Interchange Modification Study Addendum #1

Appendix

November 2021

APPENDIX A

ORIGINAL IMS DOCUMENT

U.S. Department of Transportation
Federal Highway Administration

Ohio Division

200 North High Street, Rm 328
Columbus, Ohio 43215
614-280-6896
614-280-6876
@dot.gov

January 18, 2011

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 January 6, 2012 request for FHWA Ohio Division to review and approve the *MAD-70-10.27 at SR-29 Interchange Modification Study (IMS)*. This IMS proposes to modify the interchange at SR 29 at I-70 in Madison County to mitigate increased traffic due to a private development on the SR 29 corridor. The interchange will be modified in Opening Day by installation of a single lane roundabout at the westbound ramp intersection, addition of a left turn lane on the eastbound off ramp and relocation of the Snyder Road intersection with SR 29. The final build condition will include construction of dual lane roundabouts at both ramp intersections and widening the SR 29 structure over I70.

Based on the data provided in the Interchange Modification Study dated February 2010 and revised December 2011, *FHWA conditionally approves the modification to the I-70 interchange at SR 29*. The modifications will not have a significant adverse impact on the operation of the Interstate facility based on current and future traffic.

Please note that the final approval of the Interchange Modification Study is conditional on the completion of the NEPA process and the fulfillment of planning requirements.

If you have any questions or comments, please contact Sara Lowry, Transportation Engineer, at (614) 280-6835, or Sara.Lowry@dot.gov.

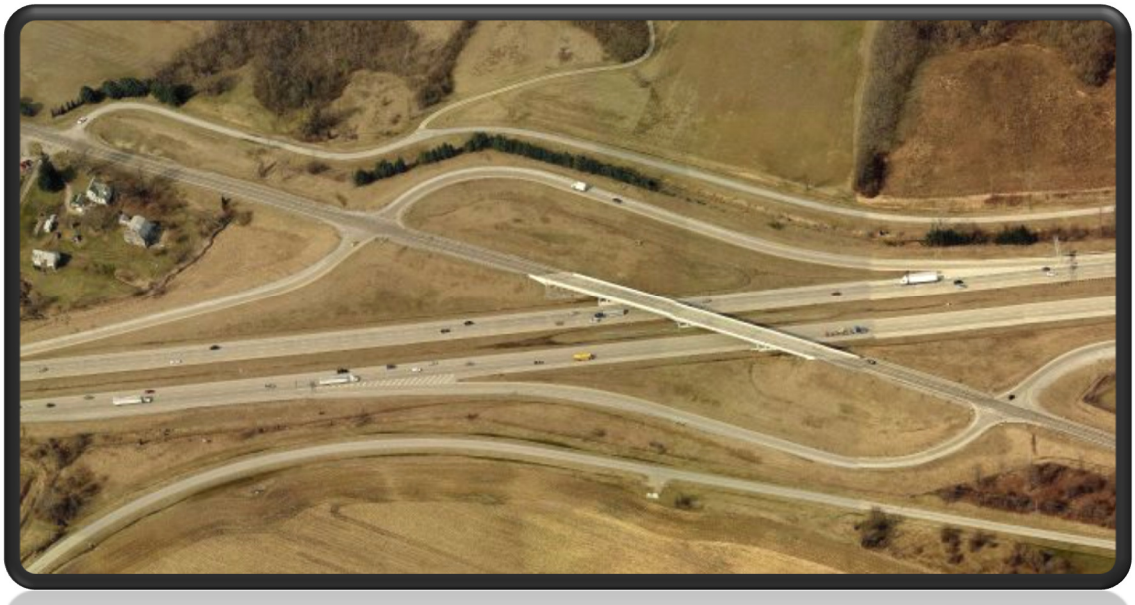
Sincerely,

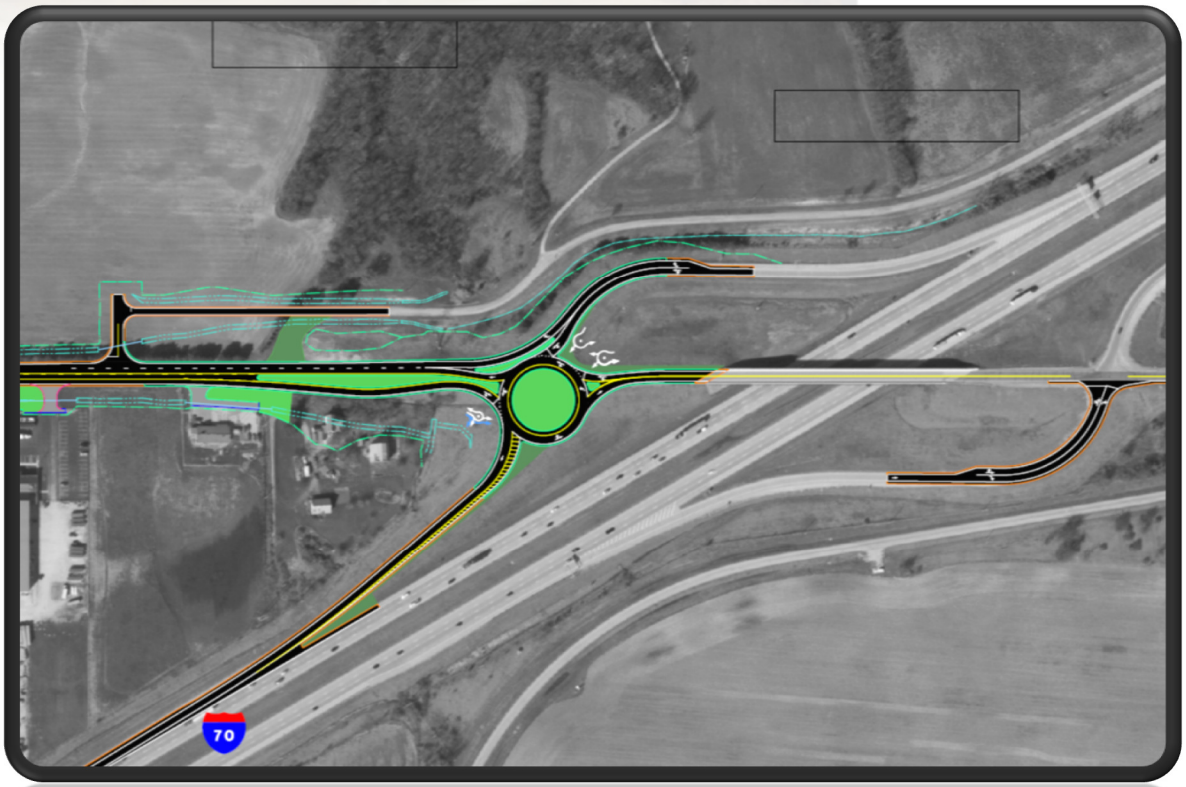
For: Laura S. Leffler
Division Administrator

e-cc: A. Blalock
S. Lowry
Dirk Gross, ODOT ORES
Heather McColeman, ODOT ORES

File: MAD-83245/Design

Interchange Modification Study
IR-70 at SR 29
MAD-70-10.27
PID 83245





Interchange Modification Study
IR-70 at SR 29
MAD-70-10.27
PID 83245

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I. Executive Summary:

The goal of this study is to demonstrate the impacts to mainline IR-70 resulting from the needed improvements of the interchange at SR 29. Proposed commercial development on the SR 29 corridor will cause degradation to the SR 29 interchange ramp intersections. This project originated as a permit for site drive improvements along SR 29 and thus is privately funded by the developers who own property along the corridor. ODOT has participated thru a cooperative effort to identify the most economical solution for mitigation of the development traffic based upon the resulting traffic volumes.

In order to facilitate a timely response to the increased traffic using the interchange while considering the funds available, the Department has opted to build the project in two phases. Opening Day (Phase I) conditions will include construction of a single lane roundabout at the westbound ramp intersection, addition of a left turn lane on the eastbound off ramp and relocation of a local road intersection (Snyder Road) with SR 29. The final build condition will include construction of dual lane roundabouts at both ramp intersections and widening of the SR 29 structure over IR-70. Both build conditions are shown in Figures 2 and 3 in Appendix B.

II. Background:

The proposed project originated as an access permit application submitted to ODOT by the Village of West Jefferson to install a traffic signal and turn lane at the intersection of State Route 29 and Commerce Parkway. Two Traffic Impacts Studies were completed in 2007 by private developers owning 879 acres of land located on the south side of SR 29 with existing or planned warehouse and distribution facilities. In order to assess the impacts to State Route 29 and the adjacent Interstate 70 and State Route 29 interchange, ODOT requested these traffic studies be combined in order to fully evaluate the impacts to this interchange. The combined Traffic Impact Study included placeholder traffic to address traffic generated by an approximately 120 acre parcel on the north side of SR 29, adjacent to the interchange. Existing warehouse/logistics facilities currently exist within the proposed project area for Target Stores, Restoration Hardware, Fed Ex, Kellogg Company, Staples/Quill, BST, Inc. Electric U.S. Inc., Gramag and others. The TIS is available in electronic format upon request.

The Mid-Ohio Regional Planning Commission completed the 2030 Thoroughfare Plan for the Village of West Jefferson. This thoroughfare plans show that the land use around the interchange will be warehouse and distribution facilities. Traffic congestion will result from the development around the interchange and the vicinity of West Jefferson if nothing is done.

An agreement between ODOT and two private developers who own land along State Route 29 allocated $3.5 million to mitigate the impacts of the increased traffic from the existing and proposed warehouse developments. This funding is set to expire in August of 2012. Therefore this project is being constructed in two phases. Phase I is fundable based upon the monies available from the developers and meets the traffic needs of opening day conditions.

III. Purpose and Need:

The purpose of this project is to accommodate existing and future traffic demands generated by existing and committed development occurring near the Interstate 70 and State Route 29 interchange.

The project is needed because approximately 1,000 acres of land adjacent to the Interstate 70 and State Route 29 interchange have or will be developed into warehouse/distribution facilities. The resulting increase in traffic will result in a failing Level of Service at the ramp intersections if no improvements are built[1].

IV. Study Area:

SR 29 in Madison County crosses the county in a south-easterly direction and is classified as a major rural collector throughout. The route is a 2 lane facility which has a posted speed of 55 MPH and terminates at US 40 just southeast of the interchange at IR-70. The interchange is at milepost 10.27 of Interstate 70 and milepost 10.61 of SR 29 and lies just northwest of the Village of West Jefferson. SR 29 provides the main access into the Village of West Jefferson from the interstate and also services the growing industrial area that the Village has worked to grow.

[1] Text for Background and Purpose and Need provided by District 6, Environmental Section, Planning and Engineering

Included in the Study Area are the adjacent interchanges. They are US 142 to the east and US 42 to the west along IR-70. Refer to Figure 1.

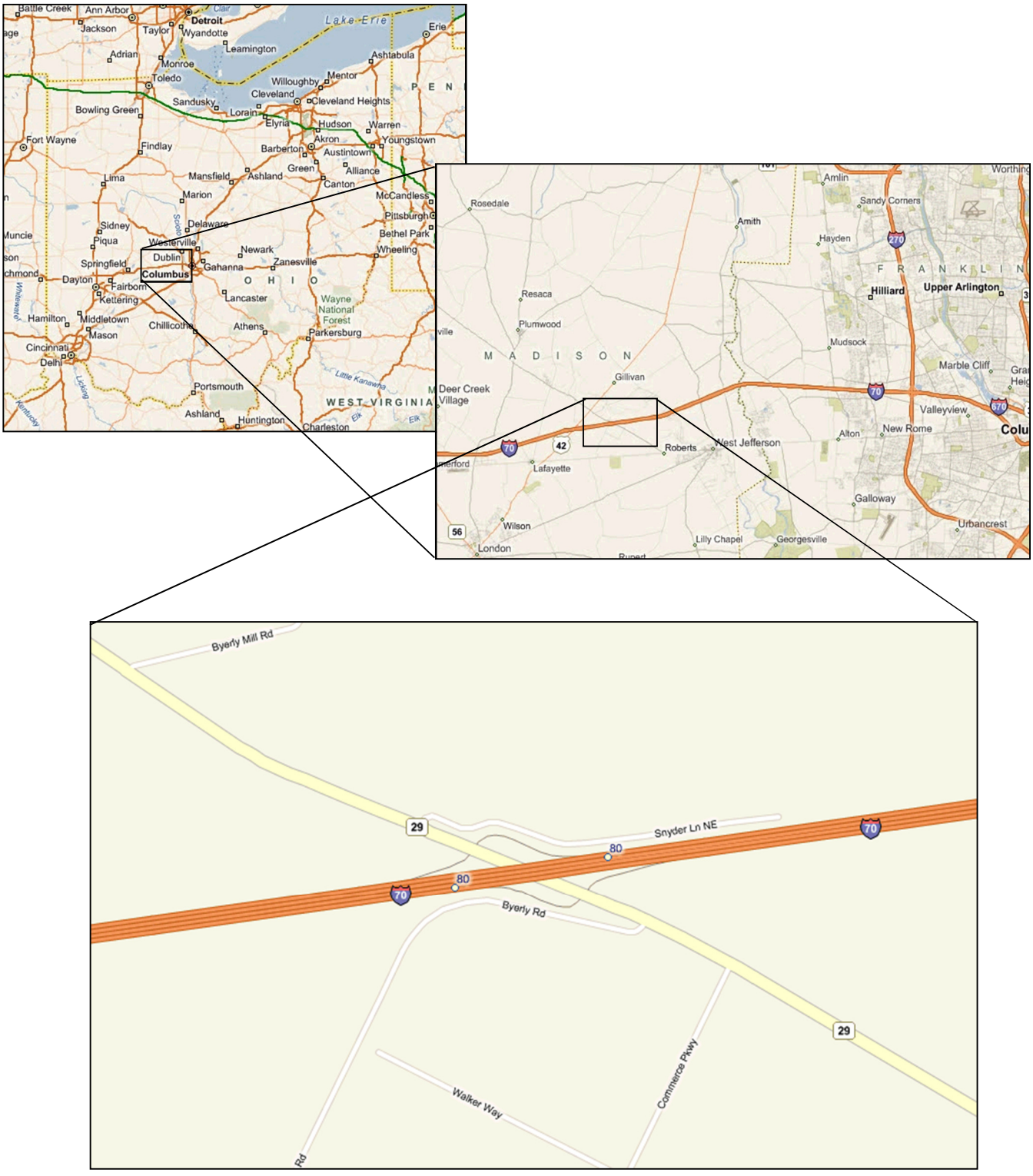


Figure 1 – Location Map

V. Analysis Years:

Opening Year for the project is 2010 with the Design Year established as 2030. The No Build condition for this study is defined as the existing diamond interchange which includes ramps that operate under stop control. The Opening Day build condition is presented in Figure 2 and consists of a single lane roundabout at the westbound ramps intersection and the addition of a left turn lane at the eastbound ramps. The Design Year Build condition is a two-lane roundabout at both ramp intersections, referred to as double roundabouts, and is presented in Figure 3. Construction of the Design Year Build Condition requires widening of the SR 29 structure over IR-70.

VI. Alternatives Considered:

The interchange solutions that were considered were a diamond interchange and the double roundabout interchange. Both options require a modification to the existing 2-lane bridge. The expanded diamond would have required the bridge to be widened for the opening day build condition as side by side left turn lanes are required on the structure. The projected cost of the diamond interchange is approximately $10M. Conversely, the roundabout option allows for an affordable phased design which works with the existing 2-lane bridge, will mitigate the additional traffic for opening day operations and provide a long term solution when the traffic volumes necessitate. The roundabout will be based upon design speeds of 35 MPH and will be lit.

No other solutions were examined given the constraints of the cost of expanding the 2-lane bridge.

VII. Existing Conditions:

a. Road Geometry & Access Locations

SR 29 is a northwest - southeast roadway with a posted speed of 55 MPH. The facility is a 2-lane major collector highway originating in West Jefferson at US 40. The roadway connects to Mechanicsburg and other parts of western Ohio. Both ramp intersections are stop controlled.

IR-70 is a major east – west facility spanning the entire state. The speed limit on this section of interstate is 65 MPH. The interstate is a 6-lane principal arterial interstate.

b. Crash Data

Crash mitigation is not part of the purpose and need of this project. An examination of ODOT's Safety Hot Spots did not identify any areas of high crashes within the projects limits.

c. Land Use

The land use in the immediate study area is mostly warehousing space, especially to the south of the interchange. There are numerous existing and future developments which are in burgeoning states of development.

d. Environmental Conditions

The closest noteworthy environmental area is the Big Darby watershed. This project will not impact the boundary of the watershed.

VIII. Traffic Volumes:

Certified traffic was provided by the ODOT Office of Technical Services. As mentioned previously, the opening year for this traffic is 2010, and the design year is 2030. Refer to Appendix A for a copy of the certified traffic.

IX. Traffic Analysis:

Based upon Certified Traffic, Highway Capacity Software (HCS) was used to analyze the mainline IR-70 operations and the ramp intersection operations at the SR 29 interchange. The proposed roundabouts were analyzed utilizing Sidra Software.

a. Freeway Section Analysis

Five sections of IR-70 mainline were analyzed for the AM and PM peak hour volumes in both directions. The mainline sections were analyzed from US 42 to SR 142. The results of these analyses are summarized in Table 1. The traffic analyses were run for the Opening Day and Design Year demand volumes since phased improvements are proposed.

Since the ramp intersections are currently operating under stop control there can be no existence of constrained traffic. Therefore the No Build and Build mainline traffic volumes are identical and are unaffected by the ramp intersection operations when comparing the mainline No Build Condition to the Build Condition. The mainline operations exhibit a Level of Service (LOS) of D at two locations in the Design Year. However, this section of the interstate has recently been improved thru an add lane project and consists of three lanes in each direction. To obtain a LOS of C would require tens of millions of dollars and would increase the cost and scope of this project beyond the current purpose and need.

Table 1: HCS Freeway Section Levels of Service

Location	AM		PM	
	2010	2030	2010	2030
EB IR-70 Middle of US 42 (#2)	A	B	B	B
EB IR-70 East of US 42 (#4)	B	B	B	C
EB IR-70 Middle of SR 29 (#6)	A	B	B	B
EB IR-70 East of SR 29 (#8)	B	B	B	C
EB IR-70 Middle of SR 142 (#10)	B	B	B	C
WB IR-70 Middle of SR 142 (#13)	A	B	C	D
WB IR-70 East of SR 29 (#15)	A	B	C	D
WB IR-70 Middle of SR 29 (#17)	A	A	B	C
WB IR-70 East of US 42 (#19)	A	A	C	C
EB IR-70 Middle of US 42 (#21)	A	A	B	C

Please refer to Appendix C for the Freeway Section HCS Analyses. The freeway operations will not be degraded with the recommended improvements on SR 29.

b. Ramp Junction Analysis

Merge and diverge analyses were conducted for all ramps associated with the SR 29, US 42, and SR 142 interchanges along IR-70. Please refer to Tables 2 and 3 for a summary of these analyses.

Table 2: HCS Merge Levels of Service

Location	AM		PM	
	2010	2030	2010	2030
EB IR-70 & US 42 (#3)	B	C	B	C
EB IR-70 & SR 29 (#7)	B	B	C	C
EB IR-70 & SR 142 (#11)	B	C	B	C
WB IR-70 & SR 142 (#14)	B	B	C	D
WB IR-70 & SR 29 (#18)	B	B	C	C
WB IR-70 & US 42 (#22)	B	B	B	C

Table 3: HCS Diverge Levels of Service

Location	AM		PM	
	2010	2030	2010	2030
EB IR-70 & US 42 (#1)	B	B	B	C
EB IR-70 & SR 29 (#5)	B	C	B	C
EB IR-70 & SR 142 (#9)	B	B	B	C
WB IR-70 & SR 142 (#12)	B	B	C	D
WB IR-70 & SR 29 (#16)	B	B	C	D
WB IR-70 & US 42 (#20)	B	B	C	D

Please refer to Appendix D for HCS Merge and Diverge Analyses.

c. Ramp Intersection Analysis

The intersections of the IR-70 Ramps at SR 29 were analyzed using HCS and Sidra software. These analyses are summarized in Tables 4 and 5.

The Opening Day build condition includes a single lane "expandable" roundabout at the IR-70 westbound ramp intersection and the addition of a right turn lane on the eastbound off ramp. As can be seen by the No Build intersection analyses, the westbound ramp exhibits the highest delay, thus it was selected as the critical intersection for applying mitigative measures.

The proposed IR-70 westbound ramp single lane roundabout will operate extremely well under the Opening Day traffic volumes. The eastbound IR-70 eastbound off ramp is improved over the no build condition for Opening Day traffic volumes and indicates marked improvement for the off ramp heavy right turning volumes.

The Design Year build condition includes dual lane roundabouts at both ramp intersections which will necessitate the expansion of the SR 29 Bridge. The Design Year build condition operates at acceptable or better levels of service.

Please refer to Appendix E and F for the HCS and Sidra Intersection Analyses, respectively.

Table 4: HCS Intersection Levels of Service of SR 29 at the IR-70 WB Ramps

Condition	WB IR-70 Off Ramp (LOS/Delay)			SR 29 (LOS/Delay)				Critical Approach or Total Intersection (LOS/Delay)
	WBL	WBT	WBR	NBL	NBT	SBT	SBR	
2010 AM No Build	F/160.1	F/160.1	F/160.1	A/8.5	A/8.5	N/A	N/A	F/160.1
2010 AM Build	B/14.8	B/14.8	N/A	A/5.2	A/5.2	C/22.9	C/22.9	C/15.2
2010 PM No Build	F/531.3	F/531.3	F/531.3	A/8.7	A/8.7	N/A	N/A	F/531.3
2010 PM Build	C/18.1	C/18.1	N/A	A/8.1	A/8.1	C/15.6	C/15.6	B/11.0
2030 AM No Build	F/748.1	F/748.1	F/748.1	A/8.8	A/8.8	N/A	N/A	F/748.1
2030 AM Build	C/27.8	C/27.8	N/A	A/4.1	A/4.1	B/14.0	B/13.7	B/18.9
2030 PM No Build	F/2950	F/2950	F/2950	A/9.7	A/9.7	N/A	N/A	F/2950
2030 PM Build	C/33.8	C/33.8	N/A	A/5.8	A/5.8	B/12.8	B/12.5	B/14.9

Table 5: HCS Intersection Levels of Service of SR 29 at the IR-70 EB Ramps

Condition	EB IR-70 Ramp (LOS/Delay)			SR 29 (LOS/Delay)				Critical Approach or Total Intersection (LOS/Delay)
	EBL	EBT	EBR	NBR	NBT	SBT	SBL	
2010 AM No Build	E/44.0	E/44.0	E/44.0	N/A	N/A	A/8.6	A/8.6	E/44.0
2010 AM Build	D/30.3	D/30.3	D/28.9	N/A	N/A	A/8.6	A/8.6	D/29.0
2010 PM No Build	D/27.4	D/27.4	D/27.4	N/A	N/A	B/11.9	B/11.9	D/27.4
2010 PM Build	E/42.7	E/42.7	C/16.4	N/A	N/A	B/11.9	B/11.9	C/18.5
2030 AM No Build	F/430.9	F/430.9	F/430.9	N/A	N/A	A/9.5	A/9.5	F/430.9
2030 AM Build	A/7.6	A/7.6	C/34.5	A/7.0	A/5.9	A/8.2	A/8.2	B/13.5
2030 PM No Build	F/494.2	F/494.2	F/494.2	N/A	N/A	C/21.2	C/21.2	F/494.2
2030 PM Build	A/6.4	A/6.4	B/18.6	C/29.5	B/12.6	A/7.6	A/7.6	B/16.6

d. Turn Lane Length Determination

Tables 6 and 7 provide the queue lengths based upon the ODOT Location and Design Manual, Figure 401-10 and the Sidra output files as appropriate. The opening day queue for the eastbound off ramp is based upon an unsignalized condition. The opening day queue length for the westbound ramp and the design year queue lengths for both ramps are taken from the Sidra output files.

At the eastbound off ramp, the longest queue length occurs for the opening day condition and shall be constructed as such and will remain for the final build condition. Conversely, the queue length at the westbound off ramp occurs under design year conditions. However, the design year condition will be used to determine the bypass lane length for the opening day condition. This will be done to lessen future construction impacts to the off ramps. Providing more storage than necessary will not adversely affect the opening day operations. Table 8 provides the turn lane lengths for the exit ramp

intersections. All turn lane lengths include the 50 foot taper. Refer to Appendix G for the queuing and turn lane length calculations.

Table 6: Queue Lengths for Intersection of SR 29 at the IR-70 WB Ramps

Condition	Off Ramp (FT)		SR 29 (FT)	
	WBL/T	WBR	NB	SB
No Build Available Storage	1425 (ramp length)		1260*	615*
Opening Day AM	80	Free	0	107
Opening Day PM	91	Free	0	50
Design Year AM	178**	Free	0	37
Design Year PM	169	Free	0	27

*Distance to adjacent intersection/driveway **Controls

Table 7: Queue Lengths for Intersection of SR 29 at the IR-70 EB Ramps

Condition	Off Ramp (FT)		SR 29 (FT)	
	EBL/T	EBR	SB	NB
No Build Available Storage	1320 (ramp length)		1260*	688*
Opening Day AM	50	200**	N/A	N/A
Opening Day PM	50	175	N/A	N/A
Design Year AM	3	112	0	31
Design Year PM	3	70	0	372

*Distance to adjacent intersection/driveway **Controls

Table 8: Turn Lane Lengths for Ramp Intersections

Location	Left/Thru (FT)	Right (FT)
WB Off Ramp	N/A	230
EB Off Ramp	250	N/A

e. Summary of Results

In summation, the recommended improvements will not cause degradation of the mainline as defined in the ODOT Location and Design Manual, Section 550.1. The modifications that are recommended will provide the necessary capacity and storage improvements required to mitigate the impacts of the proposed development traffic.

f. Relocation/Closure of Roadways

Two roadways adjacent to the interchange will need to be modified to promote good access management. Snyder Lane will be relocated to meet the recommended drive spacing of ODOT's Location and Design Manual Volume 1, Section 801.2. The bypass lane which is being proposed on the IR-70 westbound ramp roundabout in the northbound direction will be merging downstream. The relocation will provide adequate distance for the merge to occur prior to the access point.

Byerly Road to the south of the eastbound ramp intersection is under the control of the Madison County Engineer's Office. Byerly Road has access to US 40 at the other end so this roadway shall be closed as part of the final phase of the project in order for the eastbound ramp roundabout to operate efficiently.

X. Cost Estimate:

The cost of construction for Phase 1 is estimated at roughly $3.4 million. The Right-of-Way costs for Phase I are an additional $600,000. The funds secured thru the developer agreement are $3.5 million. The District has available 629 State Funds for any funding shortfalls, if they exist. Phase II has been estimated at approximately $8.4 million. Phase II is currently planned to be constructed by capturing the future value of development. The detailed cost itemization for both phases is included in Tables 9 and 10.

Table 9: Phase 1 Cost Estimate

Category	Qty	Unit	$/Unit	$
Pavement	1	Lump	1,066,776.77	1,066,777.00
Curb & Gutter, Type 2	6212	Ft	14.00	86,968.00
Earthwork				
Excavation	22848	Cu Yd	6.75	154,224.00
Embankment	21322	Cu Yd	5.50	117,271.00
Drainage				
Closed System	2000	Ft	200.00	400,000.00
Erosion Control (1)	1	Lump	105,000.00	105,000.00
Lighting	4	Each	32,500.00	130,000.00
Traffic Control	1	Lump	261,363.00	261,363.00
Utility Relocation (2)	1	Lump	41,000.00	41,000.00
Maintenance of Traffic (3)	1	Lump	70,878.09	70,879.00
Design Contingency (4)	1	Lump	365,022.30	365,023.00
Construction Inspection (5)	1	Lump	279,850.50	279,851.00
Inflation (6)	1	Lump	317,071.00	317,071.00
Total				**$3,395,427.00**

(1) Includes seeding & mulching, erosion control, soil analysis, water, BMP's etc.
(2) Taken from original cost estimate
(3) 3% of total cost
(4) 15% of total cost
(5) 10% of total cost
(6) 10.3% of total cost (assumed construction mid-point of July, 2013)

Table 10: Phase 2 Cost Estimate

Category	Qty	Unit	$/Unit	$
Pavement	1	Lump	719,299.77	719,299.77
Curb & Gutter, Type 2	6930	Ft	14.00	97,020.00
Earthwork				
Excavation	18307	Cu Yd	7.00	128,149.00
Embankment	11173	Cu Yd	6.00	67,038.00
Drainage				
Closed System	2000	Ft	200.00	400,000.00
Erosion Control (1)	1	Lump	45,000.00	95,000.00
Lighting	4	Each	32,500.00	130,000.00
Traffic Control	1	Lump	262,919.00	262,919.00
Bridge (2)	22880	Sq Ft	180.00	4,118,400.00
Maintenance of Traffic (3)	1	Lump	180,534.77	180,535.00
Design Contingency (4)	1	Lump	821,859.15	821,860.00
Construction Inspection (5)	1	Lump	620,390.10	620,391.00
Inflation (6)	1	Lump	786,984.00	786,984.00
Total				**$8,427,596.00**

(1) Includes seeding & mulching, erosion control, soil analysis, water, BMP's etc.
(2) Includes approach slabs
(3) 3% of total cost
(4) 15% of total cost
(5) 10% of total cost
(6) 10.3% of total cost (assumed construction mid-point of July 2013)
(7) Assumed all utility relocations completed in Phase 1

XI. Environmental Impacts:

There are no significant environmental impacts identified for the full build condition of this project. The only substantial right-of-way being acquired for this project is for the relocation of Snyder Lane which will be aligned on a small portion of an existing disturbed farm field. The Draft Categorical Exclusion Level 3 Document is based upon the full Build condition and is subject to ongoing public coordination. The CE Level 3 is being prepared by ODOT's District 6 environmental team.

XII. Recommendations:

Due to funding constraints, there is need for a phased improvement plan for the interchange. As already stated, the Department and the Village of West Jefferson have worked to secure funding from the developers involved. The Opening Day build condition includes construction of a single lane roundabout at the westbound ramp as this ramp exhibits the greatest delay if no improvements are constructed. At this time, ODOT and the Village have obtained the necessary funds from the developers to move forward.

ODOT has committed that another bridge will be added to provide two lanes in each direction on SR 29. This will also require that the roundabout on the north side of the interchange will be expanded along with a new roundabout on the south side of the interchange. Funding for this phase will need to be determined. The northern roundabout has been sized to accommodate conversion to a dual lane roundabout. As part of the Phase 1 construction project, Snyder Lane will be relocated approximately 700 feet north of the roundabout.

Based on the analyses, the recommended improvements to the ramps do not degrade freeway operations within the study area. The SR 29 corridor will need to be monitored in the future years to assure that the ramp terminals are operating adequately.

The Opening Day improvements will be implemented in 2013.

Appendix A

Certified Traffic

INTER-OFFICE COMMUNICATION

TO: James Young, P.E., Office of Roadway Engineering Services

FROM: Leigh A. Oesterling, Project Analyses Admin., Office of Technical Services

SUBJECT: MAD-70-10.27 (SR 29 IMS) PID 83245

DATE: November 8, 2007

In reply to a request dated September 4, 2007, attached are a set of plates showing ADT, A.M. and P.M. design hour volumes for the subject project. If needed K and D factors can be derived from the attached plates.

Please use the following truck factors.

			IR 70		SR 29	
	w/o US 42	w/o SR 29	w/o SR 142	e/o SR 142	n/o IR 70	s/o IR 70
T24:	0.39	0.36	0.34	0.32	0.11	0.20
TD AM:	0.33	0.31	0.29	0.27	0.07	0.17
TD PM:	0.23	0.22	0.20	0.19	0.07	0.12

RAMPS

IR 70 @ SR 142

	WB Off	WB on	EB Off	EB on
T24:	0.05	0.10	0.10	0.04
TD AM:	0.06	0.10	0.04	0.02
TD PM:	0.02	0.01	0.05	0.03

IR 70 @ SR 29

	WB Off	WB on	EB Off	EB on
T24:	0.23	0.16	0.18	0.21
TD AM:	0.29	0.20	0.20	0.15
TD PM:	0.18	0.04	0.07	0.15

IR 70 @ US 42

	WB Off	WB on	EB Off	EB on
T24:	0.28	0.45	0.48	0.27
TD AM:	0.32	0.44	0.49	0.23
TD PM:	0.18	0.33	0.45	0.18

If you have any questions, please contact me at (614) 752-5747.

