyst	SJB	Analysis Date	Mar 25, 2013	Area Type	Other
Jurisdiction	Strongsville	Time Period	AM	PHF	0.92
Intersection	Howe Rd @ Drake Rd	Analysis Year	2035	Analysis Period	1> 7:00
File Name	19_Howe & Drake 2035 AN	/I No Build.xus			
Project Description					



ntersection Howe Rd @ Drake Rd			Time F	erioa	AIVI			PHF		0.92		- 3		<b>~</b> -	
Intersection	Howe Rd @ Drake	Rd	Analys	is Year	2035			Analysis	Period	1> 7:0	00	122		v c	
File Name	19_Howe & Drake	2035 AN	/I No Bu	ild.xus									<b>ጎ</b> ቱ		
Project Description	NO BUILD												4 1 4 9	rr	
Demand Information	on			EB			WE	3		NB			SB		
Approach Movemer	nt		L	Т	R	L	Т	R	L	Т	R	L	Т	R	
Demand (v), veh/h			290	230	10	10	190	_	40	570		70	110	90	
				h 11:											
Signal Information	Y	1 -		ellis .	La	1.3 5						rt a		×	
Cycle, s 110		2		ľ %12	<u>,</u>						1	$\mathbf{Y}_{2}$	3	❤ ₄	
Offset, s		End	Green		14.0	31.5	0.0	0.0	0.0			1 4		Ā	
Uncoordinated Ye		On	Yellow		4.0	4.0	0.0	0.0	0.0			<b>D</b> 7		Z	
Force Mode Fix	ed Simult. Gap N/S	On	Red 1.5		1.5	1.5	0.0	0.0	0.0		5	6	7	8	
Timer Results			EBI		EBT	WB	1	WBT	NBI		NBT	SBI		SBT	
Assigned Phase			7		4	,,,,,		8	110		2	03.		6	
Case Number			1.0		4.0			5.3			6.0			5.0	
Phase Duration, s				5 .	56.5			37.0			53.5		$\neg$	53.5	
Change Period, (Y-	hange Period, (Y+Rc), s				5.5			5.5			5.5			5.5	
Max Allow Headway	Max Allow Headway ( <i>MAH</i> ), s				3.2			3.2			3.2		$\neg$	3.2	
Queue Clearance T	Queue Clearance Time (gs), s			3	11.7			15.9			35.4			45.6	
Green Extension Ti	Green Extension Time $(g_e)$ , s			15.3 1°				1.3			2.1			0.8	
Phase Call Probabi	lity		1.00 1.		1.00			1.00			1.00			1.00	
Max Out Probability	,		1.00 0.0		0.00			0.00			0.05			1.00	
Movement Group	Results			EB			WB			NR	NB		SB		
Approach Movemen			L	T	R	L	Т	R	L	T	R	L	T	R	
Assigned Movemer			7	4	14	3	8	18	5	2	12	1	6	16	
Adjusted Flow Rate			315	261		11	207	239	43	652		76	120	98	
-	Flow Rate (s), veh/h/lr	)	1792	1852		1122	1881	1589	1169	1864		784	1881	1578	
Queue Service Time			13.3	9.7		0.8	9.7	13.9	2.6	33.4		10.2	4.2	3.2	
Cycle Queue Cleara			13.3	9.7		0.8	9.7	13.9	6.8	33.4		43.6	4.2	3.2	
Green Ratio (g/C)	(0 )		0.43	0.46		0.29	0.29	0.29	0.44	0.44		0.44	0.44	0.56	
Capacity (c), veh/h			482	859		387	539	455	531	813		170	821	890	
Volume-to-Capacity	Ratio (X)		0.654	0.304		0.028	0.383	0.526	0.082	0.802		0.448	0.146	0.110	
Available Capacity	(ca), veh/h		482	859		387	539	455	531	813		170	821	890	
Back of Queue (Q),	veh/ln (50th percentile)	)	5.8	4.1		0.2	4.4	5.3	0.7	15.4		2.0	1.8	1.1	
Queue Storage Rat	io (RQ) (50th percentile	<del>)</del>	0.44	0.00		0.02	0.00	0.46	0.12	0.00		0.16	0.00	0.08	
Uniform Delay (d1),	s/veh		22.5	18.4		28.3	31.5	33.0	20.7	26.9		45.8	18.7	11.2	
Incremental Delay (	d <sub>2</sub> ), s/veh		2.5	0.1		0.0	0.2	0.6	0.0	5.4		0.7	0.0	0.0	
Initial Queue Delay	(d3), 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	Control Delay (d), s/veh		25.0	18.5		28.3	31.6	33.5	20.7	32.2		46.5	18.7	11.2	
Level of Service (LC	OS)		С	В		С	С	С	С	С		D	В	В	
Approach Delay, s/\	veh / LOS		22.1		С	32.5	5	С	31.5	5	С	23.4	1	С	
Intersection Delay,	s/veh / LOS				27	7.9						С			
Multimodal Result				EB			WB			NB			SB		
Pedestrian LOS Sc	destrian LOS Score / LOS														
	destrian LOS Score / LOS														

Bicycle LOS Score / LOS

# Intersections

# **2035 No Build Condition**

**PM** 

	<b>→</b>	•	•	<b>←</b>	/	</th <th></th> <th></th>		
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR	ø1	ø4
Lane Configurations	ተተተ	7	7	ተተተ	77	777		
Volume (vph)	2030	450	100	1400	840	1850		
Turn Type	NA	Perm	Prot	NA	pt+ov	custom		
Protected Phases	6		5	2	4 5	1 4	1	4
Permitted Phases	6	6		2		1 4		
Detector Phase	6	6	5	2	4 5	14		
Switch Phase								
Minimum Initial (s)	25.0	25.0	10.0	25.0			1.0	7.0
Minimum Split (s)	32.0	32.0	17.0	32.0			20.0	20.0
Total Split (s)	101.5	101.5	25.0	66.0			60.0	23.5
Total Split (%)	67.7%	67.7%	16.7%	44.0%			40%	16%
Yellow Time (s)	5.0	5.0	5.0	5.0			5.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0			2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0				
Total Lost Time (s)	7.0	7.0	7.0	7.0				
Lead/Lag	Lead	Lead	Lag	Lag			Lead	
Lead-Lag Optimize?	Yes	Yes						
Recall Mode	None	None	None	None			None	Max
Act Effct Green (s)	94.5	94.5	18.0	59.5	42.5	76.5		
Actuated g/C Ratio	0.63	0.63	0.12	0.40	0.28	0.51		
v/c Ratio	1.33	0.44	1.03	0.82	1.19	1.05		
Control Delay	177.5	2.6	133.5	44.5	145.1	70.3		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	177.5	2.6	133.5	44.5	145.1	70.3		
LOS	F	Α	F	D	F	Е		
Approach Delay	145.7			54.9				
Approach LOS	F			D				
Intersection Summary								
Cyclo Longth: 150								

Cycle Length: 150

Actuated Cycle Length: 150 Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.33

Intersection Signal Delay: 104.2 Intersection LOS: F
Intersection Capacity Utilization Err% ICU Level of Service H

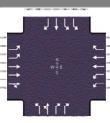
Analysis Period (min) 15

Splits and Phases: 2: I-71 SB Ramp & SR 82 Royalton Rd



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General Information				Intersection Info	rmation
Agency	Hatch Mott MacDonald			Duration, h	0.25
Analyst	SJB	Analysis Date	Mar 25, 2013	Area Type	Other
Jurisdiction	Strongsville	Time Period	PM	PHF	0.92
Intersection	SR 82 @ Howe Rd	Analysis Year	2035	Analysis Period	1> 7:00
File Name	16_SR82 & Howe 2035 PM	l No Build.xus			
Project Description	NO BUILD				



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File Name	tion	16_SR82 & Howe 2 NO BUILD	.UJO PIV	I INO BU	ııu.xuS								- 8	ጎጎተሰ	
Project Descrip	lion	INO BOILD													
Demand Inform	nation			Γ	EB		1	WB		1	NB		7	SB	
Approach Move				L	Т	R	L	T	R	L	Т	R		T	R
Demand (v), ve				190	1640		930	1930		170	100	630	210	150	270
								1000							
Signal Informa	tion				8		2		211						T
Cycle, s	150.0	Reference Phase	2		2		ĸ	51	В		×	<b>→</b> -	$\leftrightarrow$ .	١	ф
Offset, s	0	Reference Point	End	Green	44.0	32.5	13.0	16.0	17.0	0.0		1	¥ 2	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		4.0	4.0	4.0	4.0	0.0		<b>↗</b> │	<b>←</b>		❖
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	1.5	1.5	1.5	0.0		5	6	7	8
Timer Results				EBL	-	EBT	WB	L '	WBT	NBI	-	NBT	SBI	_	SBT
Assigned Phase	е			5		2	1		6			8			4
Case Number				2.0		4.0	2.0	_	3.0			9.0			9.0
Phase Duration	, S			18.5	<u> </u>	56.5	49.5	5	87.5			21.5			22.5
Change Period	, (Y+Rc)	, S		5.5		5.5	5.5		5.5			5.5			5.5
Max Allow Head	dway ( <i>N</i>	<i>IAH</i> ), s		3.1		3.1	3.1		3.1			3.3			3.3
Queue Clearan	ce Time	e (gs), s		10.8		53.0	46.0	)	84.0			18.0			19.0
Green Extension		(g <sub>e</sub> ), s		1.4		0.0	0.0	_	0.0			0.0			0.0
Phase Call Pro				1.00		1.00	1.00	_	1.00			1.00			1.00
Max Out Proba	bility			1.00		1.00	1.00	)	1.00			1.00			1.00
Manager 4 0	D							WD			ND			OD	
Movement Gro		suits			EB		-	WB	Б	-	NB -	Б	<b>-</b>	SB	Б
Approach Move Assigned Move				5		R 12	1	T 6	R 16	3	T 8	R 18	7	T 4	R 14
Adjusted Flow F		voh/h		207	1259	610	1011	2098	424	185	109	685	228	163	293
		ow Rate (s), veh/h/ln		1706	1845	1784	1723	1773	1577	1792	1881	1411	1740	1881	1586
Queue Service				8.8	51.0	51.0	44.0	82.0	25.0	15.4	8.2	16.0	9.3	12.6	17.0
Cycle Queue C				8.8	51.0	51.0	44.0	82.0	25.0	15.4	8.2	16.0	9.3	12.6	17.0
Green Ratio (g/		C Time (gc), 3		0.09	0.34	0.34	0.29	0.55	0.55	0.11	0.11	0.40	0.11	0.11	0.20
Capacity (c), ve				296	1254	606	1011	1939	862	191	201	1129	394	213	318
Volume-to-Capa		atio (X)		0.698	1.004		1.000	1.082	0.492	0.967	0.542	0.607	0.579	0.765	0.923
Available Capa				296	1254	606	1011	1939	862	191	201	1129	394	213	318
		h/ln (50th percentile)		4.1	27.8	28.8	22.8	46.3	9.2	9.9	4.0	10.0	4.3	6.9	8.0
		RQ) (50th percentile		0.32	0.00	0.00	1.02	0.00	0.93	0.84	0.00	0.00	0.98	0.00	0.00
Uniform Delay (			,	66.6	49.5	49.5	53.0	34.0	21.1	66.7	63.5	35.7	63.1	64.6	58.8
Incremental De				6.0	26.4	38.0	28.4	46.6	0.2	55.0	1.7	0.7	1.4	13.8	30.9
Initial Queue De	• • •			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 (				72.6	75.9	87.5	81.4	80.6	21.2	121.8	65.2	36.3	64.5	78.3	89.7
Level of Service				E	F	F	F	F	С	F	E	D	E	Е	F
Approach Delay				79.0		E	73.7	,	Е	55.7	7	E	78.6	3	E
Intersection De							3.2						E		
Multimodal Re	sults				EB			WB			NB			SB	
Pedestrian LOS	Score	/ LOS													
Bicycle LOS So	ore / LC	os													

		HCS 2	010 S	ignali	zed Ir	nterse	ction	Res	sults S	umm	ary		No	Build	d   14
General Inforn	nation								Intersec	tion Inf	ormatio	on		4741	ls L
Agency		Hatch Mott MacDor	nald					Ī	Duration	, h	0.25			*	
Analyst		SJB		Analys	is Date	Mar 25	, 2013		Area Typ	е	Other				4.
Jurisdiction		Strongsville		Time F	Period	PM			PHF		0.92		10 -¥	w∯E	<b>→</b>
Intersection		Howe Rd & Pomero	y Blvd/	Analys	is Year	2035			Analysis	Period 1> 7		00	22		v.
File Name		17_Howe & Pomero	y-Tracy	/ 2035 F	PM No E	Build.xus	3				,			*	
Project Descrip	tion	NO BUILD												7147	rin
Demand Inform	nation				EB			WE	В		NB			SB	
Approach Move	ement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand (v), ve	h/h			10	10	10	20	10	) 10	10	740	10	20	1040	20
Signal Informa	ition						5				_				
Cycle, s	110.0	Reference Phase	2		542	$\bowtie$	1 2	₹					$\Phi$	_	4
Offset, s	0	Reference Point	End	Green	1 :11	11.0	11.0	0.0	0.0	0.0		1	2	3	<u>Y</u> 4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		4.0	4.0	0.0		0.0					<b>→</b>
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.5	2.5	2.5	0.0		0.0		5	6	7	8
Timer Results				EBI	_	EBT	WBI		WBT	NBI	L NBT		SB	L	SBT
Assigned Phas	<u></u> е					4		$\neg$	8			2			6
Case Number					1	0.0			12.0			8.0			8.0
Phase Duration	ı, S				1	7.5			17.5		75.0				75.0
Change Period	, (Y+Rc)	, s				6.5			6.5			6.5			6.5
Max Allow Hea	dway (1	<i>IAH</i> ), s				3.3			3.3			3.1			3.1
					_							34.6			
Queue Clearan	ce Time	e (gs), s				3.3			4.5			34.6			70.5
Queue Clearan Green Extension		····				3.3 0.0		+	0.0			6.5			70.5 0.0
	n Time	····				_		+							
Green Extension	n Time bability	····			1	0.0			0.0			6.5			0.0
Green Extension Phase Call Pro	on Time bability bility	(ge), s			1	0.0		WB	0.0 1.00 0.01			6.5 1.00			0.0 1.00
Green Extension Phase Call Pro Max Out Proba	on Time bability bility oup Res	(ge), s		L	1	0.0	L	WB	0.0 1.00 0.01	L		6.5 1.00	L		0.0 1.00
Green Extension Phase Call Pro Max Out Proba  Movement Gro	on Time bability bility <b>oup Res</b> ement	(ge), s		L 7	EB	0.0	L 3		0.0 1.00 0.01	L 5	NB	6.5 1.00 0.03	L 1	SB	0.0 1.00 1.00
Green Extension Phase Call Pro Max Out Proba  Movement Gro Approach Move	on Time bability bility oup Resement	(g <sub>e</sub> ), s			EB T	0.0 1.00 0.00		Т	0.0 1.00 0.01	_	NB T	6.5 1.00 0.03		SB T	0.0 1.00 1.00
Green Extension Phase Call Pro Max Out Proba  Movement Gro Approach Move Assigned Move Adjusted Flow I	bability bility bup Resement ment Rate (v)	(g <sub>e</sub> ), s		7	EB T 4	0.0 1.00 0.00		T 8	0.0 1.00 0.01 R 18	_	NB T	6.5 1.00 0.03		SB T 6	0.0 1.00 1.00
Green Extension Phase Call Pro Max Out Proba  Movement Gro Approach Move Assigned Move Adjusted Flow I	bability bility bup Resement ment Rate (v)	(g <sub>e</sub> ), s  sults  , veh/h  ow Rate (s), veh/h/ln		7	EB T 4 22	0.0 1.00 0.00		T 8 43	0.0 1.00 0.01 R 18	_	NB T 2 826	6.5 1.00 0.03		SB T 6 1174	0.0 1.00 1.00

Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	11	22			43			826			1174	
Adjusted Saturation Flow Rate (s), veh/h/ln	1792	1716			1753			1791			1844	
Queue Service Time (gs), s	0.6	1.3			2.5			0.0			35.3	
Cycle Queue Clearance Time (gc), s	0.6	1.3			2.5			32.6			68.5	
Green Ratio (g/C)	0.10	0.10			0.10			0.62			0.62	
Capacity (c), veh/h	179	172			175			1148			1182	
Volume-to-Capacity Ratio (X)	0.061	0.127			0.248			0.719			0.993	
Available Capacity (ca), veh/h	179	172			175			1148			1182	
Back of Queue (Q), veh/ln (50th percentile)	0.3	0.6			1.1			13.1			35.1	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00			0.00			0.00			0.00	
Uniform Delay (d₁), s/veh	44.8	45.1			45.7			14.0			21.2	
Incremental Delay (d2), s/veh	0.1	0.1			0.3			1.9			24.5	
Initial Queue Delay (d3), s/veh	0.0	0.0			0.0			0.0			0.0	
Control Delay (d), s/veh	44.9	45.2			46.0			15.9			45.7	
Level of Service (LOS)	D	D			D			В			D	
Approach Delay, s/veh / LOS	45.	1	D	46.0	)	D	15.9	9	В	45.7	·	D
Intersection Delay, s/veh / LOS			33	3.9						С		
Multimodal Results		EB			WB			NB			SB	

Pedestrian LOS Score / LOS Bicycle LOS Score / LOS

R 110

		HCS 2	010 S	ignali	zed I	nterse	ection	Re	sults	Sum	ma	ry		No	Build
General Inforn	nation								Interse	ction l	nfo	rmatior	<b>.</b>		4781 <b>9</b>
Agency		Hatch Mott MacDor	nald						Duratio			0.25	•		4
Analyst		SJB		Analys	is Date	Mar 25	5, 2013		Area T			Other		- J	
Jurisdiction		Strongsville		Time P		PM	,		PHF	7   0		0.92			w‡E
Intersection		Howe Rd @ Shurm	er Rd	-		2035			Analys	is Perio	nd	1> 7:00	)		
File Name		18_Howe & Shurme							7 thaiye	0110	, u	12 7.00		-	K.4
Project Descrip	tion	NO BUILD	J. 2000		Danaix										41474
Troject Becomp		110 00120													
Demand Inform	mation				EB			V	/B			NB			SB
Approach Move	ement			L	Т	R	L	1	T R		L	Т	R	L	Т
Demand (v), ve	h/h			100	0	50				5	50	660			960
															"
Signal Informa	ation				21			П							
Cycle, s	110.0	Reference Phase	2		P 54	Ħ								<b>T</b> .	_
Offset, s	0	Reference Point	End	Green	72.0	27.0	0.0	0.	0 0.0	) 0	.0		1		3
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		4.0	0.0	0.			.0	_			
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	0.0	0.	0.0	0 0	.0		5	6	7
Timer Results				EBL	-	EBT	WBL		WBT	N	<b>IBL</b>	N	IBT	SBI	
						4							_		

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		12.0				6.0		8.0
Phase Duration, s		32.5				77.5		77.5
Change Period, (Y+Rc), s		5.5				5.5		5.5
Max Allow Headway (MAH), s		3.3				3.2		3.2
Queue Clearance Time (gs), s		10.8				74.0		66.6
Green Extension Time (ge), s		0.3				0.0		3.0
Phase Call Probability		1.00				1.00		1.00
Max Out Probability		0.00				1.00		0.78

Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement	7	4	14				5	2			6	16
Adjusted Flow Rate (v), veh/h		163					54	717			1163	
Adjusted Saturation Flow Rate (s), veh/h/ln		1701					486	1881			1847	
Queue Service Time (gs), s		8.8					7.4	23.4			64.6	
Cycle Queue Clearance Time (gc), s		8.8					72.0	23.4			64.6	
Green Ratio (g/C)		0.25					0.65	0.65			0.65	
Capacity (c), veh/h		418					98	0.65 1231			1209	
Volume-to-Capacity Ratio (X)		0.390					0.555	0.583			0.962	
Available Capacity (ca), veh/h		418					98	1231			1209	
Back of Queue (Q), veh/ln (50th percentile)		3.7					1.6	8.8			29.2	
Queue Storage Ratio (RQ) (50th percentile)		0.00					0.81	0.00			0.00	
Uniform Delay (d1), s/veh		34.6					52.8	10.6			17.7	
Incremental Delay (d2), s/veh		0.2					4.1	0.5			17.4	
Initial Queue Delay (d3), s/veh		0.0					0.0	0.0			0.0	
Control Delay (d), s/veh		34.9					56.9	11.1			35.2	
Level of Service (LOS)		С					E	В			D	
Approach Delay, s/veh / LOS	34.9	9	С	0.0			14.3	3	В	35.2	2	D
Intersection Delay, s/veh / LOS			27	<b>7</b> .5						С		

EΒ

**Multimodal Results** 

Pedestrian LOS Score / LOS Bicycle LOS Score / LOS

WB

SB

NB

_	
General Information Intersection Information	<b>1</b>
Agency Hatch Mott MacDonald Duration, h 0.25	2+4
Analyst SJB Analysis Date Mar 25, 2013 Area Type Other	
Jurisdiction Strongsville Time Period PM PHF 0.92	w   €
Intersection Howe Rd @ Drake Rd Analysis Year 2035 Analysis Period 1> 7:00	,
File Name 19_Howe & Drake 2035 PM No Build.xus	14
Project Description NO BUILD	414727
Demand Information   EB   WB   NB	SB
Approach Movement L T R L T R L T R L	TR
Demand (v), veh/h 210 350 40 30 290 170 40 330 20 240	510 260
Signal Information	_
Cycle, s 110.0 Reference Phase 2  Offset s 0 Reference Point Ford	3 → 4
Offset, s 0 Reference Point End Green 10.0 36.0 10.0 32.0 0.0 0.0	l K
Uncoordinated Yes Simult. Gap E/W On Yellow 4.0 4.0 4.0 0.0 0.0	シーケー
Force Mode   Fixed   Simult. Gap N/S   On   Red   1.5   1.5   1.5   1.5   0.0   0.0   5	7 8
Timer Results EBL EBT WBL WBT NBL NBT SBL	SBT
Assigned Phase 7 4 8 2 1	6
Case Number         1.0         4.0         5.3         6.3         1.0	3.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4		8		2	1	6
Case Number	1.0	4.0		5.3		6.3	1.0	3.0
Phase Duration, s	15.5	53.0		37.5		41.5	15.5	57.0
Change Period, (Y+Rc), s	5.5	5.5		5.5		5.5	5.5	5.5
Max Allow Headway (MAH), s	3.1	3.1		3.1		3.2	3.1	3.2
Queue Clearance Time (gs), s	11.6	20.8		17.7		21.0	12.0	26.4
Green Extension Time $(g_e)$ , s	0.0	1.9		1.8		2.7	0.0	2.8
Phase Call Probability	1.00	1.00		1.00		1.00	1.00	1.00
Max Out Probability	1.00	0.00		0.02		0.05	1.00	0.02

Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	Т	R	L	Т	R	L T R		R	L	Т	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	228	424		33	315	185	43 380			261	554	283
Adjusted Saturation Flow Rate (s), veh/h/ln	1792	1832		967	1881	1589	660 1862			1792	1881	1578
Queue Service Time (gs), s	9.6	18.8		2.8	15.7	10.3	5.8 19.0			10.0	24.4	10.6
Cycle Queue Clearance Time (gc), s	9.6	18.8		6.2	15.7	10.3	14.8 19.0			10.0	24.4	10.6
Green Ratio (g/C)	0.40	0.43		0.29	0.29	0.29	0.33	0.33		0.44	0.47	0.56
Capacity (c), veh/h	362	791		318	547	462	228	609		384	881	883
Volume-to-Capacity Ratio (X)	0.630	0.536		0.103	0.576	0.400	0.191	0.624		0.679	0.629	0.320
Available Capacity (ca), veh/h	362	791		318	547	462	228	609		384	881	883
Back of Queue (Q), veh/ln (50th percentile)	4.2	8.0		0.7	7.2	3.9	0.9	8.6		4.7	10.6	3.6
Queue Storage Ratio (RQ) (50th percentile)	0.32	0.00		0.06	0.00	0.34	0.16	0.00		0.37	0.00	0.28
Uniform Delay (d1), s/veh	24.6	23.1		31.1	33.2	31.3	33.5	31.3		24.0	22.1	13.0
Incremental Delay (d2), s/veh	2.7	0.4		0.1	1.0	0.2	0.1	1.5		4.0	1.1	0.1
Initial Queue Delay (d3), 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	27.3	23.5		31.2	34.2	31.5	33.6	32.8		28.0	23.2	13.1
Level of Service (LOS)	С	С		С	С	С	С	С		С	С	В
Approach Delay, s/veh / LOS	24.8	3	С	33.1		С	32.9	)	С	21.7	7	С
Intersection Delay, s/veh / LOS			26	5.4						С		

EΒ

**Multimodal Results** 

Pedestrian LOS Score / LOS Bicycle LOS Score / LOS

WB

SB

NB

# Intersections

# **2035 Build Condition**

**AM** 

	-	•	•	<b>←</b>	/	~
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR
Lane Configurations	ተተተ	7	ሻ	ተተተ	77	777
Volume (vph)	2050	280	210	1020	370	680
Turn Type	NA	Perm	Prot	NA	Over	Prot
Protected Phases	6		5	2	5	1
Permitted Phases	6	6		2		1
Detector Phase	6	6	5	2	5	1
Switch Phase						
Minimum Initial (s)	25.0	25.0	10.0	25.0	10.0	1.0
Minimum Split (s)	32.0	32.0	17.0	32.0	17.0	20.0
Total Split (s)	70.0	70.0	80.0	60.0	80.0	90.0
Total Split (%)	46.7%	46.7%	53.3%	40.0%	53.3%	60.0%
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lead
Lead-Lag Optimize?	Yes	Yes				
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	63.3	63.3	34.6	68.4	34.6	29.5
Actuated g/C Ratio	0.57	0.57	0.31	0.61	0.31	0.26
v/c Ratio	0.87	0.31	0.84	0.39	0.49	0.75
Control Delay	26.5	2.5	50.9	12.1	33.1	43.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.5	2.5	50.9	12.1	33.1	43.1
LOS	С	Α	D	В	С	D
Approach Delay	23.6			22.9		
Approach LOS	С			С		
Intersection Summary						
Cycle Length: 150						
Actuated Cycle Length: 112						
Natural Cycle: 80						
Control Type: Actuated-Unc	oordinated					
Maximum v/c Ratio: 0.87						
Intersection Signal Delay: 20	6.7			lr	ntersectio	n LOS: C
Intersection Capacity Utiliza						of Service
Analysis Period (min) 15						
0 111 1 101 101 101	00.0		<b>5</b>	<b>D</b> .		
Splits and Phases: 2: I-71	SB Ramp	8 SR 82	Royaltor	ı Ra		T.
ø1						1
90 s						60