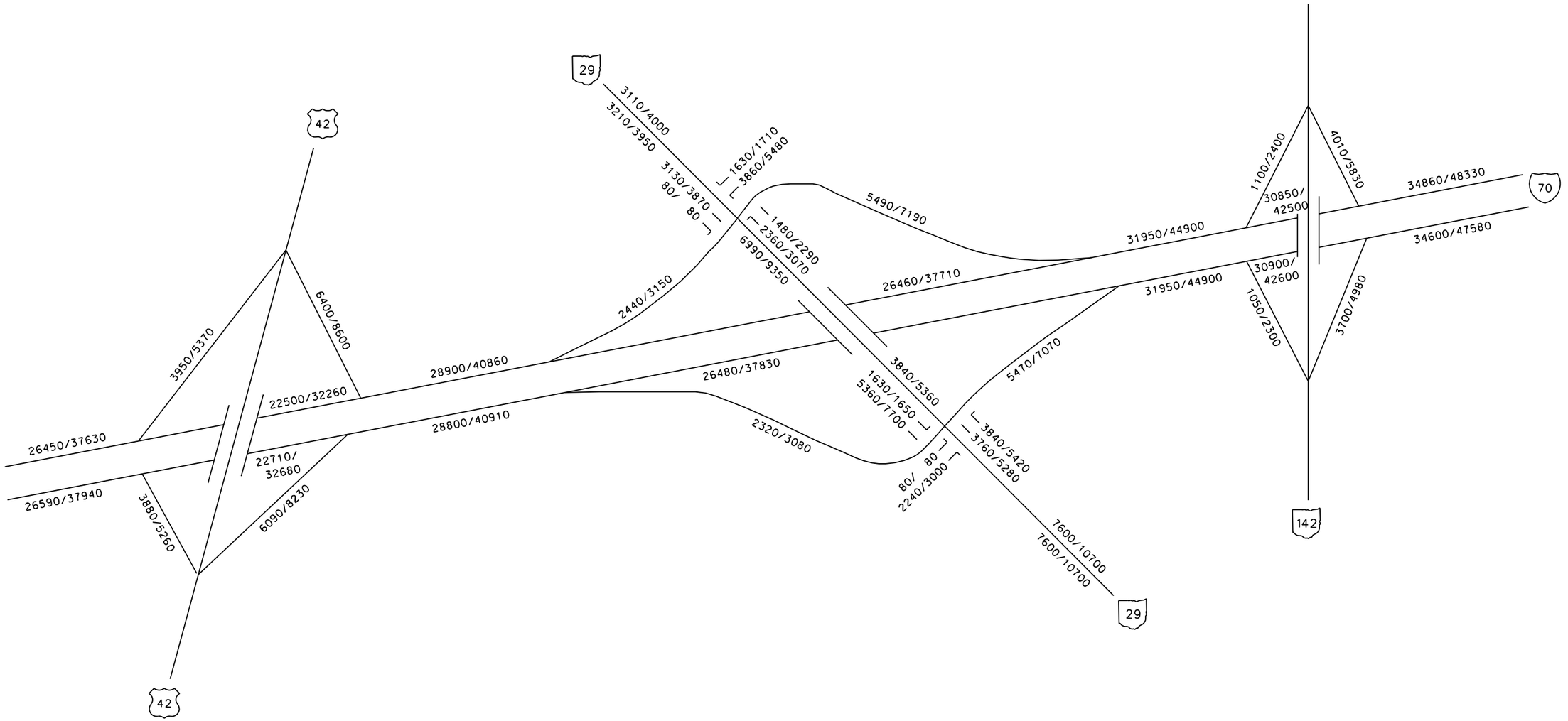
LAO

LAO:lo

c: J. McQuirt, OTS–P. Siddle, OTS–File

MAD–70–10.27
PID 83245
PLATE 1 OF 3

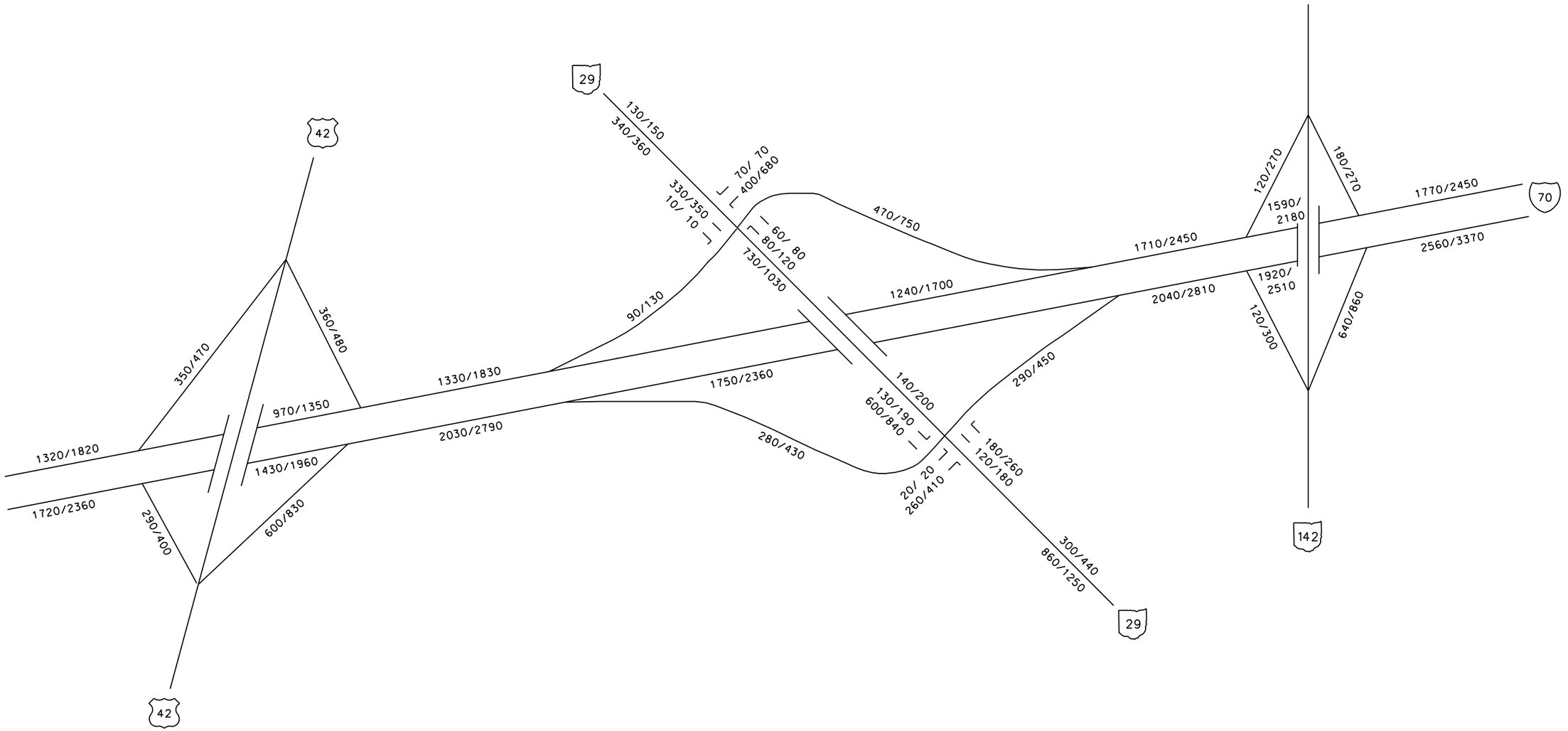
Build



MAD–70–10.27 PID–83245 IMS	
2010/2030 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

MAD–70–10.27
PID 83245
PLATE 2 OF 3

Build



MAD–70–10.27 PID–83245 IMS	
2010/2030 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

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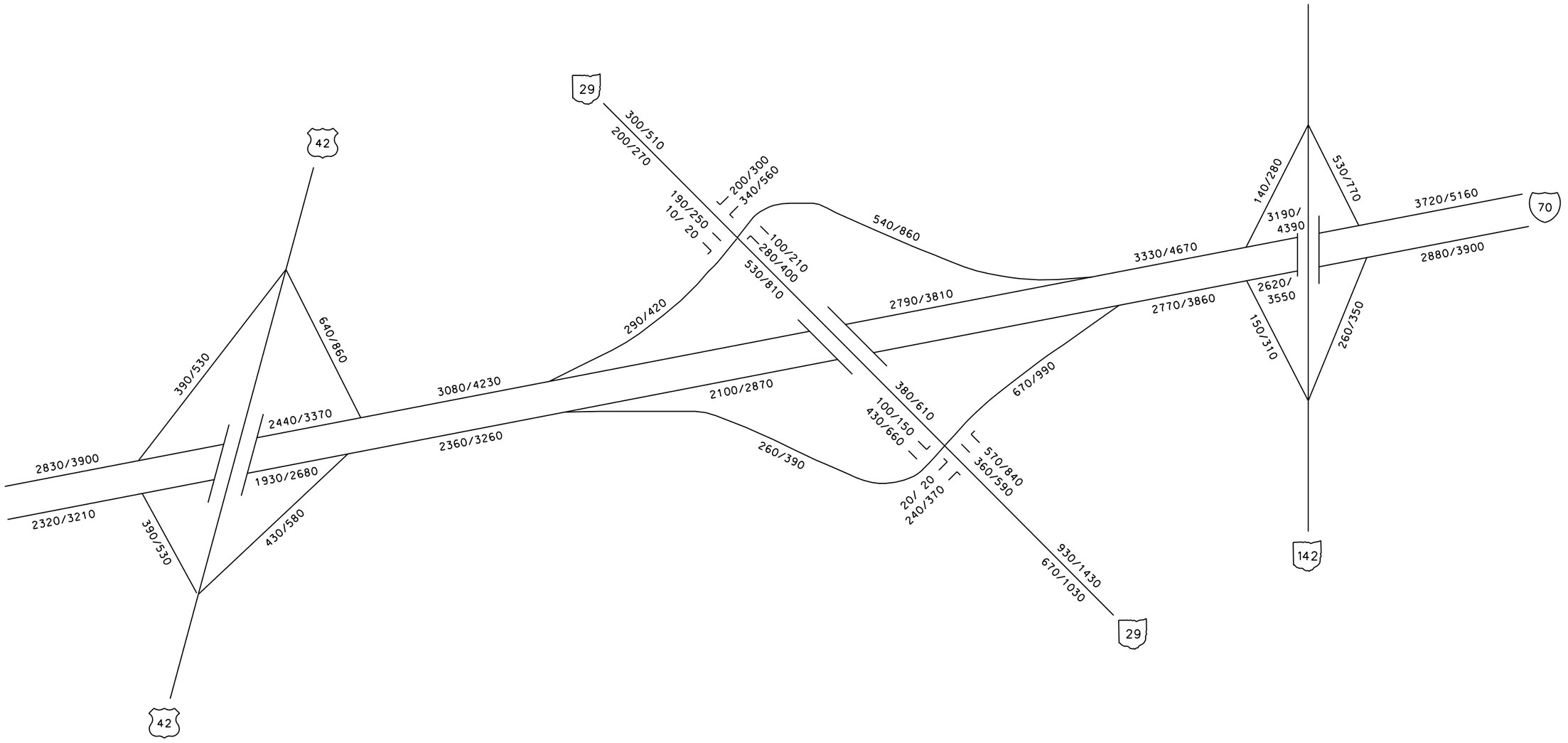
MAD–70–10.27
PID 83245
PLATE 3 OF 3

Build



MAD–70–10.27 PID–83245 IMS	
2010/2030 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

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Appendix B

Opening Day and Design Year Figures

PREPARED BY:
ODOT
OFFICE OF ROADWAY ENGINEERING

PRELIMINARY CONCEPT
S.R. 29 & I.R. 70
INTERCHANGE IMPROVEMENTS

SR 29
INTERCHANGE

ROUNDABOUT

EXISTING
STRUCTURE

29

70

29

70

N

0 250
125 500

SCALE IN FEET

FIGURE 2:
OPENING DAY LAYOUT

PREPARED BY:
ODOT
OFFICE OF ROADWAY ENGINEERING

PRELIMINARY CONCEPT
S.R. 29 & I.R. 70
INTERCHANGE IMPROVEMENTS

SR 29
INTERCHANGE

ROUNDABOUT

EXISTING
STRUCTURE

PROPOSED
STRUCTURE

ROUNDABOUT

29

70

70

29

N

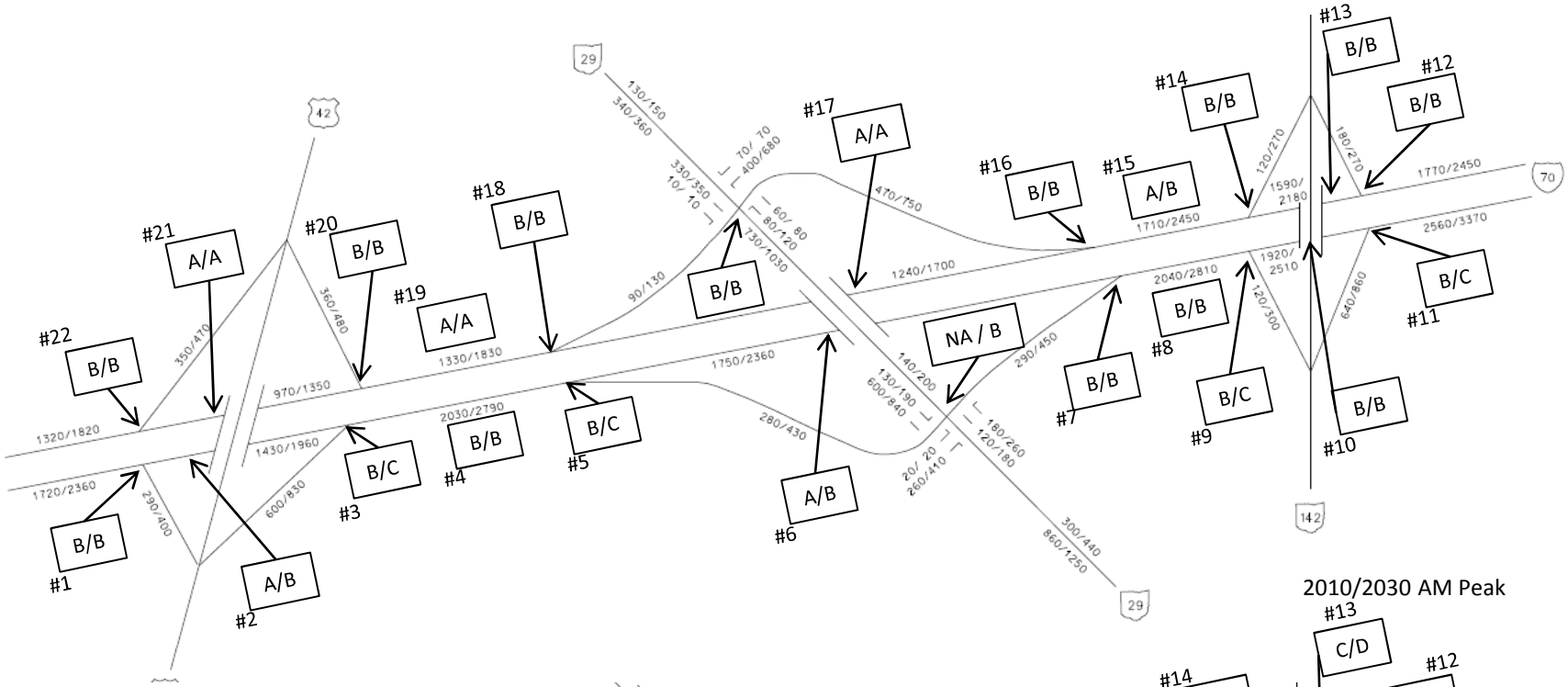
0 250
125 500

SCALE IN FEET

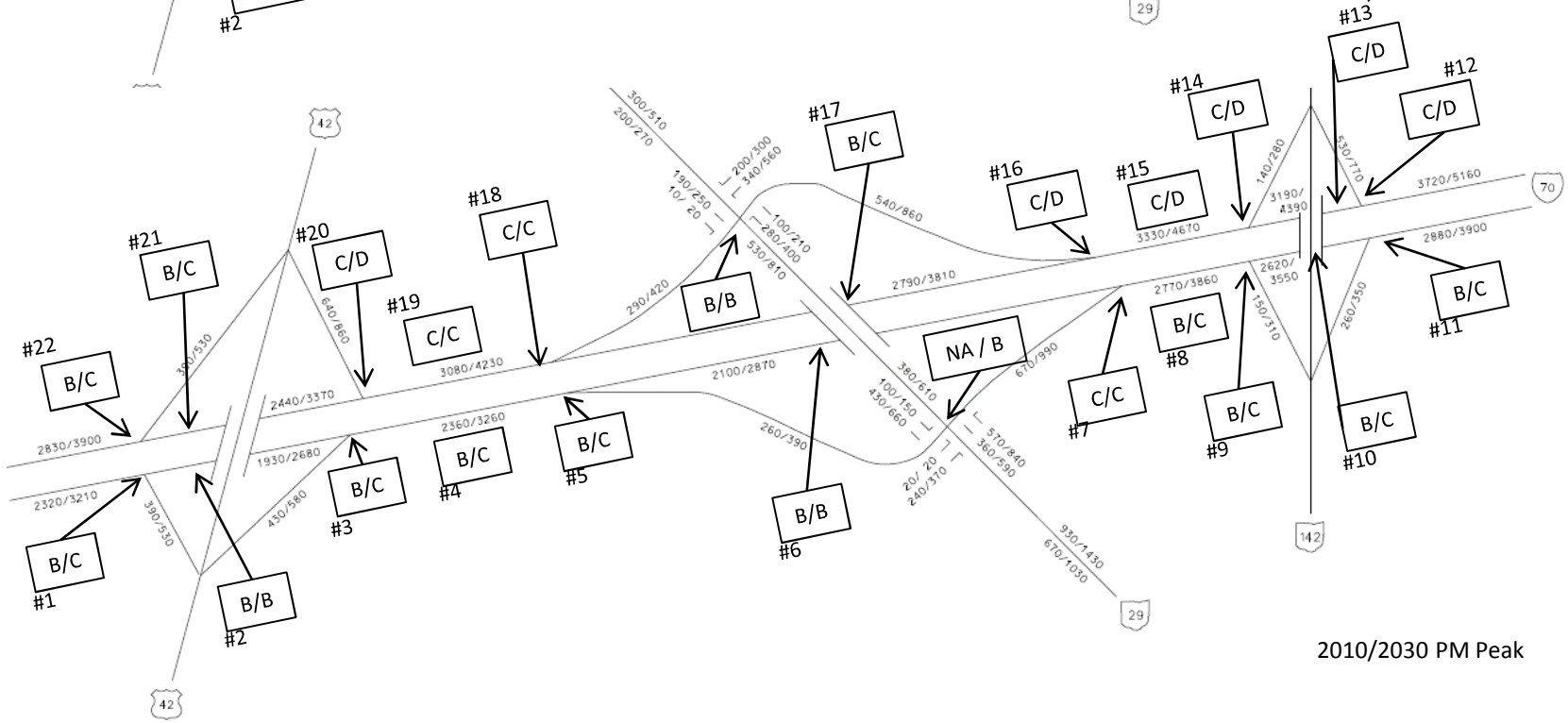
FIGURE 3:
DESIGN YEAR LAYOUT
INTERCHANGE ROUNDABOUTS

Appendix C

HCS
Freeway Mainline Analyses



2010/2030 AM Peak



2010/2030 PM Peak

2010 AM Freeway HCS Analyses

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #21
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	970	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	269	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	404	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	404	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	5.8	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #19
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1330	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	369	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	554	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	554	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	7.9	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #17
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1240	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	344	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	517	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	517	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	7.4	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #15
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 142 and SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1710	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	475	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	713	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	713	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	10.2	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #13
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1590	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	442	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	663	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	663	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	9.5	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #10
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1920	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	533	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	800	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	800	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	11.4	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29 and SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2040	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	567	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	850	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	850	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	12.1	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1750	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	486	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	729	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	729	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	10.4	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #4
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2030	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	564	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	846	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	846	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	12.1	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1430	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	397	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	596	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	596	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	8.5	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

2010 PM Freeway HCS Analyses

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #21
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2440	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	678	v
Trucks and buses	23	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.897	
Driver population factor, fp	1.00	
Flow rate, vp	1008	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1008	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	14.4	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #19
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3080	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	856	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	1266	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1266	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	18.1	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2790	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	775	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	1147	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1147	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	16.4	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #15
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 142 and SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3330	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	925	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1357	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1357	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	19.4	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #13
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3190	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	886	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1300	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1300	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	18.6	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #10
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2620	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	728	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1067	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1067	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	15.2	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point # 8
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29 and SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2770	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	769	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1129	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1129	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	16.1	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #6
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2100	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	583	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	863	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	863	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	12.3	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #4
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2360	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	656	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	970	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	970	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	13.9	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #2
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1930	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	536	v
Trucks and buses	23	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.897	
Driver population factor, fp	1.00	
Flow rate, vp	797	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	797	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	11.4	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

2030 AM Freeway HCS Analyses

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #21
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1350	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	375	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	563	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	563	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	8.0	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #19
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1830	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	508	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	763	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	763	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	10.9	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #17
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1700	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	472	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	708	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	708	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	10.1	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #15
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 142 and SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2450	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	681	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	1021	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1021	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	14.6	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #13
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2180	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	606	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	908	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	908	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	13.0	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #10
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2510	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	697	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	1046	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1046	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	14.9	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #8
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29 and SR 142
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2810	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	781	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	1171	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1171	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	16.7	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #6
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2360	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	656	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	983	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	983	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	14.0	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #4
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2790	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	775	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	1163	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1163	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	16.6	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Point #2
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	AM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	1960	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	544	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	817	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	817	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	11.7	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

2030 PM Freeway HCS Analyses

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #21
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3370	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	936	v
Trucks and buses	23	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.897	
Driver population factor, fp	1.00	
Flow rate, vp	1392	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1392	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	19.9	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #17
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3810	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1058	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	1566	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1566	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.6	mi/h
Number of lanes, N	3	
Density, D	22.5	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #15
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w SR 142 and SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	4670	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1297	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1903	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1903	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	66.5	mi/h
Number of lanes, N	3	
Density, D	28.6	pc/mi/ln

Level of service, LOS	D

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #13
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	4390	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1219	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1789	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1789	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	68.0	mi/h
Number of lanes, N	3	
Density, D	26.3	pc/mi/ln

Level of service, LOS	D

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #10
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 142
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3550	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	986	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1446	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1446	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.9	mi/h
Number of lanes, N	3	
Density, D	20.7	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #8
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29 and SR 142
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3860	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1072	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	1573	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1573	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.6	mi/h
Number of lanes, N	3	
Density, D	22.6	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #6
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2870	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	797	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	1180	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1180	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	16.9	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #4
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	3260	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	906	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	1340	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1340	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	19.1	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #2
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 EB
From/To:	b/w US 42
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	2680	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	744	v
Trucks and buses	23	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.897	
Driver population factor, fp	1.00	
Flow rate, vp	1107	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1107	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	15.8	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

Appendix D

HCS
Merge and Diverge Analyses

2010 AM Merge HCS Analyses

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #22
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	970	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	350	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	970	350		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	269	97		v
Trucks and buses	25	25		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1213	438	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 717 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1651	7200	No
v_3 or v_{av34}	496 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 717		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	717	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 11.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.298	
Space mean speed in ramp influence area,	S_R = 61.6	mph
Space mean speed in outer lanes,	S_O = 70.0	mph
Space mean speed for all vehicles,	S = 63.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #18
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1240	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	90	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1240	90		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	344	25		v
Trucks and buses	25	20		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.909	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1550	110	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 917 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1660	7200	No
v_3 or v_{av34}	633 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 917		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	917	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 10.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.297	
Space mean speed in ramp influence area,	S_R = 61.7	mph
Space mean speed in outer lanes,	S_O = 69.5	mph
Space mean speed for all vehicles,	S = 64.5	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #14
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1590	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	120	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1590	120		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	442	33		v
Trucks and buses	25	10		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.952	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1988	140	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1176 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2128	7200	No
v_3 or v_{av34}	812 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1176		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1176	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 12.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.301	
Space mean speed in ramp influence area,	S_R = 61.6	mph
Space mean speed in outer lanes,	S_0 = 68.9	mph
Space mean speed for all vehicles,	S = 64.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #11
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1920	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	640	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1920	640		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	533	178		v
Trucks and buses	25	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2400	718	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1420 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3118	7200	No
v_3 or v_{av34}	980 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1420		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1420	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 18.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.319	
Space mean speed in ramp influence area,	S_R = 61.1	mph
Space mean speed in outer lanes,	S_O = 68.3	mph
Space mean speed for all vehicles,	S = 63.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #7
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1750	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	290	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1750	290		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	486	81		v
Trucks and buses	25	15		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.930	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2188	346	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1294 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2534	7200	No
v_3 or v_{av34}	894 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1294		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1294	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.306	
Space mean speed in ramp influence area,	S_R = 61.4	mph
Space mean speed in outer lanes,	S_O = 68.6	mph
Space mean speed for all vehicles,	S = 63.8	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #3
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1430	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	600	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1430	600		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	397	167		v
Trucks and buses	25	25		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1788	750	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1058 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2538	7200	No
v_3 or v_{av34}	730 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1058		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1058	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.310	
Space mean speed in ramp influence area,	S_R = 61.3	mph
Space mean speed in outer lanes,	S_O = 69.2	mph
Space mean speed for all vehicles,	S = 63.4	mph

2010 PM Merge HCS Analyses

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #22
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2440	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	390	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2440	390		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	678	108		v
Trucks and buses	23	25		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.897	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3023	488	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1788 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3511	7200	No
v_3 or v_{av34}	1235 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1788		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1788	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.324	
Space mean speed in ramp influence area,	S_R = 60.9	mph
Space mean speed in outer lanes,	S_O = 67.4	mph
Space mean speed for all vehicles,	S = 63.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #18
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2790	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	290	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2790	290		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	775	81		v
Trucks and buses	22	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.901	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3441	329	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM}) =$ 2035 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3770	7200	No
v_3 or v_{av34}	1406 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2035		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2035	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A =$ 20.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.327	
Space mean speed in ramp influence area,	S_R = 60.8	mph
Space mean speed in outer lanes,	S_O = 66.7	mph
Space mean speed for all vehicles,	S = 62.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #14
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3190	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	140	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3190	140		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	886	39		v
Trucks and buses	20	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.909	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3899	156	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2306 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4055	7200	No
v_3 or v_{av34}	1593 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2306		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2306	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 21.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.332	
Space mean speed in ramp influence area,	S_R = 60.7	mph
Space mean speed in outer lanes,	S_O = 66.1	mph
Space mean speed for all vehicles,	S = 62.7	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #11
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2620	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	260	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2620	260		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	728	72		v
Trucks and buses	19	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.913	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3188	292	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1886 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3480	7200	No
v_3 or v_{av34}	1302 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1886		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1886	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.320	
Space mean speed in ramp influence area,	S_R = 61.0	mph
Space mean speed in outer lanes,	S_O = 67.1	mph
Space mean speed for all vehicles,	S = 63.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #7
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2100	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	670	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2100	670		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	583	186		v
Trucks and buses	22	15		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.901	0.930	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2590	800	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1532 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3390	7200	No
v_3 or v_{av34}	1058 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1532		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1532	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 20.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.326	
Space mean speed in ramp influence area,	S_R = 60.9	mph
Space mean speed in outer lanes,	S_O = 68.0	mph
Space mean speed for all vehicles,	S = 62.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #3
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1930	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	430	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1930	430		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	536	119		v
Trucks and buses	23	18		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.897	0.917	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2391	521	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1414 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2912	7200	No
v_3 or v_{av34}	977 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} = 1414		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1414	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.313	
Space mean speed in ramp influence area,	S_R = 61.2	mph
Space mean speed in outer lanes,	S_0 = 68.3	mph
Space mean speed for all vehicles,	S = 63.4	mph

2030 AM Merge HCS Analyses

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #22
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1350	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	470	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1350	470		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	375	131		v
Trucks and buses	25	25		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1688	588	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 998 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2276	7200	No
v_3 or v_{av34}	690 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 998		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	998	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 14.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.305	
Space mean speed in ramp influence area,	S_R = 61.5	mph
Space mean speed in outer lanes,	S_O = 69.3	mph
Space mean speed for all vehicles,	S = 63.6	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #18
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1700	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	130	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1700	130		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	472	36		v
Trucks and buses	25	20		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.909	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2125	159	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1257 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2284	7200	No
v_3 or v_{av34}	868 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1257		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1257	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 13.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.302	
Space mean speed in ramp influence area,	S_R = 61.5	mph
Space mean speed in outer lanes,	S_0 = 68.7	mph
Space mean speed for all vehicles,	S = 64.1	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #14
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2180	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	270	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2180	270		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	606	75		v
Trucks and buses	25	10		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.952	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2725	315	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1612 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3040	7200	No
v_3 or v_{av34}	1113 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1612		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1612	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.313	
Space mean speed in ramp influence area,	S_R = 61.2	mph
Space mean speed in outer lanes,	S_0 = 67.8	mph
Space mean speed for all vehicles,	S = 63.5	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #11
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2510	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	860	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2510	860		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	697	239		v
Trucks and buses	25	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3138	965	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1856 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4103	7200	No
v_3 or v_{av34}	1282 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1856		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1856	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 23.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.351	
Space mean speed in ramp influence area,	S_R = 60.2	mph
Space mean speed in outer lanes,	S_O = 67.2	mph
Space mean speed for all vehicles,	S = 62.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #7
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2360	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	450	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2360	450		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	656	125		v
Trucks and buses	25	15		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.930	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2950	537	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1745 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3487	7200	No
v_3 or v_{av34}	1205 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1745		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1745	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.324	
Space mean speed in ramp influence area,	S_R = 60.9	mph
Space mean speed in outer lanes,	S_0 = 67.5	mph
Space mean speed for all vehicles,	S = 63.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #3
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1960	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	830	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1960	830		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	544	231		v
Trucks and buses	25	23		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.897	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2450	1028	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM}) =$ 1449 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3478	7200	No
v_3 or v_{av34}	1001 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1449		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1449	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A =$ 21.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.332	
Space mean speed in ramp influence area,	S_R = 60.7	mph
Space mean speed in outer lanes,	S_O = 68.2	mph
Space mean speed for all vehicles,	S = 62.7	mph

2030 PM Merge HCS Analyses

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #22
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3370	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3370	530		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	936	147		v
Trucks and buses	23	25		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.897	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4175	663	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2470 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4838	7200	No
v_3 or v_{av34}	1705 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2470		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2470	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 26.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.375	
Space mean speed in ramp influence area,	S_R = 59.5	mph
Space mean speed in outer lanes,	S_O = 65.7	mph
Space mean speed for all vehicles,	S = 61.5	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #18
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3810	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	420	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3810	420		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1058	117		v
Trucks and buses	22	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.901	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4699	476	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2779 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5175	7200	No
v_3 or v_{av34}	1920 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2779		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2779	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.387	
Space mean speed in ramp influence area,	S_R = 59.2	mph
Space mean speed in outer lanes,	S_O = 64.9	mph
Space mean speed for all vehicles,	S = 61.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #14
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4390	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	280	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4390	280		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1219	78		v
Trucks and buses	20	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.909	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5366	313	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3174 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5679	7200	No
v_3 or v_{av34}	2192 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 3174		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3174	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 29.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M_S = 0.413	
Space mean speed in ramp influence area,	S_R = 58.4	mph
Space mean speed in outer lanes,	S_0 = 63.9	mph
Space mean speed for all vehicles,	S = 60.4	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #11
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 142 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3550	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	350	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3550	350		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	986	97		v
Trucks and buses	20	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.909	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4339	395	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2567 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4734	7200	No
v_3 or v_{av34}	1772 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2567		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2567	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 25.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.361	
Space mean speed in ramp influence area,	S_R = 59.9	mph
Space mean speed in outer lanes,	S_O = 65.4	mph
Space mean speed for all vehicles,	S = 61.8	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #7
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	SR 29 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2870	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	990	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2870	990		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	797	275		v
Trucks and buses	22	15		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.901	0.930	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3540	1182	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2094 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4722	7200	No
v_3 or v_{av34}	1446 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} = 2094		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2094	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 27.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.389	
Space mean speed in ramp influence area,	S_R = 59.1	mph
Space mean speed in outer lanes,	S_O = 66.6	mph
Space mean speed for all vehicles,	S = 61.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Point #3
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	US 42 On Ramp
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2680	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	580	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2680	580		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	744	161		v
Trucks and buses	23	18		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.897	0.917	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3320	702	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1964 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4022	7200	No
v_3 or v_{av34}	1356 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1964		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1964	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 22.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.342	
Space mean speed in ramp influence area,	S_R = 60.4	mph
Space mean speed in outer lanes,	S_O = 66.9	mph
Space mean speed for all vehicles,	S = 62.5	mph

2010 AM Diverge HCS Analyses

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #20
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB US 42 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1330	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	360	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1330		360			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	369		100			v
Trucks and buses	25		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1663	450	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.698 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1296 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1663	7200	No
$v_{FO} = v_F - v_R$	1213	7200	No
v_R	450	2000	No
$v_{3 \text{ or } av34}$	367 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1296		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1296	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 10.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.469

Space mean speed in ramp influence area, S_R = 56.9 mph

Space mean speed in outer lanes, S_O = 76.8 mph

Space mean speed for all vehicles, S = 60.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #16
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 29 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1710	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	470	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1710		470			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	475		131			v
Trucks and buses	25		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2138	588	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.680 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1641 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2138	7200	No
$v_{FO} = v_F - v_R$	1550	7200	No
v_R	588	2000	No
v_3 or v_{av34}	497 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 1641		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1641	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 13.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.481	
Space mean speed in ramp influence area,	S_R = 56.5	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 60.2	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #12
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 142 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1770	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	180	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1770		180			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	492		50			v
Trucks and buses	25		6			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.971	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2213	206	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.695 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1601 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2213	7200	No
$v_{FO} = v_F - v_R$	2007	7200	No
v_R	206	2000	No
v_3 or v_{av34}	612 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 1601	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1601	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 13.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.447	
Space mean speed in ramp influence area,	S_R = 57.5	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 61.8	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #9
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 142 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2040	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	120	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2040	120		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	567	33		v
Trucks and buses	25	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2550	136	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.690 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1802 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2550	7200	No
$v_{FO} = v_F - v_R$	2414	7200	No
v_R	136	2000	No
v_3 or v_{av34}	748 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 1802	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1802	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 15.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.440	
Space mean speed in ramp influence area,	S_R = 57.7	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 62.2	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #5
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 29 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2030	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	280	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2030		280			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	564		78			v
Trucks and buses	25		20			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.909	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2538	342	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.681 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1837 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2538	7200	No
$v_{FO} = v_F - v_R$	2196	7200	No
v_R	342	2000	No
v_3 or v_{av34}	701 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 1837	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1837	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 15.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.459	
Space mean speed in ramp influence area,	S_R = 57.2	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 61.5	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #1
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 42 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1720	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	290	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1720		290			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	478		81			v
Trucks and buses	25		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2150	363	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.690 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1595 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2150	7200	No
$v_{FO} = v_F - v_R$	1787	7200	No
v_R	363	2000	No
v_3 or v_{av34}	555 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 1595	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1595	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 13.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.461	
Space mean speed in ramp influence area,	S_R = 57.1	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 61.1	mph

2010 PM Diverge HCS Analyses

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #20
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB US 42 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3080	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	640	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3080		640			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	856		178			v
Trucks and buses	22		18			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.901	0.917	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3799	775	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.629 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2678 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3799	7200	No
$v_{FO} = v_F - v_R$	3024	7200	No
v_R	775	2000	No
$v_{3 \text{ or } av34}$	1121 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2678		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2678	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 22.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.498	
Space mean speed in ramp influence area,	S_R = 56.1	mph
Space mean speed in outer lanes,	S_O = 76.3	mph
Space mean speed for all vehicles,	S = 60.8	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #16
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 29 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3330	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	540	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3330	540		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	925	150		v
Trucks and buses	20	18		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.909	0.917	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4070	654	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.628 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2800 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4070	7200	No
$v_{FO} = v_F - v_R$	3416	7200	No
v_R	654	2000	No
$v_{3 \text{ or } av34}$	1270 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 2800	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2800	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 23.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.487

Space mean speed in ramp influence area, S_R = 56.4 mph

Space mean speed in outer lanes, S_O = 75.7 mph

Space mean speed for all vehicles, S = 61.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #12
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 142 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3720	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3720		530			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1033		147			v
Trucks and buses	25		6			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.971	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4650	607	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.616 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3097 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4650	7200	No
$v_{FO} = v_F - v_R$	4043	7200	No
v_R	607	2000	No
$v_{3 \text{ or } av34}$	1553 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 3097	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3097	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 26.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.483

Space mean speed in ramp influence area, S_R = 56.5 mph

Space mean speed in outer lanes, S_O = 74.6 mph

Space mean speed for all vehicles, S = 61.5 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #9
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 142 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2770	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	150	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2770	150		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	769	42		v
Trucks and buses	20	5		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.909	0.976	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3386	171	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.667 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2317 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3386	7200	No
$v_{FO} = v_F - v_R$	3215	7200	No
v_R	171	2000	No
v_3 or v_{av34}	1069 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 2317	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2317	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 19.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.443	
Space mean speed in ramp influence area,	S_R = 57.6	mph
Space mean speed in outer lanes,	S_O = 76.5	mph
Space mean speed for all vehicles,	S = 62.5	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #5
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 29 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2360	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	260	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2360	260		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	656	72		v
Trucks and buses	22	7		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.901	0.966	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2911	299	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.673 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2058 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2911	7200	No
$v_{FO} = v_F - v_R$	2612	7200	No
v_R	299	2000	No
$v_{3 \text{ or } av34}$	853 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 2058	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2058	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 17.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.455

Space mean speed in ramp influence area, S_R = 57.3 mph

Space mean speed in outer lanes, S_O = 76.8 mph

Space mean speed for all vehicles, S = 61.9 mph

HCS+: Ramps and Ramp Junctions Release 5.4

Roadway Engineering Services
ODOT
1980 West Broad Street

Phone: 614-387-1622 Fax:
E-mail:

Diverge Analysis

Analyst:	Point #1
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 42 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2320	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	390	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2320		390			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	644		108			v
Trucks and buses	23		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.897	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2874	488	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.666 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2076 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2874	7200	No
$v_{FO} = v_F - v_R$	2386	7200	No
v_R	488	2000	No
$v_{3 \text{ or } av34}$	798 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2076		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2076	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 17.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.472	
Space mean speed in ramp influence area,	S_R = 56.8	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 61.2	mph

2030 AM Diverge HCS Analyses

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #20
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB US 42 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	1830	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	480	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1830		480			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	508		133			v
Trucks and buses	25		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2288	600	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.675 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1740 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2288	7200	No
$v_{FO} = v_F - v_R$	1688	7200	No
v_R	600	2000	No
$v_{3 \text{ or } av34}$	548 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 1740	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1740	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.482

Space mean speed in ramp influence area, S_R = 56.5 mph

Space mean speed in outer lanes, S_O = 76.8 mph

Space mean speed for all vehicles, S = 60.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #16
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 29 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2450	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	750	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2450		750			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	681		208			v
Trucks and buses	25		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3063	938	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.640 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2299 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3063	7200	No
$v_{FO} = v_F - v_R$	2125	7200	No
v_R	938	2000	No
v_3 or v_{av34}	764 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 2299	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2299	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 19.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.512	
Space mean speed in ramp influence area,	S_R = 55.7	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 59.8	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #12
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 142 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2450	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	270	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2450		270			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	681		75			v
Trucks and buses	25		6			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.971	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3063	309	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.669 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2152 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3063	7200	No
$v_{FO} = v_F - v_R$	2754	7200	No
v_R	309	2000	No
$v_{3 \text{ or } av34}$	911 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2152		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2152	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 18.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.456

Space mean speed in ramp influence area, S_R = 57.2 mph

Space mean speed in outer lanes, S_O = 76.8 mph

Space mean speed for all vehicles, S = 61.9 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #9
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 142 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2810	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	300	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2810		300			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	781		83			v
Trucks and buses	25		4			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3513	340	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.657 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2423 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3513	7200	No
$v_{FO} = v_F - v_R$	3173	7200	No
v_R	340	2000	No
v_3 or v_{av34}	1090 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2423		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2423	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 20.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.459

Space mean speed in ramp influence area, S_R = 57.2 mph

Space mean speed in outer lanes, S_O = 76.4 mph

Space mean speed for all vehicles, S = 62.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #5
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 29 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2790	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	430	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2790	430		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	775	119		v
Trucks and buses	25	20		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.889	0.909	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3488	526	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.649 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2447 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3488	7200	No
$v_{FO} = v_F - v_R$	2962	7200	No
v_R	526	2000	No
$v_{3 \text{ or } av34}$	1041 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2447		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2447	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 20.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.475

Space mean speed in ramp influence area, S_R = 56.7 mph

Space mean speed in outer lanes, S_O = 76.6 mph

Space mean speed for all vehicles, S = 61.5 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #1
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB US 42 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2360	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	400	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2360		400			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	656		111			v
Trucks and buses	25		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.889	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2950	500	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.663 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2125 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2950	7200	No
$v_{FO} = v_F - v_R$	2450	7200	No
v_R	500	2000	No
v_3 or v_{av34}	825 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 2125	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2125	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 18.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.473	
Space mean speed in ramp influence area,	S_R = 56.8	mph
Space mean speed in outer lanes,	S_O = 76.8	mph
Space mean speed for all vehicles,	S = 61.2	mph

2030 PM Diverge HCS Analyses

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #20
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB US 42 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4230	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	860	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4230		860			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1175		239			v
Trucks and buses	22		18			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.901	0.917	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5217	1042	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.582 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3470 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5217	7200	No
$v_{FO} = v_F - v_R$	4175	7200	No
v_R	1042	2000	No
v_3 or v_{av34}	1747 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 3470	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3470	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 29.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, D_S = 0.522

Space mean speed in ramp influence area, S_R = 55.4 mph

Space mean speed in outer lanes, S_O = 73.9 mph

Space mean speed for all vehicles, S = 60.5 mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	point #19
Agency or Company:	ODOT
Date Performed:	10/21/2009
Analysis Time Period:	PM Peak
Freeway/Direction:	I-70 WB
From/To:	b/w US 42 and SR 29
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Flow Inputs and Adjustments

Volume, V	4230	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1175	v
Trucks and buses	22	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.901	
Driver population factor, fp	1.00	
Flow rate, vp	1739	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1739	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	68.5	mi/h
Number of lanes, N	3	
Density, D	25.4	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #16
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 29 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4670	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	860	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4670		860			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1297		239			v
Trucks and buses	20		18			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.909	0.917	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5708	1042	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.569 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3699 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5708	7200	No
$v_{FO} = v_F - v_R$	4666	7200	No
v_R	1042	2000	No
v_3 or v_{av34}	2009 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 3699		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3699	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 31.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.522	
Space mean speed in ramp influence area,	S_R = 55.4	mph
Space mean speed in outer lanes,	S_O = 72.9	mph
Space mean speed for all vehicles,	S = 60.5	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #12
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 WB
Junction:	70 WB SR 142 Off
Jurisdiction:	
Analysis Year:	2010
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5160	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	770	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5160		770			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1433		214			v
Trucks and buses	19		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.913	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6278	864	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.563 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3914 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6278	7200	No
$v_{FO} = v_F - v_R$	5414	7200	No
v_R	864	2000	No
v_3 or v_{av34}	2364 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 3914	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3914	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 33.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.506	
Space mean speed in ramp influence area,	S_R = 55.8	mph
Space mean speed in outer lanes,	S_O = 71.5	mph
Space mean speed for all vehicles,	S = 60.9	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #9
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 142 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3860	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	310	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3860		310			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1072		86			v
Trucks and buses	20		5			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.909	0.976	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4718	353	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.626 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3085 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4718	7200	No
$v_{FO} = v_F - v_R$	4365	7200	No
v_R	353	2000	No
$v_{3 \text{ or } av34}$	1633 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 3085		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3085	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 26.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.460

Space mean speed in ramp influence area, S_R = 57.1 mph

Space mean speed in outer lanes, S_O = 74.3 mph

Space mean speed for all vehicles, S = 62.1 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #5
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB SR 29 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3260	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	390	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3260		390			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	906		108			v
Trucks and buses	22		7			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.901	0.966	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4021	448	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.639 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2731 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4021	7200	No
$v_{FO} = v_F - v_R$	3573	7200	No
v_R	448	2000	No
v_3 or v_{av34}	1290 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A}	= 2731	(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2731	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 23.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.468

Space mean speed in ramp influence area, S_R = 56.9 mph

Space mean speed in outer lanes, S_O = 75.7 mph

Space mean speed for all vehicles, S = 61.8 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Point #1
Agency/Co.:	ODOT
Date performed:	10/21/2009
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-70 EB
Junction:	70 EB US 42 Off
Jurisdiction:	
Analysis Year:	2030
Description:	MAD-70-10.27 PID 83245

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3210	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3210		530			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	892		147			v
Trucks and buses	23		25			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.897	0.889	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3977	663	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.630 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2751 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3977	7200	No
$v_{FO} = v_F - v_R$	3314	7200	No
v_R	663	2000	No
$v_{3 \text{ or } av34}$	1226 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} = 2751		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2751	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 23.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.488

Space mean speed in ramp influence area, S_R = 56.3 mph

Space mean speed in outer lanes, S_O = 75.9 mph

Space mean speed for all vehicles, S = 61.2 mph

Appendix E

HCS
Intersection Analyses

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: PM No Build
Intersection: EB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2030
Project ID: MAD-70-10.27
East/West Street: I-70 EB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		590	840	150	660	
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR		655	933	166	733	
Percent Heavy Vehicles		--	--	12	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1 0		0 1		
Configuration		TR		LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				20	1	370
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				22	1	411
Percent Heavy Vehicles				7	7	7
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	1 0	
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT					LTR	
v (vph)		166					434	
C(m) (vph)		386					219	
v/c		0.43					1.98	
95% queue length		2.10					31.97	
Control Delay		21.2					494.2	
LOS		C					F	
Approach Delay							494.2	
Approach LOS							F	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: AM No Build
Intersection: EB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2030
Project ID: MAD-70-10.27
East/West Street: I-70 EB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		180	260	190	840	
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR		200	288	211	933	
Percent Heavy Vehicles		--	--	17	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				20	1	410
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				22	1	455
Percent Heavy Vehicles				20	20	20
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT					LTR	
v (vph)		211					478	
C(m) (vph)		1002					258	
v/c		0.21					1.85	
95% queue length		0.79					32.94	
Control Delay		9.5					430.9	
LOS		A					F	
Approach Delay							430.9	
Approach LOS							F	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: PM No Build
Intersection: EB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2010
Project ID: MAD-70-10.27
East/West Street: I-70 EB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		360	570	100	430	
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR		400	633	111	477	
Percent Heavy Vehicles		--	--	12	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1 0		0 1		
Configuration		TR		LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				20	1	240
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				22	1	266
Percent Heavy Vehicles				7	7	7
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	1 0	
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT					LTR	
v (vph)		111					289	
C(m) (vph)		635					441	
v/c		0.17					0.66	
95% queue length		0.63					4.59	
Control Delay		11.9					27.4	
LOS		B					D	
Approach Delay							27.4	
Approach LOS							D	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: PM Build
Intersection: EB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2010
Project ID: MAD-70-10.27
East/West Street: I-70 EB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		360	570	100	430	
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR		400	633	111	477	
Percent Heavy Vehicles		--	--	12	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				20	1	240
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				22	1	266
Percent Heavy Vehicles				7	7	7
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
Lanes				0	1	1
Configuration					LT	R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT				LT		R
v (vph)		111				23		266
C(m) (vph)		635				118		578
v/c		0.17				0.19		0.46
95% queue length		0.63				0.69		2.41
Control Delay		11.9				42.7		16.4
LOS		B				E		C
Approach Delay							18.5	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: AM No Build
Intersection: EB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2010
Project ID: MAD-70-10.27
East/West Street: I-70 EB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		120	180	130	600	
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR		133	200	144	666	
Percent Heavy Vehicles		--	--	17	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1 0		0 1		
Configuration		TR		LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				20	1	260
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				22	1	288
Percent Heavy Vehicles				20	20	20
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	1 0	
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT					LTR	
v (vph)		144					311	
C(m) (vph)		1147					384	
v/c		0.13					0.81	
95% queue length		0.43					7.16	
Control Delay		8.6					44.0	
LOS		A					E	
Approach Delay							44.0	
Approach LOS							E	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: AM Build
Intersection: EB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2010
Project ID: MAD-70-10.27
East/West Street: I-70 EB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		120	180	130	600	
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR		133	200	144	666	
Percent Heavy Vehicles		--	--	17	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				20	1	260
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				22	1	288
Percent Heavy Vehicles				20	20	20
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
Lanes				0	1	1
Configuration				LT		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT				LT		R
v (vph)		144				23		288
C(m) (vph)		1147				165		429
v/c		0.13				0.14		0.67
95% queue length		0.43				0.47		4.81
Control Delay		8.6				30.3		28.9
LOS		A				D		D
Approach Delay							29.0	
Approach LOS							D	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: PM No Build
Intersection: I-70 WB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2030
Project ID: MAD-70-10.27
East/West Street: I-70 WB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	400	210			250	20
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Hourly Flow Rate, HFR	444	233			277	22
Percent Heavy Vehicles	12	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration		LT				TR
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	560	1	300			
Peak Hour Factor, PHF	0.90	0.90	0.90			
Hourly Flow Rate, HFR	622	1	333			
Percent Heavy Vehicles	18	18	18			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT			LTR				
v (vph)	444			956				
C(m) (vph)	1207			129				
v/c	0.37			7.41				
95% queue length	1.71			106.73				
Control Delay	9.7			2950				
LOS	A			F				
Approach Delay				2950				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: AM No Build
Intersection: I-70 WB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2030
Project ID: MAD-70-10.27
East/West Street: I-70 WB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	120	80			350	10
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Hourly Flow Rate, HFR	133	88			388	11
Percent Heavy Vehicles	17	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration		LT				TR
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	680	1	70			
Peak Hour Factor, PHF	0.90	0.90	0.90			
Hourly Flow Rate, HFR	755	1	77			
Percent Heavy Vehicles	29	29	29			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT			LTR				
v (vph)	133			833				
C(m) (vph)	1083			322				
v/c	0.12			2.59				
95% queue length	0.42			68.44				
Control Delay	8.8			748.1				
LOS	A			F				
Approach Delay				748.1				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: PM No Build
Intersection: I-70 WB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2010
Project ID: MAD-70-10.27
East/West Street: I-70 WB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	280	100			190	10
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Hourly Flow Rate, HFR	311	111			211	11
Percent Heavy Vehicles	12	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration		LT				TR
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	340	1	200			
Peak Hour Factor, PHF	0.90	0.90	0.90			
Hourly Flow Rate, HFR	377	1	222			
Percent Heavy Vehicles	18	18	18			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT			LTR				
v (vph)	311			600				
C(m) (vph)	1290			287				
v/c	0.24			2.09				
95% queue length	0.95			44.21				
Control Delay	8.7			531.3				
LOS	A			F				
Approach Delay				531.3				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: ODOT
Agency/Co.:
Date Performed: 1/15/2010
Analysis Time Period: AM No Build
Intersection: I-70 WB Ramps/SR 29
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2010
Project ID: MAD-70-10.27
East/West Street: I-70 WB Ramps
North/South Street: SR 29
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	80	60			330	10
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Hourly Flow Rate, HFR	88	66			366	11
Percent Heavy Vehicles	17	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration		LT				TR
Upstream Signal?		No			No	

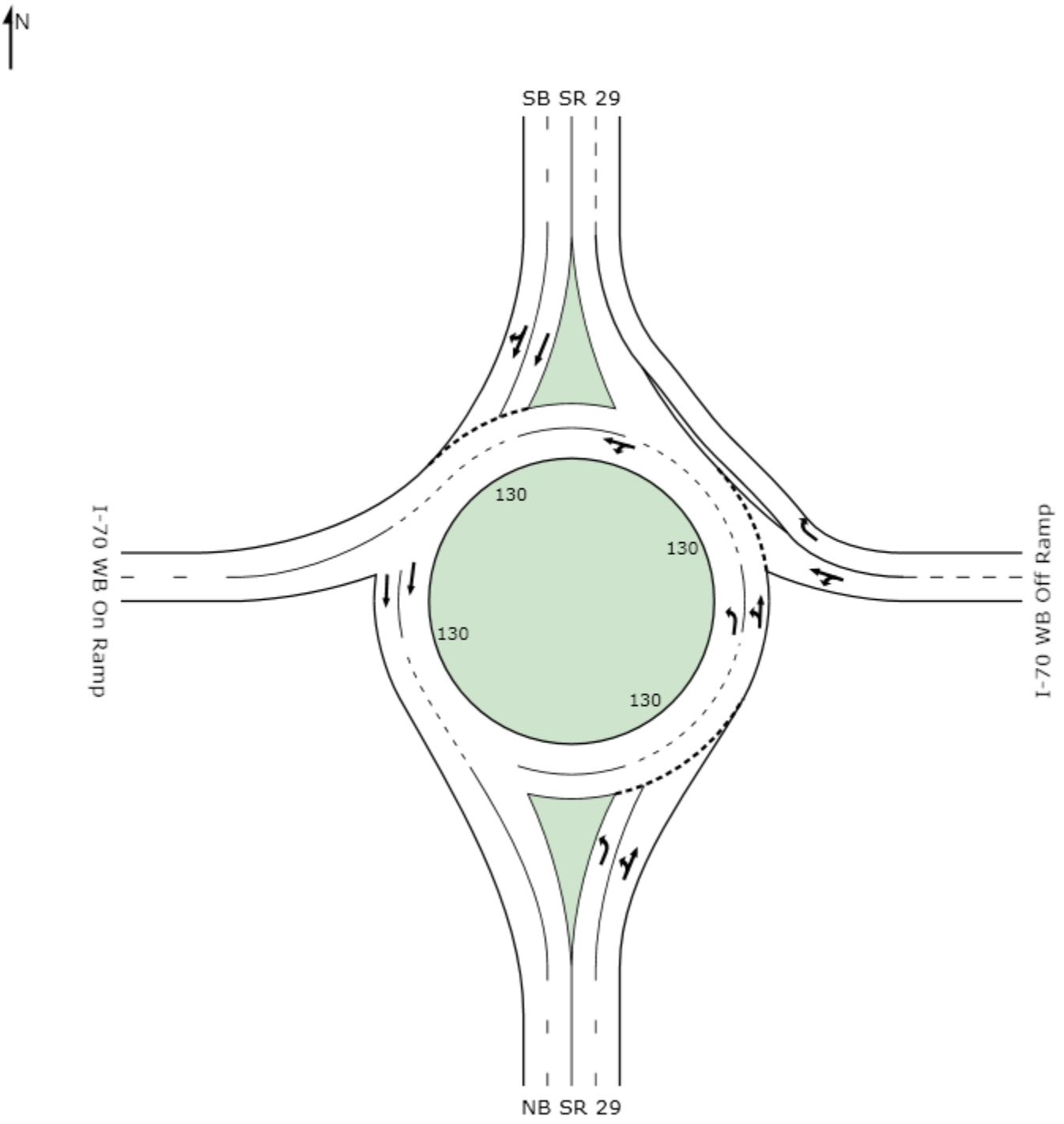
Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	400	1	70			
Peak Hour Factor, PHF	0.90	0.90	0.90			
Hourly Flow Rate, HFR	444	1	77			
Percent Heavy Vehicles	29	29	29			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT			LTR				
v (vph)	88			522				
C(m) (vph)	1104			417				
v/c	0.08			1.25				
95% queue length	0.26			22.02				
Control Delay	8.5			160.1				
LOS	A			F				
Approach Delay				160.1				
Approach LOS				F				

Appendix F

Sidra Intersection Analyses


N
SB SR 29
I-70 WB On Ramp
I-70 WB Off Ramp
NB SR 29
130
130
130
130

MOVEMENT SUMMARY

Site: 2030 PM WB Ramp

2030 PM WB Ramp (Dual Lanes)
Roundabout
Design Life Analysis (Practical Capacity): Results for 0 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: NB SR 29											
3L	L	435	12.0	0.286	5.8	LOS A	0.0	0.0	0.00	0.75	30.2
8T	T	228	12.0	0.286	5.8	LOS A	0.0	0.0	0.00	0.46	41.5
Approach		663	12.0	0.286	5.8	LOS A	0.0	0.0	0.00	0.65	33.1
East: I-70 WB Off Ramp											
1L	L	609	18.0	0.870	33.8	LOS C	5.9	168.2	0.74	1.14	18.0
6T	T	1	18.0	0.870	33.8	LOS C	5.9	168.2	0.74	1.04	18.5
6R	R	326	18.0	0.227	0.0	X	X	X	X	0.43	34.7
Approach		936	18.0	0.870	22.0	LOS C	5.9	168.2	0.48	0.90	21.4
North: SB SR 29											
4T	T	272	7.0	0.315	12.8	LOS B	1.0	26.6	0.70	0.86	29.8
4R	R	22	7.0	0.315	12.5	LOS B	1.0	25.9	0.69	0.87	26.5
Approach		293	7.0	0.315	12.8	LOS B	1.0	26.6	0.69	0.86	29.5
All Vehicles		1892	14.2	0.870	14.9	LOS B	5.9	168.2	0.35	0.81	25.6

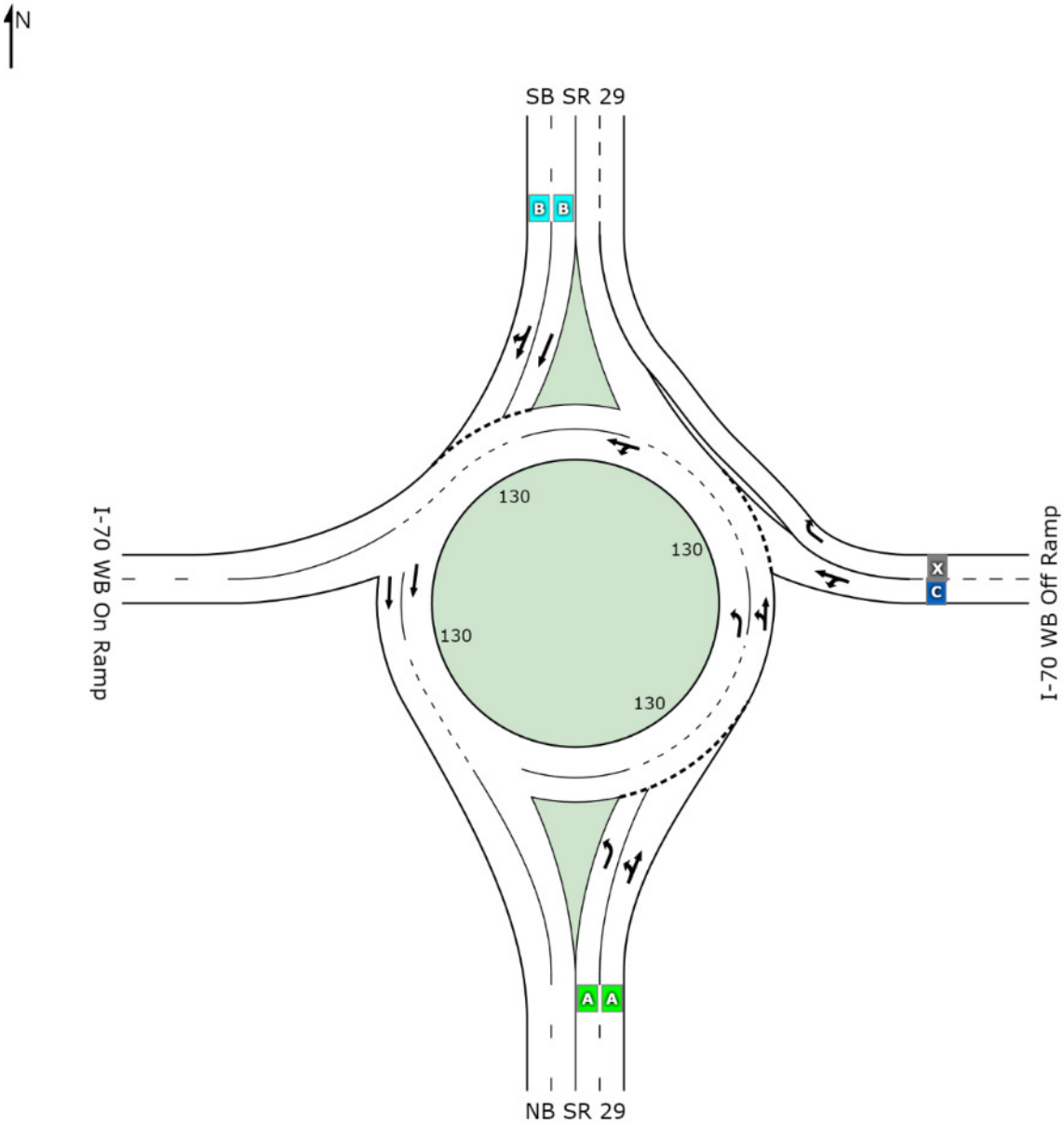
X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

LEVEL OF SERVICE SUMMARY

Site: 2030 PM WB Ramp

2030 PM WB Ramp (Dual Lanes)
Roundabout
Design Life Analysis (Practical Capacity): Results for 0 years



	South	East	North	West	Intersection
LOS	A	C	B	NA	B

X: Not applicable for Continuous lane.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
HCM Delay Model used. Geometric Delay not included.

MOVEMENT SUMMARY

Site: 2030 AM WB Ramp

2030 AM WB Ramp (Dual Lanes)
Roundabout
Design Life Analysis (Practical Capacity): Results for 0 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: NB SR 29											
3L	L	130	17.0	0.098	4.1	LOS A	0.0	0.0	0.00	0.74	30.2
8T	T	87	17.0	0.098	4.1	LOS A	0.0	0.0	0.00	0.47	41.5
Approach		217	17.0	0.098	4.1	LOS A	0.0	0.0	0.00	0.63	33.6
East: I-70 WB Off Ramp											
1L	L	739	29.0	0.858	27.8	LOS C	5.8	177.3	0.52	0.86	19.4
6T	T	1	29.0	0.858	27.8	LOS C	5.8	177.3	0.52	0.67	20.3
6R	R	76	29.0	0.057	0.0	X	X	X	X	0.43	34.8
Approach		816	29.0	0.858	25.2	LOS C	5.8	177.3	0.47	0.82	20.2
North: SB SR 29											
4T	T	380	7.0	0.396	14.0	LOS B	1.4	36.6	0.70	0.87	29.1
4R	R	11	7.0	0.396	13.7	LOS B	1.4	35.6	0.69	0.88	26.0
Approach		391	7.0	0.396	14.0	LOS B	1.4	36.6	0.70	0.87	29.0
All Vehicles		1425	21.1	0.858	18.9	LOS B	5.8	177.3	0.46	0.81	23.5

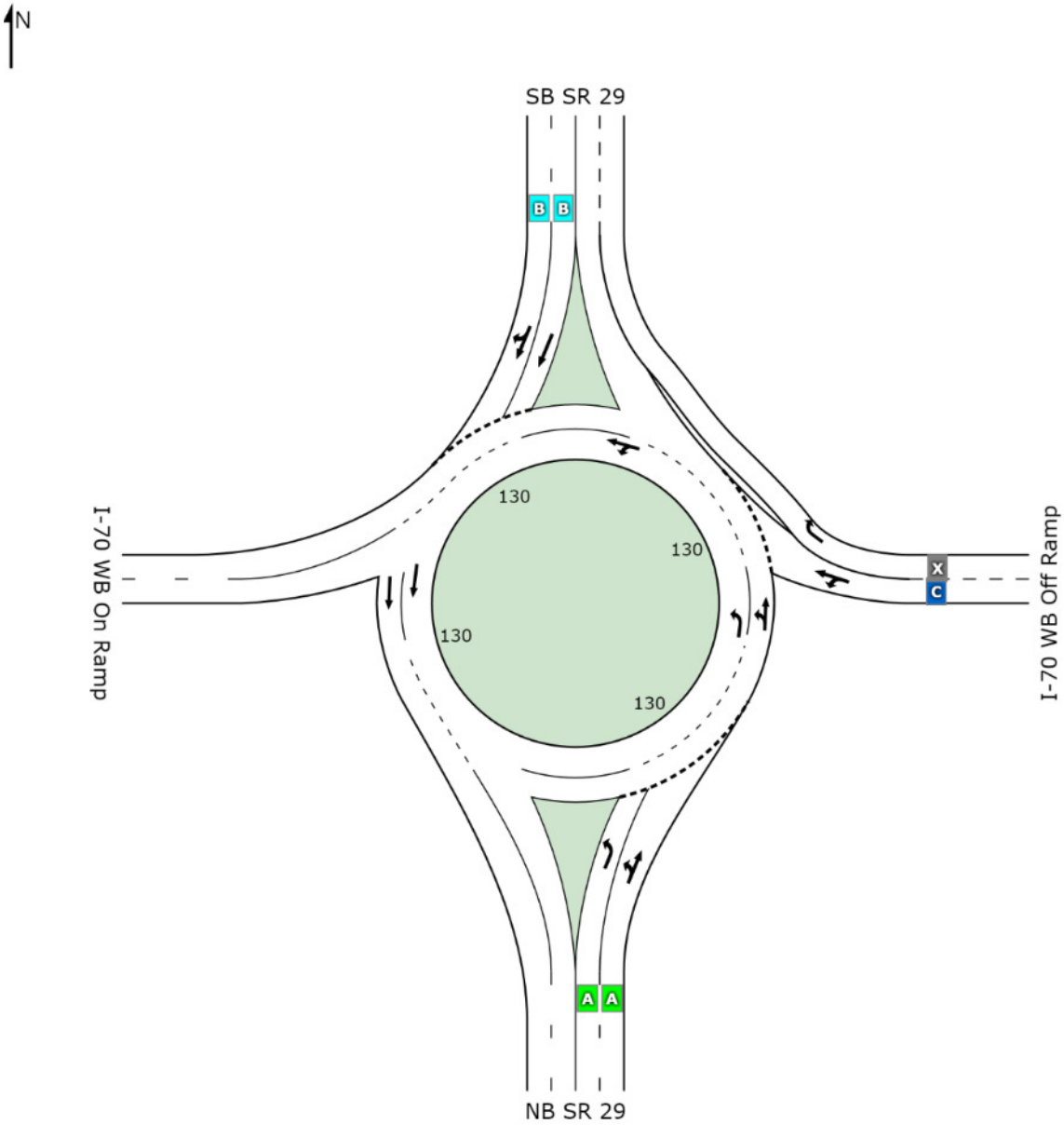
X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

LEVEL OF SERVICE SUMMARY

Site: 2030 AM WB Ramp

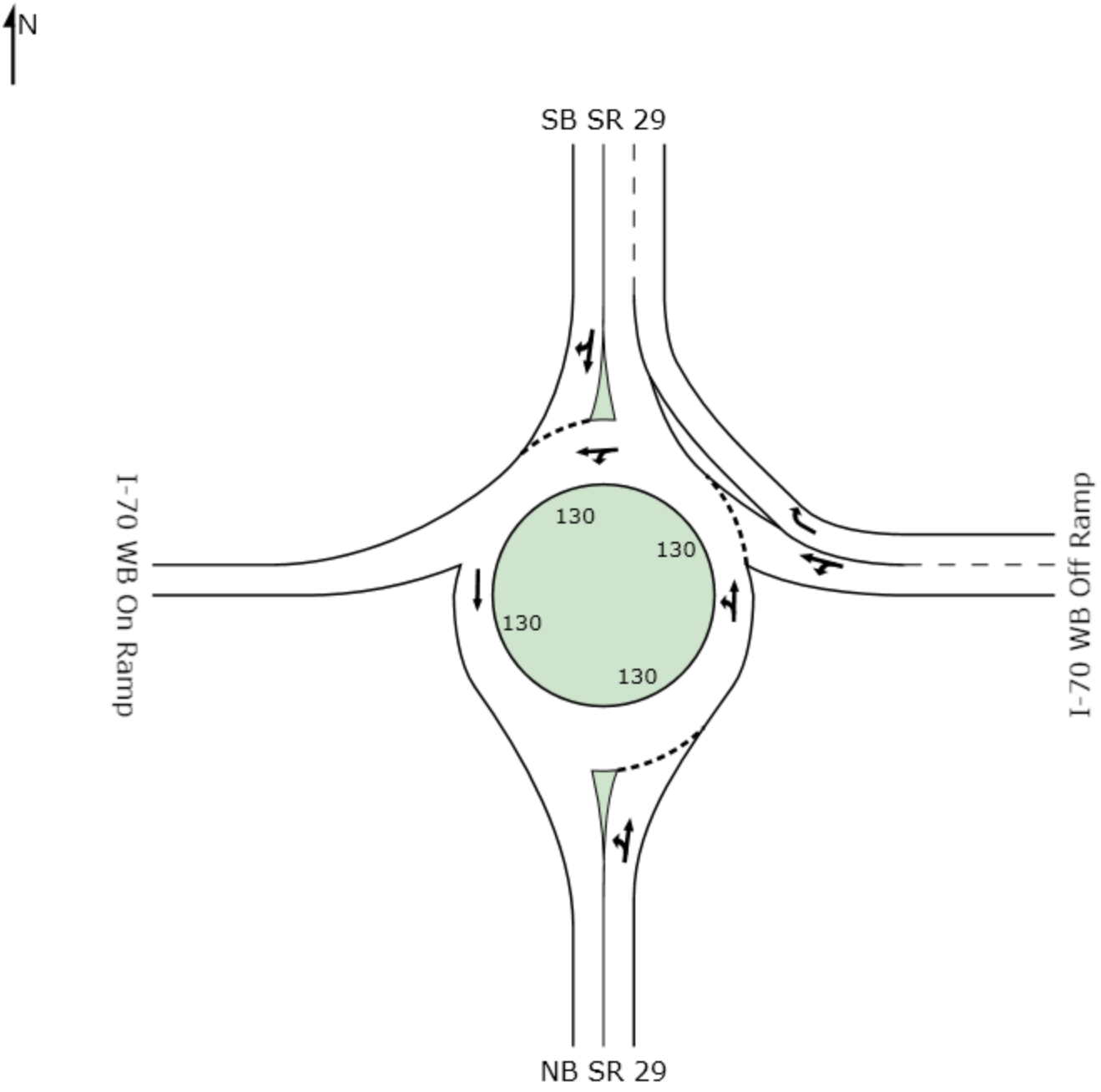
2030 AM WB Ramp (Dual Lanes)
Roundabout
Design Life Analysis (Practical Capacity): Results for 0 years



	South	East	North	West	Intersection
LOS	A	C	B	NA	B

X: Not applicable for Continuous lane.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
HCM Delay Model used. Geometric Delay not included.