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**Build** | 13

		HCS 2	010 5	ignaii	zea II	nterse	ection	Kes	suits	Summ	ary			Bull	a   13
0	4!									-4: 1	: 4!		1		en ibe:
General Inforn	nation									ction In		on	- 1	111	Ļ
Agency		Hatch Mott MacDor	nald	1		1		_	Duratio		0.25				
Analyst		SJT				Jun 8,	2015		Area Ty	ре	Othe	<u> </u>	_===		-
Jurisdiction		Strongsville		Time F		AM		_	PHF		0.92		_=		
Intersection		SR 82 @ Howe Rd		11	is Year	2035			Analysi	s Period	1> 7:	00	_ ~		· -
File Name		16_SR82 & Howe 2	2035 AN	1 Build.x	us									1111	
Project Descrip	tion	Build													
Demand Inform	nation				EB			WE	3		NB		7	SB	
Approach Move					T	R	L	T			T	R	L	T	R
Demand (v), ve				30	1400	60	110	154	_	_		890	40	10	10
Bernaria (v), ve	11/11			- 00	1400		110	104	10   00	120	00	000	40	10	10
Signal Informa	ation				-		2	21	S .	$\top$					1
Cycle, s	150.0	Reference Phase	2		2	<b>₽</b> ; `	$\exists \exists$	B		117	<b>•</b>	<b>/</b> →	$\leftrightarrow \Box$	]	<b>4</b>
Offset, s	0	Reference Point	End	Green	35.0	31.5	13.5	20.				1	2	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		4.0	4.0	4.0				<b>7</b>	<b>—</b>		KŤ2
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	1.5	1.5				5	6	7	8
Timer Results				EBI		EBT	WB	L	WBT	NE	L	NBT	SBI		SBT
Assigned Phas	e			5		2	1		6			8		$\neg \vdash$	4
Case Number				2.0		4.0	2.0		3.0			9.0			9.0
Phase Duration	1, S			19.0	) :	56.0	40.5	5	77.5			27.5		$\neg \vdash$	26.0
Change Period	, (Y+Rc)	), S		5.5		5.5	5.5		5.5			5.5			5.5
Max Allow Hea	dway (A	<i>IAH</i> ), s		3.0		3.0	3.1		3.0			3.3		$\neg$	3.3
Queue Clearan				3.3	-	42.6	6.1		71.7			24.0			3.6
Green Extension	n Time	(ge), S		3.3		2.9	0.3	$\neg$	0.2		$\neg$	0.0		$\overline{}$	0.1
Phase Call Pro				1.00	)	1.00	1.00		1.00			1.00			1.00
Max Out Proba	bility			0.22	2 (	0.36	0.00		1.00			1.00		工	0.00
Movement Gro	oup Res	sults			EB			WB		_	NB			SB	
Approach Move				L	Т	R	L	Т	R		Т	R	L	Т	R
Assigned Move				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow		, veh/h		33	1069	518	120	1674	54	130	33	967	43	11	11

Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	Т	R	L	T	R	L	T	R	L	Т	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	33	1069	518	120	1674	54	130	33	967	43	11	11
Adjusted Saturation Flow Rate (s), veh/h/ln	1706	1845	1789	1723	1773	1577	1792	1881	1411	1740	1881	1587
Queue Service Time (gs), s	1.3	40.6	40.6	4.1	69.7	2.8	10.1	2.3	22.0	1.6	0.8	0.8
Cycle Queue Clearance Time (gc), s	1.3	40.6	40.6	4.1	69.7	2.8	10.1	2.3	22.0	1.6	0.8	0.8
Green Ratio (g/C)	0.09	0.34	0.34	0.23	0.48	0.48	0.15	0.15	0.38	0.14	0.14	0.23
Capacity (c), veh/h	307	1242	602	804	1702	757	263	276	1072	476	257	360
Volume-to-Capacity Ratio (X)	0.106	0.860	0.861	0.149	0.983	0.072	0.496	0.118	0.902	0.091	0.042	0.030
Available Capacity (ca), veh/h	307	1242	602	804	1702	757	263	276	1072	476	257	360
Back of Queue (Q), veh/ln (50th percentile)	0.6	19.5	19.8	1.8	33.6	1.0	4.6	1.1	18.2	0.7	0.4	0.3
Queue Storage Ratio (RQ) (50th percentile)	0.05	0.00	0.00	0.08	0.00	0.11	0.39	0.00	0.00	0.17	0.00	0.00
Uniform Delay (d1), s/veh	62.7	46.5	46.5	45.7	38.4	21.0	58.9	55.6	43.9	56.6	56.2	45.2
Incremental Delay (d2), s/veh	0.1	6.1	11.6	0.0	17.9	0.0	0.5	0.1	10.3	0.0	0.0	0.0
Initial Queue Delay (d3), 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	62.8	52.5	58.0	45.7	56.3	21.0	59.4	55.6	54.2	56.6	56.3	45.2
Level of Service (LOS)	E	D	E	D	Е	С	Е	Е	D	E	E	D
Approach Delay, s/veh / LOS	54.5	5	D	54.5	5	D	54.8	3	D	54.7	7	D
Intersection Delay, s/veh / LOS			54	1.6						D		
Multimodal Results		EB			WB			NB			SB	

Pedestrian LOS Score / LOS Bicycle LOS Score / LOS

		HCS 2	010 S	ignali	zed	Interse	ection	n Res	sults S	umm	ary			Buil	d   14
Canaral Inform	aation								Intersec	tion Inf	0 mm 04 i			a 1 ± 1	be U
General Inforn	nation	Hatch Mott MacDor	vold.						Duration		0.25	on		411	
Agency Analyst		SJT	laiu	Analys	sic Date	e Jun 8,	2015		Area Typ		Other		- 4		L.
Jurisdiction		Strongsville		Time F		AM	2013		PHF	·e	0.92			w‡e	45— 8±
Intersection		Howe Rd & Pomero	w Blyd/			_		_	Analysis	Poriod	1> 7:0	00			
File Name		17_Howe & Pomero	-						Allalysis	renou	1>7.0	00	-		
Project Descrip	tion	Build ALT 1 & 2	Jy-11ac	y 2033 F	AIVI BUI	iu.xus							-	117	2.0
1 Toject Descrip	uon	Bulla ALI T & Z													
Demand Inform					EB			WE	3		NB			SB	N.
Approach Move				L	Т	R	L	Т	R	L	Т	R	L	T	R
Demand (v), ve	h/h			10	10	10	10	10	10	10	1220	10	20	20	10
Signal Informa	ation				h III	<del></del>	I 6			<u> </u>					
Cycle, s	110.0	Reference Phase	2	1		_=	1 8	Ħ					<b>N</b>		
Offset, s	0	Reference Point	End									1	2	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Green Yellow		23.5 4.0	23.0 4.0	0.0		0.0					<b>→</b>
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	1.5	0.0		0.0		5	6	7	8
						111			10.0	10.0					
Timer Results				EBI	-	EBT	WB	L	WBT	NBI		NBT	SBI	L	SBT
Assigned Phase	е					4			8			2			6
Case Number						10.0			12.0			6.0			6.0
Phase Duration	1, S					29.0			28.5			52.5			52.5
Change Period	, (Y+Rc)	, S				5.5			5.5			5.5			5.5
Max Allow Hea	dway ( <i>l</i> l	<i>//AH</i> ), s				3.3			3.3			3.1			3.1
Queue Clearan	ce Time	e ( <i>g</i> s), s				3.1			3.7			36.8			42.3
Green Extension	n Time	( <i>g</i> <sub>e</sub> ), s				0.0			0.0			2.7			1.8
Phase Call Pro	bability					1.00			1.00			1.00			1.00
Max Out Proba	bility					0.00			0.00			0.21			0.70
Movement Gro	oun Res	sults			EB			WB			NB			SB	
Approach Move		,uito		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Move				7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow I		. veh/h		11	22			33		11	669	668	22	16	16
		ow Rate (s), veh/h/ln		1792	1723			1745	5	1381	1881	1876	411	1881	1662
Queue Service				0.5	1.1			1.7	1	0.5	34.8	34.8	5.5	0.6	0.6
Cycle Queue C		*		0.5	1.1			1.7		1.1	34.8	34.8	40.3	0.6	0.6
Green Ratio (g/		(0 //		0.21	0.21			0.21	1	0.43	0.43	0.43	0.43	0.43	0.43
Capacity (c), ve				383	368			365		648	804	801	111	804	710
Volume-to-Cap	acity Ra	itio (X)		0.028	0.059			0.089	9	0.017	0.833	0.833	0.196	0.020	0.023
Available Capa	city (ca)	, veh/h		383	368			365		648	804	801	111	804	710
Back of Queue	(Q), vel	n/ln (50th percentile)		0.2	0.5			0.7		0.2	16.5	16.5	0.6	0.2	0.2
Queue Storage	Ratio (	RQ) (50th percentile	)	0.00	0.00			0.00		0.03	0.00	0.00	0.09	0.00	0.00
Uniform Delay	(d1), s/v	eh		34.2	34.4			35.1		18.5	28.0	28.0	45.9	18.2	18.2
Incremental De				0.0	0.0			0.0		0.0	7.1	7.1	0.3	0.0	0.0
Initial Queue Do	elay (d3)	), s/veh		0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
0 1 1 1 1				040	04.5			05.4		40.5	05.4	05.4	40.0	400	400

34.2

34.4

С

34.5

С

ΕB

С

34.7

Control Delay (d), s/veh

Approach Delay, s/veh / LOS

Intersection Delay, s/veh / LOS

Level of Service (LOS)

**Multimodal Results** 

35.1

D

WB

D

35.1

18.5

В

35.0

35.1

D

NB

35.1

D

С

46.2

D

С

29.4

18.2

В

SB

18.2

В

С

#### **HCS 2010 Signalized Intersection Results Summary General Information Intersection Information** Hatch Mott MacDonald Duration, h 0.25 Agency SJB Analyst Analysis Date Mar 25, 2013 Area Type Other PHF 0.92 Jurisdiction Strongsville Time Period AM Intersection Howe Rd @ Shurmer Rd Analysis Year 2035 **Analysis Period** 1>7:00 18 Howe & Shurmer 2035 AM Build.xus File Name **Project Description** BUILD **Demand Information** EB **WB** NB SB Approach Movement L R L R R L R 1030 Demand (v), veh/h 100 0 20 230 50 110 50 20 10 **Signal Information** Cycle, s 110.0 Reference Phase 2 54 Offset, s 0 Reference Point End 0.0 Green 12.0 32.5 14.0 4.0 26.0 Uncoordinated Yes Simult. Gap E/W On Yellow 4.0 4.0 4.0 0.0 4.0 0.0 Force Mode Fixed Simult. Gap N/S On Red 1.5 1.5 1.0 0.0 1.5 0.0 **Timer Results EBL EBT WBL** WBT NBL **NBT** SBL SBT **Assigned Phase** 4 3 8 2 7 5 6 Case Number 1.1 4.0 1.1 4.0 1.0 4.0 7.3 Phase Duration, s 19.0 31.5 23.0 35.5 17.5 55.5 38.0 Change Period, (Y+Rc), s 5.0 5.5 5.0 5.5 5.5 5.5 5.5 Max Allow Headway (MAH), s 3.3 3.3 3.1 3.3 3.1 3.0 3.0 Queue Clearance Time (gs), s 6.6 3.2 12.7 11.4 4.0 29.3 2.9 Green Extension Time $(g_e)$ , s 0.1 0.4 0.2 0.4 0.0 2.8 3.1 Phase Call Probability 1.00 1.00 1.00 1.00 1.00 1.00 1.00 0.01 0.00 0.14 0.00 0.02 0.00 Max Out Probability 0.00 NB SB **Movement Group Results** EΒ WB Approach Movement L Т R L Т R L Т R L Т R **Assigned Movement** 7 4 14 3 8 18 5 2 6 16 Adjusted Flow Rate (v), veh/h 109 22 250 174 54 1120 22 11 Adjusted Saturation Flow Rate (s), veh/h/ln 1774 1774 1658 1792 1572 1791 1881 1576 1.2 2.0 27.3 Queue Service Time (gs), s 4.6 10.7 9.4 0.9 0.5 Cycle Queue Clearance Time $(g_c)$ , s 4.6 1.2 10.7 9.4 2.0 27.3 0.9 0.5 Green Ratio (g/C) 0.36 0.24 0.41 0.27 0.42 0.45 0.30 0.30 Capacity (c), veh/h 495 372 668 452 658 1628 556 466 Volume-to-Capacity Ratio (X) 0.219 0.059 0.374 0.385 0.083 0.688 0.039 0.023 Available Capacity (ca), veh/h 495 372 668 452 658 1628 556 466 Back of Queue (Q), veh/ln (50th percentile) 1.9 0.5 4.4 3.7 8.0 11.3 0.4 0.2 Queue Storage Ratio (RQ) (50th percentile) 0.00 0.00 0.00 0.00 0.41 0.00 0.00 0.00 Uniform Delay (d1), s/veh 24.0 32.5 22.4 32.5 18.9 23.8 27.6 27.5 Incremental Delay (d2), s/veh 0.1 0.0 0.1 0.2 0.0 1.0 0.0 0.0 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 24.1 32.5 22.5 32.7 19.0 24.8 27.6 27.5 Level of Service (LOS) С С С С В С С С 24.6 25.5 С 26.7 С С 27.6 С Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS С 25.2

**Multimodal Results** 

Pedestrian LOS Score / LOS Bicycle LOS Score / LOS WB

ΕB

SB

NB

# Intersections

### **2035 Build Condition**

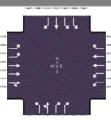
**PM** 

	<b>→</b>	•	•	<b>←</b>	<i>&gt;</i>	</th
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR
Lane Configurations	ተተተ	7	ሻ	ተተተ	77	777
Volume (vph)	2030	450	310	1190	840	1240
Turn Type	NA	Perm	Prot	NA	Over	Prot
Protected Phases	6		5	2	5	1
Permitted Phases	6	6		2		1
Detector Phase	6	6	5	2	5	1
Switch Phase						
Minimum Initial (s)	25.0	25.0	10.0	25.0	10.0	1.0
Minimum Split (s)	32.0	32.0	17.0	32.0	17.0	20.0
Total Split (s)	78.0	78.0	72.0	72.0	72.0	78.0
Total Split (%)	52.0%	52.0%	48.0%	48.0%	48.0%	52.0%
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lead
Lead-Lag Optimize?	Yes	Yes				
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	71.2	71.2	59.6	69.4	59.6	61.5
Actuated g/C Ratio	0.49	0.49	0.41	0.48	0.41	0.42
v/c Ratio	0.93	0.61	0.93	0.57	0.79	0.84
Control Delay	43.5	23.3	61.6	29.3	42.9	43.0
Queue Delay	2.4	0.0	0.0	0.0	0.0	0.0
Total Delay	45.9	23.3	61.6	29.3	42.9	43.0
LOS	D	С	Е	С	D	D
Approach Delay	41.8			39.9		
Approach LOS	D			D		
Intersection Summary						
Cycle Length: 150						
Actuated Cycle Length: 144	.9					
Natural Cycle: 90						
Control Type: Actuated-Und	oordinated	l				
Maximum v/c Ratio: 0.93						
Intersection Signal Delay: 4	1.6			lr	ntersectio	n LOS: D
Intersection Capacity Utiliza				J(	CU Level	of Service
Analysis Period (min) 15						
Cality and Dhagas 2, 1, 71	I CD Dame	. 0 CD 01	Dovolton	י טא		
Splits and Phases: 2: I-71	I SB Ramp	0 & SK 82	Royalloi	ı Ku	1.4	
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78 s					72	

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**Build | 13** 

General Information				Intersection Info	rmation
Agency	Hatch Mott MacDonald			Duration, h	0.25
Analyst	SJT	Analysis Date	Jun 8, 2015	Area Type	Other
Jurisdiction	Strongsville	Time Period	PM	PHF	0.92
Intersection	SR 82 @ Howe Rd	Analysis Year	2035	Analysis Period	1> 7:00
File Name	16_SR82 & Howe 2035 PM	1 Build.xus			
Project Description	Build ALT 1 & 2				



File Name		16_SR82 & Howe 2	.035 PN	/ Build.x	us									1400	
Project Descrip	tion	Build ALT 1 & 2												1111	
		•								_					
Demand Inform					EB			WB		-	NB		-	SB	
Approach Move				L	Т	R	L	T	R	L	Т	R	<u> </u>	Т	R
Demand (v), ve	h/h		_	190	1640	80	210	1830	390	170	100	630	210	150	270
Signal Informa	ation				N.					T				-	
Cycle, s	150.0	Reference Phase	2		2		=_3	842			×	<u> </u>	_	1	<b>小</b>
Offset, s	0	Reference Point	End		7		400					T	2	3	4
Uncoordinated	Yes	Simult. Gap E/W	On	Green Yellow		42.0	4.0	22.5 4.0	16.0 4.0	0.0		,	<b>←</b>		rt x
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	1.5	1.5	1.5	0.0		5	6	7	Y
		•													
Timer Results				EBI	-	EBT	WB	L	WBT	NBI		NBT	SBI	-	SBT
Assigned Phas	e			5		2	1		6			8			4
Case Number				2.0		4.0	2.0		3.0			9.0			9.0
Phase Duration	1, S			15.5	5	63.0	37.5	5	85.0			21.5			28.0
Change Period	, (Y+Rc)	, S		5.5		5.5	5.5		5.5			5.5			5.5
Max Allow Head	dway ( <i>N</i>	<i>IAH</i> ), s		3.1		3.1	3.1		3.1			3.3			3.3
Queue Clearan	ce Time	e (gs), s		11.0		50.1	10.4	1	81.5			18.0			24.5
Green Extension	n Time	(g <sub>e</sub> ), s		0.0		1.0	0.5		0.0			0.0			0.0
Phase Call Pro	bability			1.00		1.00	1.00	)	1.00			1.00			1.00
Max Out Proba	bility			1.00		1.00	0.00	)	1.00			1.00			1.00
								\4/D			NID			0.0	
Movement Gro		suits			EB	Б		WB	Б	-	NB -	Б	-	SB	
Approach Move				5	T 2	12	1	6	16	3	8 8	18	7	T 4	R 14
Adjusted Flow I		voh/h		207	1259	610	228	1989	424	185	109	685	228	163	293
		ow Rate (s), veh/h/ln		1706	1845	1784	1723	1773	1577	1792	1881	1411	1740	1881	1588
Queue Service				9.0	47.9	48.1	8.4	79.5	25.9	15.4	8.2	16.0	9.0	12.1	22.5
Cycle Queue C				9.0	47.9	48.1	8.4	79.5	25.9	15.4	8.2	16.0	9.0	12.1	22.5
Green Ratio (g/		C Time (gc), 3		0.07	0.38	0.38	0.21	0.53	0.53	0.11	0.11	0.32	0.15	0.15	0.22
Capacity (c), ve				227	1414	684	735	1880	836	191	201	903	522	282	344
Volume-to-Cap		itio (X)		0.908	0.891		0.311	1.058	0.507	0.967	0.542	0.758	0.437	0.578	0.852
Available Capa				227	1414	684	735	1880	836	191	201	903	522	282	344
		n/In (50th percentile)		5.0	23.0	23.6	3.6	42.9	9.6	9.9	4.0	11.8	4.0	6.0	8.0
Queue Storage	Ratio (	RQ) (50th percentile	)	0.40	0.00	0.00	0.16	0.00	0.98	0.84	0.00	0.00	0.92	0.00	0.00
Uniform Delay				69.5	43.3	43.3	49.7	35.3	22.7	66.7	63.5	45.8	58.0	59.3	56.4
Incremental De	lay (d2),	s/veh		35.1	7.2	13.6	0.1	38.1	0.2	55.0	1.7	3.4	0.2	1.9	17.4
Initial Queue De	elay (d3)	), 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/vel	า		104.7	50.5	57.0	49.8	73.4	22.9	121.8	65.2	49.2	58.2	61.3	73.8
Level of Service	e (LOS)			F	D	E	D	F	С	F	E	D	Е	E	Е
Approach Delay	y, s/veh	/LOS		57.8	3	E	63.2	2	E	64.7	7	E	65.6	3	E
Intersection De	lay, s/ve	eh / LOS				61	.9						E		
Multimodal Re		// 00			EB			WB			NB			SB	
Pedestrian LOS				_									_		
Bicycle LOS So	core / LC	JS													

	_	HCS 2	010 S	ignali	zed l	nters	ectior	n Res	ults S	umma	ary	_		Buile	d   14
General Inform	nation								ntersec	tion Info	ormatic	n	<u> </u>	a,a,.	a L
Agency		Hatch Mott MacDor	nald						Duration		0.25			417	
Analyst		SJT		Analys	sis Date	Jun 8	. 2015		Area Typ		Other				<b>℃</b>
Jurisdiction		Strongsville		Time F		PM	,		PHF		0.92			w ‡ E	<b>→</b>
Intersection		Howe Rd & Pomero	ov Blvd/						Analysis	Period	1> 7:0	00			······································
File Name		17_Howe & Pomero									1.,			544	
Project Descrip	otion	Build ALT 1 & 2	, 11ao	, 2000 .	W Ban	a.xao								1   P	F (
1 Tojout Booting		Dalla / KET   CC 2													
Demand Infor	mation				EB			WB	,		NB			SB	
Approach Move	ement			L	Т	R	L	T	R	L	Т	R	L	T	R
Demand (v), ve	eh/h			10	10	10	20	10	10	10	950	10	20	460	20
Signal Informa	1				245	2	5	<u> </u>					-4-		_
Cycle, s	110.0	Reference Phase	2		1 saz	<u>'</u>	6	7				1	$\mathbf{Y}_{2}$	3	<b>←</b> ₄
Offset, s	0	Reference Point	End	Green	41.0	24.5	25.0	0.0	0.0	0.0					<u></u>
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow		4.0	4.0	0.0	0.0	0.0					7
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.5	2.5	2.5	0.0	0.0	0.0		5	6	7	8
Timer Results				EBI		EBT	WB	L	WBT	NBI		NBT	SBI		SBT
Assigned Phas	e					4			8			2		$\perp$	6
Case Number						10.0			12.0			6.0			6.0
Phase Duration	n, s					31.0			31.5			47.5			47.5
Change Period						6.5			6.5			6.5			6.5
Max Allow Hea						3.3			3.3			3.1			3.1
Queue Clearar	ce Time	e (gs), s				3.1			4.2			28.6			32.5
Green Extension	on Time	( <i>g</i> e), s				0.0			0.1			3.0			2.6
Phase Call Pro	bability					1.00			1.00			1.00			1.00
Max Out Proba	bility					0.00			0.00			0.16			0.34
Movement Gro	oun Pos	culte			EB			WB			NB			SB	
Approach Move		buits		-	T	R	L	T	R	L	T	R	L	T	R
Assigned Move				7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow		veh/h		11	22	17		43	10	11	523	521	22	263	258
		ow Rate (s), veh/h/ln		1792	1723			1757		885	1881	1874	544	1881	1838
Queue Service				0.5	1.1			2.2		1.0	26.6	26.6	4.0	11.2	11.3
Cycle Queue C		·		0.5	1.1			2.2		12.3	26.6	26.6	30.5	11.2	11.3
Green Ratio (g		e Time ( <i>gc)</i> , 3		0.22	0.22			0.23		0.37	0.37	0.37	0.37	0.37	0.37
Capacity (c), ve				399	384			399		304	701	699	137	701	685
Volume-to-Cap		atio ( M		0.027	0.057			0.109	1	0.036	0.746	0.746	0.159	0.376	0.377
Available Capa				399	384			399		304	701	699	137	701	685
		n/ln (50th percentile)		0.2	0.5			0.9	1	0.2	12.4	12.3	0.5	4.9	4.8
		RQ) (50th percentile)		0.2	0.00			0.00		0.2	0.00	0.00	0.09	0.00	0.00
Uniform Delay			1	33.4	33.7			33.7		29.7	30.0	30.0	43.2	25.2	25.2
Incremental De				0.0	0.0			0.0		0.0	3.9	3.9	0.2	0.1	0.1
Initial Queue D				0.0	0.0			0.0		0.0	0.0	0.0	0.2	0.1	0.1
Control Delay (				33.4	33.7			33.7		29.7	33.8	33.9	43.4	25.3	25.3
Level of Service				C C	33.7 C			33.7 C		29.7 C	33.6 C	33.9 C	43.4 D	25.3 C	25.3 C
Approach Dela							22 -		С						
Approach Dela	y, s/ven	/ LU3		33.6	,	С	33.7		C	33.8	)	С	26.0	,	С

Intersection Delay, s/veh / LOS

Pedestrian LOS Score / LOS

**Multimodal Results** 

WB

31.3

EΒ

SB

С

NB

#### **HCS 2010 Signalized Intersection Results Summary General Information Intersection Information** Hatch Mott MacDonald Duration, h 0.25 Agency SJB Analyst Analysis Date Mar 25, 2013 Area Type Other PHF 0.92 Jurisdiction Strongsville Time Period PM Intersection Howe Rd @ Shurmer Rd Analysis Year 2035 **Analysis Period** 1>7:00 18 Howe & Shurmer 2035 PM Build .xus File Name **Project Description** BUILD **Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R Demand (v), veh/h 100 0 50 520 90 210 50 660 440 50 **Signal Information** Cycle, s 110.0 Reference Phase 2 54 Offset, s 0 Reference Point End Green 43.0 0.0 14.0 5.0 0.0 27.0 Uncoordinated Yes Simult. Gap E/W On Yellow 4.0 4.0 4.0 0.0 0.0 4.0 Force Mode Fixed Simult. Gap N/S 0.0 On Red 1.5 1.0 1.0 1.5 0.0 **Timer Results EBL EBT WBL** WBT NBL **NBT** SBL SBT **Assigned Phase** 4 3 8 2 7 6 Case Number 1.1 4.0 1.1 4.0 6.0 7.0 Phase Duration, s 19.0 32.5 29.0 42.5 48.5 48.5 Change Period, (Y+Rc), s 5.0 5.5 5.0 5.5 5.5 5.5 Max Allow Headway (MAH), s 3.3 3.3 3.1 3.3 3.1 3.1 Queue Clearance Time (gs), s 6.5 5.0 26.0 39.0 30.8 24.8 Green Extension Time $(g_e)$ , s 0.1 0.8 0.0 0.0 2.7 3.0 Phase Call Probability 1.00 1.00 1.00 1.00 1.00 1.00 0.01 0.00 0.08 0.02 Max Out Probability 1.00 1.00 WB NB SB **Movement Group Results** EΒ Approach Movement L Т R L Т R L Т R L Т R **Assigned Movement** 7 4 14 3 8 18 5 2 6 16 Adjusted Flow Rate (v), veh/h 109 54 565 326 54 717 478 54 Adjusted Saturation Flow Rate (s), veh/h/ln 1774 1572 1774 1654 876 1881 1577 1791 17.9 22.8 2.4 Queue Service Time (gs), s 4.5 3.0 24.0 5.9 16.8 28.8 Cycle Queue Clearance Time $(g_c)$ , s 4.5 3.0 24.0 17.9 16.8 22.8 2.4 Green Ratio (g/C) 0.37 0.25 0.48 0.34 0.39 0.39 0.39 0.39 Capacity (c), veh/h 291 386 746 556 226 1400 735 617 Volume-to-Capacity Ratio (X) 0.373 0.141 0.758 0.586 0.240 0.512 0.650 0.088 Available Capacity (ca), veh/h 291 386 746 556 226 1400 735 617 Back of Queue (Q), veh/ln (50th percentile) 1.9 1.2 11.4 7.1 1.3 7.0 10.3 0.9 Queue Storage Ratio (RQ) (50th percentile) 0.00 0.00 0.00 0.00 0.64 0.00 0.00 0.00 Uniform Delay (d1), s/veh 26.4 32.4 22.3 30.2 39.1 25.5 27.4 21.1 Incremental Delay (d2), s/veh 0.3 0.1 4.0 1.1 0.2 0.1 1.6 0.0 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 26.7 32.5 26.4 31.3 39.3 25.7 29.0 21.2 Level of Service (LOS) С С С С D С С С 28.6 С 28.2 С 26.6 С 28.2 С Approach Delay, s/veh / LOS

Intersection Delay, s/veh / LOS

Pedestrian LOS Score / LOS Bicycle LOS Score / LOS

**Multimodal Results** 

WB

27.7

ΕB

SB

С

NB

# **SR 82 Corridor**

### **2035 No Build Condition**

**AM** 

10/7/2015

1: I-71	NB Off	Ramp

	-	4	7
Lane Group	EBT	WBT	NBL
Lane Configurations	<b>^</b>	<b>^</b>	ሻሻ
Volume (vph)	730	2040	290
Turn Type	NA	NA	Prot
Protected Phases	2	6	8
Permitted Phases			
Detector Phase	2	6	8
Switch Phase			
Minimum Initial (s)	32.0	32.0	10.0
Minimum Split (s)	53.0	38.0	20.0
Total Split (s)	102.0	102.0	48.0
Total Split (%)	68.0%	68.0%	32.0%
Yellow Time (s)	3.6	3.6	3.0
All-Red Time (s)	2.2	2.2	3.0
Lost Time Adjust (s)	-1.4	-2.0	-1.4
Total Lost Time (s)	4.4	3.8	4.6
Lead/Lag			
Lead-Lag Optimize?			
Recall Mode	C-Max	C-Max	None
Act Effct Green (s)	109.1	109.7	31.9
Actuated g/C Ratio	0.73	0.73	0.21
v/c Ratio	0.31	0.61	0.81
Control Delay	4.7	11.1	61.8
Queue Delay	0.0	0.0	0.0
Total Delay	4.7	11.1	61.8
LOS	А	В	Е
Approach Delay	4.7	11.1	61.8
Approach LOS	Α	В	Е
Intersection Summary			

#### Intersection Summary

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 42 (28%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 75

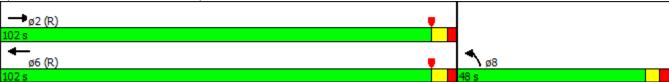
Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 17.9 Intersection LOS: B
Intersection Capacity Utilization 58.6% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: I-71 NB Off Ramp



	-	•	•	<b>←</b>	~	1		
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR	ø1	ø4
Lane Configurations	<b>^</b>	7	ሻ	ተተተ	77	777		
Volume (vph)	2050	280	100	1130	370	960		
Turn Type	NA	custom	Prot	NA	pt+ov	custom		
Protected Phases	6	7	5	2	4 5	14	1	4
Permitted Phases	6	67		2		1 4		
Detector Phase	6	7	5	2	4 5	1 4		
Switch Phase								
Minimum Initial (s)	25.0	4.0	10.0	25.0			1.0	7.0
Minimum Split (s)	32.0	10.6	17.0	32.0			20.0	20.0
Total Split (s)	110.0	20.0	20.0	80.0			50.0	20.0
Total Split (%)	73.3%	13.3%	13.3%	53.3%			33%	13%
Yellow Time (s)	3.6	3.6	3.6	3.6			3.6	3.0
All-Red Time (s)	3.0	3.0	3.0	3.0			3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0				
Total Lost Time (s)	6.6	6.6	6.6	6.6				
Lead/Lag	Lead		Lag	Lag			Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	C-Max			None	Max
Act Effct Green (s)	103.4	123.4	13.4	75.9	34.0	60.9		
Actuated g/C Ratio	0.69	0.82	0.09	0.51	0.23	0.41		
v/c Ratio	1.14	0.27	0.85	0.58	0.67	0.80		
Control Delay	91.9	2.9	96.8	22.0	58.8	43.9		
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0		
Total Delay	91.9	2.9	96.8	22.2	58.8	43.9		
LOS	F	Α	F	С	Е	D		
Approach Delay	80.2			28.3				
Approach LOS	F			С				
Intersection Summary								
Cycle Length: 150								
Actuated Cycle Length: 15	0							
Offset: 148 (99%), Referer	nced to phas	se 2:WBT	, Start of	Yellow				
Natural Cycle: 150								
Control Type: Actuated-Co	ordinated							
Maximum v/c Ratio: 1.14								
Intersection Signal Delay:	57.7			lr	ntersectio	n I OS: F		

Intersection Signal Delay: 57.7 Intersection LOS: E
Intersection Capacity Utilization Err% ICU Level of Service H

Analysis Period (min) 15





	•	<b>→</b>	•	←	•	4	<b>†</b>	/	<b>/</b>	ţ	4	
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	44	<b>↑</b> ↑↑	ሻሻ	<b>^</b>	7	ሻ	र्स	77	ሻሻ	<b>†</b>	7	
Volume (vph)	30	1400	420	1620	50	120	30	890	40	10	10	
Turn Type	Prot	NA	Prot	NA	pm+ov	Split	NA	pm+ov	Split	NA	pm+ov	
Protected Phases	5	2	1	6	4	8	8	1	4	4	5	
Permitted Phases					6			8			4	
Detector Phase	5	2	1	6	4	8	8	1	4	4	5	
Switch Phase												
Minimum Initial (s)	4.0	27.0	10.0	27.0	10.0	10.0	10.0	10.0	10.0	10.0	4.0	
Minimum Split (s)	8.0	40.6	16.0	46.6	41.6	20.0	20.0	16.0	41.6	41.6	8.0	
Total Split (s)	19.0	73.0	30.0	84.0	17.0	30.0	30.0	30.0	17.0	17.0	19.0	
Total Split (%)	12.7%	48.7%	20.0%	56.0%	11.3%	20.0%	20.0%	20.0%	11.3%	11.3%	12.7%	
Yellow Time (s)	3.5	3.6	3.0	3.6	3.6	3.6	3.6	3.0	3.6	3.6	3.5	
All-Red Time (s)	0.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.5	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	
Total Lost Time (s)	2.0	4.6	4.0	4.6	4.6	5.0	5.0	4.4	5.0	5.0	2.4	
Lead/Lag	Lag	Lag	Lead	Lead				Lead			Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max	None	C-Max	None	None	None	None	None	None	None	
Act Effct Green (s)	15.1	68.4	35.5	92.7	105.6	15.9	15.9	56.0	11.6	11.6	30.8	
Actuated g/C Ratio	0.10	0.46	0.24	0.62	0.70	0.11	0.11	0.37	0.08	0.08	0.21	
v/c Ratio	0.11	1.42	0.64	0.86	0.05	0.55	0.55	1.33	0.18	0.18	0.05	
Control Delay	53.2	225.0	58.8	28.8	1.0	74.6	74.2	194.9	66.6	68.0	0.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	53.2	225.0	58.8	28.8	1.0	74.6	74.2	194.9	66.6	68.0	0.2	
LOS	D	F	Е	С	Α	Е	Е	F	Е	Е	Α	
Approach Delay		221.4		34.4			174.2			51.9		
Approach LOS		F		С			F			D		

#### Intersection Summary

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 150

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.42

Intersection Signal Delay: 125.4 Intersection LOS: F
Intersection Capacity Utilization 79.5% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 3: Howe Road & SR 82 Royalton Rd



### **Detailed Measures of Effectiveness**

10/6/2015

# Zone A Totals

Number of Intersections 4
Control Delay / Veh (s/v) 53
Queue Delay / Veh (s/v) 0
Total Delay / Veh (s/v) 53
Total Delay (hr) 258
Stops / Veh 0.51
Stops (#) 8948
Average Speed (mph) 7
Total Travel Time (hr) 327
Distance Traveled (mi) 2395
Fuel Consumed (gal) 353
Fuel Economy (mpg) 6.8
CO Emissions (kg) 24.68
NOx Emissions (kg) 4.80
VOC Emissions (kg) 5.72
VOC Emissions (kg) 5.72 Unserved Vehicles (#) 903

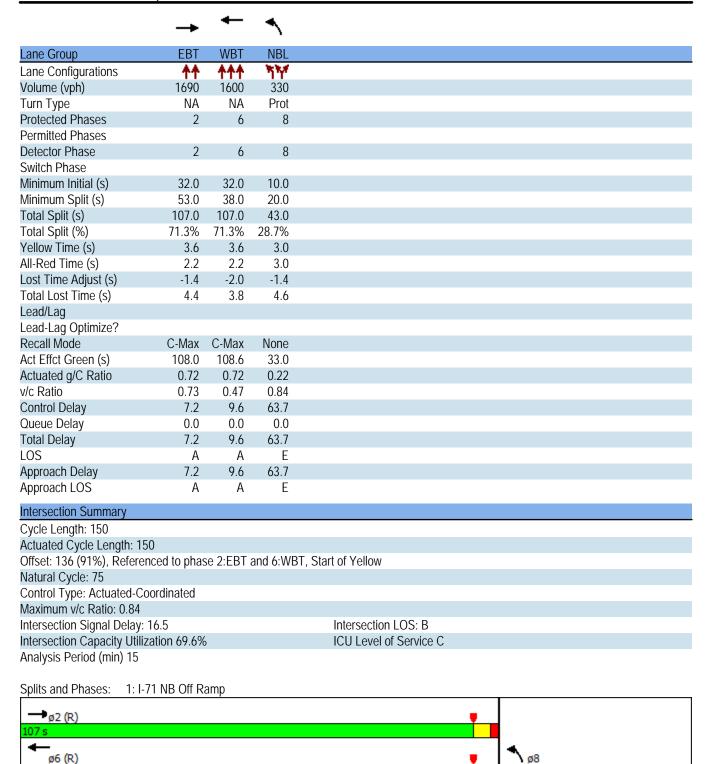
# **SR 82 Corridor**

### **2035 No Build Condition**

**PM** 

1: I-71 NB Off Ramp

10/7/2015



	-	•	•	←	-	~		
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR	ø1	ø4
Lane Configurations	<b>^</b>	7	7	444	77	777		
Volume (vph)	2030	450	100	1400	840	1850		
Turn Type	NA	Perm	Prot	NA	pt+ov	custom		
Protected Phases	6		5	2	4 5	1 4	1	4
Permitted Phases	6	6		2		1 4		
Detector Phase	6	6	5	2	4 5	1 4		
Switch Phase								
Minimum Initial (s)	25.0	25.0	10.0	25.0			1.0	7.0
Minimum Split (s)	32.0	32.0	17.0	32.0			20.0	20.0
Total Split (s)	101.0	101.0	23.0	62.0			62.0	26.0
Total Split (%)	67.3%	67.3%	15.3%	41.3%			41%	17%
Yellow Time (s)	3.6	3.6	3.6	3.6			3.6	3.0
All-Red Time (s)	3.0	3.0	3.0	3.0			3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0				
Total Lost Time (s)	6.6	6.6	6.6	6.6				
Lead/Lag	Lead	Lead	Lag	Lag			Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	C-Max			None	Max
Act Effct Green (s)	94.4	94.4	16.4	55.4	43.0	81.4		
Actuated g/C Ratio	0.63	0.63	0.11	0.37	0.29	0.54		
v/c Ratio	1.33	0.44	1.14	0.88	1.18	0.98		
Control Delay	167.8	0.3	154.2	40.9	139.7	50.4		
Queue Delay	0.0	0.0	0.0	0.0	0.0	40.6		
Total Delay	167.8	0.3	154.2	40.9	139.7	91.0		
LOS	F	Α	F	D	F	F		
Approach Delay	137.4			54.3				
Approach LOS	F			D				
Intersection Summary								
Cycle Length: 150								
Actuated Cycle Length: 15								
Offset: 86 (57%), Reference	ed to phase	e 2:WBT,	Start of Y	ellow				
Natural Cycle: 150								
Control Type: Actuated-Co	ordinated							
Maximum v/c Ratio: 1.33								
Intersection Signal Delay:						n LOS: F		
Intersection Capacity Utiliz	ation Err%			IC	CU Level	of Service	H	
Analysis Period (min) 15								





	•	<b>→</b>	•	←	•	4	<b>†</b>	<i>&gt;</i>	<b>&gt;</b>	ļ	4	
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	14.14	ተተ <sub>ጉ</sub>	ሻሻ	44	7	7	<b>†</b>	77	1,1	<b>†</b>	7	
Volume (vph)	190	1640	930	1930	390	170	100	630	210	150	270	
Turn Type	Prot	NA	Prot	NA	pm+ov	Split	NA	pm+ov	Split	NA	pm+ov	
Protected Phases	5	2	1	6	4	8	8	1	4	4	5	
Permitted Phases					6			8			4	
Detector Phase	5	2	1	6	4	8	8	1	4	4	5	
Switch Phase												
Minimum Initial (s)	7.0	27.0	10.0	27.0	10.0	10.0	10.0	10.0	10.0	10.0	7.0	
Minimum Split (s)	13.0	40.6	16.0	46.6	41.6	20.0	20.0	16.0	41.6	41.6	13.0	
Total Split (s)	16.0	64.0	39.0	87.0	23.0	24.0	24.0	39.0	23.0	23.0	16.0	
Total Split (%)	10.7%	42.7%	26.0%	58.0%	15.3%	16.0%	16.0%	26.0%	15.3%	15.3%	10.7%	
Yellow Time (s)	3.0	3.6	3.0	3.6	3.6	3.6	3.6	3.0	3.6	3.6	3.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	
Total Lost Time (s)	4.0	4.6	4.0	4.6	4.6	5.0	5.0	4.4	5.0	5.0	4.4	
Lead/Lag	Lag	Lag	Lead	Lead				Lead			Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max	None	C-Max	None	None	None	None	None	None	None	
Act Effct Green (s)	12.0	59.4	35.8	83.2	101.3	18.5	18.5	58.9	17.7	17.7	34.3	
Actuated g/C Ratio	0.08	0.40	0.24	0.55	0.68	0.12	0.12	0.39	0.12	0.12	0.23	
v/c Ratio	0.79	1.41	1.42	1.03	0.49	0.84	0.49	0.63	0.64	0.82	0.86	
Control Delay	71.7	218.2	232.2	56.7	4.7	94.5	69.1	40.1	70.9	92.0	57.1	
Queue Delay	0.0	0.0	0.0	26.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
Total Delay	71.7	218.2	232.2	83.3	4.7	94.5	69.1	40.1	70.9	92.0	57.3	
LOS	Е	F	F	F	Α	F	Е	D	Е	F	Е	
Approach Delay		204.8		117.5			53.5			69.1		
Approach LOS		F		F			D			Е		

#### **Intersection Summary**

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 28 (19%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 145

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.42

Intersection Signal Delay: 130.4 Intersection LOS: F
Intersection Capacity Utilization 93.2% ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 3: Howe Road & SR 82 Royalton Rd



10/6/2015

# Zone A Totals

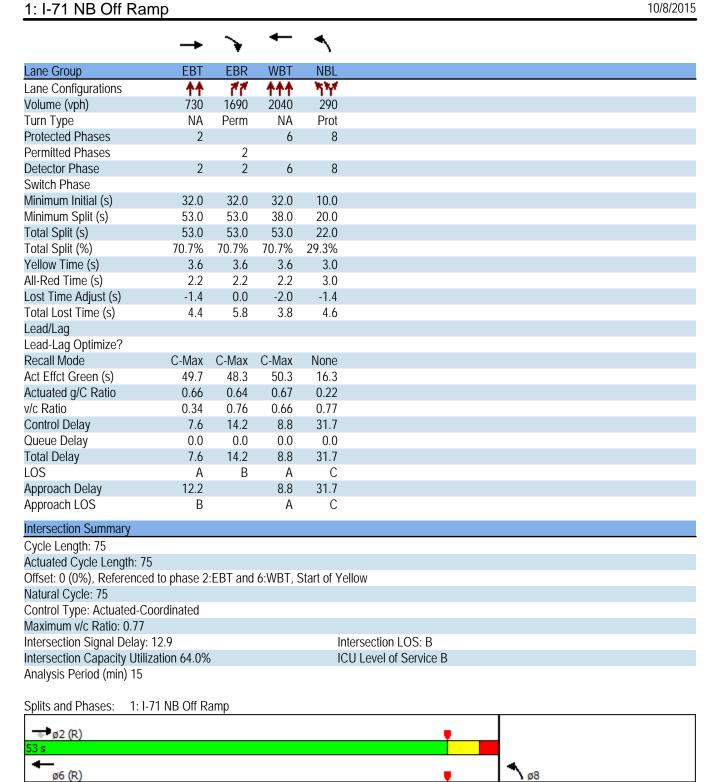
Number of Interceptions	4
Number of Intersections	4
Control Delay / Veh (s/v)	68
Queue Delay / Veh (s/v)	6
Total Delay / Veh (s/v)	74
Total Delay (hr)	450
Stops / Veh	0.51
Stops (#)	11254
Average Speed (mph)	6
Total Travel Time (hr)	537
Distance Traveled (mi)	3111
Fuel Consumed (gal)	543
Fuel Economy (mpg)	5.7
CO Emissions (kg)	37.97
NOx Emissions (kg)	7.39
VOC Emissions (kg)	8.80
Unserved Vehicles (#)	1482
Vehicles in dilemma zone (#)	161
Performance Index	481.2

# **SR 82 Corridor**

### **2035 Build Condition**

**AM** 

10/8/2015



	<b>→</b>	•	•	←	/	~				
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR	ø1	ø4		
Lane Configurations	ተተተ	7	ሻ	<b>^</b>	77	777				
Volume (vph)	2050	280	210	1020	370	680				
Turn Type	NA	custom	Prot	NA	pt+ov	custom				
Protected Phases	6	7	5	2	4 5	14	1	4		
Permitted Phases	6	67		2		1 4				
Detector Phase	6	7	5	2	4 5	1 4				
Switch Phase										
Minimum Initial (s)	25.0	4.0	10.0	25.0			1.0	7.0		
Minimum Split (s)	32.0	10.6	17.0	32.0			20.0	20.0		
Total Split (s)	87.0	23.0	40.0	97.0			30.0	23.0		
Total Split (%)	58.0%	15.3%	26.7%	64.7%			20%	15%		
Yellow Time (s)	3.6	3.6	3.6	3.6			3.6	3.0		
All-Red Time (s)	3.0	3.0	3.0	3.0			3.0	3.0		
Lost Time Adjust (s)	0.0	0.0	0.0	0.0						
Total Lost Time (s)	6.6	6.6	6.6	6.6						
Lead/Lag	Lead		Lag	Lag			Lead			
Lead-Lag Optimize?										
Recall Mode	None	None	None	C-Max			None	Max		
Act Effct Green (s)	80.4	103.4	33.4	93.7	57.0	43.1				
Actuated g/C Ratio	0.54	0.69	0.22	0.62	0.38	0.29				
v/c Ratio	0.94	0.31	0.71	0.42	0.40	0.71				
Control Delay	26.8	2.5	63.8	15.4	35.4	51.2				
Queue Delay	1.6	0.0	0.0	0.0	0.0	0.3				
Total Delay	28.4	2.5	63.8	15.4	35.4	51.4				
LOS	С	Α	Е	В	D	D				
Approach Delay	25.0			23.8						
Approach LOS	С			С						
Intersection Summary										
Cycle Length: 150										
Actuated Cycle Length: 150	0									
Offset: 24 (16%), Reference		e 2:WBT,	Start of Y	'ellow						
Natural Cycle: 90	·									
Control Type: Actuated-Co	ordinated									
Maximum v/c Ratio: 0.94										
Intersection Signal Delay: 2	29.3			Ir	ntersectio	n LOS: C				
Intersection Capacity Utiliza	ation Err%			10	CU Level	of Service	· H			
Analysis Period (min) 15										
Splits and Phases: 2: I-7	'1 SB Ramı	o & SR 82	Royaltor	n Rd						
<b>4</b>	-								₩,	
ø1	ø2 (l	R)							rø4	
30 s	97 s								23 s	

**√r**ø5

### 3: Howe Road & SR 82 Royalton Rd

10/8/2015

	ၨ	<b>→</b>	•	<b>←</b>	•	4	<b>†</b>	<b>/</b>	<b>&gt;</b>	ļ	✓	
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	ሻሻ	<b>↑</b> ↑	ሻሻ	<b>^</b>	7	7	र्स	77	ሻሻ	<b>†</b>	7	
Volume (vph)	30	1400	110	1540	50	120	30	890	40	10	10	
Turn Type	Prot	NA	Prot	NA	pm+ov	Split	NA	pm+ov	Split	NA	pm+ov	
Protected Phases	5	2	1	6	4	8	8	1	4	4	5	
Permitted Phases					6			8			4	
Detector Phase	5	2	1	6	4	8	8	1	4	4	5	
Switch Phase												
Minimum Initial (s)	7.0	27.0	10.0	27.0	10.0	10.0	10.0	10.0	10.0	10.0	7.0	
Minimum Split (s)	13.0	40.6	16.0	46.6	41.6	20.0	20.0	16.0	41.6	41.6	13.0	
Total Split (s)	13.0	65.0	33.0	85.0	17.0	35.0	35.0	33.0	17.0	17.0	13.0	
Total Split (%)	8.7%	43.3%	22.0%	56.7%	11.3%	23.3%	23.3%	22.0%	11.3%	11.3%	8.7%	
Yellow Time (s)	3.0	3.6	3.0	3.6	3.6	3.6	3.6	3.0	3.6	3.6	3.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	
Total Lost Time (s)	4.0	4.6	4.0	4.6	4.6	5.0	5.0	4.4	5.0	5.0	4.4	
Lead/Lag	Lag	Lag	Lead	Lead				Lead			Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max	None	C-Max	None	None	None	None	None	None	None	
Act Effct Green (s)	9.0	64.0	39.8	97.4	110.3	16.0	16.0	60.4	11.6	11.6	25.2	
Actuated g/C Ratio	0.06	0.43	0.27	0.65	0.74	0.11	0.11	0.40	0.08	0.08	0.17	
v/c Ratio	0.19	0.88	0.15	0.78	0.05	0.55	0.55	0.85	0.18	0.18	0.06	
Control Delay	65.4	41.5	46.9	17.9	0.6	74.5	74.0	49.0	66.6	68.0	0.3	
Queue Delay	0.0	1.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	65.4	42.4	46.9	18.3	0.6	74.5	74.0	49.0	66.6	68.0	0.3	
LOS	E	D	D	В	Α	E	Е	D	Е	E	Α	
Approach Delay		42.9		19.7			53.3			51.9		
Approach LOS		D		В			D			D		

#### **Intersection Summary**

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 118 (79%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 145

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 36.4 Intersection LOS: D
Intersection Capacity Utilization 79.5% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 3: Howe Road & SR 82 Royalton Rd



### **Detailed Measures of Effectiveness**

10/6/2015

### Zone A Totals

Number of Intersections	4
Control Delay / Veh (s/v)	18
Queue Delay / Veh (s/v)	0
Total Delay / Veh (s/v)	19
Total Delay (hr)	95
Stops / Veh	0.50
Stops (#)	9204
Average Speed (mph)	14
Total Travel Time (hr)	163
Distance Traveled (mi)	2362
Fuel Consumed (gal)	230
Fuel Economy (mpg)	10.3
CO Emissions (kg)	16.06
NOx Emissions (kg)	3.12
VOC Emissions (kg)	3.72
Unserved Vehicles (#)	0
Vehicles in dilemma zone (#)	230
Performance Index	120.7

### **SR 82 Corridor**

### **2035 Build Condition**

**PM** 

# Timings 1: I-71 NB Off Ramp

	-	•	←	•	
Lane Group	EBT	EBR	WBT	NBL	
Lane Configurations	<b>^</b>	77	<b>^</b>	ሻሻ	
Volume (vph)	1690	1180	1600	330	
Turn Type	NA	Perm	NA	Prot	
Protected Phases	2		6	8	
Permitted Phases		2			
Detector Phase	2	2	6	8	
Switch Phase					
Minimum Initial (s)	32.0	32.0	32.0	10.0	
Minimum Split (s)	53.0	53.0	38.0	20.0	
Total Split (s)	54.0	54.0	54.0	21.0	
Total Split (%)	72.0%	72.0%	72.0%	28.0%	
Yellow Time (s)	3.6	3.6	3.6	3.0	
All-Red Time (s)	2.2	2.2	2.2	3.0	
Lost Time Adjust (s)	-1.4	0.0	-2.0	-1.4	
Total Lost Time (s)	4.4	5.8	3.8	4.6	
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	C-Max	C-Max	C-Max	None	
Act Effct Green (s)	49.8	48.4	50.4	16.2	
Actuated g/C Ratio	0.66	0.65	0.67	0.22	
v/c Ratio	0.79	0.57	0.51	0.86	
Control Delay	10.8	1.3	6.8	40.6	
Queue Delay	0.0	0.0	0.0	0.0	
Total Delay	10.8	1.3	6.8	40.6	
LOS	В	Α	Α	D	
Approach Delay	6.9		6.8	40.6	
Approach LOS	А		Α	D	
Intersection Summary					
Cycle Length: 75					
Actuated Cycle Length: 7	5				
Offset: 0 (0%), Reference	d to phase 2	:EBT and	6:WBT,	Start of Y	ellow
Natural Cycle: 75					
Control Type: Actuated-C	oordinated				
Maximum v/c Ratio: 0.86					
Intersection Signal Delay:	10.7			ıl	ntersection LOS: B
Intersection Capacity Utili		) )		[(	CU Level of Service C
Analysis Period (min) 15					
Splits and Phases: 1: I-	71 NB Off R	amp			
▼ ø2 (R)					
54 s					
-					

ø6 (R)

	-	•	•	•	<i>&gt;</i>	1	
Lane Group	EBT	EBR	WBL	WBT	NBR2	SWR	
Lane Configurations	ተተተ	7	ሻ	ተተተ	77	777	
Volume (vph)	2030	450	310	1190	840	1240	
Turn Type	NA	Perm	Prot	NA	Over	Prot	
Protected Phases	6		5	2	5	1	
Permitted Phases	6	6		2		1	
Detector Phase	6	6	5	2	5	1	
Switch Phase							
Minimum Initial (s)	25.0	25.0	10.0	25.0	10.0	1.0	
Minimum Split (s)	32.0	32.0	17.0	32.0	17.0	20.0	
Total Split (s)	84.0	84.0	66.0	74.0	66.0	76.0	
Total Split (%)	56.0%	56.0%	44.0%	49.3%	44.0%	50.7%	
Yellow Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.6	6.6	6.6	6.6	6.6	6.6	
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?							
Recall Mode	None	None	None	C-Max	None	None	
Act Effct Green (s)	77.4	77.4	59.4	78.3	59.4	58.5	
Actuated g/C Ratio	0.52	0.52	0.40	0.52	0.40	0.39	
v/c Ratio	0.94	0.59	0.97	0.53	0.85	0.81	
Control Delay	51.8	32.8	72.9	27.3	50.4	45.0	
Queue Delay	3.1	0.0	0.0	0.0	0.0	0.4	
Total Delay	54.9	32.8	72.9	27.3	50.4	45.4	
LOS	D	С	Е	С	D	D	
Approach Delay	50.9			42.2			
Approach LOS	D			D			
Intersection Summary							
Cycle Length: 150							
Actuated Cycle Length: 15	50						
Offset: 56 (37%), Reference		2·WRT	Start of Y	'ellow			
Natural Cycle: 90	ccu to priuse	, 2.0001,	Start or 1	CHOW			
Control Type: Actuated-Co	oordinated						
Maximum v/c Ratio: 0.97	Jordinated						
Intersection Signal Delay:	<i>1</i> 7 3			lr	ntarsactio	n LOS: D	
Intersection Capacity Utiliz						of Service	
Analysis Period (min) 15	Lation Lii /0				20 FEAGL	or Service	<i>-</i> 11
Analysis i Gilou (IIIII) 15							
Splits and Phases: 2: I-	71 SB Ramp	& SR 82	Royaltor	n Rd			
ø1					-   ◆	ø2 (R)	
76 s					74 s	p2 (N)	
					7 13		
₩ <b>ø</b> 6						<b>√</b> Cø5	5
04 =						cc -	