N
SB SR 29
I-70 WB On Ramp
I-70 WB Off Ramp
NB SR 29
130
130
130
130

MOVEMENT SUMMARY

Site: 2010 PM WB Ramp

2010 PM WB Ramp (Single Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: NB SR 29											
3L	L	304	12.0	0.409	8.1	LOS A	0.0	0.0	0.00	0.79	30.2
8T	T	109	12.0	0.409	8.1	LOS A	0.0	0.0	0.00	0.42	41.6
Approach		413	12.0	0.409	8.1	LOS A	0.0	0.0	0.00	0.69	32.4
East: I-70 WB Off Ramp											
1L	L	370	18.0	0.615	18.1	LOS C	3.2	90.5	0.66	0.97	22.1
6T	T	1	18.0	0.615	18.1	LOS C	3.2	90.5	0.66	0.83	23.5
6R	R	217	18.0	0.152	0.0	X	X	X	X	0.44	34.7
Approach		588	18.0	0.615	11.4	LOS B	3.2	90.5	0.42	0.78	25.3
North: SB SR 29											
4T	T	207	7.0	0.448	15.6	LOS C	1.8	48.7	0.68	0.88	28.3
4R	R	11	7.0	0.448	15.6	LOS C	1.8	48.7	0.68	0.90	25.1
Approach		217	7.0	0.448	15.6	LOS C	1.8	48.7	0.68	0.88	28.1
All Vehicles		1218	14.0	0.615	11.0	LOS B	3.2	90.5	0.32	0.77	27.9

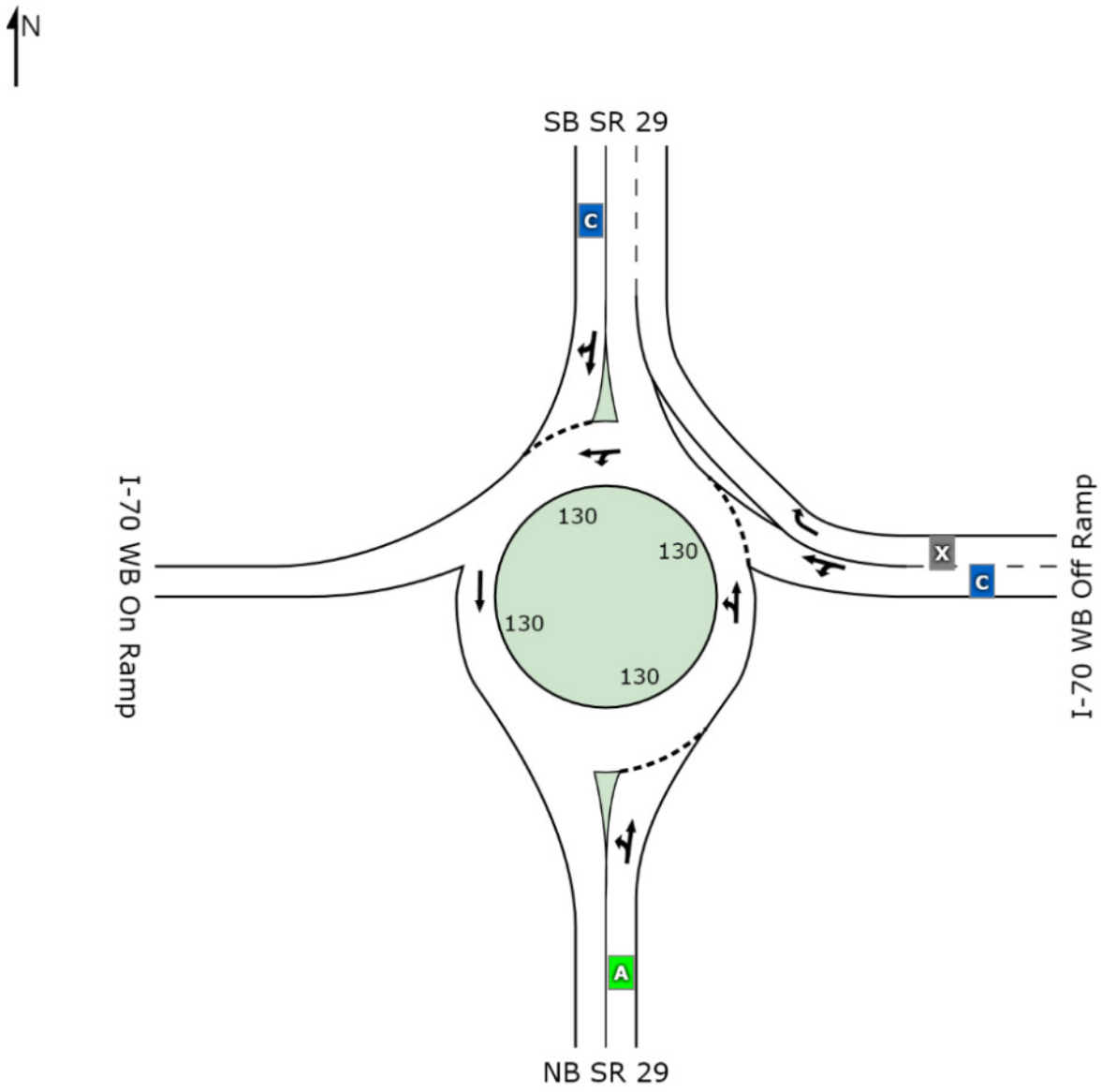
X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

LEVEL OF SERVICE SUMMARY

Site: 2010 PM WB Ramp

2010 PM WB Ramp (Single Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years



	South	East	North	West	Intersection
LOS	A	B	C	NA	B

X: Not applicable for Continuous lane.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
HCM Delay Model used. Geometric Delay not included.

MOVEMENT SUMMARY

Site: 2010 AM WB Ramp

2010 AM WB Ramp (Single Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: NB SR 29											
3L	L	87	17.0	0.158	5.2	LOS A	0.0	0.0	0.00	0.84	30.2
8T	T	65	17.0	0.158	5.2	LOS A	0.0	0.0	0.00	0.43	41.6
Approach		152	17.0	0.158	5.2	LOS A	0.0	0.0	0.00	0.67	34.0
East: I-70 WB Off Ramp											
1L	L	435	29.0	0.595	14.8	LOS B	2.6	79.4	0.45	0.72	23.2
6T	T	1	29.0	0.595	14.8	LOS B	2.6	79.4	0.45	0.49	25.2
6R	R	76	29.0	0.057	0.0	X	X	X	X	0.44	34.7
Approach		512	29.0	0.595	12.6	LOS B	2.6	79.4	0.38	0.68	24.4
North: SB SR 29											
4T	T	359	7.0	0.680	22.9	LOS C	4.1	107.0	0.77	0.98	24.5
4R	R	11	7.0	0.680	22.9	LOS C	4.1	107.0	0.77	1.02	22.2
Approach		370	7.0	0.680	22.9	LOS C	4.1	107.0	0.77	0.98	24.5
All Vehicles		1034	19.4	0.680	15.2	LOS C	4.1	107.0	0.46	0.79	25.5

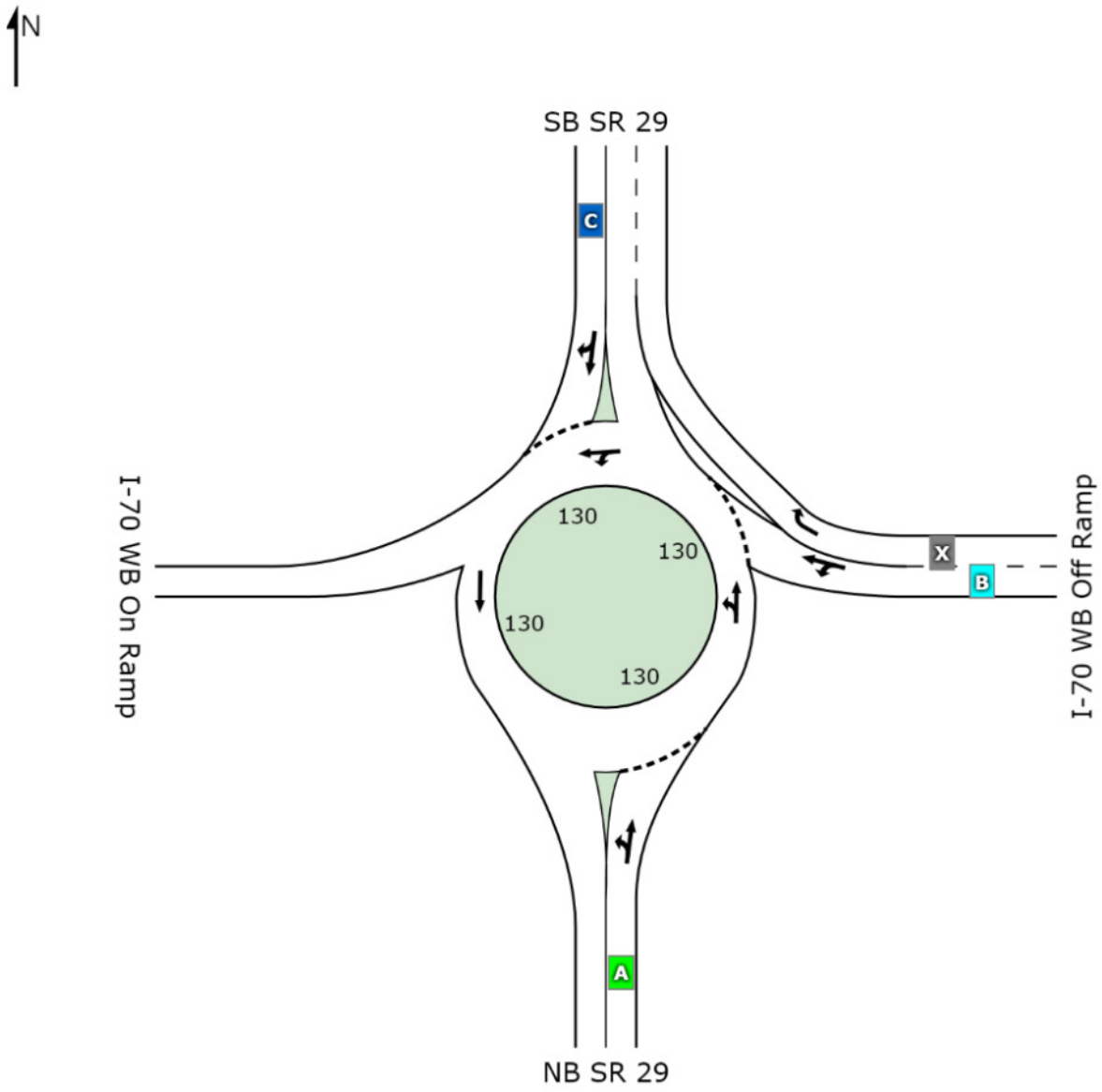
X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

LEVEL OF SERVICE SUMMARY

Site: 2010 AM WB Ramp

2010 AM WB Ramp (Single Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years



	South	East	North	West	Intersection
LOS	A	B	C	NA	C

X: Not applicable for Continuous lane.

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
HCM Delay Model used. Geometric Delay not included.

MOVEMENT SUMMARY

Site: 2030 PM EB Ramps

2030 PM EB Ramp (Dual Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 0 years

Movement Performance - Vehicles

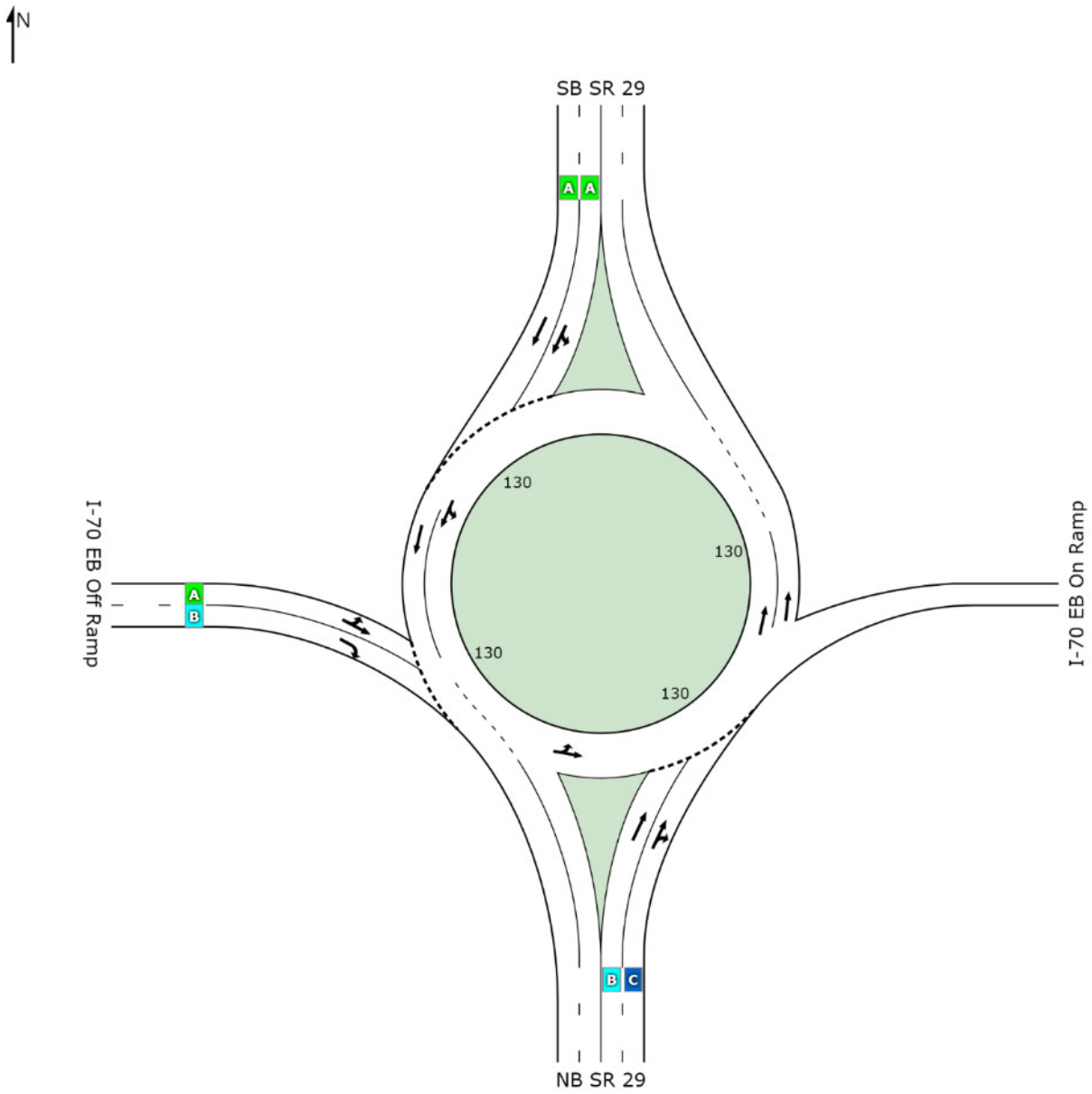
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: NB SR 29											
8T	T	641	12.0	0.631	12.6	LOS B	3.9	105.5	0.52	0.56	26.5
8R	R	913	12.0	0.899	29.5	LOS C	13.5	371.1	0.84	0.89	18.8
Approach		1554	12.0	0.899	22.5	LOS C	13.5	371.1	0.71	0.75	21.3
North: SB SR 29											
7L	L	163	12.0	0.444	7.6	LOS A	0.0	0.0	0.00	0.93	26.1
4T	T	913	12.0	0.444	7.6	LOS A	0.0	0.0	0.00	0.22	29.8
Approach		1076	12.0	0.444	7.6	LOS A	0.0	0.0	0.00	0.33	29.1
West: I-70 EB Off Ramp											
5L	L	22	7.0	0.038	6.4	LOS A	0.1	2.5	0.54	0.85	25.0
2T	T	1	7.0	0.038	6.4	LOS A	0.1	2.5	0.54	0.65	27.7
2R	R	402	7.0	0.641	18.6	LOS B	2.6	69.1	0.72	0.94	22.2
Approach		425	7.0	0.641	18.0	LOS B	2.6	69.1	0.71	0.93	22.3
All Vehicles		3055	11.3	0.899	16.6	LOS B	13.5	371.1	0.46	0.63	23.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

LEVEL OF SERVICE SUMMARY

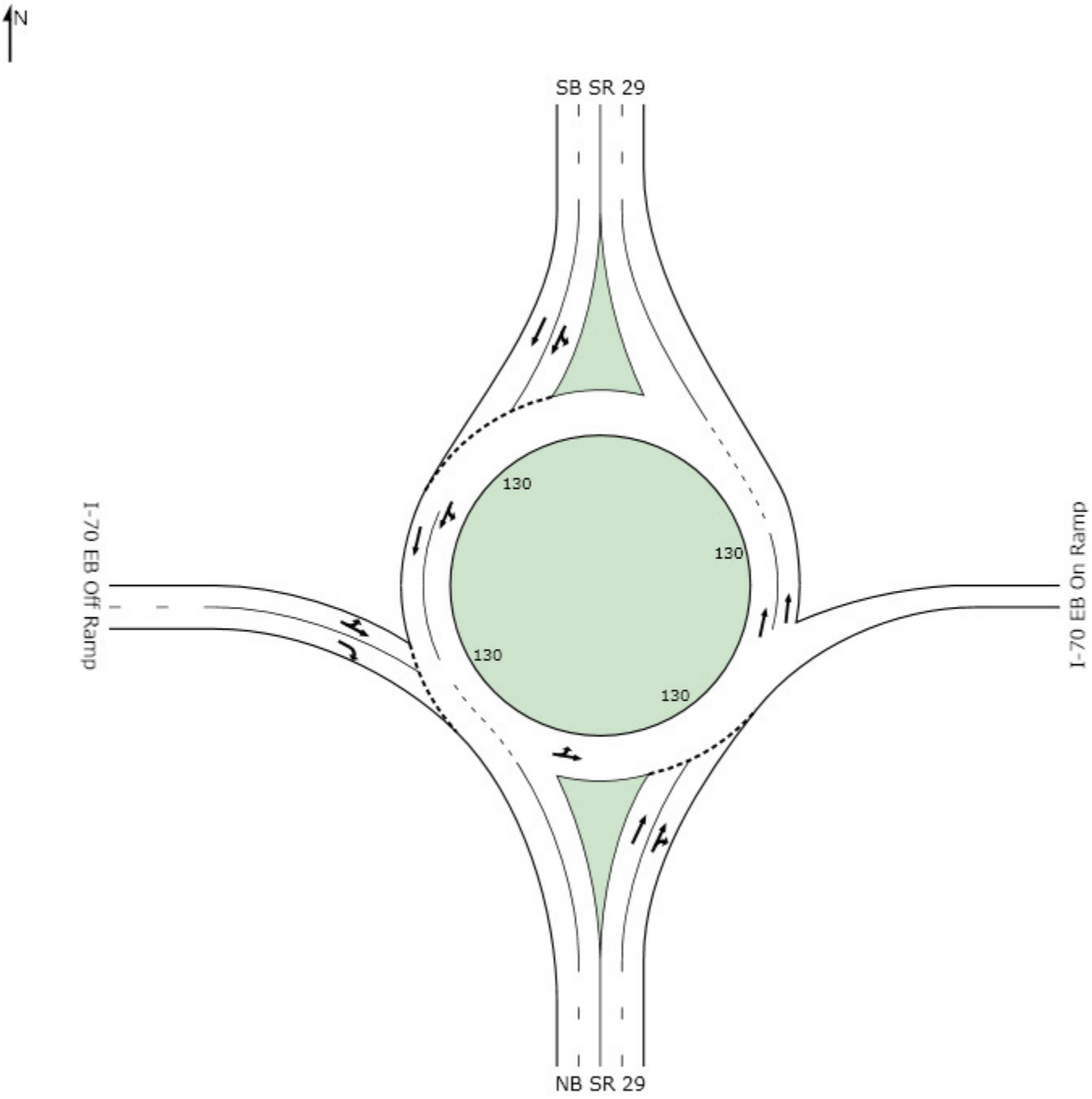
Site: 2030 PM EB Ramps

2030 PM EB Ramp (Dual Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 0 years



	South	East	North	West	Intersection
LOS	C	NA	A	B	B

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
HCM Delay Model used. Geometric Delay not included.


N
SB SR 29
I-70 EB Off Ramp
I-70 EB On Ramp
NB SR 29
130
130
130
130

MOVEMENT SUMMARY

Site: 2030 AM EB Ramp

2030 AM EB Ramp (Dual Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years

Movement Performance - Vehicles

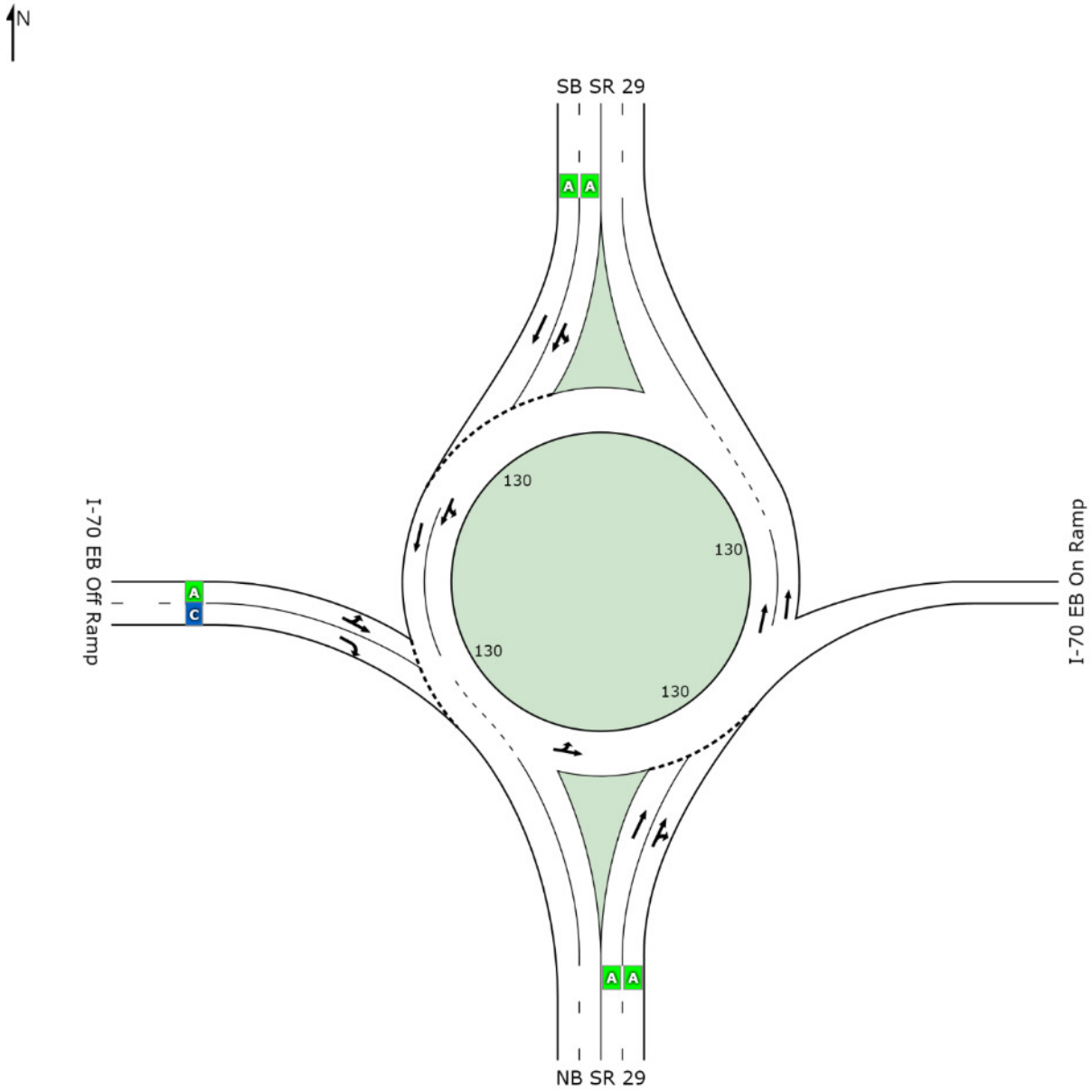
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: NB SR 29											
8T	T	196	17.0	0.208	5.9	LOS A	0.7	19.8	0.36	0.47	30.7
8R	R	283	17.0	0.300	7.0	LOS A	1.1	30.9	0.39	0.57	27.3
Approach		478	17.0	0.300	6.5	LOS A	1.1	30.9	0.38	0.53	28.5
North: SB SR 29											
7L	L	207	17.0	0.475	8.2	LOS A	0.0	0.0	0.00	0.89	26.1
4T	T	913	17.0	0.475	8.2	LOS A	0.0	0.0	0.00	0.22	29.8
Approach		1120	17.0	0.475	8.2	LOS A	0.0	0.0	0.00	0.35	29.0
West: I-70 EB Off Ramp											
5L	L	22	20.0	0.044	7.6	LOS A	0.1	2.8	0.56	0.85	24.5
2T	T	1	20.0	0.044	7.6	LOS A	0.1	2.8	0.56	0.67	27.1
2R	R	446	20.0	0.823	34.5	LOS C	3.9	112.0	0.78	1.11	17.6
Approach		468	20.0	0.823	33.2	LOS C	3.9	112.0	0.77	1.10	17.9
All Vehicles		2066	17.7	0.823	13.5	LOS B	3.9	112.0	0.26	0.56	25.4

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

LEVEL OF SERVICE SUMMARY

Site: 2030 AM EB Ramp

2030 AM EB Ramp (Dual Lane)
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years



	South	East	North	West	Intersection
LOS	A	NA	A	C	B

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
HCM Delay Model used. Geometric Delay not included.

Appendix G

Turn Lane Length Analyses

Queue Analysis for EB Off Ramp, L&D Manual, Figure 401-10

AM Conditions

- 2010 (Opening Day) Volumes for EB Off Ramp: 20 L, 260 R
- Unsignalized stop, assume 60 cycles/hour

Left Turn Analysis:

- Avg. vehicles/cycle = 20 vehicles/~~hour~~ x 1 ~~hour~~/60 cycles
  = 1 vehicles/cycle
- Using Figure 401-10, the queue length is 50 feet

Right Turn Analysis:

- Avg. vehicles/cycle = 260 vehicles/~~hour~~ x 1 ~~hour~~/60 cycles
  = 5 vehicles/cycle
- Using Figure 401-10, the queue length is 200 feet* Controls

PM Conditions

- 2010 (Opening Day) Volumes for EB Off Ramp: 20 L, 240 R
- Unsignalized stop, assume 60 cycles/hour

Left Turn Analysis:

- Avg. vehicles/cycle = 20 vehicles/~~hour~~ x 1 ~~hour~~/60 cycles
  = 1 vehicles/cycle
- Using Figure 401-10, the queue length is 50 feet

Right Turn Analysis:

- Avg. vehicles/cycle = 240 vehicles/~~hour~~ x 1 ~~hour~~/60 cycles
  = 4 vehicles/cycle
- Using Figure 401-10, the queue length is 175 feet

Turn Lane Length Determination for EB Off Ramp, L&D Manual, Figure 401-9

Conditions:

- Use AM conditions (controlling condition)
- Unsignalized Stopped Crossroad
- Condition A (ramp, provide storage only)
- Design for Left turn lane as per L&D Manual, Section 503.7 (minor movement)

Turn Lane Length = 50'(taper) + Storage Length = 50' + 50' = 100 feet

However, to avoid blockage from Right turn lane queue, Left turn lane length will need to provide 200'of storage.

Left Turn Lane Length = 50' (taper) + 200' = 250 feet

Turn Lane Length Determination for WB Off Ramp, Sidra Output

Conditions:

- Use maximum queue (opening day vs. design year) to provide maximum storage on opening day and minimize future ramp construction.
- From Sidra, the maximum left turn queue is 178 feet. Round to 180 feet.

Bypass Lane Length = Left Lane Queue + 50' = 180' + 50' = 230 feet

APPENDIX B

2018 IOS DOCUMENT

INTEROFFICE COMMUNICATION

TO: Mitch Blackford, District 6 Deputy Director
ATTENTION: Steve Fellenger, P.E., District 6 Project Manager
FROM: David J. Holstein, P.E., Administrator, Office of Roadway Engineering Administrator
BY: Mary Bapu-Tamaskar, P.E., Traffic Studies Engineer, Office of Roadway Engineering
DATE: November 30, 2018
SUBJECT: MAD-70-10.29, PID 93605, I-70 & SR-29 Interchange

The Office of Roadway Engineering has reviewed the subject report and determined the proposed improvements at the subject interchange will not degrade operations on I-70. **The study meets ODOT requirements for an Interchange Operations Study (IOS) and therefore is approved.**

Improvements include the following traffic control and lane assignment changes (changes are underlined):

- At the SR-29 & I-70 EB Ramps intersection:
  - Intersection is under stop-control (only the I-70 EB off-ramp movement) and will change to signal-control.
  - EB approach (I-70 EB off-ramp) is 2-lanes (L-TR). No proposed changes.
  - WB approach (I-70 EB on-ramp) is 1-lane. No proposed changes.
  - NB approach (SR-29 WB) from 1-lane (TR) to 2-lanes (T-R).
  - SB approach (SR-29 EB) from 1-lane (LT) to 2-lanes (L-T).
- At the SR-29 & Commerce Parkway intersection:
  - Intersection is under signal-control and will be upgraded to accommodate an exclusive SR-29 WBL turn lane.
  - EB approach (Commerce Parkway) from 1-lane (LR) to 2-lanes (L-R).
  - WB approach does not exist. No proposed changes.
  - NB approach (SR-29 WB) from 1-lane (LT) to 2-lanes (L-T).
  - SB approach (SR-29 EB) is 2-lanes (T-R). No proposed changes.

Attached is a schematic showing the proposed improvements.

If you have questions, please contact Mary Bapu-Tamaskar at Mary.Bapu-Tamaskar@dot.ohio.gov or 614.644.7888

DLH:MBT

c: FHWA (Dan Brodhag, Rachel LeVee); D-06 (Mitch Blackford, Thom Slack, Dirk Gross); CO (Rick Bruce, Brent Bogard, Gary Harrington)

Project Condor: SR-29 Proposed Network 1 Roadway Improvements Concepts at I-70 and Commerce Parkway (5/2/2018)

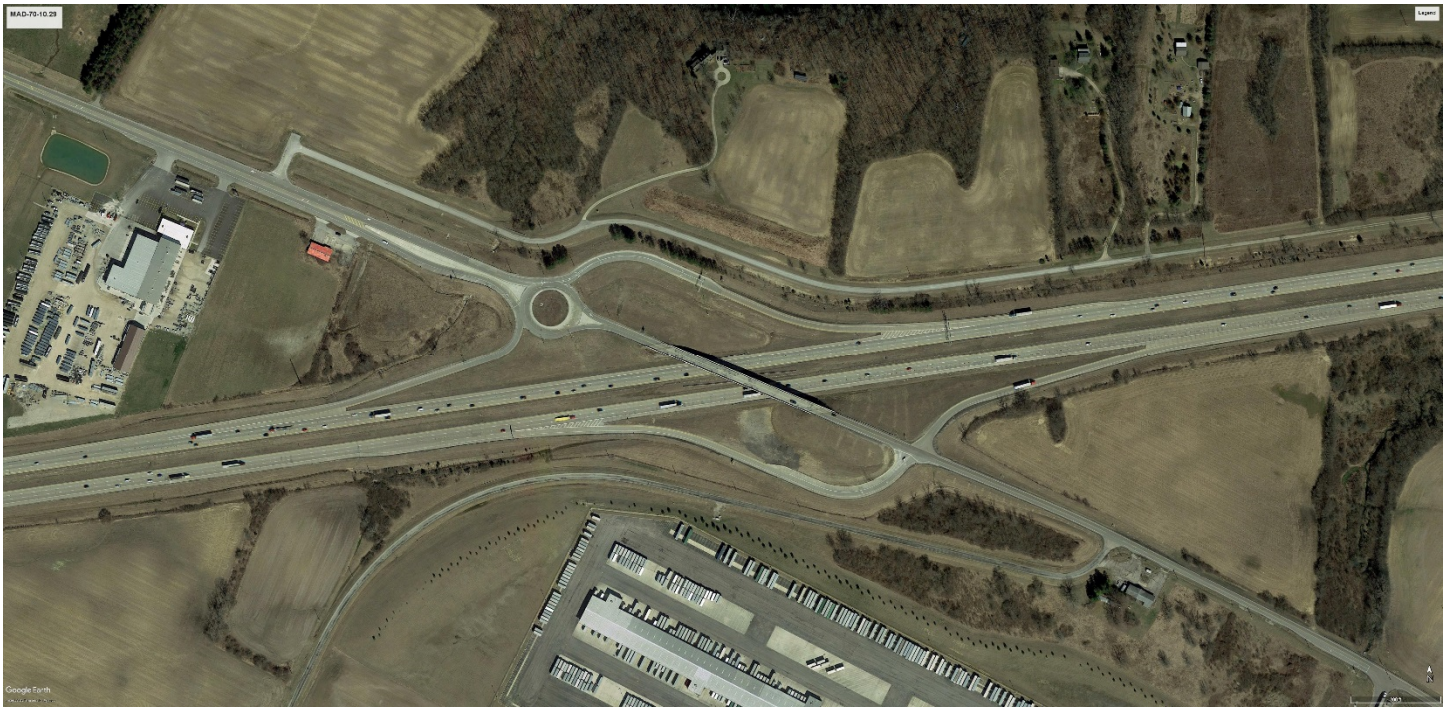
0 50 100 200 Feet

1 inch = 50 feet
102" x 36"

Stantec

INTERCHANGE OPERATIONS STUDY (IOS) FOR MAD-70-10.29, PID 93605

INTERCHANGE AT I-70/SR-29



Prepared By:

Ohio Department of Transportation

Office of Roadway Engineering

1980 West Broad Street

Columbus, Ohio 43223

Completion Date: November 30, 2018

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Executive Summary

The purpose of this document is to reevaluate the approved IMS for the I-70 & SR-29 interchange in Madison County and to confirm if the Build condition will provide acceptable traffic operations for design-year 2030. Additionally, Phase 2 improvements, opening-year 2019, have been analyzed to see if improvements provide a benefit over providing no interim improvements.