### 3: Howe Road & SR 82 Royalton Rd

10/8/2015

	۶	-	•	<b>←</b>	•	•	<b>†</b>	~	/	ţ	1	
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	14.14	ተተ <sub>ጉ</sub>	1,1	<b>^</b>	7	ሻ	<b>†</b>	77	1,1	<b>†</b>	7	
Volume (vph)	190	1640	210	1830	390	170	100	630	210	150	270	
Turn Type	Prot	NA	Prot	NA	pm+ov	Split	NA	pm+ov	Split	NA	pm+ov	
Protected Phases	5	2	1	6	4	8	8	1	4	4	5	
Permitted Phases					6			8			4	
Detector Phase	5	2	1	6	4	8	8	1	4	4	5	
Switch Phase												
Minimum Initial (s)	7.0	27.0	10.0	27.0	10.0	10.0	10.0	10.0	10.0	10.0	7.0	
Minimum Split (s)	13.0	40.6	16.0	46.6	41.6	20.0	20.0	16.0	41.6	41.6	13.0	
Total Split (s)	15.0	69.0	34.0	88.0	24.0	23.0	23.0	34.0	24.0	24.0	15.0	
Total Split (%)	10.0%	46.0%	22.7%	58.7%	16.0%	15.3%	15.3%	22.7%	16.0%	16.0%	10.0%	
Yellow Time (s)	3.0	3.6	3.0	3.6	3.6	3.6	3.6	3.0	3.6	3.6	3.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	
Total Lost Time (s)	4.0	4.6	4.0	4.6	4.6	5.0	5.0	4.4	5.0	5.0	4.4	
Lead/Lag	Lag	Lag	Lead	Lead				Lead			Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max	None	C-Max	None	None	None	None	None	None	None	
Act Effct Green (s)	11.0	69.5	25.7	84.2	103.0	17.8	17.8	48.1	18.4	18.4	34.0	
Actuated g/C Ratio	0.07	0.46	0.17	0.56	0.69	0.12	0.12	0.32	0.12	0.12	0.23	
v/c Ratio	0.87	0.98	0.45	0.97	0.49	0.87	0.51	0.78	0.62	0.78	0.86	
Control Delay	79.2	39.4	57.2	36.6	3.2	100.6	70.8	52.3	69.1	86.8	57.7	
Queue Delay	0.0	0.0	0.0	6.0	0.0	0.0	0.0	2.5	0.0	0.0	0.2	
Total Delay	79.2	39.4	57.2	42.6	3.2	100.6	70.8	54.8	69.1	86.8	58.0	
LOS	E	D	Е	D	Α	F	Е	D	E	F	Е	
Approach Delay		43.0		35.9			65.1			67.7		
Approach LOS		D		D			E			Е		

#### **Intersection Summary**

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 16 (11%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 145

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.98

Intersection Signal Delay: 46.3 Intersection LOS: D
Intersection Capacity Utilization 89.7% ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 3: Howe Road & SR 82 Royalton Rd



10/6/2015

### Zone A Totals

N	
Number of Intersections	4
Control Delay / Veh (s/v)	25
Queue Delay / Veh (s/v)	1
Total Delay / Veh (s/v)	26
Total Delay (hr)	153
Stops / Veh	0.55
Stops (#)	11603
Average Speed (mph)	12
Total Travel Time (hr)	233
Distance Traveled (mi)	2831
Fuel Consumed (gal)	313
Fuel Economy (mpg)	9.0
CO Emissions (kg)	21.89
NOx Emissions (kg)	4.26
VOC Emissions (kg)	5.07
Unserved Vehicles (#)	0
Vehicles in dilemma zone (#)	317
Performance Index	184.7

# **Freeway Segments**

### **2035 No Build Condition**

**AM** 

	BASIC FR	EEWAY SE	GMENTS WORKSHEE		
	-				
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott N 6/2/2015 AM	/lacDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year	el SB @ <i>I-</i> 80 2035	
Project Description I-71 /	SR 82 IMS		•		
✓ Oper.(LOS)			es.(N)	Plar	nning Data
Flow Inputs					
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	2220	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 3 0 Level	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi	
Calculate Flow Adjus	tmonte		Ор/Войн 70		
				1.0	
f <sub>p</sub>	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	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	3		$f_{LC}$		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph			·
LOS and Performanc	e Measures	5	Design (N)		
Operational (LOS) v <sub>p</sub> = (V or DDHV) / (PHF x l x f <sub>p</sub> )	N x f <sub>HV</sub> 799	pc/h/ln	Design (N) Design LOS v <sub>p</sub> = (V or DDHV) / (PHF x	N x f <sub>HV</sub>	pc/h/ln
^ 'p <sup>/</sup> S	65.0	mph	x f <sub>p</sub> )		рслілії
D = v <sub>p</sub> / S	12.3	pc/mi/ln	S		mph
LOS	В	ролиши	D = v <sub>p</sub> / S Required Number of Lanes	s, N	pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3		f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

General Information			Site Information			
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott Ma 6/2/2015 AM Lanes 1+2		Highway/Direction of Travel From/To Jurisdiction Analysis Year	SB I-80 to SR 82 WB 2035		
	R 82 IMS	<u>'</u>	- <b>,</b>			
✓ Oper.(LOS)			Des.(N)	☐ Pla	anning Data	
Flow Inputs					-	
Volume, V AADT Peak-Hr Prop. of AADT, K	1565	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub>	0.94 3 0		
Peak-Hr Direction Prop, D DDHV = AADT x K x D		veh/h	General Terrain: Grade % Length Up/Down %	Level mi		
Calculate Flow Adjustme	ents					
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 0.985		
Speed Inputs			Calc Speed Adj and FFS			
Lane Width		ft	<u> </u>			
Rt-Side Lat. Clearance		ft ft	f <sub>LW</sub>		mph	
Number of Lanes, N	2	II.	f <sub>LC</sub>		mph	
Total Ramp Density, TRD	_	ramps/mi	TRD Adjustment		mph	
FFS (measured)	65.0	mph	FFS	65.0	mph	
Base free-flow Speed, BFFS		mph				
LOS and Performance M	easures		Design (N)			
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x N x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	x f <sub>HV</sub> x 845 65.0 13.0 B	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \times N)$ $f_p)$ S $D = v_p / S$ Required Number of Lanes, N		pc/h/ln mph pc/mi/ln	
Glossary			Factor Location			
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service DDHV - Directional design ho	S - Speed D - Density FFS - Free-flow BFFS - Base fr		E <sub>R</sub> - Exhibits 11-10, 11-12 E <sub>T</sub> - Exhibits 11-10, 11-11, 11 f <sub>p</sub> - Page 11-18 LOS, S, FFS, v <sub>p</sub> - Exhibits 11-		f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-1	

SJT Hatch Mott Ma 6/2/2015 AM Lane 3 82 IMS		Highway/Direction of Travel From/To Jurisdiction Analysis Year  Des.(N)  Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub>	0.94 3	R 82 WB nning Data
82 IMS	veh/h	Des.(N)  Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub>	O.94	nning Data
	veh/h	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub>	0.94 3	nning Data
2290	veh/h	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub>	0.94 3	nning Data
2290	-	%Trucks and Buses, $P_T$	3	
2290	-	%Trucks and Buses, $P_T$	3	
	10.11 00.1	•		
			0	
		General Terrain:	Level	
	veh/h	Grade % Length Up/Down %	mi	
nts				
1.00		E <sub>R</sub>	1.2	
1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.985	
		Calc Speed Adj and FFS		
	ft			
	ft	$f_{LW}$		mph
2		$f_{LC}$		mph
	ramps/mi	TRD Adjustment		mph
65.0	mph	FFS	65.0	mph
	mph			·
asures		Design (N)		
		Design (N)		
t <sub>HV</sub> x 1236	pc/h/ln		(f <sub>HV</sub> x	n a /la /l n
65.0	mnh	f <sub>p</sub> )		pc/h/ln
	-	S		mph
	ролиши	$D = v_p / S$		pc/mi/ln
Ü		Required Number of Lanes, N		
		Factor Location		
S - Speed				
-				f <sub>LW</sub> - Exhibit 11-8
-	w speed	'	-13	f <sub>LC</sub> - Exhibit 11-9
		f <sub>p</sub> - Page 11-18		TRD - Page 11-1
ır volume	•	LOS, S, FFS, v <sub>p</sub> - Exhibits 11-	2, 11-3	
All Rights Reserved	<u> </u>	HCS 2010 <sup>TM</sup> Version 6.50	Genera	rated: 10/12/2015 11:3
	1.00 1.5  2 65.0  asures  f <sub>HV</sub> X 1236 65.0 19.0 C  S - Speed D - Density FFS - Free-flor BFFS - Base from the second sec	1.00 1.5  ft ft 2 ramps/mi 65.0 mph mph  asures  fHV X 1236 pc/h/ln 65.0 mph 19.0 pc/mi/ln C  S - Speed D - Density FFS - Free-flow speed BFFS - Base free-flow speed	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$f_{HV} = \frac{1}{[1+P_T(E_T-1)+P_R(E_R-1)]} - 0.985$ $\begin{array}{c ccccccccccccccccccccccccccccccccccc$

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	T	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 AM No Build	lacDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year	el SB @ SR 82 2035	2 WB
Project Description <i>I-71</i> /					
✓ Oper.(LOS)			Des.(N)	Plan	ning Data
Flow Inputs					<u> </u>
Volume, V AADT	1750	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub>	0.94 3	
Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D DDHV = AADT x K x D		veh/h	%RVs, P <sub>R</sub> General Terrain: Grade % Length Up/Down %	0 Level mi	
Calculate Flow Adjus	tments				
f <sub>p</sub>	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	)] <i>0.</i> 985	
Speed Inputs			Calc Speed Adj and I	FFS	
Lane Width		ft			
Rt-Side Lat. Clearance		ft	$f_{LW}$		mph
Number of Lanes, N	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph			•
LOS and Performanc	e Measures		Design (N)		
Operational (LOS) v <sub>p</sub> = (V or DDHV) / (PHF x I x f <sub>p</sub> ) S	N x f <sub>HV</sub> 630 65.0	pc/h/ln mph	$\frac{\text{Design (N)}}{\text{Design LOS}}$ $v_p = (V \text{ or DDHV}) / (PHF \text{ x})$ $x f_p)$ S	N x f <sub>HV</sub>	pc/h/ln
$D = v_p / S$	9.7	pc/mi/ln			mph
LOS	Α		D = v <sub>p</sub> / S Required Number of Lanes	s, N	pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		E <sub>R</sub> - Exhibits 11-10, 11-12 E <sub>T</sub> - Exhibits 11-10, 11-11, f <sub>p</sub> - Page 11-18 LOS, S, FFS, v <sub>p</sub> - Exhibits 11-3		f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	Т	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	6/4/2015		Highway/Direction of Trave From/To Jurisdiction Analysis Year	I SB @ SR 82 I 2035	ЕВ
	SR 82 IMS		7 thatyold 1 dai		
✓ Oper.(LOS)			Pes.(N)	Planni	ing Data
Flow Inputs			( )		<u> </u>
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	1380	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 4 0 Level	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi	
Calculate Flow Adjus	tments				
fp	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	)] 0.980	
Speed Inputs			Calc Speed Adj and I		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f <sub>LW</sub>		mph
Number of Lanes, N	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph		00.0	
LOS and Performance	e Measures		Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x N x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	N x f <sub>HV 4</sub> 99 65.0 7.7 A	pc/h/ln mph pc/mi/ln	$\frac{\text{Design (N)}}{\text{Design LOS}}$ $v_p = (V \text{ or DDHV}) / (PHF \text{ x})$ $x f_p)$ $S$ $D = v_p / S$ Required Number of Lanes		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design I	S - Speed D - Densit FFS - Free BFFS - Bas nour volume	ty -flow speed	$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13 f	<sub>LW</sub> - Exhibit 11-8 <sub>LC</sub> - Exhibit 11-9 「RD - Page 11-11

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	Т	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 AM No Build	lacDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year		o SR 303
	SR 82 IMS				
✓ Oper.(LOS)			Pes.(N)	Plar	nning Data
Flow Inputs			· ,		
Volume, V AADT	1760	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub>	0.94 4	
Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D DDHV = AADT x K x D		veh/h	%RVs, P <sub>R</sub> General Terrain: Grade % Length Up/Down %	0 Level mi	
Calculate Flow Adjus	tments				
fp	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	)] 0.980	
Speed Inputs			Calc Speed Adj and I	FFS	
Lane Width		ft			
Rt-Side Lat. Clearance		ft	$f_{LW}$		mph
Number of Lanes, N	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performanc	e Measures		Design (N)		
Operational (LOS) v <sub>p</sub> = (V or DDHV) / (PHF x l	N x f <sub>HV 627</sub>	n o //o // n	Design (N) Design LOS	NI v. f	
x f <sub>p</sub> )	037	pc/h/ln	$v_p = (V \text{ or DDHV}) / (PHF x)$	IN X I <sub>HV</sub>	pc/h/ln
s	65.0	mph	x f <sub>p</sub> ) S		mph
$D = v_p / S$	9.8	pc/mi/ln	D = v <sub>p</sub> / S		pc/mi/ln
LOS	Α		Required Number of Lanes	s, N	рсліплі
Glossary			Factor Location		
N - Number of lanes	S - Spee	d			f F.J. 9 44 0
V - Hourly volume	D - Densi		E <sub>R</sub> - Exhibits 11-10, 11-12	11 12	f <sub>LW</sub> - Exhibit 11-8
v <sub>p</sub> - Flow rate		-flow speed	E <sub>T</sub> - Exhibits 11-10, 11-11,	11-13	f <sub>LC</sub> - Exhibit 11-9
LOS - Level of service speed		se free-flow	f <sub>p</sub> - Page 11-18 LOS, S, FFS, v <sub>p</sub> - Exhibits	11-2,	TRD - Page 11-11
DDHV - Directional design	hour volume		11-3		

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	Т	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 AM No Build	acDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year	el SB @ SR 303 2035	:
Project Description I-71 /	SR 82 IMS				
✓ Oper.(LOS)			es.(N)	Planni	ng Data
Flow Inputs					
Volume, V AADT Peak-Hr Prop. of AADT, K	1120	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub>	0.94 4 0	
Peak-Hr Direction Prop, D DDHV = AADT x K x D		veh/h	General Terrain: Grade % Length Up/Down %	Level mi	
Calculate Flow Adjus	tments				
f <sub>p</sub> E <sub>⊤</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 11.0 980	
Speed Inputs			Calc Speed Adj and I		
			Calc Speed Auj and I	13	
Lane Width Rt-Side Lat. Clearance Number of Lanes, N	3	ft ft	f <sub>LW</sub>		mph
·	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD	CE 0	ramps/mi	TRD Adjustment		mph
FFS (measured) Base free-flow Speed, BFFS	65.0	mph mph	FFS	65.0	mph
LOS and Performanc	e Measures		Design (N)		
Operational (LOS) v <sub>p</sub> = (V or DDHV) / (PHF x l	N x f <sub>HV</sub>	pc/h/ln	Design (N) Design LOS v <sub>p</sub> = (V or DDHV) / (PHF x	Nyf	
x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	65.0 6.2 A	mph pc/mi/ln	$v_p = (V \text{ of } DBHV) / (V \text{ if } V  if $		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Bas		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13 f	<sub>LW</sub> - Exhibit 11-8 <sub>LC</sub> - Exhibit 11-9 <sup>-</sup> RD - Page 11-11

# **Freeway Segments**

### **2035 No Build Condition**

**PM** 

	BASIC FRI	EWAY SE	GMENTS WORKSHEE	T	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 PM	lacDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year	el SB @ <i>I-80</i> 2035	
	SR 82 IMS		,		
✓ Oper.(LOS)			es.(N)	Plar	ning Data
Flow Inputs			. ,		J
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	5470	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 3 0 Level	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi	
Calculate Flow Adjus	tmonts		<b>Ор</b> /Во <b>W</b> II /0		
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 )] 0.985	
Speed Inputs			Calc Speed Adj and I		
Lane Width		ft			
Rt-Side Lat. Clearance Number of Lanes, N	3	ft	f <sub>LW</sub>		mph
· ·	3		$f_{LC}$		mph
Total Ramp Density, TRD	05.0	ramps/mi	TRD Adjustment		mph
FFS (measured) Base free-flow Speed, BFFS	65.0	mph mph	FFS	65.0	mph
LOS and Performanc	e Measures		Design (N)		
Operational (LOS) $v_p = (V \text{ or DDHV}) / (PHF x I x f_p)$ S	N x f <sub>HV</sub> 1969 60.4	pc/h/ln mph	$\frac{\text{Design (N)}}{\text{Design LOS}}$ $v_p = (V \text{ or DDHV}) / (PHF \text{ x} \text{ x f}_p)$	N x f <sub>HV</sub>	pc/h/ln
$D = v_p / S$	32.6	pc/mi/ln	S		mph
LOS	D	<b>P</b> • · · · · · · · ·	$D = v_p / S$ Required Number of Lanes	s, N	pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3		f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

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General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 PM - Lane 1		Highway/Direction of Travel From/To Jurisdiction Analysis Year	SB I-80 to S 2035	SR 82 WB
	R 82 IMS		,		
✓ Oper.(LOS)			Des.(N)	☐ Pla	anning Data
Flow Inputs					
Volume, V AADT Peak-Hr Prop. of AADT, K	3720	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub>	0.94 3 0	
Peak-Hr Direction Prop, D DDHV = AADT x K x D		veh/h	General Terrain: Grade % Length Up/Down %	Level mi	
Calculate Flow Adjustme	ents				
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 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 <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph			·
LOS and Performance M	easures		Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x N x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	x f <sub>HV</sub> x 2008 59.8 33.6 D	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \times N)$ $f_p)$ S $D = v_p / S$ Required Number of Lanes, N		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service DDHV - Directional design ho		w speed free-flow speed	E <sub>R</sub> - Exhibits 11-10, 11-12 E <sub>T</sub> - Exhibits 11-10, 11-11, 11 f <sub>p</sub> - Page 11-18 LOS, S, FFS, v <sub>p</sub> - Exhibits 11-		f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-1

General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott MacDonald 6/2/2015		Highway/Direction of Travel From/To Jurisdiction Analysis Year	SB I-80 to S 2035	SR 82 WB
Project Description I-71 / SF	PM - Lane 3		Analysis Teal	2000	
✓ Oper.(LOS)	. 02 11110		Des.(N)	Pla	nning Data
Flow Inputs			()		
Volume, V	4540	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 <sub>R</sub>	0	
Peak-Hr Direction Prop, D DDHV = AADT x K x D		veh/h	General Terrain: Grade % Length Up/Down %	Level mi	
Calculate Flow Adjustme	nts				
$f_p$	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	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 <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph			•
LOS and Performance Me	easures		Design (N)		
			Dosign (NI)		
Operational (LOS)			Design (N)		
$v_p = (V \text{ or DDHV}) / (PHF x N x)$	( f <sub>HV</sub> x 2451	pc/h/ln	Design LOS v <sub>D</sub> = (V or DDHV) / (PHF x N x	(fully X	
f <sub>p</sub> )		•	$f_p$ )		pc/h/ln
S	49.3	mph	S		mph
$D = v_p / S$	49.7	pc/mi/ln	$D = v_p / S$		pc/mi/ln
LOS	F		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed				
V - Hourly volume	D - Density		E <sub>R</sub> - Exhibits 11-10, 11-12		f <sub>LW</sub> - Exhibit 11-8
v - Hourly volume v <sub>p</sub> - Flow rate	FFS - Free-flo	w sneed	E <sub>T</sub> - Exhibits 11-10, 11-11, 11	-13	f <sub>LC</sub> - Exhibit 11-9
LOS - Level of service		ree-flow speed	f <sub>p</sub> - Page 11-18		TRD - Page 11-1
DDHV - Directional design ho		ice-now speed	LOS, S, FFS, v <sub>p</sub> - Exhibits 11-	2, 11-3	

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	Т	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 PM No Build	acDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year	SB @ SR 82 2035	WB
	SR 82 IMS		. ,		
✓ Oper.(LOS)			es.(N)	Planr	ning Data
Flow Inputs			· ,		
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D DDHV = AADT x K x D	4140	veh/h veh/day veh/h	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain: Grade % Length	0.94 3 0 Level mi	
DDHV - AADIX K X D		ven/m	Grade % Length Up/Down %	1111	
Calculate Flow Adjus	tments				
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 )] 0.985	
Speed Inputs			Calc Speed Adj and I	FS	
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) Base free-flow Speed, BFFS	65.0	mph mph	FFS	65.0	mph
LOS and Performanc	e Measures		Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x l x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	N x f <sub>HV</sub> 1490 64.9 23.0 C	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \text{ x} \text{ x f}_p)$ S $D = v_p / S$	N x f <sub>HV</sub>	pc/h/ln mph pc/mi/ln
			Required Number of Lanes	s, N	
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13	f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	T	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott Ma 6/4/2015 PM No Build	acDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year	I SB @ SR 82 E 2035	ĒΒ
	SR 82 IMS		7 thatyold 1 dai		
✓ Oper.(LOS)		Пр	es.(N)	Plannir	ng Data
Flow Inputs			· /		<u> </u>
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	3300	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 4 0 Level	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi	
Calculate Flow Adjus	tments		·		
fp	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980	
Speed Inputs			Calc Speed Adj and F	FS	
Lane Width		ft			
Rt-Side Lat. Clearance		ft	$f_{LW}$		mph
Number of Lanes, N	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph		00.0	Шрп
LOS and Performance	e Measures		Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x N x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	N x f <sub>HV</sub> 1194 65.0 18.4 C	pc/h/ln mph pc/mi/ln	$\frac{\text{Design (N)}}{\text{Design LOS}}$ $v_p = (V \text{ or DDHV}) / (PHF \text{ x})$ $x f_p)$ $S$ $D = v_p / S$ Required Number of Lanes		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design h	S - Speed D - Densit FFS - Free- BFFS - Bas nour volume	ty -flow speed	$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13 f <sub>L</sub>	<sub>.W</sub> - Exhibit 11-8 <sub>.C</sub> - Exhibit 11-9 RD - Page 11-11

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	T	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 PM No Build	lacDonald	Highway/Direction of Trave From/To Jurisdiction Analysis Year		o SR 303
	SR 82 IMS		,		
✓ Oper.(LOS)			Des.(N)	Plar	nning Data
Flow Inputs			· ,		
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D DDHV = AADT x K x D	3850	veh/h veh/day veh/h	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain: Grade % Length	0.94 4 0 Level mi	
			Up/Down %		
Calculate Flow Adjus	tments				
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 )] 0.980	
Speed Inputs			Calc Speed Adj and I		
Lane Width		ft			
Rt-Side Lat. Clearance Number of Lanes, N	3	ft	f <sub>LW</sub>		mph mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured) Base free-flow Speed, BFFS	65.0	mph mph	FFS	65.0	mph
LOS and Performanc	e Measures		Design (N)		
Operational (LOS) $v_p = (V \text{ or DDHV}) / (PHF \times I)$ $x f_p)$ $S$ $D = v_p / S$ $LOS$	N x f <sub>HV</sub> 1393 65.0 21.4 C	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \text{ x} \text{ x f}_p)$ S $D = v_p / S$ Required Number of Lanes		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3		f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

	BASIC FR	EEWAY SE	GMENTS WORKSHEE	T	
				· <del>-</del>	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott N 6/2/2015 PM No Build		Highway/Direction of Trave From/To Jurisdiction Analysis Year	el SB @ SR 303 2035	
Project Description I-71 /	SR 82 IMS				
✓ Oper.(LOS)			es.(N)	Plannii	ng Data
Flow Inputs					
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D DDHV = AADT x K x D	2440	veh/h veh/day veh/h	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain: Grade % Length	0.94 4 0 Level mi	
			Up/Down %		
Calculate Flow Adjus	tments				
fp	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	)] 0.980	
Speed Inputs			Calc Speed Adj and	FFS	
Lane Width		ft			
Rt-Side Lat. Clearance		ft	$f_{LW}$		mph
Number of Lanes, N	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph		00.0	трп
LOS and Performanc	e Measures	3	Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x I  x f <sub>p</sub> )  S D = v <sub>p</sub> / S	65.0 13.6	pc/h/ln mph pc/mi/ln	$\frac{\text{Design (N)}}{\text{Design LOS}}$ $v_p = (V \text{ or DDHV}) / (PHF \text{ x})$ $x f_p)$ $S$ $D = v_p / S$	N x f <sub>HV</sub>	pc/h/ln mph pc/mi/ln
LOS	В		Required Number of Lanes	s, N	
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13 f <sub>L</sub>	<sub>.W</sub> - Exhibit 11-8 <sub>.C</sub> - Exhibit 11-9 'RD - Page 11-11

# **Freeway Segment**

### **2035 Build Condition**

**AM** 

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	Т	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/2/2015 AM Build ALT		Highway/Direction of Trave From/To Jurisdiction Analysis Year	I SB @ SR 82 2035	WB
	SR 82 IMS	7 0 2	7 thatyold 1 dai	2000	
✓ Oper.(LOS)	<u> </u>		Pes.(N)	Plann	ing Data
Flow Inputs			( )		<b>J</b>
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	2030	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 3 0 Level	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi	
Calculate Flow Adjus	tments		·		
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = \frac{1}{[1 + P_T(E_T - 1) + P_R(E_R - 1)]}$	1.2 )1 <i>0.985</i>	
Speed Inputs			Calc Speed Adj and F		
Lane Width		ft	Caro opoda / taj aria :		
Rt-Side Lat. Clearance	•	ft	f <sub>LW</sub>		mph
Number of Lanes, N	3		$f_{LC}$		mph
Total Ramp Density, TRD	05.0	ramps/mi	TRD Adjustment		mph
FFS (measured) Base free-flow Speed, BFFS	65.0	mph mph	FFS	65.0	mph
LOS and Performanc	e Measures		Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x I x f <sub>p</sub> ) S	N x f <sub>HV</sub> 731 65.0 11.2	pc/h/ln mph	$\frac{\text{Design (N)}}{\text{Design LOS}}$ $v_p = (V \text{ or DDHV}) / (PHF \text{ x})$ $x f_p)$ $S$	N x f <sub>HV</sub>	pc/h/ln mph
D = v <sub>p</sub> / S LOS	В	pc/mi/ln	D = v <sub>p</sub> / S Required Number of Lanes	s, N	pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Bas		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13	f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

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	BASIC FRE	EWAY SE	GMENTS WORKSHEE	T	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott M 6/4/2015 AM Build ALT		Highway/Direction of Trave From/To Jurisdiction Analysis Year	SB @ SR 82 2035	EB
	SR 82 IMS		. ,		
✓ Oper.(LOS)			es.(N)	Planni	ing Data
Flow Inputs					
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D DDHV = AADT x K x D	1660	veh/h veh/day veh/h	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain: Grade % Length	0.94 4 0 Level mi	
			Up/Down %		
Calculate Flow Adjus	tments				
f <sub>p</sub> E <sub>T</sub>	1.00 1.5		$E_R$ $f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	1.2 )] 0.980	
Speed Inputs			Calc Speed Adj and I		
Lane Width		ft			
Rt-Side Lat. Clearance Number of Lanes, N	3	ft	f <sub>LW</sub>		mph mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured) Base free-flow Speed, BFFS	65.0	mph mph	FFS	65.0	mph
LOS and Performanc	e Measures		Design (N)		
Operational (LOS) $v_p = (V \text{ or DDHV}) / (PHF \times I)$ $x f_p)$ $S$ $D = v_p / S$ $LOS$	N x f <sub>HV</sub> 600 65.0 9.2 A	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \text{ x} \text{ x f}_p)$ S $D = v_p / S$ Required Number of Lanes		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13 f	f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

# **Freeway Segment**

**2035 Build Condition** 

**PM** 

	BASIC FRE	EWAY SE	GMENTS WORKSHEE	Т	
General Information			Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	SJT Hatch Mott Ma 6/2/2015 PM Build ALT		Highway/Direction of Trave From/To Jurisdiction Analysis Year	I SB @ SR 82 2035	WB
•	SR 82 IMS	7 0.2	7 thatyolo 1 cai	2000	
✓ Oper.(LOS)			es.(N)	Plann	ing Data
Flow Inputs					3
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	4750	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 3 0 Level	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi	
Calculate Flow Adjus	tments		Op. Dom. 70		
f <sub>p</sub>	1.00		E <sub>R</sub>	1.2	
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	)] 0.985	
Speed Inputs			Calc Speed Adj and F		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	$f_{LW}$		mph
Number of Lanes, N	3		f <sub>LC</sub>		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	65.0	mph	FFS	65.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance	e Measures		Design (N)		
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x N x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	N x f <sub>HV</sub> 1710 63.6 26.9 D	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \text{ x})$ $x f_p$ S $D = v_p / S$ Required Number of Lanes		pc/h/ln mph pc/mi/ln
Glossary			Factor Location		
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design l		ty	E <sub>R</sub> - Exhibits 11-10, 11-12 E <sub>T</sub> - Exhibits 11-10, 11-11, f <sub>p</sub> - Page 11-18 LOS, S, FFS, v <sub>p</sub> - Exhibits 11-3	11-13 f	f <sub>LW</sub> - Exhibit 11-8 f <sub>LC</sub> - Exhibit 11-9 TRD - Page 11-11

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	BASIC FRI	EWAY SE	GMENTS WORKSHEE	Т		
General Information			Site Information			
Analyst Agency or Company Date Performed Analysis Time Period	6/4/2015		Highway/Direction of Trave From/To Jurisdiction Analysis Year	el SB @ SR 82 EB 2035		
	SR 82 IMS	•	7 maryolo 1 dai			
✓ Oper.(LOS)			Pes.(N)	Planni	ing Data	
Flow Inputs			( )		<u> </u>	
Volume, V AADT Peak-Hr Prop. of AADT, K Peak-Hr Direction Prop, D	3910	veh/h veh/day	Peak-Hour Factor, PHF %Trucks and Buses, P <sub>T</sub> %RVs, P <sub>R</sub> General Terrain:	0.94 4 0 Level		
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi		
Coloulata Flour Adius	tmonto		Ор/Домп /6			
Calculate Flow Adjus						
f <sub>p</sub>	1.00		E <sub>R</sub>	1.2		
E <sub>T</sub>	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	)] 0.980		
Speed Inputs			Calc Speed Adj and I	FFS		
Lane Width		ft				
Rt-Side Lat. Clearance		ft	$f_{LW}$		mph	
Number of Lanes, N	3		f <sub>LC</sub>		mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph	
FFS (measured)	65.0	mph	FFS	65.0	mph	
Base free-flow Speed, BFFS		mph		00.0	тірп	
LOS and Performanc	e Measures		Design (N)			
Operational (LOS)  v <sub>p</sub> = (V or DDHV) / (PHF x I x f <sub>p</sub> ) S D = v <sub>p</sub> / S LOS	N x f <sub>HV</sub> 1414 65.0 21.8 C	pc/h/ln mph pc/mi/ln	Design (N) Design LOS $v_p = (V \text{ or DDHV}) / (PHF \text{ x} \text{ x } f_p)$ S $D = v_p / S$ Required Number of Lanes		pc/h/ln mph pc/mi/ln	
Glossary			Factor Location			
N - Number of lanes V - Hourly volume v <sub>p</sub> - Flow rate LOS - Level of service speed DDHV - Directional design	BFFS - Ba		$E_R$ - Exhibits 11-10, 11-12 $E_T$ - Exhibits 11-10, 11-11, $f_p$ - Page 11-18 LOS, S, FFS, $v_p$ - Exhibits 11-3	11-13 f	<sub>LW</sub> - Exhibit 11-8 <sub>LC</sub> - Exhibit 11-9 FRD - Page 11-11	

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### Freeway Merges / Diverges

### **2035 No Build Condition**

**AM** 

	RAI	MPS AND	RAMP JUN	CTIONS W	ORKSHE	ET			
General Infor				Site Infor					
Analyst	SJT		Fr	eeway/Dir of Tr	avel I-7	71 SB			
Agency or Company	Hatcl	h Mott MacDon	ald Ju	inction	I-8	30			
Date Performed	6/04/	2015	Ju	risdiction					
Analysis Time Period	AM		Ar	nalysis Year	20	)35			
Project Description	I-71 / SR 82 IN	/IS							
Inputs								_	
Upstream Adj Ramp		Freeway Num	ber of Lanes, N	3				Downstream Adj	
		Ramp Numbe	r of Lanes, N	1				Ramp	
☐ Yes ☐ On		Acceleration L	ane Length, L	680				☐Yes ☐On	
		1	ane Length L						
No ☐ Off Preeway Volume, V <sub>F</sub>								☑ No ☐ Off	
- <sub>-un</sub> = ft		1		2220				L <sub>down</sub> = ft	
<sub>-up</sub> = ft		Ramp Volume	13	490				down	
√ <sub>u</sub> = veh/h		1	-Flow Speed, S <sub>FF</sub>	65.0				$V_D = veh/h$	
u romm		Ramp Free-Fl	ow Speed, S <sub>FR</sub>	40.0					
Conversion to	pc/h Und	der Base (	Conditions						
(pc/h)	\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	PHF	Terrain	%Truck	%Rv	$f_HV$	f <sub>p</sub>	$V = V/PHF \times f_{HV} \times f_{p}$	
, ,	(Veh/hr)	0.04	Laval				<u> </u>	<u> </u>	
Freeway	2220	0.94	Level	3	0	0.985	1.00	2397	
Ramp UpStream	490	0.94	Level	6	0	0.971	1.00	537	
DownStream							+		
Jownoudani		Merge Areas					Diverge Areas		
Estimation of		and go and and			Estimation of v <sub>12</sub>				
		/ D \				12			
	$V_{12} = V_{F}$				$V_{12} = V_R + (V_F - V_R)P_{FD}$				
- <sub>EQ</sub> =		ation 13-6 or			L <sub>EQ</sub> = (Equation 13-12 or 13-13)				
P <sub>FM</sub> =	0.597	using Equat	ion (Exhibit 13-6)		P <sub>FD</sub> = using Equation (Exhibit 13-7)				
/ <sub>12</sub> =	1430	pc/h			V <sub>12</sub> = pc/h				
/ <sub>3</sub> or V <sub>av34</sub>	967 p	c/h (Equatio	n 13-14 or 13-		V <sub>3</sub> or V <sub>av34</sub> pc/h (Equation 13-14 or 13-17)				
	17)					> 2 700 na/b2		•	
Is $V_3$ or $V_{av34} > 2,70$					Is $V_3$ or $V_{av34} > 2,700$ pc/h? $\square$ Yes $\square$ No Is $V_3$ or $V_{av34} > 1.5 * V_{12}/2$ $\square$ Yes $\square$ No				
Is $V_3$ or $V_{av34} > 1.5$ *	V <sub>12</sub> /2	s 🗌 No			Is $v_3$ or $v_{av34}$	> 1.5 ° V <sub>12</sub> /2			
f Yes,V <sub>12a</sub> =			on 13-16, 13-		If Yes,V <sub>12a</sub> =		pc/h (Equatio 13-19)	on 13-16, 13-18, or	
		13-19)					10-19)		
Capacity Che	it.			T	Capacity				
	Actual	C	apacity	LOS F?		Actua		apacity LOS F?	
					$V_{F}$		Exhibit 13	-8	
$V_{FO}$	2934	Exhibit 13-8		No	$V_{FO} = V_{F}$ -	$V_R$	Exhibit 13	-8	
FO					V <sub>R</sub>		Exhibit 13	3-	
							10		
	u Maraa In			· · · · · · · · · · · · · · · · · · ·	Flow Ente		erge Influe		
Flow Entering			Desirable	Violation?		Actual	Max Des	sirable Violation?	
	Actual	1							
Flow Entering V <sub>R12</sub>		Max Exhibit 13-8	4600:All	No	V <sub>12</sub>		Exhibit 13-8		
	Actual 1967	Exhibit 13-8	4600:All			Service D		on (if not F)	
V <sub>R12</sub> Level of Serv	Actual 1967	Exhibit 13-8	4600:All <b>if not F)</b>		Level of S				
V <sub>R12</sub> <b>Level of Serv</b> D <sub>R</sub> = 5.475 +	Actual 1967 ice Detern 0.00734 v <sub>R</sub> + 0	Exhibit 13-8	4600:All <b>if not F)</b>		Level of S		eterminatio		
V <sub>R12</sub> <b>Level of Serv</b> D <sub>R</sub> = 5.475 +  D <sub>R</sub> = 16.3 (pc/m	Actual 1967 <b>ice Detern</b> 0.00734 v <sub>R</sub> + ( i/ln)	Exhibit 13-8	4600:All <b>if not F)</b>		Level of S D <sub>F</sub> D <sub>R</sub> = (pc/	<sub>R</sub> = 4.252 + ( /mi/ln)	eterminatio		
$V_{R12}$ Level of Serv. $D_R = 5.475 + 0$ $D_R = 16.3 \text{ (pc/m}$ $D_R = 16.3 \text{ (pc/m}$	Actual 1967 ice Detern 0.00734 v <sub>R</sub> + ( i/ln) 13-2)	Exhibit 13-8	4600:All <b>if not F)</b>		Level of $S$ $D_{R} = (pc)$ $LOS = (Ex)$	<sub>R</sub> = 4.252 + ( /mi/ln) hibit 13-2)	<b>eterminatio</b> 0.0086 V <sub>12</sub> - 0		
$V_{R12}$ Level of Serv $D_R = 5.475 + 0$ $D_R = 16.3 \text{ (pc/m}$ $D_R = 16.3 \text{ (pc/m}$ $D_R = 16.3 \text{ (pc/m}$	Actual 1967 ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2)	Exhibit 13-8	4600:All <b>if not F)</b>		Level of S	<sub>R</sub> = 4.252 + 1 /mi/ln) hibit 13-2) e <b>terminati</b>	<b>eterminatio</b> 0.0086 V <sub>12</sub> - 0		
$V_{R12}$ Level of Serv. $D_R = 5.475 + 0.08 = B$ (Exhibit Speed Determine) $M_S = 0.294$ (Exil	Actual 1967  ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2) inination  bit 13-11)	Exhibit 13-8	4600:All <b>if not F)</b>		$\begin{array}{ccc} \textbf{Level of S} \\ & \textbf{D}_{\text{I}} \\ \textbf{D}_{\text{R}} = & (\text{pc.} \\ \textbf{LOS} = & (\text{Ex} \\ \textbf{Speed De} \\ \textbf{D}_{\text{S}} = & (\text{Ext.} \\ \end{array}$	R = 4.252 + (mi/ln) hibit 13-2) eterminati hibit 13-12)	<b>eterminatio</b> 0.0086 V <sub>12</sub> - 0		
Level of Serv $D_R = 5.475 +$ $D_R = 16.3 \text{ (pc/m}$ $D_R = 16.3 \text{ (pc/m)}$ $D_R = $	Actual 1967 ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2)	Exhibit 13-8	4600:All <b>if not F)</b>		$\begin{array}{ccc} \textbf{Level of S} \\ & & \textbf{D}_{\text{I}} \\ \textbf{D}_{\text{R}} = & (\text{pc.} \\ \textbf{LOS} = & (\text{Ex} \\ \textbf{Speed De} \\ \textbf{D}_{\text{S}} = & (\text{Ext} \\ \textbf{S}_{\text{R}} = & \text{mph} \end{array}$	= 4.252 + (mi/ln) hibit 13-2) eterminati hibit 13-12) (Exhibit 13-12	eterminatio 0.0086 V <sub>12</sub> - 0		
$V_{R12}$ Level of Server $D_R = 5.475 + D_R = 16.3 \text{ (pc/m}$ LOS = B (Exhibit Speed Detern $M_S = 0.294 \text{ (Exilos B)}$ $M_S = 58.2 \text{ mph}$	Actual 1967  ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2) inination  bit 13-11)	Exhibit 13-8	4600:All <b>if not F)</b>		$\begin{array}{ccc} \textbf{Level of S} \\ & & \textbf{D}_{\text{I}} \\ \textbf{D}_{\text{R}} = & (\text{pc.} \\ \textbf{LOS} = & (\text{Ex} \\ \textbf{Speed De} \\ \textbf{D}_{\text{S}} = & (\text{Ext} \\ \textbf{S}_{\text{R}} = & \text{mph} \end{array}$	R = 4.252 + (mi/ln) hibit 13-2) eterminati hibit 13-12)	eterminatio 0.0086 V <sub>12</sub> - 0		
$V_{R12}$ Level of Server $D_R = 5.475 + 0.000$ $D_R = 16.3 \text{ (pc/m}$ $D_$	Actual 1967 ice Detern 0.00734 v <sub>R</sub> + ( i/ln) 13-2) inination bit 13-11) Exhibit 13-11)	Exhibit 13-8	4600:All <b>if not F)</b>		$\begin{array}{ccc} \textbf{Level of S} \\ & & \text{D}_{\text{I}} \\ \text{D}_{\text{R}} = & (\text{pc}_{\text{I}} \\ \text{LOS} = & (\text{Ex} \\ \textbf{Speed De} \\ \text{D}_{\text{S}} = & (\text{Ext} \\ \text{S}_{\text{R}} = & \text{mph} \\ \text{S}_{\text{0}} = & \text{mph} \end{array}$	= 4.252 + (mi/ln) hibit 13-2) eterminati hibit 13-12) (Exhibit 13-12	eterminatio 0.0086 V <sub>12</sub> - 0 ion		

		RAMP	S AND RAM	IP JUNCTI	ONS WC	RKS	HEET				
General Info	rmation			Site Infor							
Analyst	SJT		Fı	reeway/Dir of Tr	avel	I-71 SE	3				
Agency or Company	/ Hatch	n Mott MacDon		unction		SR 82					
Date Performed	6/4/20	015	Ju	urisdiction							
Analysis Time Perio	d AM N	lo Build	Ai	nalysis Year		2035					
Project Description	I-71 / SR 82 IM	IS									
Inputs											
Upstream Adj F	Ramp	Freeway Num Ramp Numbe	ber of Lanes, N	3 1					Downstrea Ramp	m Adj	
□Yes	On						✓Yes	On			
☑ No [	Off	Deceleration I Freeway Volu	Lane Length L <sub>D</sub>	450 2710					□No	✓ Off	
L <sub>up</sub> =	ft	Ramp Volume		960					L <sub>down</sub> =	1500 ft	
V <sub>11</sub> = V	reh/h		-Flow Speed, S <sub>FF</sub>	65.0					V <sub>D</sub> =	370 veh/h	
			low Speed, S <sub>FR</sub>	50.0							
Conversion t	<del>, .</del>	der Base	Conditions	r	1						
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv		$f_HV$	f <sub>p</sub>	v = V/PHF	x f <sub>HV</sub> x f <sub>p</sub>	
Freeway	2710	0.94	Level	3	0	0.	985	1.00	292	26	
Ramp	960	0.94	Level	2	0	0.	990	1.00	103	31	
UpStream											
DownStream	370	0.94	Level	3	0	0.	985	1.00 400			
=		Merge Areas			Diverge Areas						
Estimation o	t v <sub>12</sub>				Estimation of v <sub>12</sub>						
	$V_{12} = V_{F}$	(P <sub>FM</sub> )			$V_{12} = V_R + (V_F - V_R)P_{FD}$						
L <sub>EQ</sub> =	(Equa	tion 13-6 or	13-7)		L <sub>EQ</sub> = 592.06 (Equation 13-12 or 13-13)						
P <sub>FM</sub> =	using	Equation (	Exhibit 13-6)		P <sub>FD</sub> = 0.639 using Equation (Exhibit 13-7)						
V <sub>12</sub> =	pc/h		,		V <sub>12</sub> =			43 pc/h	(	,	
V <sub>3</sub> or V <sub>av34</sub>	•	Faustion 13	-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub> 683 pc/h (Equation 13-14 or 13-17)						
Is V <sub>3</sub> or V <sub>av34</sub> > 2,70			14 01 10 17)			> 27		3 pc/ii (∟qua ] Yes	11011 13-14	01 13-17)	
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5			16 12 19 or					☐Yes ☑ No c/h (Equation	12 16 12	10 or 12	
If Yes,V <sub>12a</sub> =	13-19)	Equation 13	-16, 13-18, or		If Yes,V <sub>12a</sub> :	=	р 19		13-10, 13-	18, 01 13-	
Capacity Che					Capacit	tv Ch		· /			
	Actual		apacity	LOS F?	Actual			Ca	pacity	LOS F?	
			y		V <sub>F</sub>		2926	Exhibit 13-8	1	No	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{F}$		1895	Exhibit 13-8	+	No	
					$V_R$		1031	Exhibit 13-1	0 2100	No	
Flow Enterin	a Merae In	fluence A	rea		Flow Entering Diverge Influence Area						
- 1011	Actual	i	Desirable	Violation?			Actual	Max Desirab		Violation?	
V <sub>R12</sub>	i	Exhibit 13-8			V <sub>12</sub>		2243	Exhibit 13-8	4400:All	No	
Level of Serv	vice Detern		if not F)		Level of Service Determination (if not F)						
$D_R = 5.475 + 0$								0086 V <sub>12</sub> - 0.	_	/	
1		0.0070 V <sub>12</sub>	0.00021 LA					0000 v <sub>12</sub> - 0.	ooa rD		
$D_R = (pc/mi/lr$						9.5 (pc					
LOS = (Exhibit						•	oit 13-2)				
Speed Deteri	mination				Speed I	Deter	minatio	n			
M <sub>S</sub> = (Exibit 1	3-11)				$D_s = 0$	.326 (E	xhibit 13-	12)			
	nibit 13-11)					7.5 mph	(Exhibit	13-12)			
	nibit 13-11)				1	-	(Exhibit				
S = mph (Exi	nibit 13-11)				1	-	•				
p.i (= XI	S = 60.2 mph (Exhibit 13-13)										

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		RAMP	S AND RAM	IP JUNCTI	ONS WO	RKSH	IEET			
General Infor	mation			Site Infor						
Analyst	SJT		Fi	reeway/Dir of Tr	avel I	I-71 SB				
Agency or Company	Hatch	n Mott MacDon	ald Ju	unction	5	SR 82 EB				
Date Performed	6/4/2	015	Jı	urisdiction						
Analysis Time Period		lo Build	A	nalysis Year	2	2035				
Project Description	I-71 / SR 82 IN	1S								
Inputs		<u> </u>		3				ſ		
Upstream Adj R	Upstream Adj Ramp  Freeway Number of Lanes, N  Ramp Number of Lanes, N								Downstreai Ramp	m Adj
✓ Yes □	On		ane Length, L <sub>A</sub>	1					Yes	On
□No	<b>✓</b> Off	ane Length L <sub>D</sub>	350					✓ No	Off	
L <sub>up</sub> = 15	500 ft	Freeway Volu Ramp Volume		1750 370					L <sub>down</sub> =	ft
ир			-Flow Speed, S <sub>FF</sub>							
V <sub>u</sub> = 96	0 veh/h	1	ow Speed, S <sub>FR</sub>	50.0				ľ	$V_D =$	veh/h
0	//- 11		111	50.0						
Conversion t	o pc/n Und I ∨	ger Base	Conditions	1		_				
(pc/h)	v (Veh/hr)	PHF	Terrain	%Truck	%Rv		ΗV	r	$v = V/PHF \times f_{HV} \times$	
Freeway	1750	0.94	Level	3	0	0.98	35	1.00	189	0
Ramp	370	0.94	Level	3	0	0.98	35	1.00	400	0
UpStream	960	0.94	Level	2	0	0.99	90	1.00	103	1
DownStream	<u> </u>	<u>.                                    </u>								
Fatimation of		Merge Areas			Diverge Areas					
Estimation of					Estimation of v <sub>12</sub>					
	$V_{12} = V_{F}$	(P <sub>FM</sub> )			$V_{12} = V_R + (V_F - V_R)P_{FD}$					
L <sub>EQ</sub> =	(Equa	ition 13-6 or	13-7)		L <sub>EQ</sub> = (Equation 13-12 or 13-13)					
P <sub>FM</sub> =	using	Equation (E	Exhibit 13-6)		P <sub>FD</sub> = 0.694 using Equation (Exhibit 13-7)					
V <sub>12</sub> =	pc/h				V <sub>12</sub> =		143	5 pc/h		
V <sub>3</sub> or V <sub>av34</sub>	pc/h (	Equation 13	-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub>		455	pc/h (Equat	ion 13-14 d	or 13-17)
Is V <sub>3</sub> or V <sub>av34</sub> > 2,70			ŕ			, > 2,700		Yes ☑ No		,
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5								Yes ☑ No		
			-16, 13-18, or					/h (Equation	13-16, 13-	18, or 13-
If Yes,V <sub>12a</sub> =	13-19)	'			If Yes,V <sub>12a</sub> =		19		,	,
Capacity Che	ecks				Capacity Checks					
	Actual	C	apacity	LOS F?		Actual		Car	pacity	LOS F?
					$V_{F}$		1890	Exhibit 13-8	7050	No
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{F}$	- V <sub>R</sub>	1490	Exhibit 13-8	7050	No
					$V_R$		400	Exhibit 13-10	2100	No
Flow Entering	a Merae In	fluence A	rea		Flow Entering Diverge Influence Area					
	Actual	1	Desirable	Violation?	1211		ctual	Max Desirab		Violation?
V <sub>R12</sub>		Exhibit 13-8			V <sub>12</sub>	14	35	Exhibit 13-8	4400:All	No
Level of Serv	ice Detern		if not F)	<u></u>		Servi	ce Det	ermination		
$D_R = 5.475 + 0.$								086 V <sub>12</sub> - 0.0		,
D <sub>R</sub> = (pc/mi/ln		12	A			.4 (pc/n		12	ט=	
LOS = (Exhibit						.4 (pc/ii (Exhibi				
Speed Deterr	· · · · · · · · · · · · · · · · · · ·				Speed D	•		<u> </u>		
•					<del> </del>		hibit 13-1			
M <sub>S</sub> = (Exibit 1	•					•	Exhibit 1	•		
	nibit 13-11)							-		
	nibit 13-11)				ľ		Exhibit 1	•		
S = mph (Exh	S = 61.4 mph (Exhibit 13-13)									

	MPS AND	RAMP JUNG	CTIONS W	ORKSHE	ET				
mation	III O AITD		Site Infor						
SJB			eeway/Dir of Tr		71 SB				
	h Mott MacDona		•						
				20	)35				
			,						
	Freeway Numb	er of Lanes. N	3				D	A al:	
Opsileani Auj Kanip								am Adj	
	1		•				ιταπρ		
		,,	750				□Yes	On	
	Deceleration La	ane Length L <sub>D</sub>					V No	Off	
	Freeway Volun	ne, V <sub>F</sub>	1380						
ft	Ramp Volume,	$V_R$	380				L <sub>down</sub> =	ft	
	1		65.0				<b>\</b> ,		
:h/h	1						V <sub>D</sub> =	veh/h	
		111							
				T					
(Veh/hr)	PHF	Terrain	%Truck	%Rv	$f_{HV}$	f <sub>p</sub>	$V = V/PHF \times f_{HV} \times f_{HV}$		
1380	0.94	Level	4	0	0.980	1.00	1	1497	
380	0.94	Level	4	0	0.980	1.00	<del>                                     </del>	412	
	<del>                                     </del>		3	0				400	
0.0	1 0.01	20101		Ť	0.000	1.00		100	
	Merge Areas					Diverge Areas			
				Estimatio					
	( D )								
.= .					V <sub>12</sub> =	$V_R + (V_F - V_F)$	$_{R})P_{FD}$		
		•		L <sub>EQ</sub> = (Equation 13-12 or 13-13)					
0.599	using Equation	on (Exhibit 13-6)							
896 p	c/h								
601 p	c/h (Equation	13-14 or 13-							
17)									
) pc/h?	s 🗹 No								
V <sub>12</sub> /2	s 🗌 No			Is V <sub>3</sub> or V <sub>av34</sub>					
896 p	c/h (Equation	13-16, 13-18,		f Yes,V <sub>12a</sub> = pc/h (Equation 13-16, 13-18, or					
	19) ` .					3-19)			
cks				Capacity	Checks				
Actual	Ca	apacity	LOS F?		Actual	Ca	pacity	LOS F?	
				V <sub>F</sub>		Exhibit 13-	-8		
1	1			_	.,	Exhibit 13-	-8		
1000	Evhibit 12 0		l Na	$V_{\Gamma} = V_{\Gamma} - V_{\Gamma}$	V <sub>D</sub>	EXHIDIT 19.			
1909	Exhibit 13-8		No	$V_{FO} = V_F - V_F$	v <sub>R</sub>			+	
1909	Exhibit 13-8		No	$V_{FO} = V_{F} - V_{R}$	v <sub>R</sub>	Exhibit 13			
		rea	No	$V_R$		Exhibit 13 10	3-		
	fluence A	<b>rea</b> Desirable	No Violation?	$V_R$		Exhibit 13	nce Area	Violation?	
ı Merge In	fluence A			V <sub>R</sub>	ering Dive	Exhibit 13 10 rge Influei	nce Area		
Merge In Actual 1308	Max D Exhibit 13-8	esirable 4600:All	Violation?	V <sub>R</sub> Flow Ente	ering Dive Actual	Exhibit 13 10 rge Influer Max Des Exhibit 13-8	nce Area	Violation?	
Merge In Actual 1308 fice Determ	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	Flow Ente	Actual	Exhibit 13 10 rge Influer Max Des Exhibit 13-8	nce Area sirable on (if not	Violation?	
Actual 1308 Fice Determ 0.00734 v R + C	Max D Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter V <sub>12</sub> Level of S	Actual  Service De Report 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	Exhibit 13 10 rge Influer Max Des Exhibit 13-8	nce Area sirable on (if not	Violation?	
Actual 1308 Fice Detern 0.00734 v R + 0	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc/	Actual  Service De R = 4.252 + 0  /mi/ln)	Exhibit 13 10 rge Influer Max Des Exhibit 13-8	nce Area sirable on (if not	Violation?	
Actual 1308 16ce Detern 0.00734 v R + 0 1/1n) 13-2)	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc/	Actual  Service De Report 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	Exhibit 13 10 rge Influer Max Des Exhibit 13-8	nce Area sirable on (if not	Violation?	
Actual 1308 Fice Detern 0.00734 v R + 0	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> D <sub>R</sub> = (pc/LOS = (Ex	Actual  Service De R = 4.252 + 0  /mi/ln)	Exhibit 13 10  rge Influer  Max Des  Exhibit 13-8  etermination  .0086 V <sub>12</sub> - 0	nce Area sirable on (if not	Violation?	
Actual 1308 Fice Detern 0.00734 v R + 0 (//In) 13-2)	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc/LOS = (Ex	Actual  Service De  Remove Actual  Service De  Remove Actual	Exhibit 13 10  rge Influer  Max Des  Exhibit 13-8  etermination  .0086 V <sub>12</sub> - 0	nce Area sirable on (if not	Violation?	
Actual 1308 ice Determ 0.00734 v R + 0 i/ln) 13-2) inination	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc/LOS = (Ex)  Speed De  D <sub>s</sub> = (Exh	Actual  Service De R = 4.252 + 0 /mi/ln) hibit 13-2) stermination iibit 13-12)	Exhibit 13 10  rge Influer  Max Des  Exhibit 13-8  eterminatio  0.0086 V <sub>12</sub> - 0	nce Area sirable on (if not	Violation?	
Actual 1308 16ce Detern 0.00734 v R + 0 13-2) 11nation 13-11 Exhibit 13-11)	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	V <sub>R</sub> Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc/LOS = (Extored De De CExtored De CEXTOR	Actual  Service De (mi/ln) hibit 13-2)  Sterminatio (Exhibit 13-12)	Exhibit 13 10  rge Influer  Max Des  Exhibit 13-8  termination .0086 V <sub>12</sub> - 0	nce Area sirable on (if not	Violation?	
Actual 1308 ice Determ 0.00734 v R + 0 i/ln) 13-2) inination	Max E Exhibit 13-8	9esirable 4600:All f <b>not F)</b>	Violation?	$\begin{array}{c c} & V_R \\ \hline Flow \ Ente \\ \hline V_{12} \\ \hline Level \ of \ S \\ \hline D_R = & (pc/LOS = (Exh Speed \ De S_R = mph S_R = mph S_R = mph \end{array}$	Actual  Service De R = 4.252 + 0 /mi/ln) hibit 13-2) stermination iibit 13-12)	Exhibit 13 10  rge Influer  Max Des  Exhibit 13-8  etermination  0.0086 V <sub>12</sub> - 0	nce Area sirable on (if not	Violation?	
	4/10/ AM N I-71 / SR 82 IN It sh/h  D pc/h Und V (Veh/hr)  1380  380  370  V12  V12 = V <sub>F</sub> 954.53  0.599  896 p. 601 p. 17) D pc/h?  Yes 896 p. or 13-	A/10/2013 AM No Build  I-71 / SR 82 IMS  Freeway Number Acceleration Labeled Freeway Volume, Freeway Free-Ramp Free-Floor Dech Under Base Control (Veh/hr)  1380 0.94 380 0.94 380 0.94 370 0.94  Merge Areas  V12  V12 = VF (PFM) 954.53 (Equation 1 0.599 using Equation 1 0.599	A/10/2013 AM No Build  An  I-71 / SR 82 IMS  Freeway Number of Lanes, N Ramp Number of Lanes, N Acceleration Lane Length, L Deceleration Lane Length L Freeway Volume, V Ramp Volume, V Ramp Free-Flow Speed, S Ramp Free-Flow	### Armon Build ### Analysis Year    Freeway Number of Lanes, N   3	A/10/2013	A/10/2013	## African State   African St	### Althoropools	