Background

Below is a brief history of constructed and future improvements at the I-70/SR-29 interchange in Madison County.

- February 01, 2012 - Interchange Modification Study (IMS) approved by FHWA for MAD-70-10.27, PID 83245
- October 01, 2014 – Phase 1 improvements constructed. The SR-29/I-70 WB Ramps intersection was converted from stop-control at off-ramp to 1-lane roundabout, with the ability to expand to a 2-lane roundabout in the future.
- Spring 2019 – Phase 2 improvements will begin and be constructed under Permit No. 18-846. The SR-29/I-70 EB Ramps intersection will change from stop-control at off-ramp to signal control.
    - EB approach: I-70 EB off-ramp exits I-70 EB as 1-lane with a 2-lane approach at SR-29 (LT-R). No changes are proposed.
    - WB approach: I-70 EB on-ramp is a 1-lane entrance ramp and joins I-70 EB as a merge. No changes are proposed.
    - NB approach: SR-29 NB is 1-lane (TR) and will change to 2-lanes (T-R).
    - SB approach: SR-29 SB is 1-lane (LT) and will change to 2-lanes (L-T).
- Beyond 2019 – Build condition per IMS will be constructed under MAD-70-10.27, PID 93605. This includes the improvements at the following intersections:
    - SR-29/I-70 WB Ramps: 1-lane to 2-lane roundabout
    - SR-29/I-70 EB Ramps: Signalized intersection to 2-lane roundabout
    - Connection between 2 roundabouts with 2 lanes per direction.

Purpose and Need

Per the Traffic Impact Study (TIS) prepared in advance of the Amazon Fulfillment Center, improvements at the SR-29/I-70 WB Ramps intersection are warranted and proposed. Due to the history and phasing of this project, the following questions need to be addressed.

1. Does the Build-Phase 2 condition build toward the Full-Build condition? Yes it does. Although Build-Phase 2 is not constructing a roundabout, some of the improvements can be salvaged when the Full-Build is constructed.
2. Does the Build-Phase 2 condition provide benefit compared to no improvements? Yes it does. Constructing turn lanes and signalizing the intersection will improve traffic operations and will provide for safer movements, especially exclusive EBL and SBL turn lanes at the SR-29/I-70 EB Ramps intersection.
3. Does the Build-Phase 2 condition preclude construction of the Full-Build condition? No it does not. None of the Build-Phase 2 improvements preclude the construction of the Full-Build condition.
4. Is the Full-Build design still valid? Yes it is. Using current traffic volumes and a projection to the original design year of 2030, the 2-lane roundabout at both interchange ramps were analyzed with HCS7, version 7.6. The Full-Build roundabouts are predicted to operate an acceptable level of service, with the roundabouts operating at an overall LOS B or better, with no approaches worse than a LOS C

Study Area

Along I-70 including the interchange at SR-29. Along SR-29 including intersections at I-70 WB Ramps, I-70 EB Ramps, and Commerce Parkway. The red line in Figure 1 shows the study area.

Figure 1: Study Area

Existing Conditions

- I-70 is a 6-lane divided interstate with limited-access.
- I-70 has a design speed within the study area of 75 mph, and a posted speed limit is 70 mph.
- SR-29 is an east-west state highway that spans between the Indiana/Ohio state line in Mercer County and US-40 in Madison County, just southeast of the I-70/SR-29 interchange.
- SR-29 is a 2-lane major collector and has a speed limit within the interchange of 50 mph. The speed limit changes to 55 mph just west of the interchange.
- The I-70/SR-29 interchange has a diamond configuration.

Analysis Years

Analyses for years 2018 (Opening-Year) and 2030 (Design-Year) were selected for the conditions shown in Table 1. See the Alternatives Considered section for additional information on the various conditions.

Table 1

Intersection(s)	Year	Condition
#1-SR-29/I-70 WB Ramps	2018	Build-Phase 1
#2-SR-29/I-70 EB Ramps #3-SR-29/Commerce	2018	No-Build vs. Build-Phase 2
#1-SR-29/I-70 WB Ramps #2-SR-29/I-70 EB Ramps	2030	Full-Build

Alternatives Considered

The various conditions with phased improvements at the SR-29 intersections are listed in Table 2 below. Red text indicates a change from the previous phase.

Table 2

Condition	Year	Intersections along SR-29 at I-70 Interchange, Madison County		
		SR-29/I-70 WB Ramps	SR-29/I-70 EB Ramps	SR-29/Commerce
No-Build	Pre-2014	Stop-control for off-ramp	Stop-control for off-ramp	Two-way stop-control
Build-Phase 1	2014	Roundabout-control (1-lane)	Stop-control for off-ramp	Signal-control, SBR turn lane added
Build-Phase 2	2019	Roundabout-control (1-lane)	Signal-control, turn lanes added	Signal-control, EBL/NBL turn lanes added
Full-Build	2019+	Roundabout-control (2-lanes)	Roundabout-control (2-lanes)	Signal-control, EBL/NBL turn lanes added

**Note: Interchange is a diamond configuration for all conditions with varying traffic control at ramp terminals.*

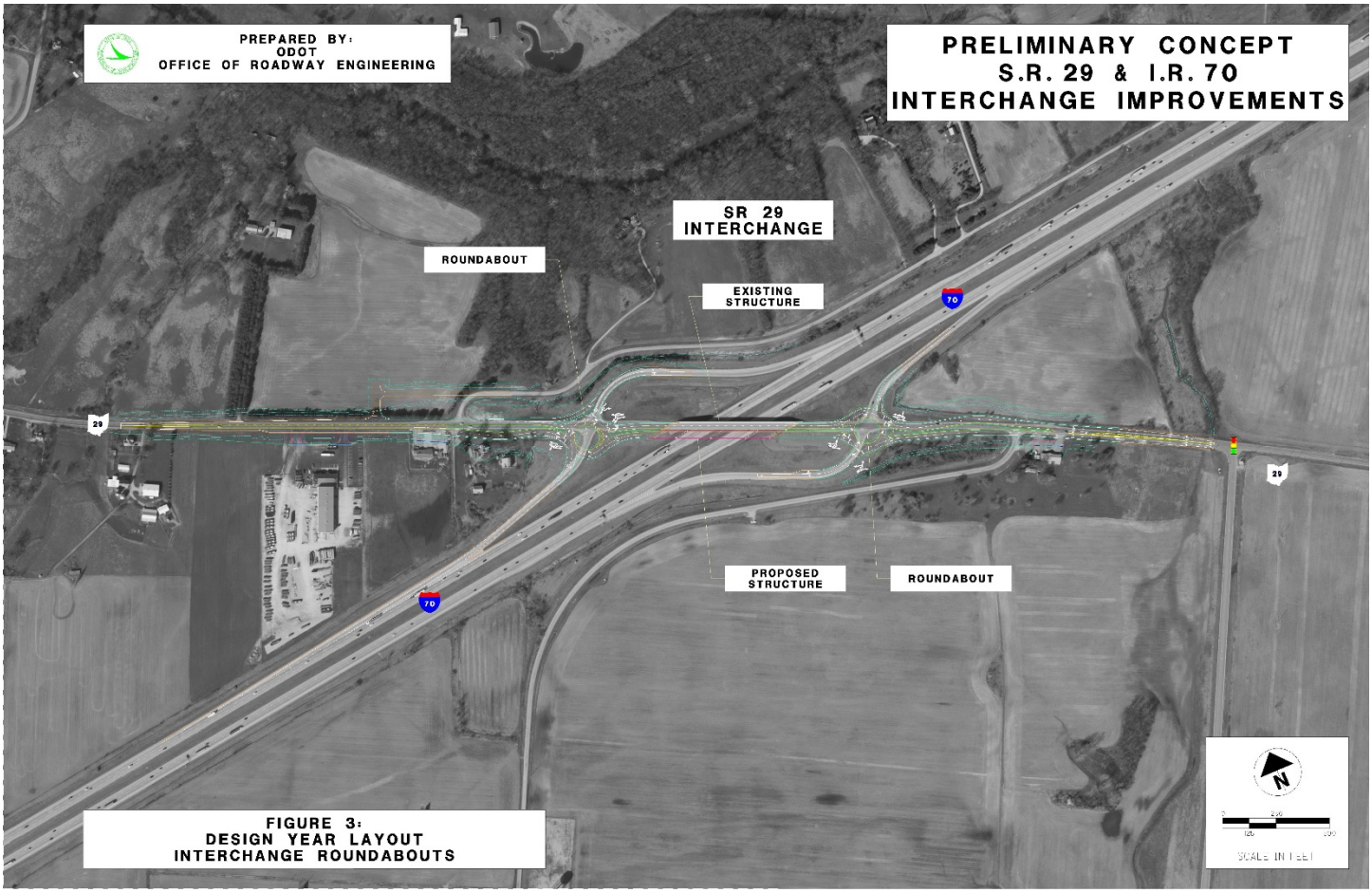
See Figures 2-5 for various conditions

Figure 2: No-Build Condition Aerial (November 2011, per Google Earth)

Figure 3: Build-Phase 1 Condition Aerial (March 2018, per Google Earth)

Figure 4: Build-Phase 2 Condition (Opening 2019), see Appendix C-1 and Appendix E (Permit plan sheet)

Figure 5: Build Condition (Design-Year 2030), see Appendix C-2



Traffic Volumes

ODOT's Office of Technical Services provided certified traffic for opening-year (2010) and design-year (2030) on November 08, 2007, see Appendix A-1. Due to the age of the certified traffic, some checks were made to see if the current and projected traffic volumes are within the IMS traffic volumes. Below is discussion on how traffic volumes were checked.

I-70 Mainline Volumes

The following sources were used:

- 11.08.2007 – Certified Traffic in IMS
- October 2017 – Data per ODOT's MS2 website (odot.ms2soft.com)
- 08.03.2018 – Growth rates using SHIFT

2017 MS2 volumes vs. 2018 IMS volumes

Hourly counts, for 24 hours/day have been collected on I-70 EB/WB, east of the SR-29 interchange from January 2017 to October 2017. Using the last full week of data, Monday-Friday, an average of the AM/PM peak hour volumes were calculated. The 2017 MS2 volumes were then compared to the 2018 interpolated traffic volumes from the IMS. In every case, the IMS volumes were higher than the MS2 volumes, this means I-70 should operate at the same or better level as predicted in the IMS; therefore, updated analyses for I-70 mainline were not prepared.

2030 MS2 volumes vs. 2030 IMS Volumes

Using the MS2 traffic volumes, growth rates from SHIFT, and a DHV factor, 2030 AM/PM peak volumes were calculated for the I-70 EB/WB segment east of the I-70/SR-29 interchange. For every case, except for I-70 EB-AM, the 2030 IMS volumes are higher than the projected 2030 MS2 volumes. The I-70 EB-AM IMS/MS2 volumes are 2810/2867, a difference of about 60 veh, or 2%. Since the IMS volumes are nearly the same or higher than the MS2 volumes I-70 should operate at the same level or better level as predicted in the IMS therefore, updated analyses for I-70 mainline were not prepared.

SR-29 Intersection Volumes

The following sources were used:

- 05.15.2018 - TIS
- 08.03.2018 – Growth rates using SHIFT

2018 TIS volumes vs. 2018 IMS volumes

The TIS provided 2018 AM/PM Background volumes and Peak-Site traffic, for the highest anticipated use which is 2 months per year, November & December. See Appendix A-4 for the comparison.

2030 TIS/SHIFT volumes vs. 2030 IMS volumes

Using the TIS traffic volumes, growth rates per SHIFT, and a DHV factor, 2030 AM/PM peak volumes were calculated for SR-29 intersections at I-70 WB Ramps and I-70 EB Ramps. See Appendix A-4 for the comparison.

SHIFT Growth rates per year (cars/trucks)

- SR-29
  - West of I-70 EB Ramps: 0.70%/2.46%
  - East of I-70 EB Ramps: 2.57%/0.55%
- I-70
  - West of SR-29: 0.85%/0.48%
  - East of SR-29: 1.06%/0.82%

Traffic Analyses

Intersection Analyses

The results in Table 3 summarize the 2018 AM/PM Build-Phase 1 conditions (current layout) for the SR-29/I-70 WB Ramps intersections for peak traffic operations of the Amazon Fulfillment Center. Although the SB approach shows a LOS E it does not create a negative impact on vehicles exiting I-70 WB or the SR-29/I-70 EB Ramps intersection.

Table 3

Intersection Analyses			2018 AM Build-Phase 1				2018 PM Build-Phase 1			
Intersection		Approach	LOS	Delay	v/c≥0.93	QSR≥1.0	LOS	Delay	v/c≥0.93	QSR≥1.0
I-1	SR-29/I-70 WB Ramps	EB	-	-	-	-	-	-	-	-
	No-Build: Roundabout (1-lane)	WB	B	13.6	-	-	D	27.3	-	-
		NB	A	3.7	-	-	A	6.6	-	-
		SB	E	49.3	-	-	D	25.8	-	-
		Intersection	C	23.3	-	-	C	20.2	-	-

The results in Tables 4-5 compare the 2018 AM/PM No-Build and Build-Phase 2 conditions for the 2 intersections being improved as part of the Phase 2 construction. The LOS and Delay improves when comparing the No-Build to Build-Phase 2 conditions.

Table 4: Intersection Analyses (LOS/Delay)			2018 AM No-Build		2018 AM Build-Phase 2		2018 PM No-Build		2018 PM Build-Phase 2	
Intersection		Approach	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
I-2	SR-29/I-70 EB Ramps	EB	F	117.3	C	31.4	F	51.2	C	31.6
	No-Build: TWSC Build - Signalized, 90s cycle length	WB	-	-	-	-	-	-	-	-
		NB	-	-	C	21.4	-	-	C	31.7
		SB	A	7.9	C	31.4	B	12.5	B	17.7
		Intersection	-	-	C	30.4	-	-	C	26.1
I-3	SR-29/Commerce	EB	C	31.8	C	30.7	C	28.0	C	26.8
	No-Build & Build are signalized, 90s cycle length	WB	-	-	-	-	-	-	-	-
		NB	B	15.9	A	8.7	C	27.9	C	26.8
		SB	C	31.9	C	31.0	B	15.1	B	16.0
		Intersection	C	30.9	C	29.6	C	21.8	C	21.7

Table 5: Intersection Analyses - v/c & QSR			2018 AM No-Build		2018 AM Build-Phase 2		2018 PM No-Build		2018 PM Build-Phase 2	
Intersection		Approach	v/c≥ 0.93	QSR≥ 1.0	v/c≥ 0.93	QSR≥ 1.0	v/c≥ 0.93	QSR≥ 1.0	v/c≥ 0.93	QSR≥ 1.0
I-2	SR-29/I-70 EB Ramps	EB	R: 1.09	-	-	-	-	-	-	-
	No-Build: TWSC Build - Signalized, 90s cycle length	WB	-	-	-	-	-	-	-	-
		NB	-	-	-	-	-	-	-	R: 1.47
		SB	-	-	T: 0.937	L: 1.62	-	-	-	L: 1.26
		Intersection	-	-	-	-	-	-	-	-
I-3	SR-29/Commerce	EB	-	-	-	-	-	-	-	-
	No-Build & Build are signalized, 90s cycle length	WB	-	-	-	-	-	-	-	-
		NB	-	-	-	-	T: 0.933	-	-	-
		SB	T: 0.979	-	T: 0.976	-	-	-	-	-
		Intersection	-	-	-	-	-	-	-	-

SR-29/I-70 WB Ramps

Per the HCS results, the Build-Phase 2 condition lowers the v/c below 0.93 for all movements. The AM No-Build condition shows the EBR movement is overcapacity (1.09). The SBL movement shows the 95th-percentile queue extends beyond the provided storage. This can be mitigated by increasing the protected phase for EBL. Furthermore, the No-Build condition is a 1-lane approach (LT) whereas the Build condition is a 2-lane approach (L-T). Providing a left turn lane, although it is short (<100') is an improvement compared to having no turn lane.

SR-29/Commerce

Per the HCS results, the Build-Phase 2 condition improves the v/c's. No movement has a QSR > 1.0.

The results in Table 6 summarize the 2030 AM/PM Build-Phase 2 (full build) conditions at the multi-lane roundabouts for the SR-29/I-70 WB Ramps and SR-29/I-70 EB Ramps intersections for peak traffic operations of the Amazon Fulfillment Center. Analyzing the SR-29/I-70 EB Ramps intersection as shown in the IMS yielded a LOS F for the EB approach. The EB approach has nearly all vehicles making a right turn. The LOS F is improved to a LOS C by changing the 2-lane EB approach from a (LT-R) to (LTR-R) lane configuration.

Table 6

Intersection Analyses			2030 AM Build-Phase 2				2030 PM Build-Phase 2			
Intersection		Approach	LOS	Delay	v/c≥ 0.93	QSR≥ 1.0	LOS	Delay	v/c≥ 0.93	QSR≥ 1.0
I-1	SR-29/I-70 WB Ramps	EB	-	-	-	-	-	-	-	-
	Build-Phase 2: Roundabout (2-lanes)	WB	C	16.0	-	-	D	28.5	-	-
		NB	A	3.3	-	-	A	4.6	-	-
		SB	C	17.6	-	-	B	13.3	-	-
		Intersection	C	15.5	-	-	C	17.3	-	-
I-2	SR-29/I-70 EB Ramps	EB	F	72.7	0.98	-	B	14.5	-	-
	Build-Phase 2: Roundabout (2-lanes)	WB	-	-	-	-	-	-	-	-
		NB	A	5.3	-	-	B	10.5	-	-
		SB	A	8.3	-	-	A	6.7	-	-
		Intersection	C	19.8	-	-	A	9.3	-	-
I-2 Change EB approach: (LT-R) to (LTR-R)	SR-29/I-70 EB Ramps	EB	D	26.5	-	-	C	15.1	-	-
	Build-Phase 2: Roundabout (2-lanes)	WB	-	-	-	-	-	-	-	-
		NB	A	5.3	-	-	B	11.0	-	-
		SB	A	8.3	-	-	A	6.7	-	-
		Intersection	B	11.3	-	-	A	9.7	-	-

I-70 Mainline Analyses

As noted above in the Traffic Volumes section above, current I-70 volumes are lower than projected in the IMS; therefore, mainline analyses were not analyzed.

Per the 2017 MS2 traffic volume data, the highest volume within the project area was 2,719 for I-70 WB during the PM peak. Using the highest truck percent in the IMS (31%), Table 7 shows the minimum demand volumes required for LOS D, LOS E, and LOS F. Based on these results, I-70 is predicted to have adequate capacity well beyond the 2030 design-year.

Table 7

Minimum Demand Volume	D	E	F
LOS	3830	4590	5170

Turn Lane Calculations

Typically, turn lanes would be calculated per the ODOT L&D Manual, Volume I, Section 401.6; however, we have an interim condition. Therefore, an assessment of the proposed turn lane lengths is evaluated below.

SR-29/I-70 EB Ramps Intersection

NBR: 325 feet of storage is proposed, the maximum turn lane length that can be provided without acquiring additional right-of-way. The 2018 AM/PM Build-Phase 2 volumes for NBR are 66/610. Per HCS, the 2018 AM/PM Build-Phase 2 95th% queues are 52'/555'. HCS predicts queuing beyond the provided storage for PM; however, the analyses assumed no vehicles turning right, a conservative approach. Realistically, the signal will operate differently in the field from the way it was analyzed in HCS. Providing a NBR turn lane is a benefit over the No-Build condition, which does not have a NBR turn lane.

SBL: 52 feet of storage is proposed, the maximum turn lane length that can be provided without widening the SR-29 bridge over I-70. The 2018 AM/PM Build-Phase 2 volumes for SBL are 150/99. Per HCS, the 2018 AM/PM Build-Phase 2 95th% queues are 138'/107'. HCS predicts queuing beyond the provided storage; however, the signal will operate differently in the field. Providing a SBL turn lane is a benefit over the No-Build condition, which does not have a SBL turn lane.

SR-29/Commerce Intersection

EBL: 165 feet of storage is proposed. The 2018 AM/PM Build-Phase 2 volumes for EBL are 77/80. Per HCS, the 2018 AM/PM Build-Phase 2 95th% queues are 78'/83'. HCS predicts queuing within the provided storage. Providing an EBL turn lane is a benefit over the No-Build condition, which does not have an EBL turn lane. Providing an EBL turn lane may allow for more green time to be given to SR-29.

NBL: 175 feet of storage is proposed, the maximum turn lane length that can be provided without acquiring additional right-of-way. The 2018 AM/PM Build-Phase 2 volumes for NBL are 10/15. Per HCS, the 2018 AM/PM Build-Phase 2 95th% queues are 11'/12'. HCS predicts queuing within the provided storage. Providing a NBL turn lane is a benefit over the No-Build condition, which does not have an NBL turn lane.

Cost Estimate

The total cost of improvements the intersections of SR-29/I-70 WB Ramps and SR-29/Commerce is $610,000, see Appendix D.

Conclusions and Recommendations

Construction of the Amazon Fulfillment Center will be complete in 2019. Although the Full-Build condition is not being constructed at this time, the Build-Phase 2 improvements are an improvement compared to the Build-Phase 1 improvements. The addition of turn lanes and signalization at the SR-29/I-70 EB Ramps intersections will improve traffic operations and should improve safety. Likewise, the construction of turn lanes at the SR-29/Commerce intersection will improve traffic operations. It should be noted that the HCS results are an apples-to-apples comparison. Additional traffic operations can be obtained once the improvements are constructed and the signals are optimized.

Based on the traffic analyses performed, it is recommended ODOT approve proposed improvements for the Build-Phase 2 condition.

Appendix A

Traffic Volumes

Appendix A-1

Certified Traffic Volumes from Approved IMS

INTER-OFFICE COMMUNICATION

TO: James Young, P.E., Office of Roadway Engineering Services

FROM: Leigh A. Oesterling, Project Analyses Admin., Office of Technical Services

SUBJECT: MAD-70-10.27 (SR 29 IMS) PID 83245

DATE: November 8, 2007

In reply to a request dated September 4, 2007, attached are a set of plates showing ADT, A.M. and P.M. design hour volumes for the subject project. If needed K and D factors can be derived from the attached plates.

Please use the following truck factors.

			IR 70		SR 29	
	w/o US 42	w/o SR 29	w/o SR 142	e/o SR 142	n/o IR 70	s/o IR 70
T24:	0.39	0.36	0.34	0.32	0.11	0.20
TD AM:	0.33	0.31	0.29	0.27	0.07	0.17
TD PM:	0.23	0.22	0.20	0.19	0.07	0.12

RAMPS

IR 70 @ SR 142

	WB Off	WB on	EB Off	EB on
T24:	0.05	0.10	0.10	0.04
TD AM:	0.06	0.10	0.04	0.02
TD PM:	0.02	0.01	0.05	0.03

IR 70 @ SR 29

	WB Off	WB on	EB Off	EB on
T24:	0.23	0.16	0.18	0.21
TD AM:	0.29	0.20	0.20	0.15
TD PM:	0.18	0.04	0.07	0.15

IR 70 @ US 42

	WB Off	WB on	EB Off	EB on
T24:	0.28	0.45	0.48	0.27
TD AM:	0.32	0.44	0.49	0.23
TD PM:	0.18	0.33	0.45	0.18

If you have any questions, please contact me at (614) 752-5747.

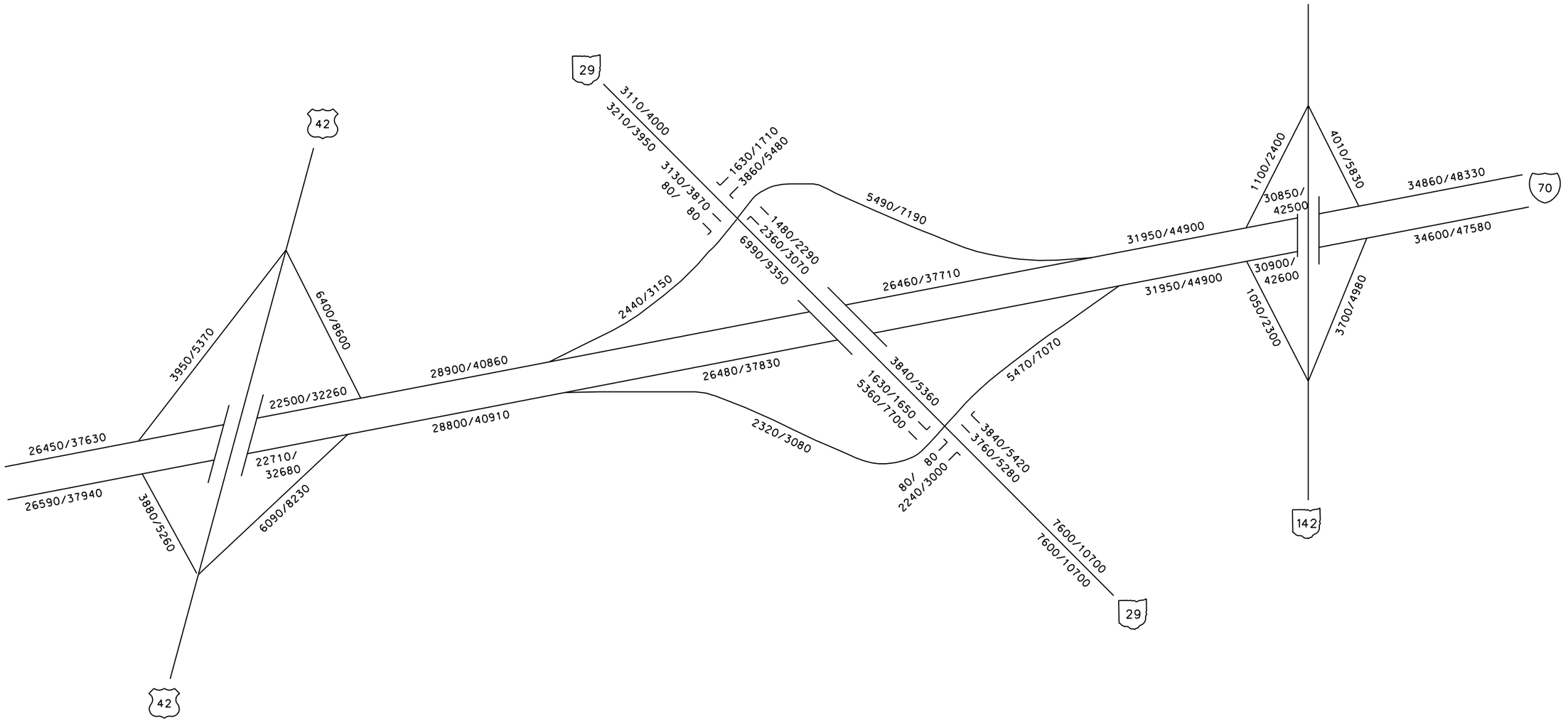
LAO

LAO:lo

c: J. McQuirt, OTS–P. Siddle, OTS–File

MAD–70–10.27
PID 83245
PLATE 1 OF 3

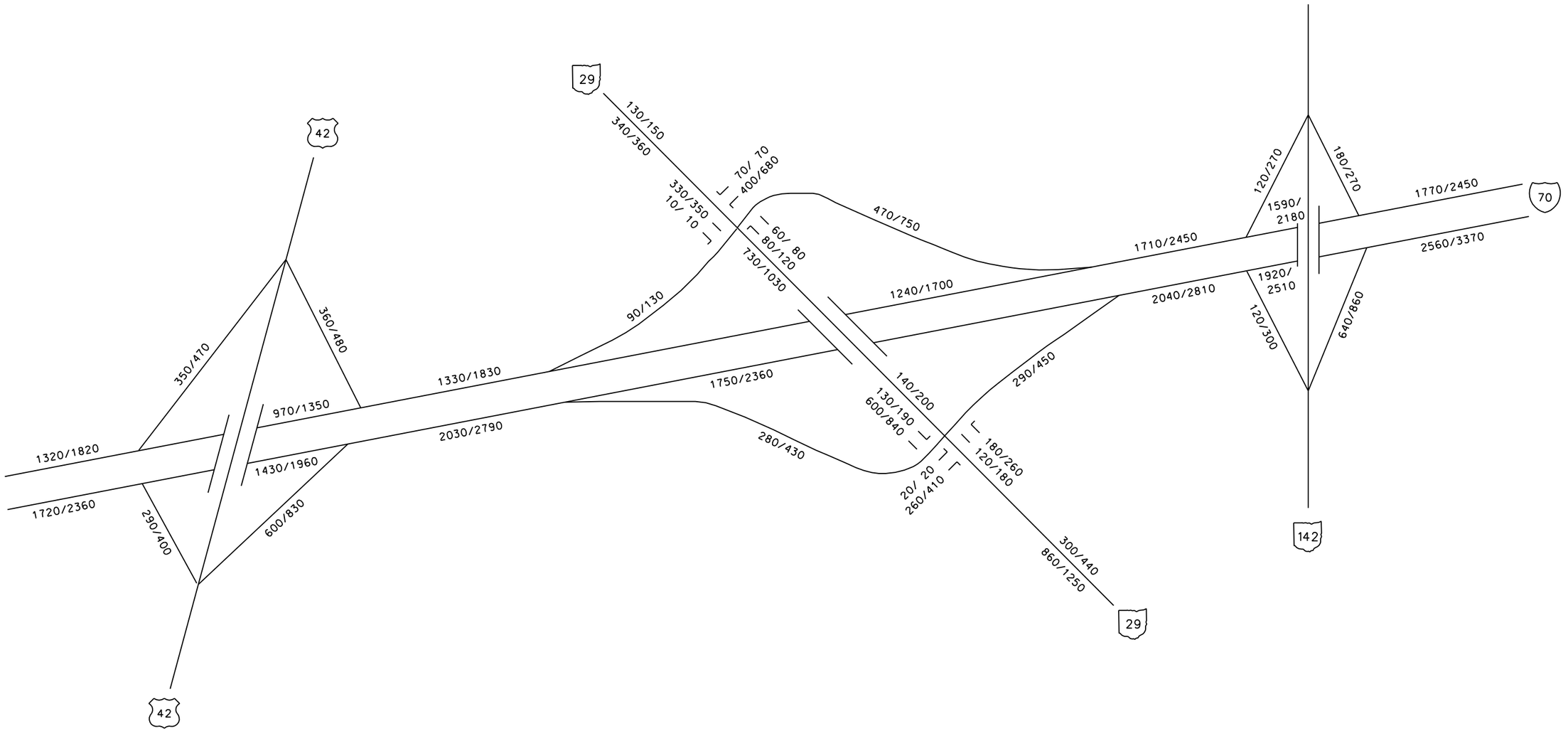
Build



MAD–70–10.27 PID–83245 IMS	
2010/2030 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