		RAMP	S AND RAN	/IP JUNCTI	ONS WO	RKS	HEET				
General Info	rmation			Site Infor							
Analyst	SJT		F	reeway/Dir of Tr		I-71 SE	3				
Agency or Company		h Mott MacDon		lunction		SR 303					
Date Performed	6/5/2	015	J	urisdiction							
Analysis Time Perio	d AM N	lo Build	A	Analysis Year		2035					
Project Description	I-71 / SR 82 IM	1S									
Inputs											
Upstream Adj F	Ramp	Freeway Num Ramp Numbe	ber of Lanes, N	3					Downstrea Ramp	m Adj	
□Yes	On	l '	ane Length, L <sub>A</sub>	,					Yes	On	
☑ No [	Off	Deceleration L Freeway Volui	ane Length L <sub>D</sub>	350 1760					<b>☑</b> No	Off	
L <sub>up</sub> =	ft	Ramp Volume	•	640				L	- <sub>down</sub> =	ft	
.,		Freeway Free	-Flow Speed, S <sub>FF</sub>	65.0				l,	/ -	veh/h	
V <sub>u</sub> = \	/eh/h		ow Speed, S <sub>FR</sub>	50.0					/ <sub>D</sub> =	ven/n	
Conversion	to pc/h Und	der Base (	Conditions								
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub> v	/ = V/PHF :	x f <sub>HV</sub> x f <sub>p</sub>	
Freeway	1760	0.94	Level	4	0	0.	980	1.00	191	0	
Ramp	640	0.94	Level	4	0	0.	980	1.00	694	4	
UpStream											
DownStream											
<b>-</b>		Merge Areas						erge Areas			
Estimation o	t v <sub>12</sub>				Estimat	ion o	t v <sub>12</sub>				
	$V_{12} = V_{F}$	(P <sub>FM</sub> )			$V_{12} = V_R + (V_F - V_R)P_{FD}$						
L <sub>EQ</sub> =	(Equa	ition 13-6 or	13-7)		L <sub>EQ</sub> =		(Ed	quation 13-12	2 or 13-13)		
P <sub>FM</sub> =	using	Equation (E	Exhibit 13-6)		P <sub>FD</sub> = 0.680 using Equation (Exhibit 13-7)						
V <sub>12</sub> =	pc/h	. ,	,		V <sub>12</sub> =			1 pc/h		,	
V <sub>3</sub> or V <sub>av34</sub>	•	Fauation 13	-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub> 389 pc/h (Equation 13-14 or 13-17)						
Is V <sub>3</sub> or V <sub>av34</sub> > 2,7		-	14 01 10 17)		Is $V_3$ or $V_{av34} > 2,700$ pc/h? $\square$ Yes $\square$ No						
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5			-16, 13-18, or		1			Yes ☑ No 'h (Equation '	13-16 13-1	18 or 13-	
If Yes,V <sub>12a</sub> =	13-19)		10, 10 10, 01		If Yes,V <sub>12a</sub> =		19)	··· (Equation	10 10, 10	10, 01 10	
Capacity Che	ecks				Capacity Checks						
	Actual	C	apacity	LOS F?			Actual	Сар	acity	LOS F?	
					V <sub>F</sub>		1910	Exhibit 13-8	7050	No	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{F}$	- V <sub>D</sub>	1216	Exhibit 13-8	7050	No	
PO					V <sub>R</sub>		694	Exhibit 13-10		No	
Elow Entorin	a Maraa In	fluonoo A	<b>***</b>			torin				110	
Flow Enterin	Actual	ir .	Desirable	Violation?	Flow Entering Diverge Influence Area  Actual Max Desirable Violation						
V <sub>R12</sub>	Actual	Exhibit 13-8	Desirable	violation:	V <sub>12</sub>			Exhibit 13-8	4400:All	No	
Level of Serv	ice Detern	<u>.                                    </u>	if not F)		+						
D <sub>R</sub> = 5.475 + 0					Level of Service Determination (if not F)  D <sub>R</sub> = 4.252 + 0.0086 V <sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> = (pc/mi/lr						$D_{R} = 14.2 \text{ (pc/mi/ln)}$					
LOS = (Exhibit					LOS = B (Exhibit 13-2)						
Speed Deter					_	•	mination	)			
M <sub>S</sub> = (Exibit 1					$D_{s} = 0.3$		xhibit 13-1				
	hibit 13-11)				S <sub>R</sub> = 58	3.2 mph	(Exhibit 13	3-12)			
	hibit 13-11)						(Exhibit 1	-			
	hibit 13-11)										
Copyright © 2013 Univ	S = 60.5 mph (Exhibit 13-13)  HCS2010 <sup>TM</sup> Version 6.50 Generated: 6/22/2015 1:41 PM										

## Freeway Merges / Diverges

**2035 No Build Condition** 

**PM** 

	RAI	MPS AND	RAMP JUNG	CTIONS W	ORKSHE	ET				
General Infor				Site Infor						
Analyst	SJT		Fr	eeway/Dir of Tra	avel I-	71 SB				
Agency or Company	Hatch	h Mott MacDon	ald Ju	nction	1-8	30				
Date Performed	6/4/2	015	Ju	risdiction						
Analysis Time Period	PM		Ar	alysis Year	20	)35				
Project Description	I-71 / SR 82 IM	/IS								
Inputs										
Upstream Adj Ramp		Freeway Num	ber of Lanes, N	3				Downstream A	di	
		Ramp Numbe	r of Lanes, N	1				Ramp	,	
☐ Yes ☐ On		Acceleration L	ane Length, L	680				Yes 🗆	٦n	
□ □.a#		1	ane Length L						JII	
☑ No ☐ Off		Freeway Volum	5	5470				☑ No □	Off	
- <sub></sub> = ft		1	•					L <sub>down</sub> = ft		
<sub>-up</sub> = ft		Ramp Volume	13	520				-down		
√ <sub>u</sub> = veh/h		1	-Flow Speed, S <sub>FF</sub>	65.0				$V_D = ver$	/h	
'u VOII/II		Ramp Free-Fl	ow Speed, S <sub>FR</sub>	40.0				b		
Conversion to	pc/h Und	der Base (	Conditions							
(pc/h)	V () ( =  - (  - = )	PHF	Terrain	%Truck	%Rv	$f_HV$	fp	v = V/PHF x f <sub>H</sub>	, x f	
" ,	(Veh/hr)	0.04	Level				<u> </u>		v p	
Freeway	5470	0.94	Level	3 6	0	0.985	1.00	5906		
Ramp UpStream	520	0.94	Level	0	0	0.971	1.00	570		
DownStream										
Downoudani		Merge Areas					Diverge Areas			
Estimation of		o.go /ouc			Estimatio	n of Vac	2.10.ge / ou c			
		(D )				12				
	$V_{12} = V_{F}$				$V_{12} = V_R + (V_F - V_R)P_{FD}$					
- <sub>EQ</sub> =		ation 13-6 or			L <sub>EQ</sub> = (Equation 13-12 or 13-13)					
P <sub>FM</sub> =	0.597	using Equat	ion (Exhibit 13-6)		P <sub>FD</sub> =		using Equat	tion (Exhibit 13-7)		
/ <sub>12</sub> =	3523	pc/h			$V_{12}$ = pc/h					
/ <sub>3</sub> or V <sub>av34</sub>	2383	pc/h (Equation	on 13-14 or 13-		V <sub>3</sub> or V <sub>av34</sub>		•	n 13-14 or 13-17)		
	17)					> 2 700 pa/b		•		
Is $V_3$ or $V_{av34} > 2,70$							?  Yes  N			
Is $V_3$ or $V_{av34} > 1.5$ *	V <sub>12</sub> /2 <b>✓</b> Ye	s 🗌 No			is v <sub>3</sub> or v <sub>av34</sub>	> 1.5 " V <sub>12</sub> /2	☐Yes ☐ N			
f Yes,V <sub>12a</sub> =			on 13-16, 13-		If Yes,V <sub>12a</sub> =		pc/n (Equat 13-19)	ion 13-16, 13-18,	or	
		13-19)				<u> </u>	10-19)			
Capacity Che	it.			T	Capacity					
	Actual		apacity	LOS F?	<del> </del>	Actu		<del> </del>	OS F?	
					V <sub>F</sub>		Exhibit 1	3-8		
$V_{FO}$	6476	Exhibit 13-8		No	$V_{FO} = V_{F}$ -	$V_R$	Exhibit 1	3-8		
<b>▼</b> E ∩		1					Exhibit 1	3_		
*FO					V_			~ I I		
					V <sub>R</sub>		10			
							verge Influe	ence Area		
Flow Entering	Actual	Max	Desirable	Violation?	Flow Ent	e <b>ring Div</b> Actual	/erge Influe	ence Area esirable Vid	lation?	
Flow Entering	Actual 4093	Max Exhibit 13-8	Desirable 4600:All	Violation?	Flow Ent	Actual	10  verge Influe  Max De  Exhibit 13-8	ence Area esirable Vid	olation?	
Flow Entering	Actual 4093	Max Exhibit 13-8	Desirable 4600:All		Flow Ent	Actual	10  verge Influe  Max De  Exhibit 13-8	ence Area esirable Vid	lation?	
Flow Entering  V <sub>R12</sub> Level of Serv	Actual 4093	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Ente	Actual Service L	10  verge Influe  Max De  Exhibit 13-8	ence Area esirable Vic	olation?	
V <sub>R12</sub> Level of Serv D <sub>R</sub> = 5.475 +	Actual 4093 ice Detern 0.00734 v <sub>R</sub> + 0	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Ente	Actual Service L	/erge Influe Max De Exhibit 13-8 Determinati	ence Area esirable Vic	olation?	
Flow Entering $V_{R12}$ Level of Serve $D_{R} = 5.475 + D_{R} = 32.9 \text{ (pc/m}$	Actual 4093 <b>ice Detern</b> 0.00734 v <sub>R</sub> + 0 i/ln)	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Ento	Actual Service L R = 4.252 + /mi/ln)	/erge Influe Max De Exhibit 13-8 Determinati	ence Area esirable Vic	plation?	
Flow Entering $V_{R12}$ Level of Serving $D_{R} = 5.475 + 0.08 = 32.9 \text{ (pc/m}.008 = 0.08 \text{ (pc/m)}$	Actual 4093 <b>ice Detern</b> 0.00734 v <sub>R</sub> + 0 i/ln) 13-2)	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		V <sub>12</sub> Level of S D <sub>R</sub> = (pc.	Actual  Service L  R = 4.252 +  /mi/ln)  hibit 13-2)	Max De Exhibit 13-8  Determination - 0.0086 V <sub>12</sub> -	ence Area esirable Vic	olation?	
Flow Entering $V_{R12}$ Level of Serve $D_R = 5.475 + D_R = 32.9 \text{ (pc/m}$ $OS = D \text{ (Exhibit)}$ Speed Determ	Actual 4093 ice Detern 0.00734 v <sub>R</sub> + ( i/ln) 13-2) nination	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Enter	Actual  Service L  R = 4.252 +  /mi/ln)  hibit 13-2)  etermina	Max De Exhibit 13-8  Determination - 0.0086 V <sub>12</sub> -	ence Area esirable Vic	olation?	
Flow Entering $V_{R12}$ Level of Servi $D_R = 5.475 + 0.000$ $D_R = 0.475 + 0.000$ $D_R = 0.475 + 0.000$ Speed Determing $D_R = 0.000$ $D_R = 0.000$ $D_R = 0.000$ $D_R = 0.000$	Actual 4093 ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2) innation bit 13-11)	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc. LOS = (Ex  Speed De  D <sub>s</sub> = (Exh	Actual  Service L  R = 4.252 +  /mi/ln)  hibit 13-2)  etermina  nibit 13-12)	Max De Exhibit 13-8  Determination  tion	ence Area esirable Vic	olation?	
Flow Entering $V_{R12}$ Level of Serving $D_R = 5.475 + 0$ $D_R = 32.9 \text{ (pc/m}$ $D_R = 0.500 \text{ (Exition of the context)}$ $D_R = 0.500 \text{ (Exition of the context)}$	Actual 4093 ice Detern 0.00734 v <sub>R</sub> + ( i/ln) 13-2) nination	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc. LOS = (Ex  Speed De  S <sub>R</sub> = mph	Actual  Service I  R = 4.252 + /mi/ln) hibit 13-2) etermina: hibit 13-12) I (Exhibit 13-13-13)	Max De Exhibit 13-8  Determination  12)	ence Area esirable Vic	plation?	
Flow Entering $V_{R12}$ Level of Serve $D_R = 5.475 + 0$ $D_R = 32.9 \text{ (pc/m}$ $D_R = 0.500 \text{ (Exiting Signature)}$	Actual 4093 ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2) innation bit 13-11)	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Enter  V <sub>12</sub> Level of S  D <sub>R</sub> = (pc. LOS = (Ex  Speed De  S <sub>R</sub> = (Ext	Actual  Service L  R = 4.252 +  /mi/ln)  hibit 13-2)  etermina  nibit 13-12)	Max De Exhibit 13-8  Determination  12)	ence Area esirable Vic	plation?	
Flow Entering $V_{R12}$ Level of Serve $D_R = 5.475 + 0$ $D_R = 32.9 \text{ (pc/m}$ $D_R = 0.500 \text{ (Exitibit)}$ Speed Detern $D_R = 0.500 \text{ (Exitibit)}$	Actual 4093 ice Detern 0.00734 v <sub>R</sub> + 0 i/ln) 13-2) inination bit 13-11) Exhibit 13-11)	Max Exhibit 13-8	Desirable 4600:All <b>if not F</b> )		Flow Enterprise Flow Enterpri	Actual  Service I  R = 4.252 + /mi/ln) hibit 13-2) etermina: hibit 13-12) I (Exhibit 13-13-13)	10	ence Area esirable Vic	plation?	

					0110 1116				_		
		RAMP	S AND RAI	MP JUNCTI		RKS	HEEI				
General Info				Site Infor		. = . 05					
Analyst	SJT	- M-# MD		Freeway/Dir of Tr	avel	I-71 SE					
Agency or Company Date Performed	y Hater 6/4/2	h Mott MacDon		Junction Jurisdiction		SR 82	WB				
Analysis Time Perio		lo Build		Analysis Year		2035					
Project Description				tilalysis i cai		2000					
Inputs	1117 011 02 111										
-		Freeway Num	ber of Lanes, N	3					<u> </u>	A 11	
Upstream Adj I	Ramp	Ramp Numbe		1					Downstrea Ramp	am Adj	
□Yes	On	i '		ı					1 '		
			ane Length, L <sub>A</sub>	450					✓ Yes	On	
✓ No	Off		ane Length L <sub>D</sub>	450					□No	✓ Off	
	<i></i>	Freeway Volu	•	5990					_	4500 <del>t</del>	
L <sub>up</sub> =	ft	Ramp Volume	e, V <sub>R</sub>	1850					L <sub>down</sub> =	1500 ft	
\ \/ = ,	V = veh/h								V <sub>D</sub> =	840 veh/h	
v <sub>u</sub> –	V <sub>u</sub> = veh/h Ramp Free-Flow Speed, S <sub>FR</sub>								J. D	010 1011/11	
Conversion	to pc/h Und	der Base	Conditions								
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	v = V/PHF	x f <sub>HV</sub> x f <sub>p</sub>	
Freeway	5990	0.94	Level	3	0	0.	985	1.00	64	168	
Ramp	1850	0.94	Level	2	0		990	1.00	<u> </u>	988	
UpStream		<del>                                     </del>									
DownStream	840	Level	3	0	0.985 1.00			9	07		
		Merge Areas		•	Diverge Areas						
Estimation o	f V <sub>12</sub>				Estimat	tion o	f v <sub>12</sub>				
	V <sub>12</sub> = V <sub>F</sub>	(P <sub>54</sub> )			<u> </u>			V <sub>R</sub> + (V <sub>F</sub> - V			
  =		tion 13-6 or	13-7)		L <sub>EQ</sub> = 4345.11 (Equation 13-12 or 13-13)						
L <sub>EQ</sub> = P <sub>FM</sub> =		Equation (			P <sub>FD</sub> = 0.555 using Equation (Exhibit 13-7)						
	pc/h	Equation (	-Allibit 10 0)		V <sub>12</sub> =			175 pc/h	uation (Exili	IDIL 10-1)	
V <sub>12</sub> =	•	C	44 40 47)					-		4 40 47)	
V <sub>3</sub> or V <sub>av34</sub>			-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub>	. 0 7		993 pc/h (Equ	lation 13-14	4 or 13-17)	
Is $V_3$ or $V_{av34} > 2.7$					u	, ,		☐Yes ☑ No			
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5			10 10 10		Is V <sub>3</sub> or V <sub>av</sub>	<sub>/34</sub> > 1.5		☐Yes ☑ No	40.40.40	40 40	
If Yes,V <sub>12a</sub> =	pc/n ( 13-19)		-16, 13-18, or		If Yes,V <sub>12a</sub>	=	p 1:	c/h (Equation	1 13-16, 13	-18, or 13-	
Capacity Ch					Capacit	ty Ch		<i>3)</i>			
	Actual		apacity	LOS F?		.,	Actual	Ca	apacity	LOS F?	
	7.00.00	İ	- Lipusity		V <sub>F</sub>		6468	Exhibit 13-	<del>`</del>	No	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{FO}$		4480	Exhibit 13-		_	
<b>V</b> FO		EXHIDIC 13-0								No	
	<u> </u>				V <sub>R</sub>		1988	Exhibit 13-1		No	
Flow Enterin	<del>1</del>	1			Flow E			rge Influen			
<u></u>	Actual		Desirable	Violation?	<del>  ,,</del>	_	Actual	Max Desira	í	Violation?	
V <sub>R12</sub>		Exhibit 13-8			V <sub>12</sub>		1475	Exhibit 13-8	4400:All	Yes	
Level of Serv								terminatio	_ •	<i>F</i> )	
$D_R = 5.475 + 0$	).00734 v <sub>R</sub> +	0.0078 V <sub>12</sub> -	0.00627 L <sub>A</sub>			$D_R = 4$	1.252 + 0	.0086 V <sub>12</sub> - 0	.009 L <sub>D</sub>		
D <sub>R</sub> = (pc/mi/lı	n)				$D_R = 3$	8.7 (pc	/mi/ln)				
LOS = (Exhibit 13-2)					LOS = E	(Exhil	oit 13-2)				
Speed Determination					Speed			on .			
					<del></del>		xhibit 13-				
						-	(Exhibit	•			
	hibit 13-11)						•	•			
	hibit 13-11)				l *	-	(Exhibit	•			
S = mph (Ex	hibit 13-13)				S = 58.7 mph (Exhibit 13-13)						

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			0 AND DA	AD HINGT	0110 1476						
Compared Info		RAMP	S AND RAI	MP JUNCTI		JKKS	HEEI				
General Infor				Site Infor		. = 4 0 =					
Analyst	SJT	. M-# MD		Freeway/Dir of Tra	avel	I-71 SE					
Agency or Company Date Performed	6/4/2	n Mott MacDon		Junction Jurisdiction		SR 82	EB				
Analysis Time Period		lo Build		Analysis Year		2035					
Project Description				Allalysis Teal		2000					
Inputs	11170110211										
		Freeway Num	ber of Lanes, N	3					<u> </u>	A 1:	
Upstream Adj R	amp	Ramp Numbe		1					Downstrea Ramp	m Aaj	
✓ Yes □	On	l '		1					_ `	_	
			ane Length, L <sub>A</sub>	0.50					☐Yes	On	
□No	<b>∕</b> Off		ane Length L <sub>D</sub>	350					✓ No	Off	
		Freeway Volu		4140					ı <u>-</u>	£L.	
L <sub>up</sub> = 15	600 ft	Ramp Volume	, V <sub>R</sub>	840				ľ	L <sub>down</sub> =	ft	
\ \/ - 40	50 veh/h	-Flow Speed, S <sub>FI</sub>	<sub>F</sub> 65.0				,	V <sub>D</sub> =	veh/h		
V <sub>u</sub> = 18	50.0					٠.	VOI.				
Conversion t	o pc/h Und	der Base (	Conditions								
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	v = V/PHF	x f <sub>HV</sub> x f <sub>p</sub>	
Freeway	4140	0.94	Level	3	0	0.	985	1.00	44	70	
Ramp	840	0.94	Level	3	0	_	985	1.00	90	17	
UpStream	1850	0.94	Level	2	0	0.	990	1.00	198	38	
DownStream				<del>-</del>							
		Merge Areas		•		Diverge Areas					
Estimation of	f v <sub>12</sub>				Estimation of v <sub>12</sub>						
	V <sub>12</sub> = V <sub>F</sub>	( P.,, )			$V_{12} = V_R + (V_F - V_R)P_{FD}$						
l =		tion 13-6 or	13_7)		l =					<b>\</b>	
L <sub>EQ</sub> = P =		Equation (E			$L_{EQ}$ = (Equation 13-12 or 13-13) $P_{FD}$ = 0.607 using Equation (Exhibit 13-7)						
P <sub>FM</sub> =	_	Equation (E	EXHIBIT 13-0)						ialion (Exili	DIL 13-7)	
V <sub>12</sub> =	pc/h				V <sub>12</sub> =			8 pc/h			
V <sub>3</sub> or V <sub>av34</sub>			-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub>			2 pc/h (Equa	ation 13-14	or 13-17)	
Is $V_3$ or $V_{av34} > 2,70$								Yes 🗹 No			
Is $V_3$ or $V_{av34} > 1.5$					Is V <sub>3</sub> or V <sub>av</sub>	<sub>v34</sub> > 1.5		Yes ☑ No			
If Yes,V <sub>12a</sub> =	pc/h (l 13-19)		-16, 13-18, or		If Yes,V <sub>12a</sub>	=	pc 19)	/h (Equation	13-16, 13-	18, or 13-	
Capacity Che					Capacit			<u> </u>			
Capacity Cite	Actual	<u> </u>	apacity	LOS F?	Capacit	y CII	Actual	Car	pacity	LOS F?	
	Actual	<del>l ĭ</del>	apacity	2001:	V <sub>F</sub>		4470	Exhibit 13-8	1 -	No	
V		F.,h;h;t, 40, 0						_	+	_	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{I}$		3563	Exhibit 13-8	+	No	
					V <sub>R</sub>		907	Exhibit 13-10	2100	No	
Flow Entering	g Merge In	1			Flow E	nterin	g Diverg	ge Influenc			
	Actual		Desirable	Violation?		/	Actual	Max Desirabl		Violation?	
V <sub>R12</sub>		Exhibit 13-8			V <sub>12</sub>		3068	Exhibit 13-8	4400:All	No	
Level of Serv					Level o			ermination		<del>-</del> )	
$D_R = 5.475 + 0.$	.00734 v <sub>R</sub> +	0.0078 V <sub>12</sub> -	0.00627 L <sub>A</sub>			$D_R = 4$	1.252 + 0.0	086 V <sub>12</sub> - 0.0	009 L <sub>D</sub>		
D <sub>R</sub> = (pc/mi/In	)				D <sub>R</sub> = 2	7.5 (pc	/mi/ln)				
LOS = (Exhibit	13-2)					: (Exhil	oit 13-2)				
· · · · · · · · · · · · · · · · · · ·							minatio	<u> </u>			
					<del></del>		xhibit 13-1				
$M_S = (Exibit 1)$					-			-			
1	nibit 13-11)						(Exhibit 1	•			
	nibit 13-11)				S <sub>0</sub> = 69.7 mph (Exhibit 13-12)						
S = mph (Exh	nibit 13-13)				S = 6	1.1 mph	(Exhibit 1	3-13)			

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Í	RAI	MPS AND	RAMP JUNG	CTIONS W	ORKSHE	ET				
General Infori		III O AITD		Site Infor		<u> </u>				
Analyst	SJB			eeway/Dir of Tr		71 SB				
Agency or Company		h Mott MacDona		nction		R 82				
Date Performed	4/10/			risdiction	O.	1 02				
Analysis Time Period		No Build		alysis Year	20	035				
Project Description			7.41	lary old 1 dai		<del>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</del>				
Inputs										
-		Freeway Numb	er of Lanes. N	3				D	A l.'	
Jpstream Adj Ramp		Ramp Number		1				Downstre Ramp	eam Aaj	
☑ Yes ☐ On	1			•				Ιταπρ		
		Acceleration La	,,	750				☐Yes	☐ On	
No ✓ Off	:	Deceleration La	ane Length L <sub>D</sub>					☑No	Off	
		Freeway Volun	ne, V <sub>F</sub>	3300						
<sub>-up</sub> = 2000 f	ft	Ramp Volume,	$V_R$	550				L <sub>down</sub> =	ft	
		1	Flow Speed, S <sub>FF</sub>	65.0						
$V_{\rm u} = 840 \text{ ve}$	⊧h/h	Ramp Free-Flo		50.0				V <sub>D</sub> =	veh/h	
Conversion to			111							
	<i>y</i>									
(pc/h)	(Veh/hr)	PHF	Terrain	%Truck	%Rv	$f_{HV}$	f <sub>p</sub>	v = V/PH	$F x f_{HV} x f_{p}$	
Freeway	3300	0.94	Level	4	0	0.980	1.00		3581	
Ramp	550	0.94	Level	4	0	0.980	1.00		597	
UpStream	840	0.94	Level	3	0	0.985	1.00	†	907	
DownStream		<del>                                     </del>								
		Merge Areas					Diverge Areas			
Estimation of	V <sub>12</sub>				Estimation of v <sub>12</sub>					
	V <sub>12</sub> = V <sub>F</sub>	(P )								
_	· <del>-</del> ·		40 0 40 <del>7</del> )		$V_{12} = V_R + (V_F - V_R)P_{FD}$					
- <sub>EQ</sub> =		(Equation			L <sub>EQ</sub> = (Equation 13-12 or 13-13)					
P <sub>FM</sub> =	0.599	using Equation	on (Exhibit 13-6)		P <sub>FD</sub> = using Equation (Exhibit 13-7)					
/ <sub>12</sub> =	2143	pc/h			$V_{12} = pc/h$					
/ <sub>3</sub> or V <sub>av34</sub>		pc/h (Equatio	n 13-14 or 13-		V <sub>3</sub> or V <sub>av34</sub>		pc/h (Equation	13-14 or 13-	.17)	
	17)					> 2,700 pc/h? [			,	
Is $V_3$ or $V_{av34} > 2,700$										
Is $V_3$ or $V_{av34} > 1.5 *$						> 1.5 * V <sub>12</sub> /2			12 10 or	
f Yes,V <sub>12a</sub> =		pc/h (Equatio	n 13-16, 13-		If Yes,V <sub>12a</sub> =		pc/h (Equatio 3-19)	,וו ווס-ווס,	13-10, 01	
		13-19)				•	0 10)			
Capacity Che	CKS				0	011				
				1	Capacity				1	
	Actual	Ca	pacity	LOS F?		Checks Actual	_	pacity	LOS F?	
		Ca	apacity	LOS F?	Capacity V <sub>F</sub>		Ca Exhibit 13	<del> </del>	LOS F?	
V <sub>EO</sub>			apacity	LOS F?		Actual	_	-8	LOS F?	
V <sub>FO</sub>	Actual	Ca Exhibit 13-8	npacity		$\frac{V_F}{V_{FO} = V_F}$	Actual	Exhibit 13 Exhibit 13 Exhibit 13	-8 -8	LOS F?	
	Actual 4178	Exhibit 13-8			$V_F$ $V_{FO} = V_F - V_R$	Actual V <sub>R</sub>	Exhibit 13 Exhibit 13 Exhibit 13 10	-8 -8 3-		
	Actual 4178 <b>y Merge In</b>	Exhibit 13-8	rea	No	$V_F$ $V_{FO} = V_F - V_R$	Actual V <sub>R</sub>	Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influei	-8 3- nce Area	a	
Flow Entering	Actual 4178  7 Merge In Actual	Exhibit 13-8  If luence A  Max D	<b>rea</b> Jesirable	No Violation?	V <sub>F</sub> V <sub>FO</sub> = V <sub>F</sub> - V <sub>R</sub>	Actual V <sub>R</sub>	Exhibit 13 Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des	-8 3- nce Area		
Flow Entering V <sub>R12</sub>	Actual 4178  g Merge In Actual 2740	Exhibit 13-8  Fluence Ai  Max D  Exhibit 13-8	rea lesirable 4600:All	No	$V_{FO} = V_{F} - V_{R}$ Flow Enter	Actual  V <sub>R</sub> ering Dive	Exhibit 13 Exhibit 13 Exhibit 13 10 Exhibit 13 Max Des Exhibit 13-8	-8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -	Violation?	
Flow Entering V <sub>R12</sub>	Actual 4178  g Merge In Actual 2740	Exhibit 13-8  Fluence Ai  Max D  Exhibit 13-8	rea lesirable 4600:All	No Violation?	$V_{FO} = V_{F} - V_{R}$ Flow Enter	Actual V <sub>R</sub>	Exhibit 13 Exhibit 13 Exhibit 13 10 Exhibit 13 Max Des Exhibit 13-8	-8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -8 -	Violation?	
Flow Entering  V <sub>R12</sub> Level of Servi	Actual  4178  7 Merge In  Actual  2740  ice Detern	Exhibit 13-8  Fluence Ai  Max D  Exhibit 13-8	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_F$ $V_{FO} = V_F - V_R$ Flow Enter $V_{12}$ Level of \$\frac{1}{2}\$	Actual  V <sub>R</sub> ering Dive	Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8	nce Areasirable	Violation?	
V <sub>R12</sub> Level of Servi	Actual 4178  7 Merge In Actual 2740  ice Detern 0.00734 v R + C	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	V <sub>F</sub> V <sub>FO</sub> = V <sub>F</sub> - V <sub>R</sub> Flow Enter V <sub>12</sub> Level of S	Actual  VR  Pering Diver  Actual  Service De  R = 4.252 + 0	Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8	nce Areasirable	a Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_{R} = 5.475 + 0$ $D_{R} = 21.9 \text{ (pc/mix)}$	Actual  4178  7 Merge In  Actual  2740  ice Detern  0.00734 v R + 0	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_{FO} = V_{F} - V_{R}$ Flow Enter $V_{12}$ Level of S $D_{R} = (pc)$	Actual  VR  Pering Dive  Actual  Service De  R = 4.252 + 0	Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8	nce Areasirable	a Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_{R} = 5.475 + 0$ $D_{R} = 21.9 \text{ (pc/mi}$ $OS = C \text{ (Exhibit 1)}$	Actual  4178  The second of th	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_F$ $V_{FO} = V_F - V_R$ Flow Entermination $V_{12}$ Level of S $D_R = (pc)$ $D_R = (pc)$	Actual  VR  Pering Dive  Actual  Service De  R = 4.252 + 0  /mi/ln)  hibit 13-2)	Exhibit 13 Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8  termination .0086 V <sub>12</sub> - 0	nce Areasirable	a Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_{R} = 5.475 + 0.00$ $D_{R} = 21.9 \text{ (pc/mi.)}$ $D_{R} = C \text{ (Exhibit 1)}$ Speed Determ	Actual  4178  The Merge In Actual 2740  The Actual 2740	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	V <sub>F</sub> V <sub>FO</sub> = V <sub>F</sub> - V <sub>R</sub> Flow Enter V <sub>12</sub> Level of S D <sub>R</sub> = (pc/LOS = (Ex	Actual  VR  Pering Diver Actual  Service De R = 4.252 + 0  /mi/ln)  hibit 13-2)  etermination	Exhibit 13 Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8  termination .0086 V <sub>12</sub> - 0	nce Areasirable	Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_{R} = 5.475 + 0.00$ $D_{R} = 21.9 \text{ (pc/mi.)}$ $D_{R} = C \text{ (Exhibit 1)}$ Speed Determ	Actual  4178  The Merge In Actual 2740  The Actual 2740	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_{FO} = V_{F} - V_{R}$ $V_{FO} = V_{F} - V_{R}$ $V_{12}$ $Level of S$ $D_{R} = (pc. LOS = (Ext) - (Ext) - (Ext)$ $D_{S} = (Ext) - (Ext)$	Actual  V <sub>R</sub> Pering Diver  Actual  Service De  R = 4.252 + 0  /mi/ln)  hibit 13-2)  Petermination  iibit 13-12)	Exhibit 13 Exhibit 13 Exhibit 13 10 Exhibit 13 Max Des Exhibit 13-8 Exhibit 13-8 Exhibit 13-8 Exhibit 13-8	nce Areasirable	a Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_R = 5.475 + 0$ $D_R = 21.9 \text{ (pc/minimum)}$ $D_R = C \text{ (Exhibit 1)}$ Speed Determing $M_S = 0.306 \text{ (Exit)}$	Actual  4178  The Merge In Actual 2740  The Actual 2740	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_F$ $V_{FO} = V_F - V_R$ Flow Ento $V_{12}$ Level of S $D_R = (pc. LOS = (Ext Speed Decomposition S) = (Ext Speed Decom$	Actual  VR  Pering Diver Actual  Service De R = 4.252 + 0  /mi/ln)  hibit 13-2)  etermination	Exhibit 13 Exhibit 13 Exhibit 13 10 Exhibit 13 Max Des Exhibit 13-8 Exhibit 13-8 Exhibit 13-8 Exhibit 13-8	nce Areasirable	Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_R = 5.475 + 6$ $D_R = 21.9 \text{ (pc/mi)}$ $D_R = C \text{ (Exhibit 1)}$ Speed Determ $D_R = 0.306 \text{ (Exibol)}$ $D_R = 0.306 \text{ (Exibol)}$ $D_R = 0.306 \text{ (Exibol)}$	Actual  4178  7 Merge In  Actual  2740  ice Detern  0.00734 v <sub>R</sub> + 0  i/ln)  13-2)  nination  pit 13-11)	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_{FO} = V_{F} - V_{R}$ $V_{FO} = V_{F} - V_{R}$ $V_{12}$ $Level of S$ $D_{R} = (pc. LOS = (Ext - Speed De SR - SR - Mathematical mat$	Actual  V <sub>R</sub> Pering Diver  Actual  Service De  R = 4.252 + 0  /mi/ln)  hibit 13-2)  Petermination  iibit 13-12)	Exhibit 13 Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8 termination .0086 V <sub>12</sub> - 0	nce Areasirable	Violation?	
Flow Entering $V_{R12}$ Level of Servi $D_R = 5.475 + 0.00$ $D_R = 21.9 \text{ (pc/mi)}$ $D_R = 0.306 \text{ (Exibit 13)}$ Speed Determ $D_R = 0.306 \text{ (Exibit 23)}$ $D_R = 0.306 \text{ (Exibit 24)}$	Actual  4178  7 Merge In  Actual  2740  ice Detern  0.00734 v R + 0  i/ln)  13-2)  nination  bit 13-11)  Exhibit 13-11)	Exhibit 13-8  offluence Ai  Max D  Exhibit 13-8  mination (ii	rea lesirable 4600:All <b>f not F)</b>	No Violation?	$V_F$ $V_{FO} = V_F - V_R$ Flow Enter $V_{12}$ Level of S $V_{R} = V_{R} - V_{R}$ $V_{R} = V_{R}$	Actual  VR  Pering Diver  Actual  Service De  R = 4.252 + 0  /mi/ln)  hibit 13-2)  Permination  ibit 13-12)  I (Exhibit 13-12)	Exhibit 13 Exhibit 13 Exhibit 13 10  rge Influer Max Des Exhibit 13-8 eterminatio .0086 V <sub>12</sub> - 0	nce Areasirable	Violation?	

		RAMP	S AND RAI	MP JUNCTI	ONS WO	RKS	HEET				
General Info	rmation			Site Infor							
Analyst	SJT		F	reeway/Dir of Tr		I-71 SE	3				
Agency or Company		h Mott MacDon		Junction		SR 303					
Date Performed	6/5/2			Jurisdiction							
Analysis Time Perio		No Build	A	Analysis Year		2035					
Project Description				,							
Inputs											
Upstream Adj I	Ramp	Freeway Num Ramp Numbe	ber of Lanes, N	3					Downstrea Ramp	m Adj	
□Yes	On	I	ane Length, L	ı					Yes	On	
☑ No [	Off		ane Length L <sub>D</sub>	350					☑ No	Off	
L <sub>up</sub> =	ft	Freeway Volu Ramp Volume		3850 1410				ļ	_ <sub>down</sub> =	ft	
The state of the s											
V <sub>u</sub> = \(\frac{1}{2}\)	$V_u$ = veh/h Freeway Free-Flow Speed, $S_{FF}$ 65.0 $V_D$ = veh. Ramp Free-Flow Speed, $S_{FR}$ 50.0								veh/h		
Conversion	to pc/h Un		111					<u>l</u>			
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	/ = V/PHF	x f <sub>HV</sub> x f <sub>p</sub>	
Freeway	3850	0.94	Level	4	0	0.	980	1.00	41	78	
Ramp	1410	0.94	Level	4	0	0.	980	1.00	15	30	
UpStream											
DownStream											
		Merge Areas						verge Areas			
Estimation o	of v <sub>12</sub>				Estimat	ion c	of v <sub>12</sub>				
	V <sub>12</sub> = V <sub>F</sub>	( P <sub>EM</sub> )					V <sub>12</sub> = '	V <sub>R</sub> + (V <sub>F</sub> - V <sub>R</sub>	)P <sub>ED</sub>		
L <sub>EQ</sub> =		tion 13-6 or	13-7)		L <sub>EQ</sub> = (Equation 13-12 or 13-13)						
_		Equation (			P <sub>FD</sub> = 0.585 using Equation (Exhibit 13-7)						
P <sub>FM</sub> =	_	Equation (	EXHIBIT 13-0)		$V_{12}$ = 3080 pc/h						
V <sub>12</sub> =	pc/h							•			
V <sub>3</sub> or V <sub>av34</sub>			-14 or 13-17)		$V_3$ or $V_{av34}$			8 pc/h (Equa	ation 13-14	or 13-17)	
Is $V_3$ or $V_{av34} > 2.7$	′00 pc/h?	s 🗌 No			Is V <sub>3</sub> or V <sub>av</sub>	<sub>34</sub> > 2,7	'00 pc/h? 🔲	Yes 🗹 No			
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5	5 * V <sub>12</sub> /2	s 🗌 No			Is V <sub>3</sub> or V <sub>av</sub>	<sub>34</sub> > 1.5	* V <sub>12</sub> /2	Yes 🗹 No			
If Yes,V <sub>12a</sub> =	pc/h ( 13-19)		-16, 13-18, or		If Yes,V <sub>12a</sub> =	•	pc 19	/h (Equation	13-16, 13-	18, or 13-	
Capacity Ch	ecks	•			Capacit	y Ch	ecks				
	Actual	C	apacity	LOS F?			Actual	Car	acity	LOS F?	
					V <sub>F</sub>		4178	Exhibit 13-8	7050	No	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{F}$	- V <sub>D</sub>	2648	Exhibit 13-8	7050	No	
FO					-	R				<del> </del>	
	<del></del>	<u> </u>			V <sub>R</sub>		1530	Exhibit 13-10	<u> </u>	No	
Flow Enterin	<del></del>	·		1 15 1 5 0	Flow En	-		ge Influenc		1.5.1.5.0	
\ <u>/</u>	Actual		Desirable	Violation?	1	_	Actual	Max Desirable		Violation?	
V <sub>R12</sub> Level of Serv	vice Deterr	Exhibit 13-8	if not E)		V <sub>12</sub>		3080	Exhibit 13-8 ermination	4400:All	No No	
D <sub>R</sub> = 5.475 + 0					+			)086 V <sub>12</sub> - 0.0	•	<del>-)</del>	
D <sub>R</sub> = (pc/mi/li	• • • • • • • • • • • • • • • • • • • •	3.33.3.12	5.555 <u>-</u> 1. –A				/mi/ln)	12	-Б		
							•				
LOS = (Exhibit						•	bit 13-2)				
Speed Deter					Speed L						
$M_S = (Exibit 1)$	•				ľ		xhibit 13-1	•			
	hibit 13-11)					-	(Exhibit 1	*			
	hibit 13-11)			1	-	(Exhibit 1	•				
S = mph (Ex	hibit 13-13)				S = 59	9.7 mph	(Exhibit 1	3-13)			
Copyright © 2013 Univ	vorcity of Elorida	All Diabta Dagge	und.		HCS2010TM			Cor	acrotod: 6/22	/2015 1:41 P	

## Freeway Merges / Diverges

#### **2035 Build Condition**

**AM** 

		RAMP	S AND RAN	/P JUNCTI	ONS WO	RKS	HEET		_	
General Info	rmation		<u> </u>	Site Infor						
Analyst	SJT		F	reeway/Dir of Tr		I-71 SE	}			
Agency or Company		n Mott MacDon		lunction		SR 82				
Date Performed	6/4/2			lurisdiction						
Analysis Time Perio		uild ALT 1 & 2	A	Analysis Year		2035				
Project Description				,						
Inputs										
Upstream Adj F	Ramp	l '	ber of Lanes, N	3					Downstrea	m Adj
□Yes	On	Ramp Numbe Acceleration L	ane Length, L	1					Ramp <b>☑</b> Yes	On
✓No	Off		ane Length L <sub>D</sub>	450					□No	✓ Off
L <sub>up</sub> =	ft	Freeway Volu Ramp Volume		2710 680					L <sub>down</sub> =	1500 ft
up.			K -Flow Speed, S <sub>FF</sub>							
V <sub>u</sub> = v	reh/h		ow Speed, S <sub>FR</sub>	50.0					V <sub>D</sub> =	370 veh/h
Conversion t	o pc/h Und	der Base (	Conditions							
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	v = V/PHF	x f <sub>HV</sub> x f <sub>p</sub>
Freeway	2710	0.94	Level	3	0	0.	985	1.00	292	26
Ramp	680	2	0	0.	990	1.00	73	1		
UpStream										
DownStream	370	0.94	Level	3	0	0.	985	1.00	40	0
		Merge Areas		•	Diverge Areas					
Estimation o	f v <sub>12</sub>				Estimat	tion o	f v <sub>12</sub>			
	V <sub>12</sub> = V <sub>F</sub>	( P <sub>514</sub> )						V <sub>R</sub> + (V <sub>F</sub> - V <sub>R</sub>	.)P <sub>EB</sub>	
_		tion 13-6 or	13_7)		=			08.71 (Equation		12 12\
L <sub>EQ</sub> =					L <sub>EQ</sub> =					-
P <sub>FM</sub> =	_	Equation (E	EXHIDIL 13-0)		P <sub>FD</sub> =			653 using Equ	iation (Exnit	oit 13-7)
V <sub>12</sub> =	pc/h				V <sub>12</sub> =			165 pc/h		
V <sub>3</sub> or V <sub>av34</sub>			-14 or 13-17)		$V_3$ or $V_{av34}$			31 pc/h (Equat	tion 13-14 (	or 13-17)
Is $V_3$ or $V_{av34} > 2,70$	00 pc/h? 🗌 Yes	s 🗌 No			Is V <sub>3</sub> or V <sub>av</sub>	<sub>v34</sub> > 2,7	00 pc/h?	☐Yes 🗹 No		
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5	* V <sub>12</sub> /2 □ Yes	s 🗌 No			Is V <sub>3</sub> or V <sub>av</sub>	<sub>/34</sub> > 1.5	* V <sub>12</sub> /2	☐Yes ☑ No		
If Yes,V <sub>12a</sub> =		Equation 13	-16, 13-18, or		If Yes,V <sub>12a</sub>			c/h (Equation	13-16, 13-	18, or 13-
Capacity Che					Capacit	tv Ch		<i>-</i>		
	Actual	C	apacity	LOS F?			Actual	Car	pacity	LOS F?
		Ì			V <sub>F</sub>		2926	Exhibit 13-8	1	No
$V_{FO}$		Exhibit 13-8			V <sub>FO</sub> = V <sub>I</sub>		2195	Exhibit 13-8		No
<b>V</b> FO		EXHIBIT 13-0						_	+	
					V <sub>R</sub>		731	Exhibit 13-10		No
Flow Enterin					Flow E	-		rge Influend		
\	Actual		Desirable	Violation?	ļ ,,		Actual	Max Desirab		Violation?
V <sub>R12</sub>		Exhibit 13-8			V <sub>12</sub>		2165	Exhibit 13-8	4400:All	No
Level of Serv								termination	•	7)
D <sub>R</sub> = 5.475 + 0	• •	0.0078 V <sub>12</sub> -	0.00627 L <sub>A</sub>			$D_R = 4$	.252 + 0	.0086 V <sub>12</sub> - 0.0	009 L <sub>D</sub>	
D <sub>R</sub> = (pc/mi/lr	1)				$D_R = 1$	8.8 (pc	/mi/ln)			
LOS = (Exhibit	13-2)				LOS = B	(Exhil	oit 13-2)			
Speed Deteri	mination				Speed	Deter	minatio	on		
M <sub>S</sub> = (Exibit 1					<del></del>		xhibit 13-			
						•	(Exhibit	•		
$S_R$ = mph (Exhibit 13-11) $S_0$ = mph (Exhibit 13-11)						-	(Exhibit	•		
•					I *	-	-	•		
p − IIIpii (⊏XI	nibit 13-13)	VII Dights Doson			S = 6	ı.ı mpn	(Exhibit	13-13)		

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		RAMP	S AND RAI	/IP JUNCTI	ONS WC	RKS	HEET				
General Infor	rmation		<u> </u>	Site Infor							
Analyst	SJT		F	reeway/Dir of Tr		I-71 SE	3				
Agency or Company		h Mott MacDon		lunction		SR 82					
Date Performed	6/4/2			Jurisdiction		01102					
Analysis Time Period		Build ALT 1 & 2		Analysis Year		2035					
Project Description											
Inputs											
Upstream Adj R	Pamn	Freeway Num	ber of Lanes, N	3					Downstrear	m Δdi	
Opstream Auj N	vanip	Ramp Numbe	r of Lanes, N	1					Ramp	ii 7 (aj	
✓ Yes	On	Acceleration L	ane Length, L						Yes	On	
□No □	/ O#		ane Length L	350							
□No	<b>✓</b> Off	Freeway Volu		2030					✓ No	Off	
L <sub>up</sub> = 15	500 ft	Ramp Volume		370				l	_ <sub>down</sub> =	ft	
ap			· · · K -Flow Speed, S <sub>FF</sub>								
$V_u = 68$	30 veh/h		ow Speed, S <sub>FR</sub>	50.0				ľ	<b>V</b> <sub>D</sub> =	veh/h	
Conversion t	la na/h l ln		111	30.0				<u>l</u>			
Conversion t	o pc/n Und       ∨			Τ.		$\overline{}$	, 1	. 1	, <del>.</del>		
(pc/h)	(Veh/hr)	PHF	Terrain	%Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	/ = V/PHF :	cf <sub>HV</sub> x f <sub>p</sub>	
Freeway	2030	0.94	Level	3	0	0.	985	1.00	219	2	
Ramp	370	0.94	Level	3	0	0.	985	1.00	400	)	
UpStream	680	0.94	Level	2	0	0.	990	1.00	73 <sup>-</sup>	1	
DownStream											
		Merge Areas			Diverge Areas						
Estimation of	f v <sub>12</sub>				Estimation of v <sub>12</sub>						
	V <sub>12</sub> = V <sub>F</sub>	(P <sub>FM</sub> )					V <sub>12</sub> =	$V_R + (V_F - V_R)$	)P <sub>FD</sub>		
L <sub>EQ</sub> =	(Equa	ition 13-6 or	13-7)		L <sub>EQ</sub> =		(E	Equation 13-12	2 or 13-13)		
P <sub>FM</sub> =	using	Equation (E	Exhibit 13-6)		P <sub>FD</sub> =		0.6	87 using Equ	ation (Exhib	it 13-7)	
V <sub>12</sub> =	pc/h		•		V <sub>12</sub> =			31 pc/h	,	,	
V <sub>3</sub> or V <sub>av34</sub>	•	Equation 13	-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub>			1 pc/h (Equat	ion 13-14 c	r 13-17)	
Is V <sub>3</sub> or V <sub>av34</sub> > 2,70						>27		Yes ☑ No		,, 10 17,	
Is V <sub>3</sub> or V <sub>av34</sub> > 1.5								Yes ☑ No			
			-16, 13-18, or					c/h (Equation	13_16 13_1	8 or 13-	
If Yes,V <sub>12a</sub> =	13-19)		-10, 13-10, 01		If Yes,V <sub>12a</sub> =	=	19		10-10, 10-1	10, 01 13-	
Capacity Che	ecks				Capacit	y Ch	ecks	•			
	Actual	С	apacity	LOS F?			Actual	Cap	acity	LOS F?	
					V <sub>F</sub>		2192	Exhibit 13-8	7050	No	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{F}$		1792	Exhibit 13-8	7050	No	
FO					V <sub>R</sub>	- K	400	Exhibit 13-10	<del> </del>	No	
	<u> </u>	<u> </u>				<u> </u>				INO	
Flow Entering		1		\/;a -+:0	Flow Er			ge Influenc		\/iala#:0	
\/	Actual		Desirable	Violation?	V		Actual	Max Desirabl	i	Violation?	
V <sub>R12</sub>	ioo Dataiii	Exhibit 13-8	if not T		V <sub>12</sub>		1631	Exhibit 13-8	4400:All	No	
Level of Serv								termination	•	)	
$D_R = 5.475 + 0.00$	• • • • • • • • • • • • • • • • • • • •	u.uu/8 V <sub>12</sub> -	U.UU02/ L <sub>A</sub>					0086 V <sub>12</sub> - 0.0	JU9 L <sub>D</sub>		
D <sub>R</sub> = (pc/mi/lr					l ''	5.1 (pc	,				
LOS = (Exhibit						•	oit 13-2)				
Speed Deterr	mination				Speed L	Deter	minatio	n			
M <sub>S</sub> = (Exibit 1	3-11)				$D_s = 0$	.269 (E	xhibit 13-	12)			
	ribit 13-11)				1	8.8 mph	(Exhibit	13-12)			
	nibit 13-11)				1	1.3 mph	(Exhibit	13-12)			
	nibit 13-13)					-	(Exhibit	· ·			
	ensity of Florida						,		rated: 6/22/20	11:22 AM	

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## Freeway Merges / Diverges

**2035 Build Condition** 

**PM** 

Agency of Company	RAMPS AND RAMP JUNCTIONS WORKSHEET									
Agency or Company Date Performed Agency or Company Project Description L71 / SR 82 IMS  ### Agency or Company Date Performed Agency Number of Lanes, N Agency Numbe										
Agency of Company Date Performed										
Date Performed										
Project Description										
Project Description   I-71 / SR 82 IMS   Inputs										
Upstream Adj Ramp										
Yes										
Yes	m Adj									
No	•									
No	On									
Freeway   Free										
Lup =   ft	<b>✓</b> Off									
Vo	1500 ft									
Ramp Free-Flow Speed, S <sub>FR</sub>   50.0   VD   Conversion to pc/h Under Base Conditions										
Conversion to pc/h Under Base Conditions	840 veh/									
Coph   V   (Veh/hr)   PHF										
Second   S										
Second Stream   Second Strea	$x f_{HV} x f_{p}$									
Ramp	38									
Merge Areas   Diverge Influence Areas   Diverge	32									
Merge Areas         Diverge Areas           Estimation of $v_{12}$ Estimation of $v_{12}$ $V_{12} = V_F (P_{FM})$ $V_{12} = V_R + (V_F - V_R)P_{FD}$ $V_{12} = V_F (P_{FM})$ $V_{12} = V_R + (V_F - V_R)P_{FD}$ $V_{12} = V_R + (V_F - V_R)P_FD$ $V_R = V_R + V$										
Estimation of $v_{12}$	7									
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$										
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	r 13-13)									
$V_{12} = \text{pc/h}  V_{12} = \text{4183 pc/h} $ $V_{3} \text{ or } V_{av34}  \text{pc/h (Equation 13-14 or 13-17)}  V_{3} \text{ or } V_{av34} > 2.700 \text{ pc/h};  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 2.700 \text{ pc/h};  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 2.700 \text{ pc/h};  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{av34} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{3} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{3} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} \text{ or } V_{3} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Is } V_{3} > 1.5 * V_{12}/2  \text{Yes}  \text{No}  \text{Yes}  \text{No}  \text{Yes}  \text{No}  \text{Yes}  \text{No}  \text{Yes}  Yes$										
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	10 1)									
$   S \lor_3 \text{ or } \lor_{av34} > 2,700 \text{ pc/h?}    \text{ Yes }   \text{ No} $ $   S \lor_3 \text{ or } \lor_{av34} > 2,700 \text{ pc/h?}    \text{ Yes }   \text{ No} $ $   S \lor_3 \text{ or } \lor_{av34} > 1.5 * \lor_{12} / 2                                 $	0 10 17									
$ S \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{No} \\ pc/h \text{ (Equation 13-16, 13-18, or } \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{No} \\ pc/h \text{ (Equation 13-16, 13-19)} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{No} \\ pc/h \text{ (Equation 13-16, 13-19)} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{No} \\ pc/h \text{ (Equation 13-16, 13-19)} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{No} \\ pc/h \text{ (Equation 13-16, 13-19)} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{12} / 2    \text{Yes }   \text{Volution 13-16, 13-19} \\  Is \lor_3 \text{ or } \lor_{av34} \gt 1.5 * \lor_{av34} \gt 1.5 * \lor_{av34} \lor 1.5 * \lor_{av34$	01 13-17									
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$										
Tes, v <sub>12a</sub>	10 10									
Capacity Checks           Actual         Capacity         LOS F?         Actual         Capacity           V <sub>F</sub> 6468         Exhibit 13-8         7050           V <sub>FO</sub> = V <sub>F</sub> - V <sub>R</sub> 5136         Exhibit 13-8         7050           V <sub>R</sub> 1332         Exhibit 13-10         2100           Flow Entering Merge Influence Area	18, OF 13-									
$V_{FO} \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$										
$V_{FO} \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	LOS F									
$V_{FO}$ Exhibit 13-8 $V_{FO} = V_F - V_R$ 5136 Exhibit 13-8 7050 $V_R$ 1332 Exhibit 13-10 2100 Flow Entering Merge Influence Area	No									
V <sub>R</sub> 1332 Exhibit 13-10 2100 Flow Entering Merge Influence Area Flow Entering Diverge Influence Area	No									
Flow Entering Merge Influence Area Flow Entering Diverge Influence Area										
	No									
I ACIDAL I MAX DESIGNIE I MINAMINITA II AMINA I MAX DESIGNIE	Violation									
V <sub>R12</sub> Exhibit 13-8         V <sub>12</sub> 4183         Exhibit 13-8         4400:All	No No									
evel of Service Determination (if not F)  Level of Service Determination (if not F)	<u>)                                    </u>									
$D_R = 5.475 + 0.00734 \text{ v}_R + 0.0078 \text{ V}_{12} - 0.00627 \text{ L}_A$ $D_R = 4.252 + 0.0086 \text{ V}_{12} - 0.009 \text{ L}_D$										
$D_{R} = (pc/mi/ln)$ $D_{R} = 36.2 (pc/mi/ln)$										
OS = (Exhibit 13-2) LOS = E (Exhibit 13-2)										
Speed Determination Speed Determination	· · · · · · · · · · · · · · · · · · ·									
$D_{\rm S} = $ (Exibit 13-11) $D_{\rm S} = 0.353$ (Exhibit 13-12)	<del>-   '</del>									
$S_R$ = mph (Exhibit 13-11) $S_R$ = 56.9 mph (Exhibit 13-12)										
$S_0 = mph (Exhibit 13-11)$ $S_0 = 66.3 mph (Exhibit 13-12)$ $S = 59.9 mph (Exhibit 13-13)$										
pyright © 2013 University of Florida, All Rights Reserved  HCS2010 <sup>TM</sup> Version 6.50 Generated: 6/22/2										