MAD–70–10.27
PID 83245
PLATE 2 OF 3

Build

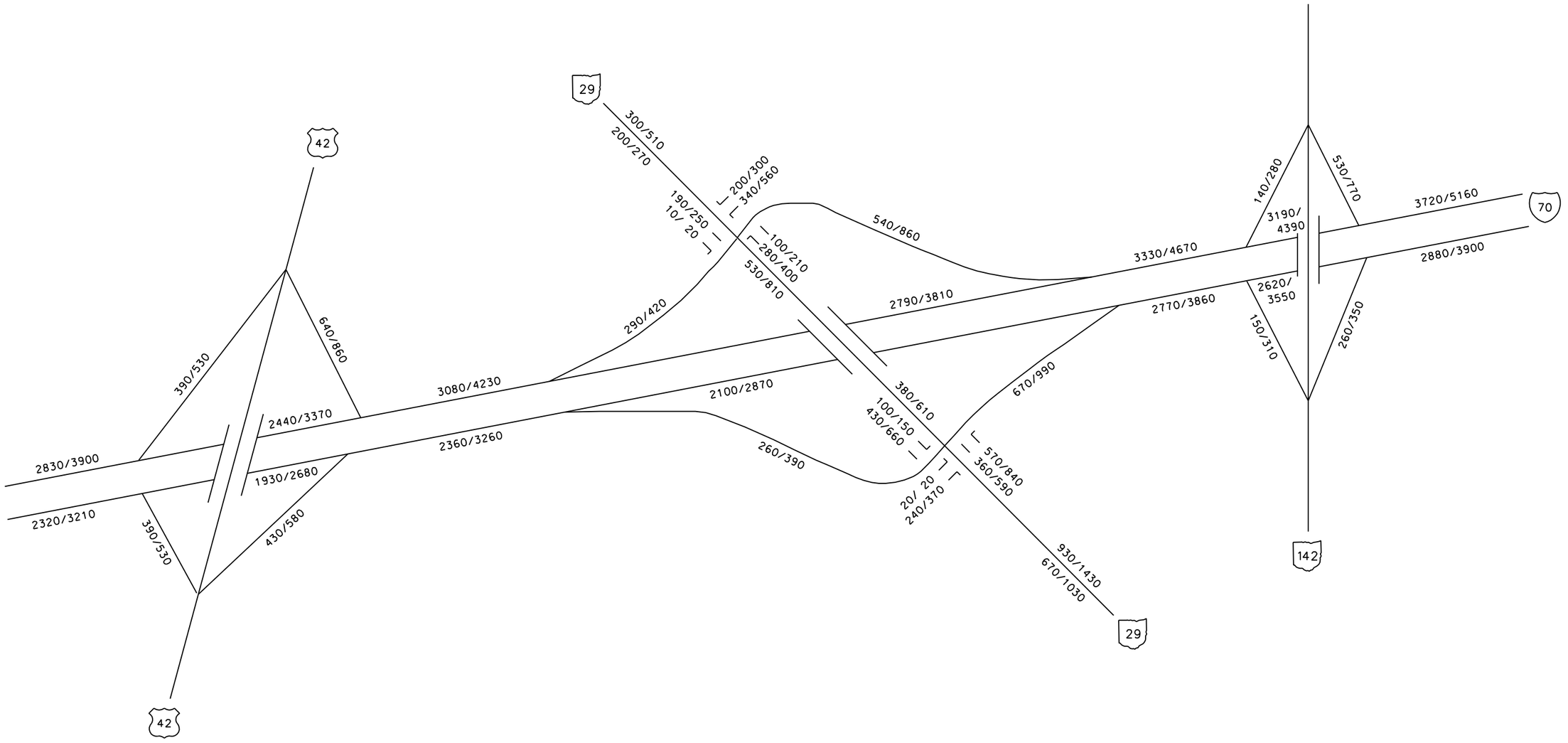


MAD–70–10.27 PID–83245 IMS	
2010/2030 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

N

MAD–70–10.27
PID 83245
PLATE 3 OF 3

Build

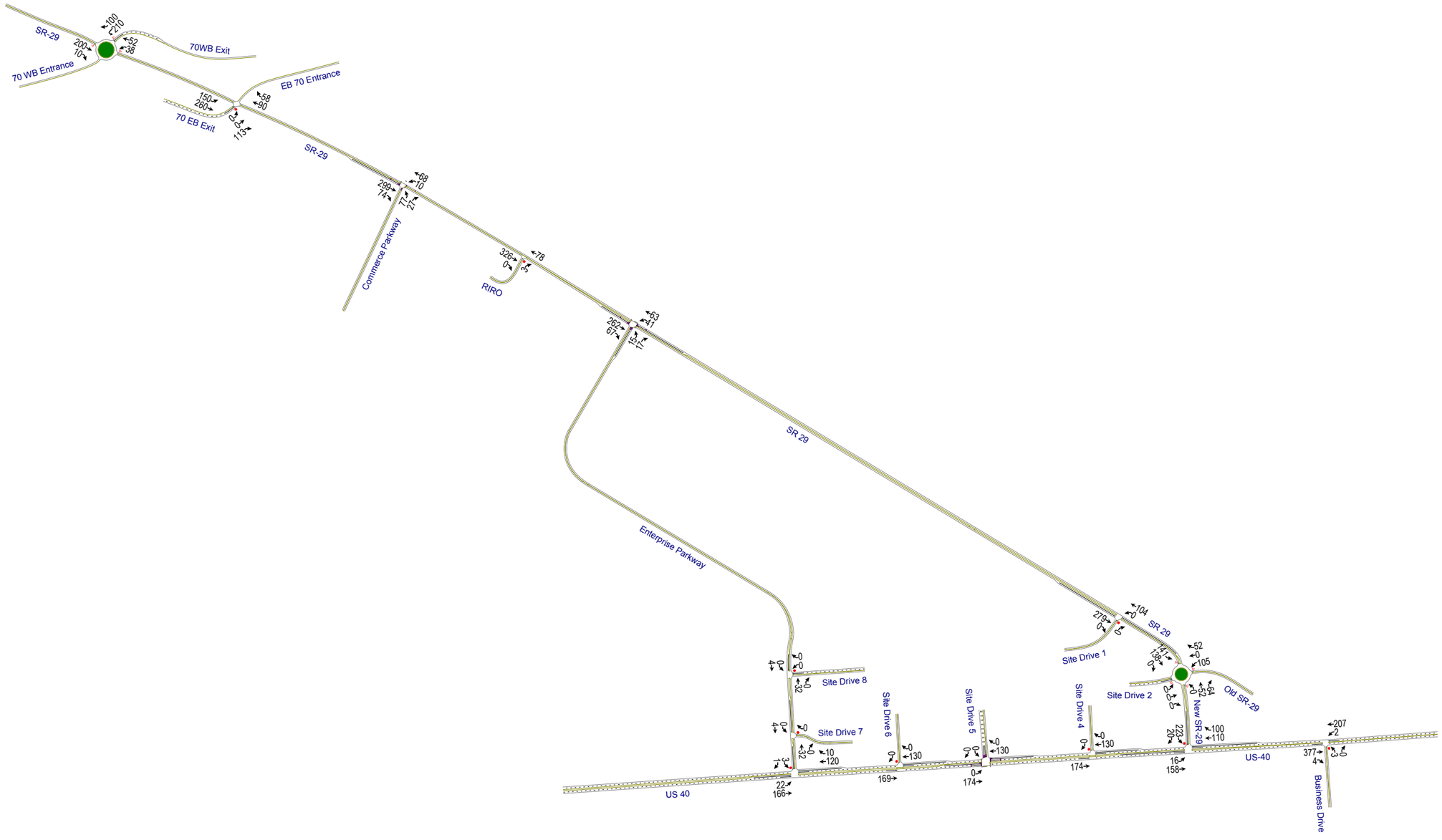


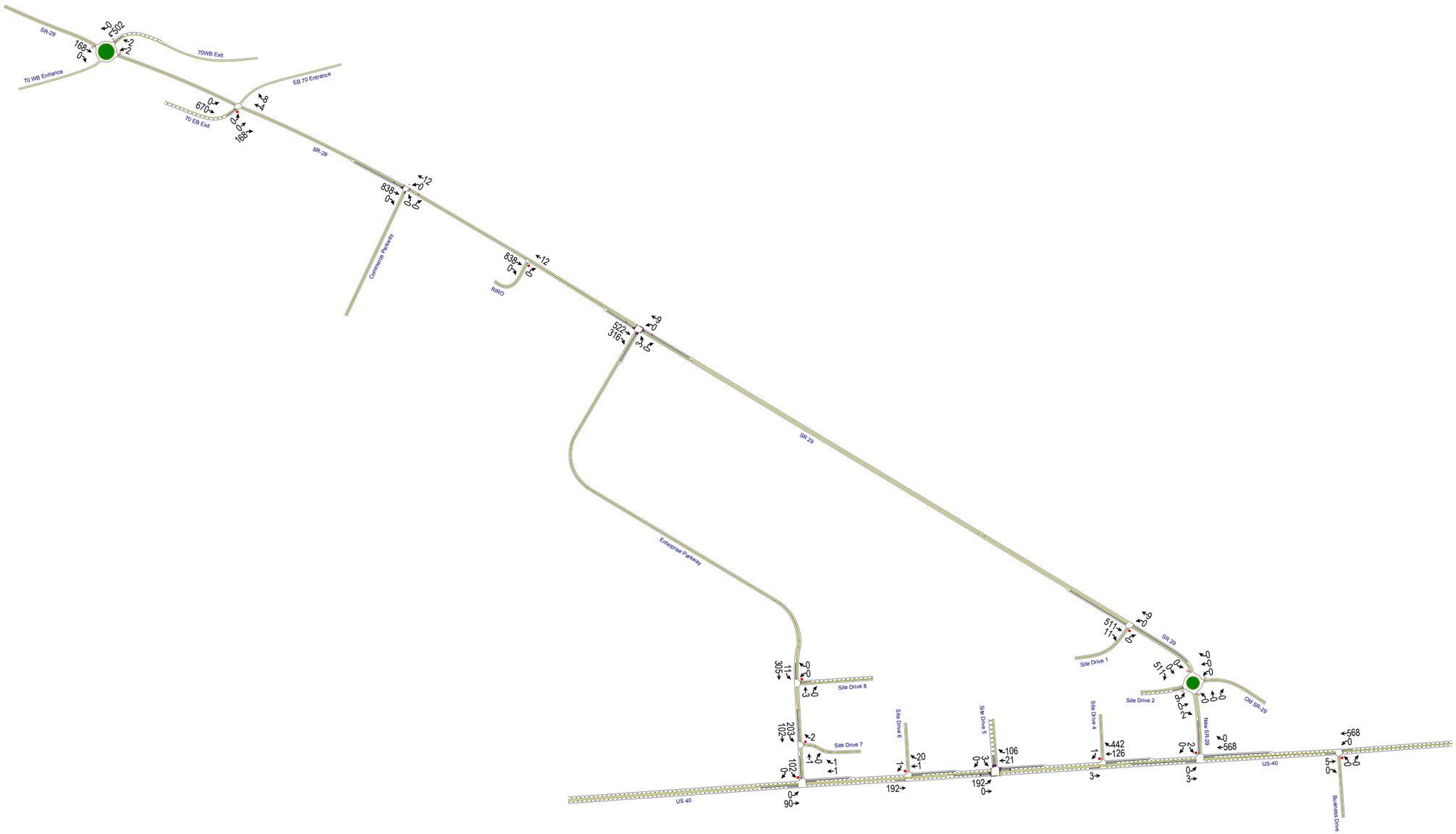
MAD–70–10.27 PID–83245 IMS	
2010/2030 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

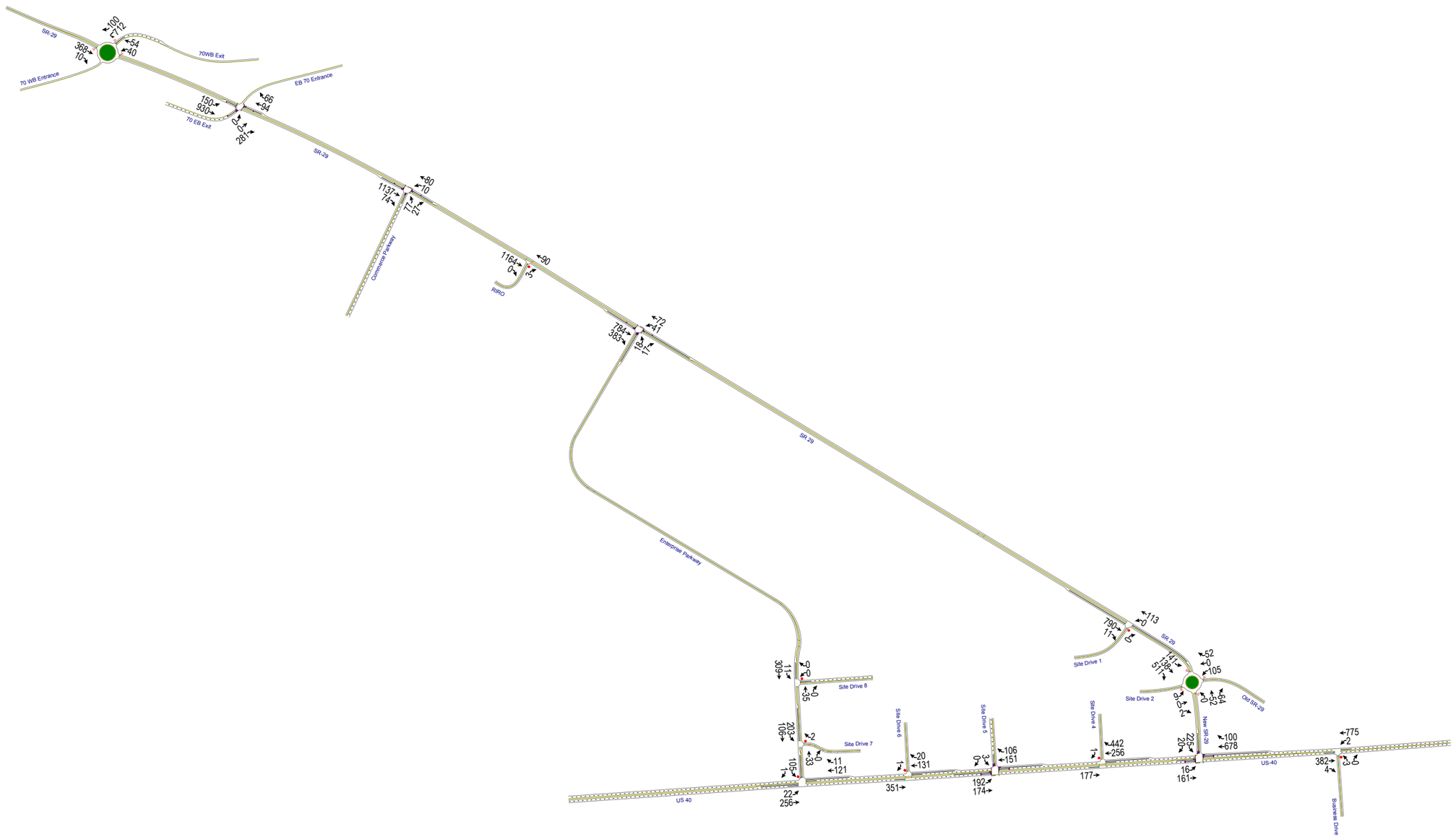
N

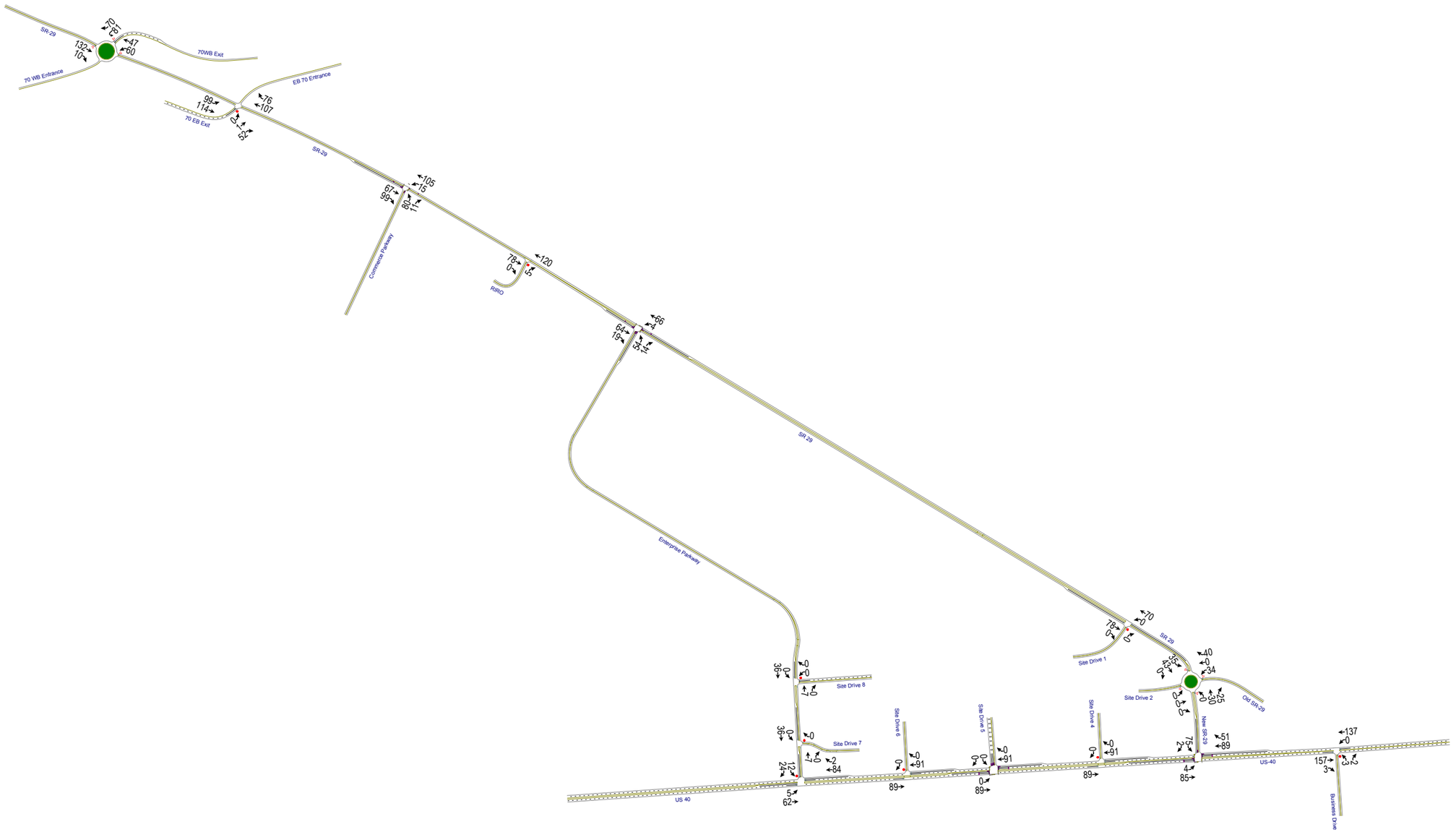
Appendix A-2

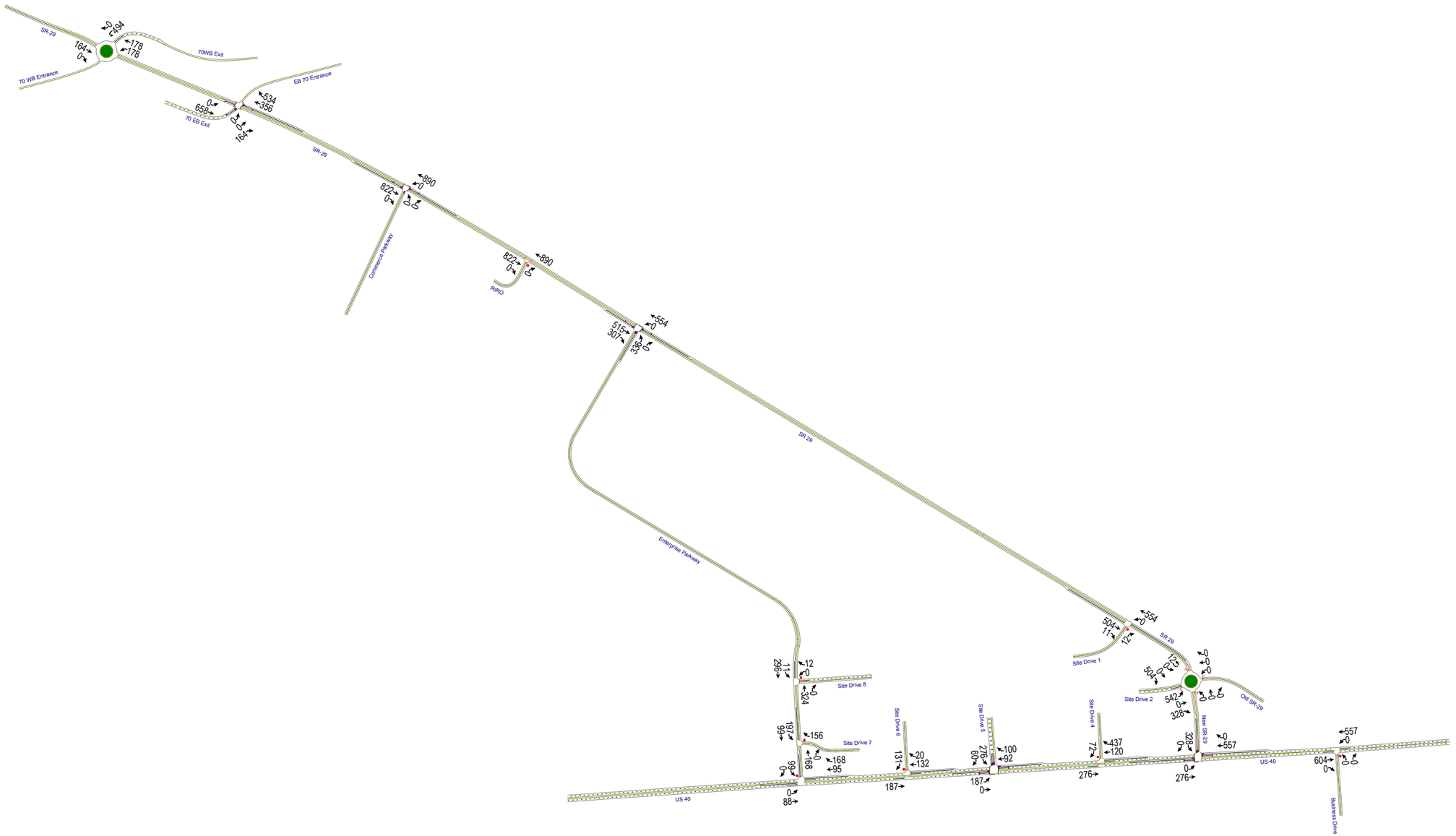
2018 Traffic Volumes from Traffic Impact Study (TIS)

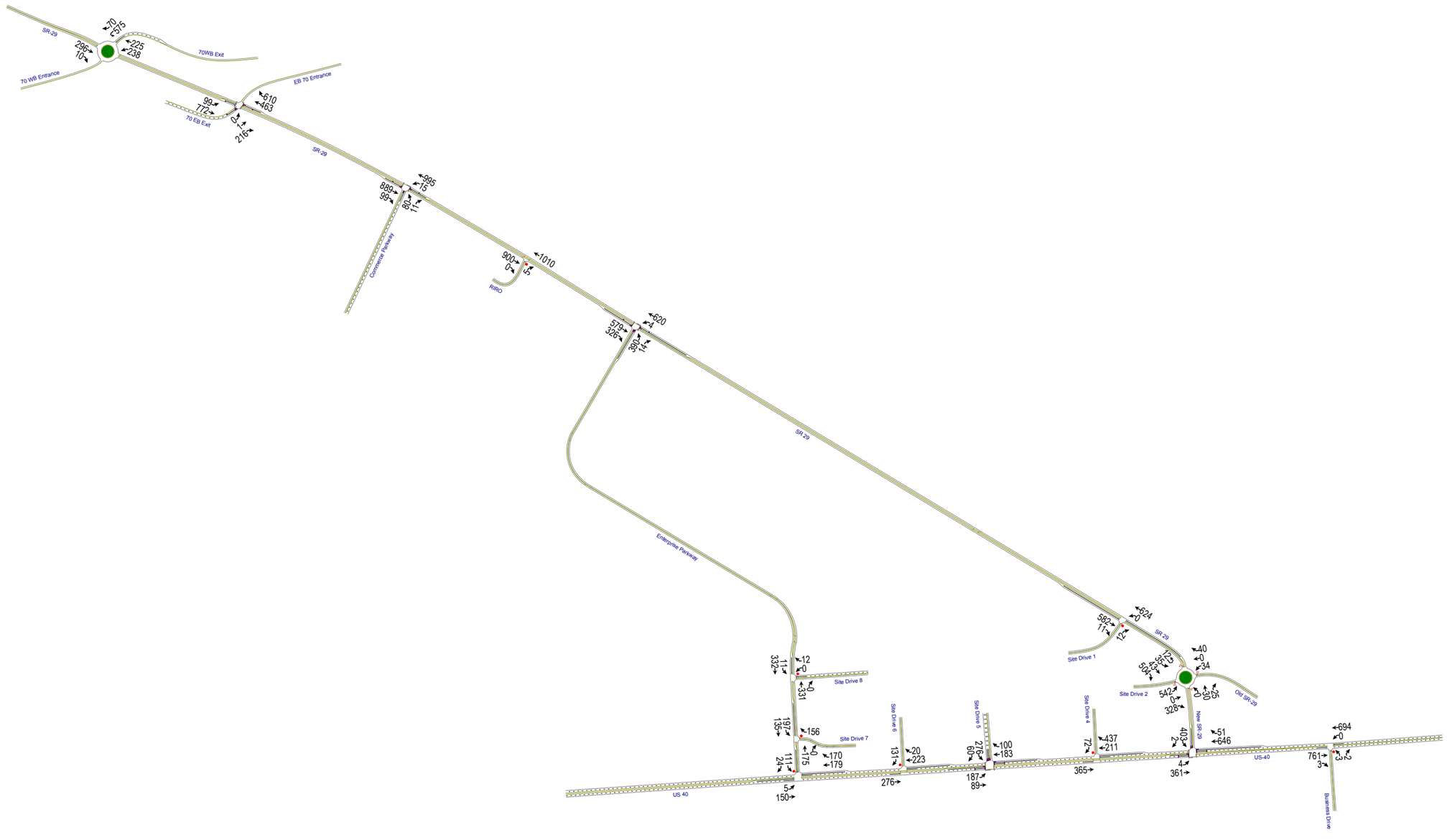

SR-29
70 WB Entrance
70WB Exit
EB 70 Entrance
70 EB Exit
SR-29
Commerce Parkway
RIRO
SR 29
Enterprise Parkway
Site Drive 1
SR 29
Site Drive 2
Old SR-29
New SR-29
Site Drive 8
Site Drive 7
Site Drive 6
Site Drive 5
Site Drive 4
US-40
US 40
Business Drive


SR-29
70 WB Entrance
70WB Exit
EB 70 Entrance
70 EB Exit
SR-29
Commerce Parkway
RIRO
SR 29
Enterprise Parkway
Site Drive 1
SR 29
Site Drive 2
Old SR-29
New SR-29
US-40
Business Drive
Site Drive 8
Site Drive 7
Site Drive 6
Site Drive 5
Site Drive 4
US 40


SR-29
70 WB Entrance
70WB Exit
70 EB Exit
EB 70 Entrance
SR-29
Commerce Parkway
RIRO
SR 29
Enterprise Parkway
Site Drive 1
Site Drive 2
Site Drive 4
Site Drive 5
Site Drive 6
Site Drive 7
Site Drive 8
New SR-29
Old SR-29
US-40
US 40
Business Drive


SR 29
70 WB Entrance
70WB Exit
EB 70 Entrance
70 EB Exit
SR 29
Commercial Parkway
RIRO
SR 29
Enterprise Parkway
Site Drive 1
SR 29
Site Drive 2
Old SR-29
New SR-29
US-40
Business Drive
Site Drive 8
Site Drive 7
Site Drive 6
Site Drive 5
Site Drive 4
US 40


SR-29
70WB Exit
70 WB Entrance
EB 70 Entrance
70 EB Exit
SR-29
Commerce Parkway
RIRO
SR-29
Enterprise Parkway
Site Drive 1
SR-29
Site Drive 2
Old SR-29
New SR-29
Site Drive 8
Site Drive 7
Site Drive 6
Site Drive 5
Site Drive 4
US-40
US 40
Business Drive


SR-29
70
175
225
238
296
10
70WB Exit
70 WB Entrance
EB 70 Entrance
99
772
610
463
0
216
70 EB Exit
SR-29
880
99
995
75
80
11
Commerce Parkway
900
0
55
1010
RIRO
578
326
620
4
360
14
SR 29
Enterprise Parkway
592
11
634
0
12
SR 29
Site Drive 1
40
0
34
352
43
504
Site Drive 2
542
0
328
25
30
Old SR-29
New SR-29
403
2
51
646
US-40
694
0
761
3
2
3
Business Drive
11
332
12
0
9
331
Site Drive 8
197
135
156
0
175
Site Drive 7
111
24
170
179
5
150
US 40
Site Drive 6
131
20
223
276
Site Drive 5
276
60
100
183
187
89
Site Drive 4
72
437
211
365
4
361

Appendix A-3

I-70 Mainline Volumes Comparison

I-70 Traffic Volume Comparison - Using data from IMS, MS2, and TIS

Step 1: I-70 mainline data was obtained from the MS2 website (odot.ms2soft.com). Hourly counts were available at one location within the project, I-70, east of the SR-29 on-off-ramps. An average of the last week of data (Mon-Fri) was calculated.

Volumes from MS2, ID 6849

Date of Count	I-70 EB, East of SR-29 On-Ramp	I-70 EB, East of SR-29 On-Ramp	Date of Count	I-70 WB, East of SR-29 Off-Ramp	I-70 WB, East of SR-29 Off-Ramp
	AM[1]	PM[2]		AM[3]	PM[4]
10/2/2017	2,328	1,989	10/23/2017	1,648	2,439
10/3/2017	2,368	2,225	10/24/2017	1,627	2,497
10/4/2017	2,323	2,593	10/25/2017	1,630	2,770
10/5/2017	2,308	2,325	10/26/2017	1,800	2,812
10/6/2017	2,225	2,825	10/27/2017	1,831	3,077
Average	**2,311**	**2,392**	Average	**1,708**	**2,719**

MS2 Volume (2017)

Notes… 1: 7-8a, 2: 4-5p, 3: Varies 9a-12p, 4-5p with one day 5-6p

Step 2: Using the 2010/2030 volumes from the IMS, 2018 volumes were interpolated. The 2018 IMS volumes were compared to the 2017 MS2 volumes. In every case, the 2018 IMS volumes are higher than the 2017 MS2 volumes. This means I-70 should operate at the same or better level as predicted in the IMS.

Year	I-70 EB		I-70 WB		
	AM	PM	AM	PM	
2010	2040	2770	1710	3330	IMS Volume (2010)
2030	2810	3860	2450	4670	IMS Volume (2030)
2018	**2348**	**3206**	**2006**	**3866**	IMS Volume (Interpolated for year 2018)
	2,311	**2,392**	**1,708**	**2,719**	MS2 Volume (2017)
	-37	**-814**	**-298**	**-1,147**	MS2-IMS (Volume)
	-2%	**-25%**	**-15%**	**-30%**	MS2-IMS (%)

Step 3: Using the 2017 MS2 volumes, growth rates obtained thru SHIFT, and a DHV factor of 1.09 (per Modeling & Forecasting), a projection of 2030 volumes were calculated. This was compared to the 2030 IMS volumes. Again, for all cases, the 2030 IMS volumes were higher than the 2030 MS2 projected volumes, with the exception of I-70 EB AM volume, which were similar. This means I-70 should operate at the same or better level as predicted in the IMS.

Year	I-70 EB		I-70 WB		
	AM	PM	AM	PM	
2017	**2,311**	**2,392**	**1,708**	**2,719**	MS2 Volume (2017)
Growth Rate	0.0106	0.0106	0.0106	0.0106	
2017-2030 Growth	**319**	**330**	**236**	**375**	
2030	**2,630**	**2,722**	**1,944**	**3,094**	Projected 2030 Volume
DHV Factor	1.09	1.09	1.09	1.09	
	2,867	**2,967**	**2,119**	**3,372**	Projected 2030 MS2 Volume (Final)
2030 IMS	**2,810**	**3,860**	**2,450**	**4,670**	
	57	**-893**	**-331**	**-1,298**	MS2-IMS Volumes
	2.02%				

Appendix A-4

SR-29 Intersection Volumes Comparison

SR-29 Intersection Traffic Volume Comparison - Using data from IMS and TIS

Step 1: Using the 2010/2030 volumes from the IMS, 2018 volumes were interpolated. The 2018 IMS volumes were compared to the 2018 TIS volumes. The volumes shown in red are volumes where the TIS volumes are greater than the IMS volumes.

Intersection:		1-SR-29/I-70 WB Ramps		I-70 WB On-Ramp			I-70 WB Off-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
124	2018	AM	IMS: Build	0	0	0	512	0	70	96	68	0	0	338	10
105	2018	AM	TIS: Background+Site	0	0	0	712	0	100	40	54	0	0	368	10
			Difference (TIS-IMS), Volume	0	0	0	200	0	30	-56	-14	0	0	30	0
			Difference (TIS-IMS), %				39%		43%	-58%	-21%			9%	

Intersection:		1-SR-29/I-70 WB Ramps		I-70 WB On-Ramp			I-70 WB Off-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
134	2018	PM	IMS: Build	0	0	0	428	0	240	328	144	0	0	214	14
115	2018	PM	TIS: Background+Site	0	0	0	575	0	70	238	225	0	0	296	10
			Difference (TIS-IMS), Volume	0	0	0	147	0	-170	-90	81	0	0	82	-4
			Difference (TIS-IMS), %				34%		-71%	-27%	56%			38%	-29%

Intersection:		2-SR-29/I-70 EB Ramps		I-70 EB Off-Ramp			I-70 EB On-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
224	2018	AM	IMS: Build	20	0	320	0	0	0	0	144	212	154	696	0
205	2018	AM	TIS: Background+Site	0	0	281	0	0	0	0	94	66	150	930	0
			Difference (TIS-IMS), Volume	-20	0	-39	0	0	0	0	-50	-146	-4	234	0
			Difference (TIS-IMS), %	-100%		-12%					-35%	-69%	-3%	34%	

Intersection:		2-SR-29/I-70 EB Ramps		I-70 EB Off-Ramp			I-70 EB On-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
234	2018	PM	IMS: Build	20	0	292	0	0	0	0	452	678	120	522	0
215	2018	PM	TIS: Background+Site	0	1	216	0	0	0	0	463	610	99	772	0
			Difference (TIS-IMS), Volume	-20	1	-76	0	0	0	0	11	-68	-21	250	0
			Difference (TIS-IMS), %	-100%		-26%					2%	-10%	-18%	48%	

Step 2: Growth rates were obtained via SHIFT. 2030 AM/PM volumes were calculated using background traffic, car/truck growth rates, and DHV factor.