		RAIVIE	S AND KAN	IP JUNCTI	ONS WO	RKS	HEET				
General Info	rmation			Site Infor							
Analyst	SJT		F	reeway/Dir of Tr		I-71 SB					
Agency or Compan		h Mott MacDon		unction		SR 82 I					
Date Performed	6/4/2	015	Jı	urisdiction							
Analysis Time Peri	od PM E	Build ALT 1 & 2	Α	nalysis Year		2035					
Project Description	I-71 / SR 82 IN	/IS									
Inputs											
Upstream Adj	Ramp	· ·	ber of Lanes, N	3					Downstrea	m Adj	
✓ Yes	On	Ramp Number Acceleration L	ane Length, L	1					Ramp □Yes		
□No	<b>✓</b> Off		ane Length L <sub>D</sub>	350					☑ res	□ On □ Off	
		Freeway Volur	'	4750							
L <sub>up</sub> = 1	1500 ft	Ramp Volume	11	840					L <sub>down</sub> =	ft	
V <sub>u</sub> = 1	240 veh/h	1	Flow Speed, $S_{FF}$ ow Speed, $S_{FR}$	65.0 50.0				ľ	V <sub>D</sub> =	veh/h	
Conversion	to nc/h Uni	l	111	30.0							
(pc/h)	V	PHF	Terrain	%Truck	%Rv	Т	f <sub>HV</sub>	f <sub>p</sub>	v = V/PHF :	( f. n. x f	
	(Veh/hr) 4750	0.94	Level	3	0	_	985	1.00	512		
Freeway Ramp	840	0.94	Level	3	0	_	985	1.00	90		
UpStream	1240	0.94	Level	2	0		990	1.00	133		
DownStream	1240	0.94	Level	2	0	0.5	990	1.00	100		
Downer dam		Merge Areas			<u> </u>		Di	iverge Areas			
Estimation o		<u> </u>			Estimation of v <sub>12</sub>						
	V <sub>12</sub> = V <sub>F</sub>	(P)			$V_{12} = V_R + (V_F - V_R)P_{FD}$						
=		ation 13-6 or	13-7)		l =			Equation 13-1			
L <sub>EQ</sub> = D -					L <sub>EQ</sub> =		•			:1 10 7\	
P <sub>FM</sub> =	_	Equation (E	XIIIDIL 13-0)		P <sub>FD</sub> =			90 using Equ	iation (Exnib	IL 13-7)	
V <sub>12</sub> =	pc/h				V <sub>12</sub> =			98 pc/h			
V <sub>3</sub> or V <sub>av34</sub>			-14 or 13-17)		V <sub>3</sub> or V <sub>av34</sub>			31 pc/h (Equa	ation 13-14	or 13-17)	
Is $V_3$ or $V_{av34} > 2.7$								Yes ☑ No			
Is $V_3$ or $V_{av34} > 1.5$					Is V <sub>3</sub> or V <sub>av3</sub>	<sub>34</sub> > 1.5		Yes 🗹 No			
If Yes,V <sub>12a</sub> =			-16, 13-18, or		If Yes,V <sub>12a</sub> =			c/h (Equation	13-16, 13-	18, or 13-	
Capacity Ch	13-19)				Capacit		19	)			
Capacity Cit		1 0	an a situ	1 100 50	Сарасп	y Cile		l Con	a a itu	1,00,50	
	Actual		apacity	LOS F?	\ \/		Actual		pacity 7050	LOS F?	
.,					V <sub>F</sub>		5129	Exhibit 13-8		No	
$V_{FO}$		Exhibit 13-8			$V_{FO} = V_{F}$	- V <sub>R</sub>	4222	Exhibit 13-8		No	
					$V_R$		907	Exhibit 13-10	2100	No	
Flow Enterir	ng Merge In	fluence A	rea		Flow En	terin	g Diver	ge Influend	ce Area		
	Actual		Desirable	Violation?			Actual	Max Desirab		Violation?	
V <sub>R12</sub>		Exhibit 13-8			V <sub>12</sub>		398	Exhibit 13-8	4400:All	No	
Level of Ser					1			ermination	•	)	
D <sub>R</sub> = 5.475 + 0		υ.0078 V <sub>12</sub> -	u.00627 L <sub>A</sub>					0086 V <sub>12</sub> - 0.0	009 L <sub>D</sub>		
D <sub>R</sub> = (pc/mi/l						).3 (pc/					
LOS = (Exhibit						•	oit 13-2)	<u> </u>			
Speed Deter					Speed D		minatio xhibit 13-1				
M <sub>S</sub> = (Exibit					ľ	•	Exhibit 13-	•			
· ·	(nihit 13-11)					.o mpn	(⊏XIIIDIL ]	•			
S <sub>R</sub> = mph (Ex	· ·				le - ^^		/E. J. 15-14 4	10 40)			
S <sub>0</sub> = mph (Ex	khibit 13-11) khibit 13-13)				ľ	-	(Exhibit 1 (Exhibit 1	•			

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## **Freeway Weave**

#### **2035 Build Condition**

**AM** 

	FREEWAY WEAVING WORKSHEET											
Genera	l Informati	on			Site Info	rmation						
Analyst Agency/Cor Date Perfor Analysis Tir Project Des Inputs	med	6/23/20 AM Bui	Mott MacDonal 115 Ild ALT 3	ld	Freeway/Dir Weaving Seg Analysis Yea	gment Location	I-71 S on SR 82 2035	SB 2 Entrance to	Howe Exit			
Weaving co Weaving nu Weaving se Freeway fre	umber of lanes, Name	s FS		1900ft 65 mph	Freeway minimum speed, S <sub>MIN</sub>							
Conver	sions to po	c/h Unde	r Base Co	ndition	3							
	V (veh/h)	PHF	Truck (%)	RV (%)	Ε <sub>Τ</sub>	ER	$f_{HV}$	fp	v (pc/h)			
$V_{FF}$	1380	0.94	4	0	1.5	1.2	0.980	1.00	1497			
$V_{RF}$	380	0.94	4	0	1.5	1.2	0.980	1.00	412			
$V_FR$	280	0.94	2	0	1.5	1.2	0.990	1.00	301			
$V_{RR}$	110	0.94	2	0	1.5	1.2	0.990	1.00	118			
$V_{NW}$	1615		•	•	•		•	V =	2283			
$V_{W}$	713							•	•			
VR	0.306											
Configu	iration Cha	aracteris	tics									
Minimum m	naneuver lanes,	N <sub>WI</sub>		2 lc	Minimum we	aving lane cl	hanges, LC <sub>MIN</sub>		713 lc/h			
	e density, ID	***		0.5 int/mi	Weaving lan	e changes, L	.C <sub>w</sub>		1058 lc/h			
Minimum R	RF lane changes,	LC <sub>RF</sub>		1 lc/pc	Non-weaving	g lane chang	es, LC <sub>NW</sub>		592 lc/h			
Minimum F	R lane changes,	LC <sub>FR</sub>		1 lc/pc	Total lane ch	nanges, LC <sub>AI</sub>	I		1650 lc/h			
Minimum R	R lane changes	, LC <sub>RR</sub>		lc/pc	Non-weaving	g vehicle inde	ex, I <sub>NW</sub>		153			
Weavin	g Segmen	t Speed,	Density, I	_evel of								
Weaving se	egment flow rate egment capacity, egment v/c ratio egment density,	, C <sub>w</sub>		2283 veh/h 7683 veh/h 0.297 9.9 pc/mi/ln A	Weaving seg		, S S <sub>W</sub> eed, S <sub>NW</sub>		0.202 58.6 mph 62.5 mph 57.1 mph 5651 ft			
				, ,	Maximum We	caving i <del>c</del> ngli	', LMAX		303 i il			
Chapter 13,	segments longer the "Freeway Merge a es that exceed the	and Diverge Se	gments".	•		solated merge	and diverge ar	eas using the	procedures of			

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## **Freeway Weave**

#### **2035 Build Condition**

**PM** 

	FREEWAY WEAVING WORKSHEET											
Genera	l Informati	on			Site Info	rmation						
	med	6/23/20 PM Bui	Mott MacDonal 115 Id ALT 3	d	Freeway/Dir Weaving Seç Analysis Yea	gment Location	I-71 S on SR 82 2035	B 2 Entrance to	Howe Exit			
Inputs					ı							
Weaving se	nfiguration Imber of lanes, N gment length, L <sub>e</sub> e-flow speed, Fl	3		One-Sided 4 1900ft 65 mph	Freeway minimum speed, S <sub>MIN</sub>							
Conver	sions to po	c/h Unde	r Base Co	nditions	3							
	V (veh/h)	PHF	Truck (%)	RV (%)	E <sub>T</sub>	ER	$f_{HV}$	fp	v (pc/h)			
$V_{FF}$	3300	0.94	4	0	1.5	1.2	0.980	1.00	3581			
$V_{RF}$	550	0.94	4	0	1.5	1.2	0.980	1.00	597			
$V_{FR}$	610	0.94	2	0	1.5	1.2	0.990	1.00	655			
$V_RR$	210	0.94	2	0	1.5	1.2	0.990	1.00	226			
$V_{NW}$	3807							V =	4960			
$V_W$	1252											
VR	0.247											
Configu	ration Cha	aracterist	tics									
Minimum m	naneuver lanes, l	N <sub>WL</sub>		2 lc	Minimum we	eaving lane ch	nanges, LC <sub>MIN</sub>		1252 lc/h			
Interchange	e density, ID			0.5 int/mi	Weaving lan	e changes, L	$C_{W}$		1597 lc/h			
Minimum R	F lane changes,	$LC_RF$		1 lc/pc	Non-weaving	g lane change	es, LC <sub>NW</sub>		1044 lc/h			
Minimum F	R lane changes,	$LC_FR$		1 lc/pc	Total lane ch	nanges, LC <sub>ALI</sub>	_		2641 lc/h			
Minimum R	R lane changes	, LC <sub>RR</sub>		lc/pc	Non-weaving	g vehicle inde	ex, I <sub>NW</sub>		362			
Weavin	g Segment	t Speed,	Density, I	_evel of	Service,	and Cap	acity					
Weaving se	egment flow rate	, v		4960 veh/h		ensity factor,			0.293			
Weaving se	egment capacity,	, c <sub>w</sub>		8278 veh/h		gment speed,			52.4 mph			
Weaving se	egment v/c ratio			0.599	_	aving speed,	**		61.6 mph			
•	egment density,	D	24	1.1 pc/mi/ln	_	n-weaving spe	1111		49.9 mph			
Level of Se	rvice, LOS			С	Maximum we	eaving length	, L <sub>MAX</sub>		5027 ft			
Notes												
Chapter 13,	segments longer to "Freeway Merge a es that exceed the	and Diverge Se	gments".	-		solated merge	and diverge are	eas using the	procedures of			

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## Appendix D

**Turn Lane Calculations** 

	ı							ZED INTERS E and 401-10		04]		
Date Compe	ted:		10/6/2015	5						- H	latch	Mott
Completed	by:	S.	JT	Check	ed by:	9	SJB		Im			onald
Project:				I-71 / SI	R82 IJS						iacb	or raid
Inters	section:			SR	82 @ I-71	SB			Cycl	e Length Kno	own:	Yes
Approache	es Analyzed	:		1					Сус	cle Length (s	ec):	150
									S	ignal Phases	s:	
Approach:	S	treet Name	e:		Design	Speed:				Cycles / Hr		24
Eastbound		SR 82			mph No			Notes:				
Westbound		SR 82			35 mph			Build 2035 PN	1 Build Volun	nes		
Northbound					mph							
Southbound					mph							
					WB - SR 82							
Volume:	Lt	Thru	Rt	Lt 310	Thru 1190	Rt O	Lt I	Thru	Rt	Lt I	Thru	Rt I
Demand:				high	1190	low						
# Lanes:				1	3	1000	<del>                                     </del>					
Avg Veh/Cycle:	0	0	0	13	50	0	0	0	0	0	0	0
Condition:				A	30							
Thru Backup:					517		i —					
L&D Length (ft) <sup>1</sup> :				525		#N/A	i —					
95% Queue (ft) <sup>2</sup> :				350			i					
5570 Queue (II.) .				-								
Recommended				WB Lt		WB Rt	1					
Turn Length (ft) <sup>1</sup> :												- 1
,	1 in	cludes 50 ft ta	iner	2	from SimTraff	îc	[created h	v Hatch Mott N	1acDonald1		ri	ev 4/22/2013

Justificatio	n for Turn Lane	Length Recomm	endations
	Eastb	oound	
Left:	n/a	Right:	n/a
	West	bound	
Left:	n/a	Right:	n/a
- available le	uctures over I-7	bar to longitudin	al joint
	.,,,		.,,
	South	bound	
Left: _	n/a	Right:	n/a

								ZED INTERS E and 401-10		04]		
Date Compet	ted:		10/6/2015	5					$\Box$		latch	Mott
Completed I	by:	S	JT	Check	ed by:	9	SJB		m			onald
Project:				I-71 / S	I-71 / SR82 IJS							011010
Inters	ection:			Howe	@ Pomero	y/Tracy			Cycle	e Length Kn	own:	Yes
Approache	es Analyzed	l:		4					Сус	cle Length (s	ec):	110
					•				S	Signal Phase	s:	
Approach:	9	Street Name	e:		Design	Speed:				Cycles / Hr		33
Eastbound		Pomeroy			2	25	mph	Notes:				
Westbound		Tracy			2	25	mph	Build ALT 1, 2			0.60	
Northbound		Howe			3	35	mph	2035 PM Build 2035 AM Build		sed for EB, WB, sed for NB	& 5B	
Southbound		Howe			3	35	mph					
	E	B - Pomero	ру		WB - Tracy	/		NB - Howe			SB - Howe	2
	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt
Volume:	10	10	10	20	10	10	10	1210	10	20	590	20
Demand:	high		high	high		high	low		low	low		low
# Lanes:	1	1			1		1	2		1	1	
Avg Veh/Cycle:	1	1	1	1	1	1	1	37	1	1	18	1
Condition:	A		Α	A		А	A		Α	A		Α
Thru Backup:		50			50			#N/A			625	
L&D Length (ft) <sup>1</sup> :	100		100	100		100	100		100	100		100
95% Queue (ft) <sup>2</sup> :							l					
	EB Lt		EB Rt	WB Lt		WB Rt	NB Lt		NB Rt	SB Lt		SB Rt
Recommended Turn Length (ft) <sup>1</sup> :							150			150		
	1 in	cludes 50 ft to	iner	2	from SimTraf	fic	Icreated h	v Hatch Mott N	lacDonald1		n	ev 4/22/2013

Justifica		e Length Recomme	endations		
Left:	n/a	Right:	n/a		
Leit.	11/4	g.r.c.	11/ 0		
	West	bound			
Left:	n/a	Right:	n/a		
	Norti	nbound			
Left:	150	Right:	n/a		
thru backup = 1200 feet over 2 lanes = 600' per lane lack of turning traffic, multiple drives, and presence of TWLTL dictate a left turn lane close to the L&D calculated value					
	Soutl	nbound			
Left:	150	Right:	n/a		
		oresence of TWLTL &D calculated valu			

	STORAGE LENGTH CALCULATION WORKSHEET - SIGNALIZED INTERSECTION From the ODOT Location & Design Manual (Vol. 1) - Sections 401-9E and 401-10E [Oct 2004]											
Date Compet	ed:		10/6/2015	5					$\Box$	- H	latch	Mott
Completed I	oy:	S	JT	Check	ed by:	S	SJB		m			onald
Project:				I-71 / SI	R82 IJS						-10.02	011010
Inters	ection:			Ho	we @ Shur	mer			Cycle	e Length Kn	own:	Yes
Approache	es Analyzed	d:		4					Сус	le Length (s	ec):	110
									S	ignal Phases	s:	
Approach:	9	Street Nam	e:		Design	Speed:				Cycles / Hr		33
Eastbound		Shurmer			2	25	mph	Notes:				
Westbound		I-71			3	35	mph	2035 PM Build	d Volumes			
Northbound		Howe			3	35	mph					
Southbound		Howe			3	35	mph					
	1	EB - Shurme	er		WB - I-71			NB - Howe			SB - Howe	<u> </u>
	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt
Volume:	100	0	50	520	90	210	50	660	0	0	440	50
Demand:	high		high	high		high	low		low	low		high
# Lanes:	1	1		1	1	1	1	2			1	1
Avg Veh/Cycle:	4	0	2	16	3	7	2	20	0	0	14	2
Condition:	A		A	A		A	A		Α	A		Α
Thru Backup:		#N/A			150		!	337.5			500	
L&D Length (ft) <sup>1</sup> :	225		150	600		325	150		#N/A	#N/A		150
95% Queue (ft) <sup>2</sup> :												
	EB Lt		EB Rt	WB Lt		WB Rt	NB Lt		NB Rt	SB Lt		SB Rt
Recommended Turn Length (ft) <sup>1</sup> :	225		-	600		350	150		-			
	1 in	cludes 50 ft to	iner	2	from SimTraf	fic	[croated h	w Hatch Mott M	acDonald1			ou 1/22/2012

Justifica	tion for Turn Lan	e Length Recomm	endations
		tbound	
Left:	225	Right:	-
	Wes	tbound	
Left:	600	Right:	350
	Nort	hbound	
Left:	150	Right:	-
	urn lane calculati	on due to low left impacts	turn
	Sout	hbound	
Left:	n/a	Right:	-
right turn	lane will form fro	om thru lane	

## Appendix E

**Cost Estimate** 

Summary of I71_SR82 Interchange Improvements Probable Costs  Build Condition				
Section		Cost		
Howe Road Off Ramp and Intersection Improvements	\$	4,700,000		
Howe Road Widening (5 lanes) North of Shurmer	\$	3,000,000		
Tot	al \$	7,700,000		

## I71\_SR82 Interchange Modification - Howe Road Off Ramp and Shurmer Intersection Preliminary Estimate of Probable Costs

ltems Control Control	Unit	Unit Cost \$ (2015)	Quantity	Total \$
General Construction Costs				
Primary Cost Drivers				
Roadway				
Clearing and Grubbing	Acre	\$2,200	1	\$2,200
Trees Removed	Acre	\$2,750	1	\$2,750
Pavement Removed  Drive Removed	Sq Yd	\$8	4,533	\$36,267
Walk Removed	Sq Yd Sq Ft	\$7 \$2	975 12,600	\$6,825 \$25,200
Excavation	Cu Yd	\$8	1,500	\$12,000
Embankment	Cu Yd	\$9	3,056	\$27,500
Guardrail	Ft	\$14	1,650	\$23,100
Curb	Ft	\$17	2,100	\$35,700
Concrete Walk (6' wide)	Sq Ft	\$6	12,600	\$75,600
Erosion Control				
Seeding & Mulching	Sq Yd	\$3	13,644	\$40,933
Erosion Control	Lump	\$10,000	1 17.0	\$10,000
Topsoil	Cu Yd	\$15	156	\$2,340
Drainage				
Type B Conduit	Ft	\$150	1,410	\$211,500
Catch Basins	Each	\$1,500	7	\$10,500
Manhole Underdrains	Each Ft	\$3,000 \$10	4,220	\$10,500 \$42,200
Officerurants	11	Ş10	4,220	342,200
Pavement				
Asphalt Pavement Ramps (3" Item 448, 9" Item 301, 6" Agg Base, Subgrade)	Sq Yd	\$45	7,408	\$333,350
Asphalt Pavement Roads (3" Item 448, 4" Item 301, 6" Agg Base, Subgrade)	Sq Yd	\$45	5,133	\$231,000
Drive Aprons (Concrete)	Sq Yd	\$55	975	\$53,625
Lighting Light Towers (Partial Interchange, every 500')	Each	\$40,000	4	\$160,000
	23011	ψ .0,000	·	<u> </u>
Traffic Control	Mile	\$200,000	0.60	\$120,100
Signage Edge Line	Mile	\$5,000	1.20	\$120,100
Lane Line	Mile	\$3,000	0.53	\$1,600
Center Line	Mile	\$6,000	0.60	\$3,600
Traffic Signals				
Traffic Signal - Howe/Shurmer/Ramp (Standard Urban Traffic Intersection)	Each	\$140,000	1	\$140,000
Noise Wall				
Noise Wall (assumed 16ft high)	Ft	\$500	720	\$360,000
Primary Cost Drivers Subtotal				\$1,985,000
Maintenance of Traffic (MOT) (3%)				\$60,000
Construction Layout Stakes (0.75%)				\$15,000
Field Office, Type B	Month	\$1,600	18	\$29,000
Mobilization				\$100,000
Contingencies (35%)				\$695,000
Summary of Probable Total Construction Costs 2015				\$2,884,000
Probable Total Construction Costs Including 15.5% Inflation for Oct 2019				\$3,331,020
Right of Way				
Right of Way Acquisition (Permanent)				\$400,000
Property Rights Acquisition (Limited Access Restriction)	Parcel	\$15,000	28	\$420,000
Engineering Costs (15% of Construction)				\$433,000
Construction Services (3% of Construction)				\$87,000
Summary of Probable Total Project Costs 2015			+ +	\$4,700,000
Juninary of Fromunic rotal Froject Costs 2015				₽ <del>4</del> ,700,000

# I71\_SR82 Interchange Modification - Howe Road Widening North of Shurmer Preliminary Estimate of Probable Costs

Items	Unit	Unit Cost \$ (2015)	Quantity	Total \$
General Construction Costs				
Primary Cost Drivers				
Filliary Cost Drivers				
Roadway				
Clearing and Grubbing	Acre	\$2,200	1	\$2,200
Trees Removed	Acre	\$2,750	1	\$2,750
Pavement Removed	Sq Yd	\$8	4,400	\$35,20
Drive Removed	Sq Yd	\$7	1,425	\$9,97
Walk Removed	Sq Ft	\$2	19,800	\$39,60
Excavation	Cu Yd	\$8	500	\$4,00
Embankment	Cu Yd	\$8	500	\$4,00
Curb	Ft	\$17	3,300	\$56,10
Concrete Walk (6' wide)	Sq Ft	\$6	19,800	\$118,80
Erosion Control				
Seeding & Mulching	Sq Yd	\$3	2,933	\$8,80
Erosion Control	Lump	\$10,000	1	\$10,00
Topsoil	Cu Yd	\$15	244	\$3,66
•		, ==		7 - 7 - 7
Drainage				
Type B Conduit	Ft	\$150	1,950	\$292,500
Catch Basins	Each	\$1,500	11	\$16,50
Manhole	Each	\$3,000	6	\$18,00
Underdrains	Ft	\$10	3,300	\$33,000
Pavement				
Asphalt Pavement Roads (3" Item 448, 4" Item 301, 6" Agg Base, Subgrade)	Sq Yd	\$45	11,000	\$495,00
Drive Aprons (Concrete)	Sq Yd	\$55	1,425	\$78,37
Traffic Control	9.41	4200.000	0.24	462.00
Signage	Mile	\$200,000	0.31	\$62,000
Edge Line	Mile	\$5,000	0.63	\$3,150
Lane Line Center Line	Mile Mile	\$3,000	0.63	\$1,890
Center Line	iville	\$6,000	0.31	\$1,860
Traffic Signals				
Traffic Signal - Howe/Tracy-Pomeroy (Standard Urban Traffic Intersection)	Each	\$140,000	1.00	\$140,000
Primary Cost Drivers Subtotal				\$1,438,000
. ,				, ,,
Maintenance of Traffic (MOT) (3%)				\$44,00
Construction Layout Stakes (0.75%)				\$11,000
Field Office, Type B	Month	\$1,600	12	\$20,000
Mobilization				\$40,00
Contingencies (35%)				\$504,000
Summary of Probable Total Construction Costs 2015				\$2,057,000
Probable Total Construction Costs Including 15.5% Inflation for Oct 2019				\$2,375,835
Right of Way				<b>A</b>
Right of Way Acquisition (Permanent)		+	+ +	\$220,00
Engineering Costs (15% of Construction)				\$309,00
Construction Services (3% of Construction)				\$62,000
Company of Duck while Tetal Businet Costs 2015			+ +	<b>62.000.001</b>
Summary of Probable Total Project Costs 2015				\$3,000,000

## **Right of Way Costs**

Total/major take parcel values

			, ,								
	Parcel	Stroot	Total Square	Total Value	Land Value			Take		Partial or	Cost
	Parcer	Street	Footage	Total value	Land value	width	length	area	land cost	Total	Cost
1	399-10-009	Howe Rd	349,786	\$194,600	\$141,400	150	550	82500	\$33,360.00	Partial	\$33,360.00
2	397-08-001	Howe Rd	33,541	\$38,700	\$38,700					Total	\$38,700.00
3	397-07-003	Shurmer Rd	60,480	\$68,900	\$68,900					Total	\$68,900
4	399-10-008	Howe Rd	67953	\$141,400	\$42,900					Total	\$141,400
											\$282,360

Parcels used to obtain average sq ft cost for partial takes

	Parcel	Street	Total Square Footage	Land Value	Avg. Sq Ft Cost
1	399-10-018	Howe Rd	51400	\$37,000	0.719844358
2	399-10-014	Howe Rd	39204	\$33,200	0.846852362
3	399-10-020	Howe Rd	41817	\$34,000	0.813066456
4	399-10-006	Howe Rd	40510	\$33,700	0.83189336
5	399-10-005	Howe Rd	59677	\$41,400	0.693734605

Avg. Cost 0.781078228 Sq Ft

#### Increase for land value appriciation, negotiations and acquisition cost. Use

3 Sq Ft

Total area of partial take

Location	Length	Width	Total Sq Ft Take
Shurmer Rd	350	20	7000
Howe Rd South of Intersection	350	20	7000
Howe Rd North of Intersection	2000	30	60000
Off Ramp along I71	1800	20	36000
			110000

Total partial take costs \$ 330,000

Total Right of Way costs \$620,000

(400,000 shown with Off Ramp, 220,000 shown on Howe)



FY 2015-2019 Business Plan Inflation Calculator:						
Not sure if you have the latest calculator? Click here.						
Last Modified: 7/25/2014  Please Enter Values in the Yellow Areas Only:	Today's Date: December 28, 2015					
Estimation Start Date: Less than or Equal to Today's Date (mm/dd/yyyy)	Enter Construction Mid-Point Date: (cannot exceed 06/01/2025) (mm/dd/yyyy)					
12/28/2015 Start Date:	10/1/2019 Construction Mid-Point Date:					
Present-Day Estimated Cost:  \$1.00 Estimated Dollar Amount:						
Estimate Start Date to Construction Mid-Poin Inflation - Start to Mid-Point of Construction						
(compounded growth rate)	Inflated Dollar Amount:					
Business Plan 15.5%	\$1.15					
Estimator's Name:						
County - Route - Section:						
PID:						
Estimator's Notes:						