Intersection:		1-SR-29/I-70 WB Ramps	I-70 WB On-Ramp			I-70 WB Off-Ramp			SR-29 NB			SR-29 SB		
Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
		Growth Rate, Cars	0.0106	0.0106	0.0106	0.0085	0.0085	0.0085	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071
		Growth Rate, Trucks	0.0082	0.0082	0.0082	0.0048	0.0048	0.0048	0.0246	0.0246	0.0246	0.0246	0.0246	0.0246
2018	AM	Background Traffic	0	0	0	210	0	100	38	52	0	0	200	10
2018	AM	Cars, %	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
2018	AM	Trucks, %	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
2018	AM	Cars, Volume	0	0	0	179	0	85	32	44	0	0	170	9
2018	AM	Trucks, Volume	0	0	0	32	0	15	6	8	0	0	30	2
2018	AM	Site Traffic (Peak Season)	0	0	0	502	0	0	2	2	0	0	168	0
2018	AM	**TIS: Background+Site**	**0**	**0**	**0**	**712**	**0**	**100**	**40**	**54**	**0**	**0**	**368**	**10**
2018	AM	**Background Traffic**	**0**	**0**	**0**	**210**	**0**	**100**	**38**	**52**	**0**	**0**	**200**	**10**
2030	AM	12-Year Growth, Cars	0	0	0	18	0	9	3	4	0	0	14	1
2030	AM	12-Year Growth, Trucks	0	0	0	2	0	1	2	2	0	0	9	1
2018	AM	Site Traffic (Peak Season)	0	0	0	502	0	0	2	2	0	0	168	0
2030	AM	Design Year, Full-Build	0	0	0	732	0	110	45	60	0	0	391	12
2030	AM	DHV Factor (0.09)	**0**	**0**	**0**	**66**	**0**	**10**	**4**	**5**	**0**	**0**	**35**	**1**
2030	AM	**Design Year, Full-Build**	**0**	**0**	**0**	**798**	**0**	**120**	**49**	**65**	**0**	**0**	**426**	**13**

Intersection:		1-SR-29/I-70 WB Ramps	I-70 WB On-Ramp			I-70 WB Off-Ramp			SR-29 NB			SR-29 SB		
Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
		Growth Rate, Cars	0.0106	0.0106	0.0106	0.0085	0.0085	0.0085	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071
		Growth Rate, Trucks	0.0082	0.0082	0.0082	0.0048	0.0048	0.0048	0.0246	0.0246	0.0246	0.0246	0.0246	0.0246
2018	PM	Background Traffic	0	0	0	81	0	70	60	47	0	0	132	10
2018	PM	Cars, %	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%
2018	PM	Trucks, %	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
2018	PM	Cars, Volume	0	0	0	75	0	64	55	43	0	0	121	9
2018	PM	Trucks, Volume	0	0	0	6	0	6	5	4	0	0	11	1
2018	PM	Site Traffic (Peak Season)	0	0	0	494	0	0	178	178	0	0	164	0
2018	PM	**TIS: Background+Site**	**0**	**0**	**0**	**575**	**0**	**70**	**238**	**225**	**0**	**0**	**296**	**10**
2018	PM	**Background Traffic**	**0**	**0**	**0**	**81**	**0**	**70**	**60**	**47**	**0**	**0**	**132**	**10**
2030	PM	12-Year Growth, Cars	0	0	0	8	0	7	5	4	0	0	10	1
2030	PM	12-Year Growth, Trucks	0	0	0	0	0	0	1	1	0	0	3	0
2018	PM	Site Traffic (Peak Season)	0	0	0	494	0	0	178	178	0	0	164	0
2030	PM	Design Year, Full-Build	0	0	0	583	0	77	244	230	0	0	309	11
2030	PM	DHV Factor (0.09)	**0**	**0**	**0**	**52**	**0**	**7**	**22**	**21**	**0**	**0**	**28**	**1**
2030	PM	**Design Year, Full-Build**	**0**	**0**	**0**	**635**	**0**	**84**	**266**	**251**	**0**	**0**	**337**	**12**

Intersection:		2-SR-29/I-70 EB Ramps	I-70 EB Off-Ramp			I-70 EB On-Ramp			SR-29 NB			SR-29 SB		
Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
		Growth Rate, Cars	0.0106	0.0106	0.0106	0.0085	0.0085	0.0085	0.0257	0.0257	0.0257	0.0257	0.0257	0.0257
		Growth Rate, Trucks	0.0082	0.0082	0.0082	0.0048	0.0048	0.0048	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
2018	AM	Background Traffic	0	0	113	0	0	0	0	90	58	150	260	0
2018	AM	Cars, %	100%	100%	89%	100%	100%	100%	100%	70%	80%	95%	95%	100%
2018	AM	Trucks, %	0%	0%	11%	0%	0%	0%	0%	30%	20%	5%	5%	0%
2018	AM	Cars, Volume	0	0	101	0	0	0	0	63	46	143	247	0
2018	AM	Trucks, Volume	0	0	12	0	0	0	0	27	12	8	13	0
2018	AM	Site Traffic (Peak Season)	0	0	168	0	0	0	0	4	8	0	670	0
2018	AM	**TIS: Background+Site**	**0**	**0**	**281**	**0**	**0**	**0**	**0**	**94**	**66**	**150**	**930**	**0**
2018	AM	**Background Traffic**	**0**	**0**	**113**	**0**	**0**	**0**	**0**	**90**	**58**	**150**	**260**	**0**
2030	AM	12-Year Growth, Cars	0	0	13	0	0	0	0	19	14	44	76	0
2030	AM	12-Year Growth, Trucks	0	0	1	0	0	0	0	2	1	1	1	0
2018	AM	Site Traffic (Peak Season)	0	0	168	0	0	0	0	4	8	0	670	0
2030	AM	Design Year, Full-Build	0	0	295	0	0	0	0	115	81	195	1007	0
2030	AM	DHV Factor (0.09)	**0**	**0**	**27**	**0**	**0**	**0**	**0**	**10**	**7**	**18**	**91**	**0**
2030	AM	**Design Year, Full-Build**	**0**	**0**	**322**	**0**	**0**	**0**	**0**	**125**	**88**	**213**	**1098**	**0**

Intersection:		2-SR-29/I-70 EB Ramps	I-70 EB Off-Ramp			I-70 EB On-Ramp			SR-29 NB			SR-29 SB		
Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
		Growth Rate, Cars	0.0106	0.0106	0.0106	0.0085	0.0085	0.0085	0.0257	0.0257	0.0257	0.0257	0.0257	0.0257
		Growth Rate, Trucks	0.0082	0.0082	0.0082	0.0048	0.0048	0.0048	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
2018	PM	Background Traffic	0	1	52	0	0	0	0	107	76	99	114	0
2018	PM	Cars, %	100%	100%	81%	100%	100%	100%	100%	92%	95%	95%	93%	100%
2018	PM	Trucks, %	0%	0%	19%	0%	0%	0%	0%	8%	5%	5%	7%	0%
2018	PM	Cars, Volume	0	1	42	0	0	0	0	98	72	94	106	0
2018	PM	Trucks, Volume	0	0	10	0	0	0	0	9	4	5	8	0
2018	PM	Site Traffic (Peak Season)	0	0	164	0	0	0	0	356	534	0	658	0
2018	PM	**TIS: Background+Site**	**0**	**1**	**216**	**0**	**0**	**0**	**0**	**463**	**610**	**99**	**772**	**0**
2018	PM	**Background Traffic**	**0**	**1**	**52**	**0**	**0**	**0**	**0**	**107**	**76**	**99**	**114**	**0**
2030	PM	12-Year Growth, Cars	0	0	5	0	0	0	0	30	22	29	33	0
2030	PM	12-Year Growth, Trucks	0	0	1	0	0	0	0	1	0	0	1	0
2018	PM	Site Traffic (Peak Season)	0	0	164	0	0	0	0	356	534	0	658	0
2030	PM	Design Year, Full-Build	0	1	222	0	0	0	0	494	632	128	806	0
2030	PM	DHV Factor (0.09)	**0**	**0**	**20**	**0**	**0**	**0**	**0**	**44**	**57**	**12**	**73**	**0**
2030	PM	**Design Year, Full-Build**	**0**	**1**	**242**	**0**	**0**	**0**	**0**	**538**	**689**	**140**	**879**	**0**

Step 3: The 2030 IMS volumes were compared to the 2030 TIS volumes from Step 2. The volumes shown in red are volumes where the TIS volumes are greater than the IMS volumes.

Intersection:		1-SR-29/I-70 WB Ramps		I-70 WB On-Ramp			I-70 WB Off-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
126	2030	AM	IMS: Build	0	0	0	680	0	70	120	80	0	0	350	10
	2030	AM	TIS+SHIFT+DHV	0	0	0	798	0	120	49	65	0	0	426	13
			Difference (TIS-IMS), Volume	0	0	0	118	0	50	-71	-15	0	0	76	3
			Difference (TIS-IMS), %				17%		71%	-59%	-19%			22%	30%

Intersection:		1-SR-29/I-70 WB Ramps		I-70 WB On-Ramp			I-70 WB Off-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
136	2030	PM	IMS: Build	0	0	0	560	0	300	400	210	0	0	250	20
	2030	PM	TIS+SHIFT+DHV	0	0	0	635	0	84	266	251	0	0	337	12
			Difference (TIS-IMS), Volume	0	0	0	75	0	-216	-134	41	0	0	87	-8
			Difference (TIS-IMS), %				13%		-72%	-34%	20%			35%	-40%

Intersection:		2-SR-29/I-70 EB Ramps		I-70 EB Off-Ramp			I-70 EB On-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
226	2030	AM	IMS: Build	20	0	410	0	0	0	0	180	260	190	840	0
	2030	AM	TIS+SHIFT+DHV	0	0	322	0	0	0	0	125	88	213	1098	0
			Difference (TIS-IMS), Volume	-20	0	-88	0	0	0	0	-55	-172	23	258	0
			Difference (TIS-IMS), %	-100%		-21%					-31%	-66%	12%	31%	

Intersection:		2-SR-29/I-70 EB Ramps		I-70 EB Off-Ramp			I-70 EB On-Ramp			SR-29 NB			SR-29 SB		
ID#	Year	Peak	Condition	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
234	2018	PM	IMS: Build	20	0	292	0	0	0	0	452	678	120	522	0
	2030	PM	TIS+SHIFT+DHV	0	1	242	0	0	0	0	538	689	140	879	0
			Difference (TIS-IMS), Volume	-20	1	-50	0	0	0	0	86	11	20	357	0
			Difference (TIS-IMS), %	-100%		-17%					19%	2%	17%	68%	

Appendix B

HCS Analyses

Appendix B-1

2018 AM/PM Build-Phase 1 at I-70 WB Ramps

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	8/13/2018
Analysis Year	2018
Time Analyzed	AM Build-Phase 1
Project Description	MAD-70-10.29 (at SR-29), No PID

Site Information

Intersection	SR-29/I-70 WB Ramps
E/W Street Name	I-70 WB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LT				LT				TR	
Volume (V), veh/h					0	712	1	100	0	40	54		0		368	10
Percent Heavy Vehicles, %					3	15	15	15	3	15	15		3		15	15
Flow Rate (v_{PCE}), pc/h					0	890	1	125	0	50	67		0		460	12
Right-Turn Bypass	None				Non-Yielding				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					891.00	125.00		117.00			472.00	
Entry Volume veh/h					774.78	108.70		101.74			410.43	
Circulating Flow (v_c), pc/h	1350			117			0			941		
Exiting Flow (v_{ex}), pc/h	0			63			67			1350		
Capacity (c_{pce}), pc/h					1224.76			1380.00			528.49	
Capacity (c), veh/h					1065.01			1200.00			459.56	
v/c Ratio (x)					0.73			0.08			0.89	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					15.5			3.7			49.3	
Lane LOS					C	A		A			E	
95% Queue, veh					6.8			0.3			9.7	
Approach Delay, s/veh				13.6			3.7			49.3		
Approach LOS				B			A			E		
Intersection Delay, s/veh | LOS	23.3						C					

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	8/13/2018
Analysis Year	2018
Time Analyzed	PM Build-Phase 1
Project Description	MAD-70-10.29 (at SR-29), No PID

Site Information

Intersection	SR-29/I-70 WB Ramps
E/W Street Name	I-70 WB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LT				LT				TR	
Volume (V), veh/h					0	575	1	70	0	238	225		0		296	10
Percent Heavy Vehicles, %					3	8	8	8	3	8	8		3		8	8
Flow Rate (v_{PCE}), pc/h					0	675	1	82	0	279	264		0		347	12
Right-Turn Bypass	None				Non-Yielding				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					676.00	82.00		543.00			359.00	
Entry Volume veh/h					625.93	75.93		502.78			332.41	
Circulating Flow (v_c), pc/h	1022			543			0			955		
Exiting Flow (v_{ex}), pc/h	0			292			264			1022		
Capacity (c_{pce}), pc/h					793.13			1380.00			521.00	
Capacity (c), veh/h					734.38			1277.78			482.41	
v/c Ratio (x)					0.85			0.39			0.69	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					30.6			6.6			25.8	
Lane LOS					D	A		A			D	
95% Queue, veh					10.0			1.9			5.2	
Approach Delay, s/veh				27.3			6.6			25.8		
Approach LOS				D			A			D		
Intersection Delay, s/veh | LOS	20.2						C					

Appendix B-2

2018 AM/PM No-Build & Build-Phase 2 at I-70 EB Ramps and Commerce

HCS7 Two-Way Stop-Control Report

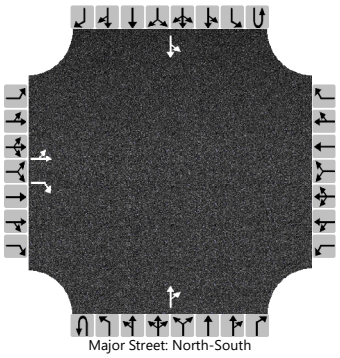
General Information

Analyst	GLH
Agency/Co.	ODOT
Date Performed	11/30/2018
Analysis Year	2018
Time Analyzed	AM No-Build
Intersection Orientation	North-South
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 EB Ramps
Jurisdiction	
East/West Street	I-70 EB Ramps
North/South Street	SR-29
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	1		0	0	0	0	0	1	0	0	0	1	0
Configuration		LT		R								TR		LT		
Volume (veh/h)		20	0	281							94	66		150	930	
Percent Heavy Vehicles (%)		3	3	11										5		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No														
Median Type | Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		7.13	6.53	6.31										4.15		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.03	3.40										2.25		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		22		305										163		
Capacity, c (veh/h)		82		279										1385		
v/c Ratio		0.26		1.09										0.12		
95% Queue Length, Q_{95} (veh)		1.0		12.4										0.4		
Control Delay (s/veh)		63.7		121.1										7.9		
Level of Service (LOS)		F		F										A		
Approach Delay (s/veh)		117.3												2.9		
Approach LOS		F														

HCS7 Two-Way Stop-Control Report

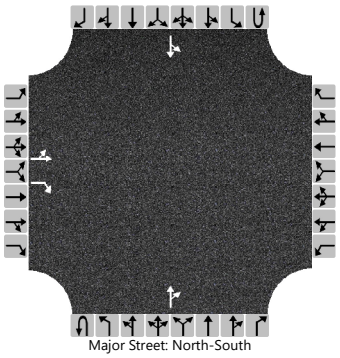
General Information

Analyst	GLH
Agency/Co.	ODOT
Date Performed	11/30/2018
Analysis Year	2018
Time Analyzed	PM No-Build
Intersection Orientation	North-South
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 EB Ramps
Jurisdiction	
East/West Street	I-70 EB Ramps
North/South Street	SR-29
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	1		0	0	0	0	0	1	0	0	0	1	0
Configuration		LT		R								TR		LT		
Volume (veh/h)		20	1	216							463	610		99	772	
Percent Heavy Vehicles (%)		3	100	19										5		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No														
Median Type | Storage		Undivided														

Critical and Follow-up Headways

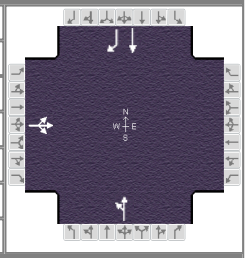
Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		7.13	7.50	6.39										4.15		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.90	3.47										2.25		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		23		235										108		
Capacity, c (veh/h)		36		341										588		
v/c Ratio		0.63		0.69										0.18		
95% Queue Length, Q_{95} (veh)		2.2		4.9										0.7		
Control Delay (s/veh)		208.2		35.9										12.5		
Level of Service (LOS)		F		E										B		
Approach Delay (s/veh)		51.2												5.2		
Approach LOS		F														

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ODOT			Duration, h	0.25
Analyst	GLH	Analysis Date	Aug 9, 2018	Area Type	Other
Jurisdiction		Time Period	AM No-Build	PHF	0.92
Urban Street		Analysis Year	2018	Analysis Period	1> 7:00
Intersection	SR-29 & Commerce	File Name	2018 AM No-Build, SR-29 & Commerce.xus		
Project Description	MAD-70-10.29, No PID				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	77	0	27				10	80			1137	74

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

								1	2	3	4	
Green	62.2	17.8	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	1.0	1.0	0.0	0.0	0.0	0.0	5	6	7	8		

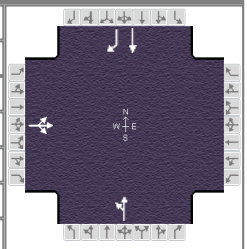
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		12.0				8.0		7.0
Phase Duration, s		22.8				67.2		67.2
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (*MAH*), s		3.0				2.9		2.9
Queue Clearance Time (g_s), s		19.8				64.2		60.2
Green Extension Time (g_e), s		0.0				0.0		1.0
Phase Call Probability		1.00				1.00		1.00
Max Out Probability		1.00				1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h		113						98			1236	80
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1439						438			1826	1120
Queue Service Time (g_s), s		6.2						4.0			58.2	2.2
Cycle Queue Clearance Time (g_c), s		6.2						62.2			58.2	2.2
Green Ratio (*g/C*)		0.20						0.69			0.69	0.69
Capacity (*c*), veh/h		285						347			1262	774
Volume-to-Capacity Ratio (*X*)		0.397						0.282			0.979	0.104
Back of Queue (*Q*), ft/ln (95 th percentile)		108						48.6			780.7	20.6
Back of Queue (*Q*), veh/ln (95 th percentile)		3.6						1.6			30.0	0.6
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00						0.04			0.49	0.11
Uniform Delay (d_1), s/veh		31.4						15.7			13.3	4.6
Incremental Delay (d_2), s/veh		0.3						0.2			20.4	0.0
Initial Queue Delay (d_3), s/veh		0.0						0.0			0.0	0.0
Control Delay (*d*), s/veh		31.8						15.9			33.7	4.6
Level of Service (LOS)		C						B			C	A
Approach Delay, s/veh / LOS	31.8	C		0.0			15.9	B		31.9	C	
Intersection Delay, s/veh / LOS	30.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.73	B	1.95	B	1.34	A	1.63	B
Bicycle LOS Score / LOS	0.67	A			0.65	A	2.66	C

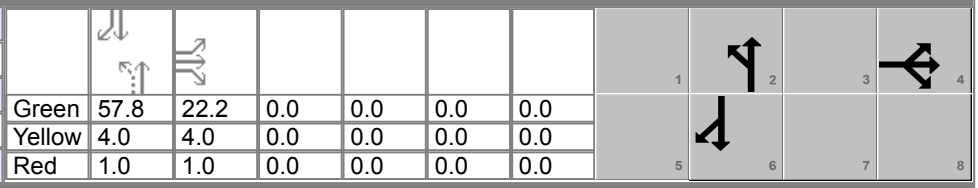
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ODOT			Duration, h	0.25
Analyst	GLH	Analysis Date	Aug 9, 2018	Area Type	Other
Jurisdiction		Time Period	PM No-Build	PHF	0.92
Urban Street		Analysis Year	2018	Analysis Period	1> 7:00
Intersection	SR-29 & Commerce	File Name	2018 PM No-Build, SR-29 & Commerce.xus		
Project Description	MAD-70-10.29, No PID				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	0	11				15	995			889	99

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	57.8	22.2	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	1.0	1.0	0.0	0.0	0.0	0.0						

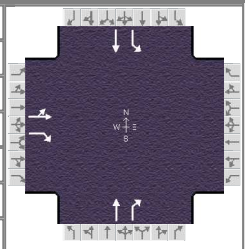
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		12.0				8.0		7.0
Phase Duration, s		27.2				62.8		62.8
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (*MAH*), s		3.0				2.9		2.9
Queue Clearance Time (g_s), s		7.9				54.8		37.0
Green Extension Time (g_e), s		0.1				1.8		5.5
Phase Call Probability		1.00				1.00		1.00
Max Out Probability		0.00				0.99		0.13

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h		99						1098			966	108
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1241						1768			1856	1045
Queue Service Time (g_s), s		5.9						17.8			35.0	3.7
Cycle Queue Clearance Time (g_c), s		5.9						52.8			35.0	3.7
Green Ratio (*g/C*)		0.25						0.64			0.64	0.64
Capacity (*c*), veh/h		306						1176			1192	671
Volume-to-Capacity Ratio (*X*)		0.323						0.933			0.811	0.160
Back of Queue (*Q*), ft/ln (95 th percentile)		96.5						653.3			444.7	38.2
Back of Queue (*Q*), veh/ln (95 th percentile)		2.9						25.3			17.4	1.1
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00						0.57			0.28	0.20
Uniform Delay (d_1), s/veh		27.8						14.8			12.0	6.4
Incremental Delay (d_2), s/veh		0.2						13.1			4.0	0.0
Initial Queue Delay (d_3), s/veh		0.0						0.0			0.0	0.0
Control Delay (*d*), s/veh		28.0						27.9			16.1	6.5
Level of Service (LOS)		C						C			B	A
Approach Delay, s/veh / LOS	28.0	C		0.0			27.9	C		15.1	B	
Intersection Delay, s/veh / LOS	21.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.73	B	1.95	B	1.35	A	1.64	B
Bicycle LOS Score / LOS	0.65	A			2.30	B	2.26	B

HCS7 Signalized Intersection Results Summary

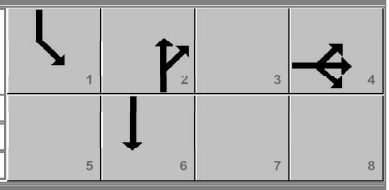
General Information				Intersection Information	
Agency	ODOT			Duration, h	0.25
Analyst	GLH	Analysis Date	Nov 30, 2018	Area Type	Other
Jurisdiction		Time Period	AM Build	PHF	0.92
Urban Street		Analysis Year	2018	Analysis Period	1> 7:00
Intersection	SR-29 & I-70 EB Ramps	File Name	2A-2018 AM Build, SR-29 & I-70 EB Ramps.xus		
Project Description	MAD-70-10.29, No PID				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	0	281					94	66	150	930	

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	18.2	30.0	26.8	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



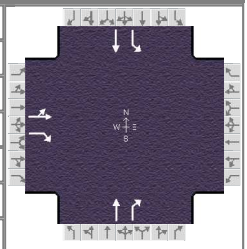
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		11.0				7.3	2.0	4.0
Phase Duration, s		31.8				35.0	23.2	58.2
Change Period, ($Y+R_c$), s		5.0				5.0	5.0	5.0
Max Allow Headway (*MAH*), s		3.2				2.9	3.0	2.9
Queue Clearance Time (g_s), s		18.5				6.5	9.4	47.6
Green Extension Time (g_e), s		0.5				2.5	0.2	0.0
Phase Call Probability		1.00				1.00	1.00	1.00
Max Out Probability		0.02				0.00	0.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h		22	305					102	72	163	1011	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1810	1472					1455	1359	1739	1826	
Queue Service Time (g_s), s		0.8	16.5					4.5	3.3	7.4	45.6	
Cycle Queue Clearance Time (g_c), s		0.8	16.5					4.5	3.3	7.4	45.6	
Green Ratio (*g/C*)		0.30	0.30					0.33	0.33	0.20	0.59	
Capacity (*c*), veh/h		539	438					485	453	352	1079	
Volume-to-Capacity Ratio (*X*)		0.040	0.697					0.211	0.158	0.464	0.937	
Back of Queue (*Q*), ft/ln (95 th percentile)		13.7	265.1					79.6	51.3	137.7	677.8	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	9.7					2.6	1.8	5.3	26.1	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.03	0.24					0.05	0.14	1.62	0.69	
Uniform Delay (d_1), s/veh		22.5	28.0					21.5	21.1	31.6	16.9	
Incremental Delay (d_2), s/veh		0.0	4.1					0.1	0.1	0.4	14.4	
Initial Queue Delay (d_3), s/veh		0.0	0.0					0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh		22.5	32.1					21.6	21.2	32.0	31.3	
Level of Service (LOS)		C	C					C	C	C	C	
Approach Delay, s/veh / LOS	31.4	C		0.0			21.4	C		31.4	C	
Intersection Delay, s/veh / LOS	30.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.96	B	1.95	B	1.40	A	1.65	B
Bicycle LOS Score / LOS	1.03	A			0.77	A	2.42	B

HCS7 Signalized Intersection Results Summary

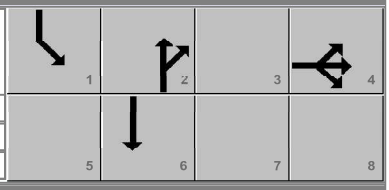
General Information				Intersection Information	
Agency	ODOT			Duration, h	0.25
Analyst	GLH	Analysis Date	Nov 30, 2018	Area Type	Other
Jurisdiction		Time Period	PM Build	PHF	0.92
Urban Street		Analysis Year	2018	Analysis Period	1> 7:00
Intersection	SR-29 & I-70 EB Ramps	File Name	2P-2018 PM Build, SR-29 & I-70 EB Ramps.xus		
Project Description	MAD-70-10.29, No PID				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1	216					463	610	99	772	

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.5	41.5	24.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



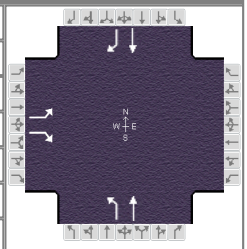
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		11.0				7.3	2.0	4.0
Phase Duration, s		29.0				46.5	14.5	61.0
Change Period, (*Y+R c*), s		5.0				5.0	5.0	5.0
Max Allow Headway (*MAH*), s		3.2				3.0	3.0	3.0
Queue Clearance Time (*g s*), s		15.6				38.4	7.3	31.8
Green Extension Time (*g e*), s		0.3				1.7	0.0	3.6
Phase Call Probability		1.00				1.00	1.00	1.00
Max Out Probability		0.01				0.98	1.00	0.39

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h		23	235					503	663	108	839	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		399	1372					1781	1547	1739	1796	
Queue Service Time (*g s*), s		4.0	13.6					19.1	36.4	5.3	29.8	
Cycle Queue Clearance Time (*g c*), s		4.0	13.6					19.1	36.4	5.3	29.8	
Green Ratio (*g/C*)		0.27	0.27					0.46	0.46	0.11	0.62	
Capacity (*c*), veh/h		106	366					821	714	184	1118	
Volume-to-Capacity Ratio (*X*)		0.215	0.642					0.613	0.929	0.586	0.751	
Back of Queue (*Q*), ft/ln (95 th percentile)		29.4	226.4					302.3	550.8	107.4	391.8	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.7	7.9					11.4	21.2	4.1	14.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.06	0.21					0.19	1.47	1.26	0.40	
Uniform Delay (*d 1*), s/veh		25.7	29.2					18.2	22.9	38.4	12.1	
Incremental Delay (*d 2*), s/veh		0.4	3.0					1.0	18.3	3.3	2.6	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0					0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh		26.0	32.2					19.2	41.2	41.6	14.6	
Level of Service (LOS)		C	C					B	D	D	B	
Approach Delay, s/veh / LOS	31.6	C		0.0			31.7	C		17.7	B	
Intersection Delay, s/veh / LOS	26.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.96	B	1.95	B	1.38	A	1.65	B
Bicycle LOS Score / LOS	0.91	A			2.41	B	2.05	B

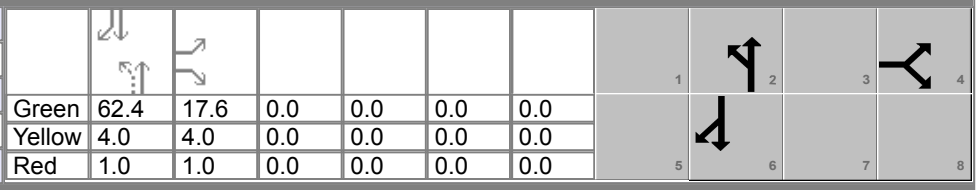
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ODOT			Duration, h	0.25
Analyst	GLH	Analysis Date	Aug 9, 2018	Area Type	Other
Jurisdiction		Time Period	AM Build	PHF	0.92
Urban Street		Analysis Year	2018	Analysis Period	1> 7:00
Intersection	SR-29 & Commerce	File Name	2018 AM Build, SR-29 & Commerce.xus		
Project Description	MAD-70-10.29, No PID				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	77		27				10	80			1137	74

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	62.4	17.6	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	1.0	1.0	0.0	0.0	0.0	0.0						

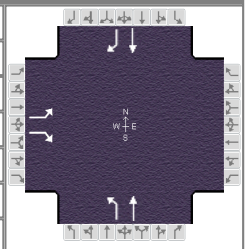
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		7.0
Phase Duration, s		22.6				67.4		67.4
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (*MAH*), s		3.0				2.9		2.9
Queue Clearance Time (g_s), s		6.3				62.1		59.8
Green Extension Time (g_e), s		0.1				0.2		1.2
Phase Call Probability		1.00				1.00		1.00
Max Out Probability		0.00				1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	84		29				11	87			1236	80
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1485		1560				411	1470			1826	1120
Queue Service Time (g_s), s	4.3		1.4				2.3	1.7			57.8	2.1
Cycle Queue Clearance Time (g_c), s	4.3		1.4				60.1	1.7			57.8	2.1
Green Ratio (*g/C*)	0.20		0.20				0.69	0.69			0.69	0.69
Capacity (*c*), veh/h	290		305				101	1019			1266	777
Volume-to-Capacity Ratio (*X*)	0.288		0.096				0.108	0.085			0.976	0.104
Back of Queue (*Q*), ft/ln (95 th percentile)	78		22.8				11.3	20			764.3	20.1
Back of Queue (*Q*), veh/ln (95 th percentile)	2.6		0.9				0.4	0.7			29.4	0.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00				0.01	0.02			0.48	0.11
Uniform Delay (d_1), s/veh	30.9		29.7				41.6	4.5			13.1	4.6
Incremental Delay (d_2), s/veh	0.2		0.1				0.2	0.0			19.7	0.0
Initial Queue Delay (d_3), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	31.1		29.7				41.8	4.5			32.8	4.6
Level of Service (LOS)	C		C				D	A			C	A
Approach Delay, s/veh / LOS	30.7		C	0.0			8.7		A	31.0		C
Intersection Delay, s/veh / LOS	29.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.96	B	1.95	B	0.66	A	1.86	B
Bicycle LOS Score / LOS		F			0.65	A	2.66	C

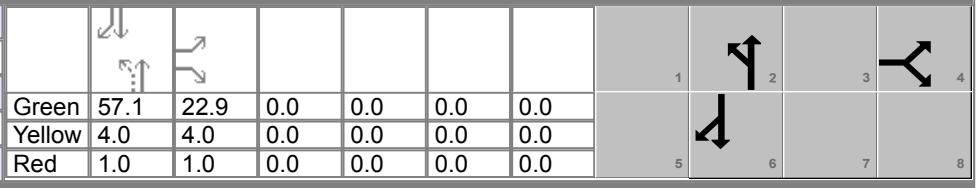
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	ODOT			Duration, h	0.25
Analyst	GLH	Analysis Date	Aug 9, 2018	Area Type	Other
Jurisdiction		Time Period	PM Build	PHF	0.92
Urban Street		Analysis Year	2018	Analysis Period	1> 7:00
Intersection	SR-29 & Commerce	File Name	2018 PM Build, SR-29 & Commerce.xus		
Project Description	MAD-70-10.29, No PID				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80		11				15	995			889	99

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	57.1	22.9	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	1.0	1.0	0.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		7.0
Phase Duration, s		27.9				62.1		62.1
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (*MAH*), s		3.0				2.9		2.9
Queue Clearance Time (g_s), s		7.0				48.9		37.8
Green Extension Time (g_e), s		0.1				3.8		5.4
Phase Call Probability		1.00				1.00		1.00
Max Out Probability		0.00				0.54		0.15

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	87		12				16	1082			966	108
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1259		1610				591	1841			1856	1045
Queue Service Time (g_s), s	5.0		0.5				1.9	46.9			35.8	3.8
Cycle Queue Clearance Time (g_c), s	5.0		0.5				37.7	46.9			35.8	3.8
Green Ratio (*g/C*)	0.25		0.25				0.63	0.63			0.63	0.63
Capacity (*c*), veh/h	320		410				220	1168			1177	663
Volume-to-Capacity Ratio (*X*)	0.271		0.029				0.074	0.926			0.821	0.162
Back of Queue (*Q*), ft/ln (95 th percentile)	82.9		8.1				11.7	642.7			460.4	39.6
Back of Queue (*Q*), veh/ln (95 th percentile)	2.5		0.3				0.5	24.9			18.0	1.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00				0.01	0.56			0.29	0.21
Uniform Delay (d_1), s/veh	26.9		25.2				26.9	14.6			12.5	6.7
Incremental Delay (d_2), s/veh	0.2		0.0				0.1	12.2			4.5	0.0
Initial Queue Delay (d_3), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	27.0		25.2				27.0	26.8			17.0	6.7
Level of Service (LOS)	C		C				C	C			B	A
Approach Delay, s/veh / LOS	26.8		C	0.0			26.8		C	16.0		B
Intersection Delay, s/veh / LOS	21.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.96	B	1.95	B	0.67	A	1.87	B
Bicycle LOS Score / LOS		F			2.30	B	2.26	B

Appendix B-3

2030 AM/PM Full-Build at I-70 EB Ramps and I-70 WB Ramps

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	8/13/2018
Analysis Year	2030
Time Analyzed	AM Build
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 WB Ramps
E/W Street Name	I-70 WB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	1	1	0	0	0	2	0
Lane Assignment							LT		L		LT		LT		TR	
Volume (V), veh/h					0	798	0	120	0	49	65		0	0	426	13
Percent Heavy Vehicles, %					15	15	15	15	15	15	15		15	15	15	15
Flow Rate (v_{PCE}), pc/h					0	997	0	150	0	61	81		0	0	532	16
Right-Turn Bypass	None				Non-Yielding				None				None			
Conflicting Lanes					2				1				2			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.3276		4.5436	4.5436		4.6453	4.3276	
Follow-Up Headway (s)					2.5352		2.5352	2.5352		2.6667	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					997.00	150.00	75.26	66.74		257.56	290.44	
Entry Volume veh/h					866.96	130.43	65.44	58.03		223.97	252.56	
Circulating Flow (v_c), pc/h	1529			142			0			1058		
Exiting Flow (v_{ex}), pc/h	0			77			81			1529		
Capacity (c_{pce}), pc/h					1258.55		1420.01	1420.01		510.05	577.74	
Capacity (c), veh/h					1094.39		1234.79	1234.79		443.52	502.38	
v/c Ratio (x)					0.79		0.05	0.05		0.50	0.50	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					18.4		3.3	3.3		18.6	16.7	
Lane LOS					C	A	A	A		C	C	
95% Queue, veh					8.7		0.2	0.1		2.8	2.8	
Approach Delay, s/veh				16.0			3.3			17.6		
Approach LOS				C			A			C		
Intersection Delay, s/veh | LOS	15.5						C					

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	8/13/2018
Analysis Year	2030
Time Analyzed	PM Build
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 WB Ramps
E/W Street Name	I-70 WB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	1	1	0	0	0	2	0
Lane Assignment							LT		L		LT		LT		TR	
Volume (V), veh/h					0	635	0	84	0	266	251		0	0	337	12
Percent Heavy Vehicles, %					8	8	8	8	8	8	8		8	8	8	8
Flow Rate (v_{PCE}), pc/h					0	745	0	99	0	312	295		0	0	396	14
Right-Turn Bypass	None				Non-Yielding				None				None			
Conflicting Lanes					2				1				2			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.3276		4.5436	4.5436		4.6453	4.3276	
Follow-Up Headway (s)					2.5352		2.5352	2.5352		2.6667	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					745.00	99.00	321.71	285.29		192.70	217.30	
Entry Volume veh/h					689.81	91.67	297.88	264.16		178.43	201.20	
Circulating Flow (v_c), pc/h	1141			607			0			1057		
Exiting Flow (v_{ex}), pc/h	0			326			295			1141		
Capacity (c_{pce}), pc/h					847.65		1420.01	1420.01		510.52	578.23	
Capacity (c), veh/h					784.86		1314.82	1314.82		472.70	535.40	
v/c Ratio (x)					0.88		0.23	0.20		0.38	0.38	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					32.3		4.7	4.4		14.0	12.6	
Lane LOS					D	A	A	A		B	B	
95% Queue, veh					11.2		0.9	0.7		1.7	1.7	
Approach Delay, s/veh				28.5			4.6			13.3		
Approach LOS				D			A			B		
Intersection Delay, s/veh | LOS	17.3						C					

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	11/30/2018
Analysis Year	2030
Time Analyzed	AM Build
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 EB Ramps
E/W Street Name	I-70 EB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	1	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment	LT		R						LT		TR		LT		T	
Volume (V), veh/h	0	20	0	322					0	0	125	88	0	213	1098	
Percent Heavy Vehicles, %	0	11	0	11					0	0	30	20	0	5	5	
Flow Rate (v_{PCE}), pc/h	0	24	0	389					0	0	177	115	0	243	1253	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)	4.6453	4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)	2.6667	2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h	24.00	389.00					137.24	154.76		703.12	792.88	
Entry Volume veh/h	21.62	350.45					109.03	122.95		669.64	755.12	
Circulating Flow (v_c), pc/h	1496			201			267			0		
Exiting Flow (v_{ex}), pc/h	358			0			201			1642		
Capacity (c_{pce}), pc/h	340.89	398.15					1113.70	1113.70		1420.01	1420.01	
Capacity (c), veh/h	307.10	358.69					884.81	884.81		1352.39	1352.39	
v/c Ratio (x)	0.07	0.98					0.12	0.14		0.50	0.56	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh	13.0	76.4					5.3	5.4		7.7	8.8	
Lane LOS	B	F					A	A		A	A	
95% Queue, veh	0.2	11.0					0.4	0.5		2.8	3.6	
Approach Delay, s/veh	72.7						5.3			8.3		
Approach LOS	F						A			A		
Intersection Delay, s/veh | LOS	19.8						C					

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	11/30/2018
Analysis Year	2030
Time Analyzed	PM Build
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 EB Ramps
E/W Street Name	I-70 EB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	1	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment	LT		R						LT		TR		LT		T	
Volume (V), veh/h	0	20	0	242					0	0	538	689	0	140	879	
Percent Heavy Vehicles, %	0	19	0	19					0	0	8	5	0	5	7	
Flow Rate (v_{PCE}), pc/h	0	26	0	313					0	0	632	786	0	160	1022	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)	4.6453	4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)	2.6667	2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h	26.00	313.00					632.00	786.00		555.54	626.46	
Entry Volume veh/h	21.85	263.03					594.45	739.30		520.53	586.99	
Circulating Flow (v_c), pc/h	1182			658			186			0		
Exiting Flow (v_{ex}), pc/h	946			0			658			1335		
Capacity (c_{pce}), pc/h	455.06	519.94					1198.90	1198.90		1420.01	1420.01	
Capacity (c), veh/h	382.40	436.93					1127.67	1127.67		1330.53	1330.53	
v/c Ratio (x)	0.06	0.60					0.53	0.66		0.39	0.44	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh	10.3	22.9					9.3	12.3		6.4	7.0	
Lane LOS	B	C					A	B		A	A	
95% Queue, veh	0.2	3.9					3.2	5.2		1.9	2.3	
Approach Delay, s/veh	22.0						11.0			6.7		
Approach LOS	C						B			A		
Intersection Delay, s/veh | LOS	10.4						B					

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	11/30/2018
Analysis Year	2030
Time Analyzed	AM Build
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 EB Ramps
E/W Street Name	I-70 EB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	EB: (LT-R) to (LTR-R)

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	1	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment	LTR		R						LT		TR		LT		T	
Volume (V), veh/h	0	20	0	322					0	0	125	88	0	213	1098	
Percent Heavy Vehicles, %	0	11	0	11					0	0	30	20	0	5	5	
Flow Rate (v_{PCE}), pc/h	0	24	0	389					0	0	177	115	0	243	1253	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)	4.6453	4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)	2.6667	2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h	194.11	218.89					137.24	154.76		703.12	792.88	
Entry Volume veh/h	174.87	197.20					109.03	122.95		669.64	755.12	
Circulating Flow (v_c), pc/h	1496			201			267			0		
Exiting Flow (v_{ex}), pc/h	358			0			201			1642		
Capacity (c_{pce}), pc/h	340.89	398.15					1113.70	1113.70		1420.01	1420.01	
Capacity (c), veh/h	307.10	358.69					884.81	884.81		1352.39	1352.39	
v/c Ratio (x)	0.57	0.55					0.12	0.14		0.50	0.56	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh	29.0	24.4					5.3	5.4		7.7	8.8	
Lane LOS	D	C					A	A		A	A	
95% Queue, veh	3.3	3.2					0.4	0.5		2.8	3.6	
Approach Delay, s/veh	26.5						5.3			8.3		
Approach LOS	D						A			A		
Intersection Delay, s/veh | LOS	11.3						B					

HCS7 Roundabouts Report

General Information

Analyst	GLH
Agency or Co.	ODOT
Date Performed	11/30/2018
Analysis Year	2030
Time Analyzed	PM Build
Project Description	MAD-70-10.29, No PID

Site Information

Intersection	SR-29/I-70 EB Ramps
E/W Street Name	I-70 EB Ramps
N/S Street Name	SR-29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	EB: (LT-R) to (LTR-R)

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	1	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment	LTR		R						LT		TR		LT		T	
Volume (V), veh/h	0	20	0	242					0	0	538	689	0	140	879	
Percent Heavy Vehicles, %	0	19	0	19					0	0	8	5	0	5	7	
Flow Rate (v_{PCE}), pc/h	0	26	0	313					0	0	632	786	0	160	1022	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)	4.6453	4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)	2.6667	2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h	159.33	179.67					632.00	786.00		555.54	626.46	
Entry Volume veh/h	133.89	150.98					594.45	739.30		520.53	586.99	
Circulating Flow (v_c), pc/h	1182			658			186			0		
Exiting Flow (v_{ex}), pc/h	946			0			658			1335		
Capacity (c_{pce}), pc/h	455.06	519.94					1198.90	1198.90		1420.01	1420.01	
Capacity (c), veh/h	382.40	436.93					1127.67	1127.67		1330.53	1330.53	
v/c Ratio (x)	0.35	0.35					0.53	0.66		0.39	0.44	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh	16.2	14.3					9.3	12.3		6.4	7.0	
Lane LOS	C	B					A	B		A	A	
95% Queue, veh	1.5	1.5					3.2	5.2		1.9	2.3	
Approach Delay, s/veh	15.1						11.0			6.7		
Approach LOS	C						B			A		
Intersection Delay, s/veh | LOS	9.7						A					

Appendix C

Schematics for Build-Phase 2 and Build conditions

Appendix C-1

Figure 4: Build-Phase 2 Condition (Opening 2019)

Project Condor: SR-29 Proposed Network 1 Roadway Improvements Concepts at I-70 and Commerce Parkway (5/2/2018)

0 50 100 200 Feet

1 inch = 50 feet
102" x 36"

Stantec

Appendix C-2

Figure 5: Build Condition (Design-Year 2030)

PREPARED BY:
ODOT
OFFICE OF ROADWAY ENGINEERING

PRELIMINARY CONCEPT
S.R. 29 & I.R. 70
INTERCHANGE IMPROVEMENTS

SR 29
INTERCHANGE

ROUNDABOUT

EXISTING
STRUCTURE

PROPOSED
STRUCTURE

ROUNDABOUT

29

70

70

29

N

0 250
125 500

SCALE IN FEET

FIGURE 3:
DESIGN YEAR LAYOUT
INTERCHANGE ROUNDABOUTS

Appendix D

Construction Cost Estimate

I-70 Eastbound Ramps and S.R. 29 Improvements

Group Number	Group Name	Ref. No.	Item No.	DESCRIPTION	UNITS	QUANTITY	UNIT COST	EXTENDED TOTAL
1	ROADWAY	1	201	CLEARING & GRUBBING	LS	LUMP	$10,000.00	$10,000.00
		2	202	PAVEMENT REMOVED	SY	280	$10.00	$2,800.00
		3	203	EXCAVATION	CY	1531	$12.00	$18,372.00
		4	203	EMBANKMENT	CY	909	$10.00	$9,090.00
		5	203	GRANULAR MATERIAL, TYPE B	CY	350	$50.00	$17,500.00
		6	204	SUBGRADE COMPACTION	SY	2073	$2.00	$4,146.00
		7	204	PROOF ROLLING	HR	1	$225.00	$225.00
		8	653	TOPSOIL FURNISHED AND PLACED	CY	242	$50.00	$12,100.00
		9	SPEC.	SOIL STERILANT	SY	1000	$2.00	$2,000.00
		10	SPEC.	MISC.: IDENTIFICATION OF BAT HABITAT TREES	LS	LUMP	$5,000.00	$5,000.00
		11	SPEC.	GEOTEXTILE FABRIC, 712.09, TYPE D	SY	2100	$3.00	$6,300.00
	ROADWAY Total							**$87,533.00**
2	EROSION CONTROL	12	601	TIED CONCRETE BLOCK MAT, TYPE 1	SY	12	$80.00	$960.00
		13	659	SEEDING AND MULCHING	SY	2178	$1.00	$2,178.00
		14	659	COMMERCIAL FERTILIZER	TON	0.3	$500.00	$150.00
		15	659	LIME	ACRE	0.1	$75.00	$7.50
		16	659	WATER	MGAL	12	$3.00	$36.00
		17	832	EROSION CONTROL	EA	5000	$1.00	$5,000.00
	EROSION CONTROL Total							**$8,331.50**
3	DRAINAGE	18	605	6" BASE PIPE UNDERDRAINS	FT	573	$7.50	$4,297.50
		19	605	6" UNCLASSIFIED PIPE UNDERDRAINS	FT	616	$11.00	$6,776.00
		20	611	PRECAST REINFORCED CONCRETE OUTLET	EA	6	$320.00	$1,920.00
		21	611	4" CONDUIT, TYPE E	FT	40	$12.00	$480.00
		22	611	6" CONDUIT, TYPE F	FT	124	$18.00	$2,232.00
	DRAINAGE Total							**$15,705.50**
4	PAVEMENT	23	252	FULL DEPTH PAVEMENT SAWING	FT	1368	$2.25	$3,078.00
		24	254	PAVEMENT PLANING, ASPHALT CONCRETE	SY	2028	$1.50	$3,042.00
		25	301	ASPHALT CONCRETE BASE, PG64-22	CY	247	$90.00	$22,230.00
		26	304	AGGREGATE BASE	CY	525	$50.00	$26,250.00
		27	407	NON-TRACKING TACK COAT	GAL	308	$3.00	$924.00
		28	442	ASPHALT CONCRETE, SURFACE COURSE, 9.5 MM, TYPE A (448)	CY	145	$150.00	$21,750.00
		29	442	ASPHALT CONCRETE, INTERMEDIATE COURSE, 9.5 MM, TYPE A (448)	CY	71	$125.00	$8,875.00
		30	452	13" NON-REINFORCED CONCRETE PAVEMENT, CLASS QC1	SY	423	$95.00	$40,185.00
		31	SPEC.	PAVEMENT REINFORCING GRID (GLASGRID 8502 OR APPROVED EQUAL)	SY	760	$95.00	$72,200.00
	PAVEMENT Total							**$198,534.00**

I-70 Eastbound Ramps and S.R. 29 Improvements

Group Number	Group Name	Ref. No.	Item No.	DESCRIPTION	UNITS	QUANTITY	UNIT COST	EXTENDED TOTAL
7	TRAFFIC CONTROL	32	621	RPM	EA	27	$25.00	$675.00
		33	621	RAISED PAVEMENT MARKER REMOVED	EA	10	$9.00	$90.00
		34	630	SIGN, FLAT SHEET	SF	12.5	$14.00	$175.00
		35	630	GROUND MOUNTED SUPPORT, NO. 3 POST	FT	106	$10.00	$1,060.00
		36	630	REMOVAL OF GROUND MOUNTED SIGN AND REERECTION	EA	11	$50.00	$550.00
		37	630	REMOVAL OF GROUND MOUNTED SIGN AND DISPOSAL	EA	5	$12.00	$60.00
		38	630	REMOVAL OF GROUND MOUNTED POST SUPPORT AND DISPOSAL	EA	9	$15.00	$135.00
		39	630	SIGN POST REFLECTOR	EA	9	$40.00	$360.00
		40	644	EDGE LINE, 6"	MILE	0.25	$2,500.00	$625.00
		41	644	CENTER LINE, 4"	MILE	0.24	$3,750.00	$900.00
		42	644	CHANNELIZING LINE, 8"	FT	305	$2.00	$610.00
		43	644	STOP LINE, 24"	FT	23	$7.00	$161.00
		44	644	LANE ARROW	EA	4	$100.00	$400.00
		45	644	REMOVAL OF PAVEMENT MARKING	EA	372	$2.00	$744.00
		46	646	EDGE LINE, 6"	MILE	0.06	$3,000.00	$180.00
		47	646	CHANNELIZING LINE, 8"	FT	55	$2.50	$137.50
		48	646	STOP LINE, 24"	FT	99	$12.00	$1,188.00
		49	646	LANE ARROW	EA	1	$170.00	$170.00
	TRAFFIC CONTROL Total							**$8,220.50**
8	TRAFFIC SIGNAL	50	625	CONDUIT, 2" 725.04	FT	298	$12.00	$3,576.00
		51	625	CONDUIT, 3" 725.04	FT	26	$18.00	$468.00
		52	625	TRENCH	FT	324	$8.00	$2,592.00
		53	625	PULL BOX, 725.08, 18"	EA	2	$800.00	$1,600.00
		54	625	PULL BOX, 725.08, 24"	EA	1	$1,000.00	$1,000.00
		55	625	GROUND ROD	EA	3	$185.00	$555.00
		56	632	TETHER WIRE, WITH ACCESSORIES	FT	130	$15.00	$1,950.00
		57	632	MESSENGER WIRE, 7 STRAND, 3/8" DIAMETER WITH ACCESSORIES	FT	130	$11.00	$1,430.00
		58	632	VEHICULAR SIGNAL HEAD, (LED), BLACK, 3-SECTION, 12" LENS, 1-WAY, POLYCARBONATE, WITH BACKPLATE, AS PER PLAN	EA	7	$800.00	$5,600.00
		59	632	VEHICULAR SIGNAL HEAD, (LED), BLACK, 5-SECTION, 12" LENS, 1-WAY, POLYCARBONATE, WITH BACKPLATE, AS PER PLAN	EA	1	$1,300.00	$1,300.00
		60	632	COVERING OF VEHICULAR SIGNAL HEAD	EA	8	$50.00	$400.00
		61	632	SIGNAL CABLE, 7 CONDUTOR, NO. 14 AWG	FT	528	$2.50	$1,320.00
		62	632	STRAIN POLE FOUNDATION	EA	2	$4,200.00	$8,400.00
		63	632	POWER CABLE, 3-1 CONDUCTOR, NO. 6 AWG	FT	381	$2.00	$762.00
		64	632	SERVICE CABLE, 3 CONDUCTOR, NO. 6 AWG	FT	50	$4.00	$200.00
		65	632	POWER SERVICE	EA	1	$2,000.00	$2,000.00
		66	632	STRAIN POLE, TYPE TC-81.10, DESIGN 13	EA	2	$12,000.00	$24,000.00
		67	633	CONTROLLER UNIT, TYPE TS2/A2, WITH CABINET, TYPE TS2, AS PER PLAN	EA	1	$15,000.00	$15,000.00
		68	633	CONTROLLER UNIT, TYPE TS2/A2, AS PER PLAN	EA	1	$2,500.00	$2,500.00
		69	633	CABINET FOUNDATION	EA	1	$2,000.00	$2,000.00
		70	633	CONTROLLER WORK PAD	EA	1	$700.00	$700.00
		71	633	UNITERRUPTIBLE POWER SUPPLY (UPS), 1000 WATT, AS PER PLAN	EA	1	$6,000.00	$6,000.00
		72	809	ADVANCE RADAR DETECTION	EA	2	$7,500.00	$15,000.00
		73	809	STOP-BAR RADAR DETECTION	EA	2	$6,700.00	$13,400.00
		74	809	HIGH SPEED ETHERNET RADIO	EA	1	$2,000.00	$2,000.00
		75	809	HIGH SPEED ETHERNET RADIO, AS PER PLAN	EA	2	$2,000.00	$4,000.00
	TRAFFIC SIGNAL Total							**$117,753.00**

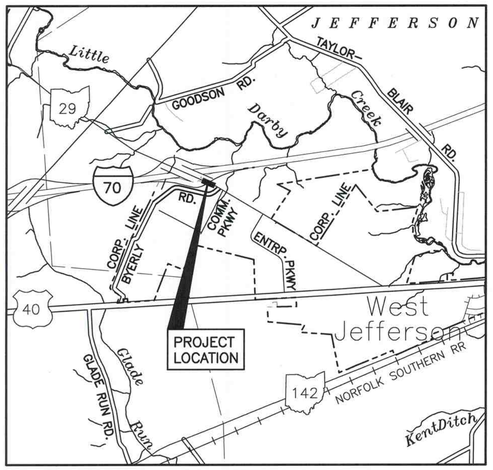
I-70 Eastbound Ramps and S.R. 29 Improvements

Group Number	Group Name	Ref. No.	Item No.	DESCRIPTION	UNITS	QUANTITY	UNIT COST	EXTENDED TOTAL
9	MAINTENANCE OF TRAFFIC	76	614	REPLACEMENT DRUM	EA	5	$60.00	$300.00
		77	614	REPLACEMENT SIGN	EA	2	$160.00	$320.00
		78	614	LAW ENFORCEMENT OFFICER WITH PATROL CAR FOR ASSISTANCE	HR	60	$85.00	$5,100.00
		79	616	WATER	MGAL	5	$100.00	$500.00
	MAINTENANCE OF TRAFFIC Total							**$6,220.00**
10	MISCELLANEOUS	80	108.03	TYPE B CPM PROGRESS SCHEDULE	LS	LUMP	$2,000.00	$2,000.00
		81	614	MAINTAINING TRAFFIC, AS PER PLAN	LS	LUMP	$50,000.00	$50,000.00
		82	623	CONSTRUCTION LAYOUT STAKES AND SURVEYING	LS	LUMP	$10,000.00	$10,000.00
		83	624	MOBILIZATION	LS	LUMP	$50,000.00	$50,000.00
	MISCELLANEOUS Total							**$112,000.00**
11	Force Account	84	(blank)	CONTINGENCY (10%)	PCT	1	$55,429.75	$55,429.75
	Force Account Total							**$55,429.75**
Grand Total								**$609,727.25**

Appendix E

Permit Traffic Control Plan Sheet

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
S.R. 29 IMPROVEMENTS AT I-70 EASTBOUND RAMPS
VILLAGE OF WEST JEFFERSON
JEFFERSON TOWNSHIP
MADISON COUNTY



LOCATION MAP

LATITUDE: 39°57'30" LONGITUDE: 83°20'30"

0 2000 4000
SCALE IN FEET

PORTIONS TO BE IMPROVED _____
STATE AND FEDERAL ROUTES _____
OTHER ROADS _____

DESIGN DESIGNATION

	S.R. 29	RAMP C	RAMP D
CURRENT ADT (2018)	3,510	3,040	1,300
DESIGN YEAR (2040)	24,670	8,070	2,650
DESIGN HOURLY VOLUME (2040)	2,467	807	265
DIRECTIONAL DISTRIBUTION	50%	100%	100%
TRUCKS	7%	15%	10%
DESIGN SPEED	50 MPH	35 MPH	35 MPH
LEGAL SPEED	50 MPH	35 MPH	35 MPH
FUNCTIONAL CLASSIFICATION	RURAL COLLECTOR		

INDEX OF SHEETS

OHIO Utilities Protection SERVICE
Call Before You Dig

UNDERGROUND UTILITIES
CONTACT BOTH SERVICES
CALL TWO WORKING DAYS
BEFORE YOU DIG
OIL & GAS PRODUCERS PROTECTIVE SERVICE CALL: 1–800–929–0988

PROJECT DESCRIPTION

THIS PROJECT CONSISTS OF THE WIDENING OF S.R. 29 TO PROVIDE TURN LANES AT THE EASTBOUND RAMPS OF I–70, INCLUDING A NEW TRAFFIC SIGNAL.

PROJECT EARTH DISTURBED AREA:	0.87 ACRES
ESTIMATED CONTRACTOR EARTH DISTURBED AREA:	0.17 ACRES
NOTICE OF INTENT EARTH DISTURBED AREA:	N/A ACRES

2016 SPECIFICATIONS

THE STANDARD SPECIFICATIONS OF THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, INCLUDING CHANGES AND SUPPLEMENTAL SPECIFICATIONS LISTED IN THE PROPOSAL SHALL GOVERN THIS IMPROVEMENT.

SOURCE BENCHMARK

MADISON COUNTY ENGINEER MONUMENT 02–016, BRASS TABLET IN MONUMENT IN THE MEDIAN LANDSCAPING AT THE NORTHEAST CORNER OF THE MADISON COUNTY ENGINEER'S OFFICE.
NORTH = 712047.38, EAST = 1722575.80,

ELEVATION= 999.24 (NAVD 88)

BENCHMARKS

BM #205

IRON PIN SET WITH "STANTEC" CAP, BEING 30.43 FEET RIGHT OF S.R. 29 CENTERLINE STATION 580+38.20.
NORTH = 713973.09, EAST = 1733368.62

ELEVATION= 970.28 (NAVD 88)

BM #206

IRON PIN SET WITH "STANTEC" CAP, BEING 21.25 FEET LEFT OF S.R. 29 CENTERLINE STATION 575+03.27.
NORTH = 714260.46, EAST = 1732914.20

ELEVATION= 973.73 (NAVD 88)

SIGNATURES BELOW SIGNIFY ONLY CONCURRENCE WITH THE GENERAL PURPOSE AND GENERAL LOCATION OF THE PROJECT. ALL TECHNICAL DETAILS REMAIN THE RESPONSIBILITY OF THE ENGINEER PREPARING THE PLANS.

VILLAGE ENGINEER, WEST JEFFERSON _____ DATE _____

VILLAGE SERVICE DIRECTOR, WEST JEFFERSON _____ DATE _____

PLAN PREPARED BY:

Stantec
Stantec Consulting Services Inc.
1500 Lake Shore Drive, Suite 100
Columbus, Ohio 43204
(614) 486-4383

Brian M Hagerty 11-9-18
REGISTERED ENGINEER DATE

ENTIRE PLAN EXCEPT TRAFFIC SIGNALS
STATE OF OHIO · BRIAN HAGERTY · E61558 · REGISTERED PROFESSIONAL ENGINEER
ENGINEER'S SEAL

Perry J. Morgan 11.9.18
REGISTERED ENGINEER DATE

TRAFFIC SIGNALS
STATE OF OHIO · PERRY J. MORGAN · E-59569 · REGISTERED PROFESSIONAL ENGINEER
ENGINEER'S SEAL

STANDARD CONSTRUCTION DRAWINGS								SUPPLEMENTAL SPECS.	
BP–2.1	7–17–15	DM–1.1	7–21–17	TC–21.20	7–20–18	MT–95.45	7–21–17	800	7–20–18
BP–2.2	7–18–08	DM–1.2	1–18–13	TC–41.20	10–18–13	MT–97.11	1–20–17	809	1–19–18
BP–2.5	7–19–13	DM–4.4	1–15–16	TC–41.30	10–18–13	MT–101.70	7–20–18	832	1–17–14
BP–3.1	7–18–14			TC–41.40	10–18–13	MT–101.75	7–15–16		
BP–8.1	7–18–08			TC–41.41	10–18–13	MT–101.90	7–21–17		
				TC–42.20	10–18–13				
RM–4.2	4–18–14								
				TC–52.10	10–18–13	MT–105.10	7–19–13		
		HL–30.11	7–20–18	TC–52.20	7–20–18	MT–120.00	1–20–17		
				TC–65.10	1–17–14				
				TC–65.11	7–21–17				
				TC–71.10	1–19–18				
				TC–81.10	7–15–16				
				TC–84.20	10–18–13				
				TC–85.21	1–20–17				
				TC–85.22	1–19–18				

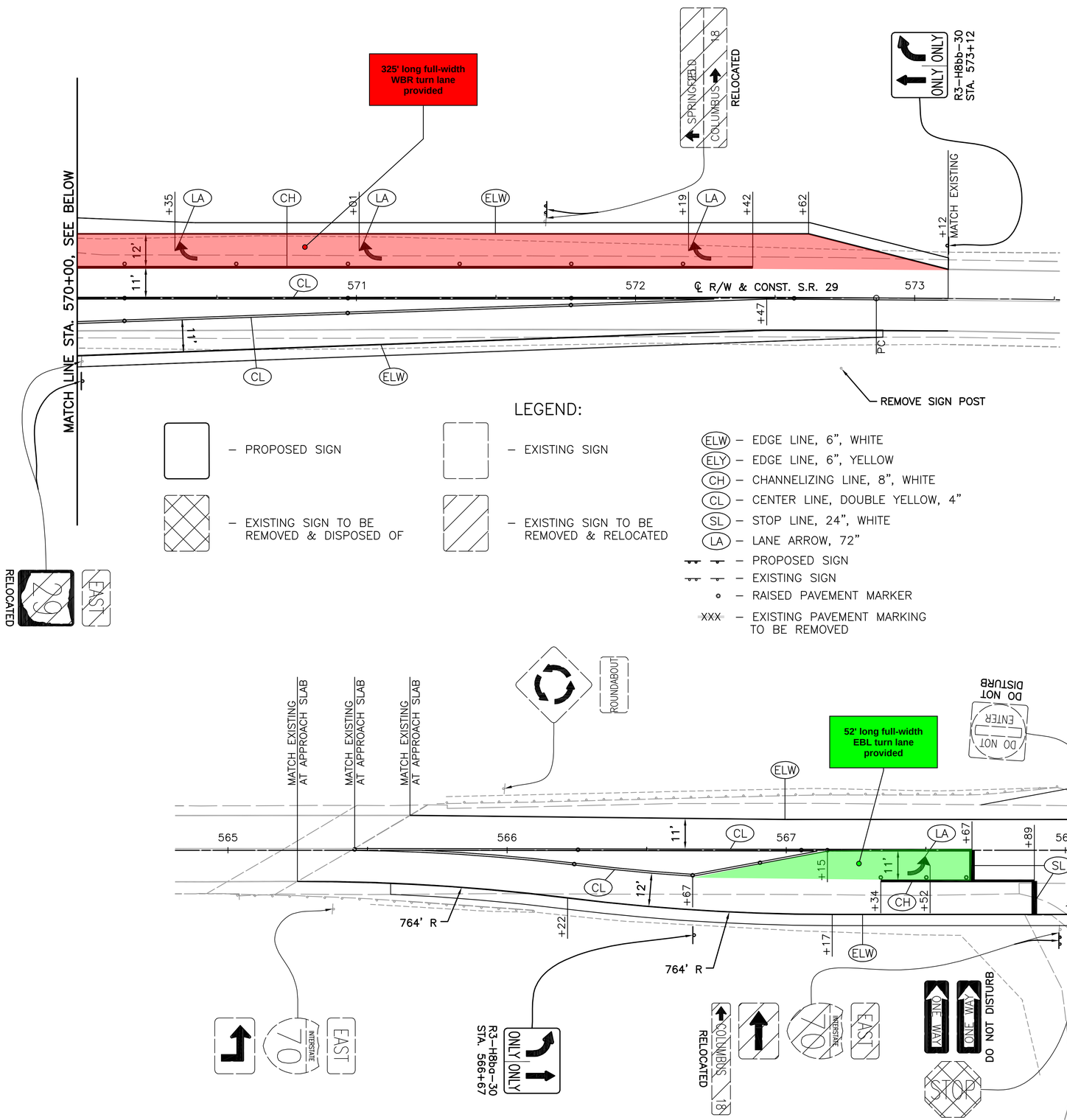
FEDERAL PROJECT NO. N/A
PID NO. N/A
CONSTRUCTION PROJECT NO. N/A
RAILROAD INVOLVEMENT N/A

S.R. 29 IMPROVEMENTS AT I-70 EASTBOUND RAMPS

1/29

SHKOLNIK, TODD (A:\736089879\I-70 interchange\transportation\design\drawing\plotset\736089879101.dwg TITLE SHEET Last Saved: Nov 08, 2018 4:02 PM Plotted: Nov 09, 2018 9:14 AM

NOTE – ALL PAVEMENT MARKINGS ON CONCRETE SHALL BE ITEM 646, EPOXY, WITH CONTRAST MARKINGS PER ITEM SECTION 301–19.



CALCULATED TJS
CHECKED BMH

TRAFFIC CONTROL
S.R. 29

S.R. 29 IMPROVEMENTS AT
I-70 EASTBOUND RAMPS

21
29

SHKOLNIK, TODD U:\173608979\I–70 interchange\transportation\design\drawing\planset\Traffic Control\173608979tc01.dwg TRAFFIC CONTROL Last Saved: Nov 02, 2018 10:17 AM Plotted: Nov 09, 2018 9:18 AM

APPENDIX C

CERTIFIED TRAFFIC

INTER-OFFICE COMMUNICATION

TO: James Young, P.E., Office of Roadway Engineering Services

FROM: Leigh A. Oesterling, Project Analyses Admin., Office of Technical Services

SUBJECT: MAD-70-10.27 (SR 29 IMS) PID 83245

DATE: November 8, 2007

In reply to a request dated September 4, 2007, attached are a set of plates showing ADT, A.M. and P.M. design hour volumes for the subject project. If needed K and D factors can be derived from the attached plates.

Please use the following truck factors.

			IR 70		SR 29	
	w/o US 42	w/o SR 29	w/o SR 142	e/o SR 142	n/o IR 70	s/o IR 70
T24:	0.39	0.36	0.34	0.32	0.11	0.20
TD AM:	0.33	0.31	0.29	0.27	0.07	0.17
TD PM:	0.23	0.22	0.20	0.19	0.07	0.12

RAMPS

IR 70 @ SR 142

	WB Off	WB on	EB Off	EB on
T24:	0.05	0.10	0.10	0.04
TD AM:	0.06	0.10	0.04	0.02
TD PM:	0.02	0.01	0.05	0.03

IR 70 @ SR 29

	WB Off	WB on	EB Off	EB on
T24:	0.23	0.16	0.18	0.21
TD AM:	0.29	0.20	0.20	0.15
TD PM:	0.18	0.04	0.07	0.15

IR 70 @ US 42

	WB Off	WB on	EB Off	EB on
T24:	0.28	0.45	0.48	0.27
TD AM:	0.32	0.44	0.49	0.23
TD PM:	0.18	0.33	0.45	0.18

If you have any questions, please contact me at (614) 752-5747.

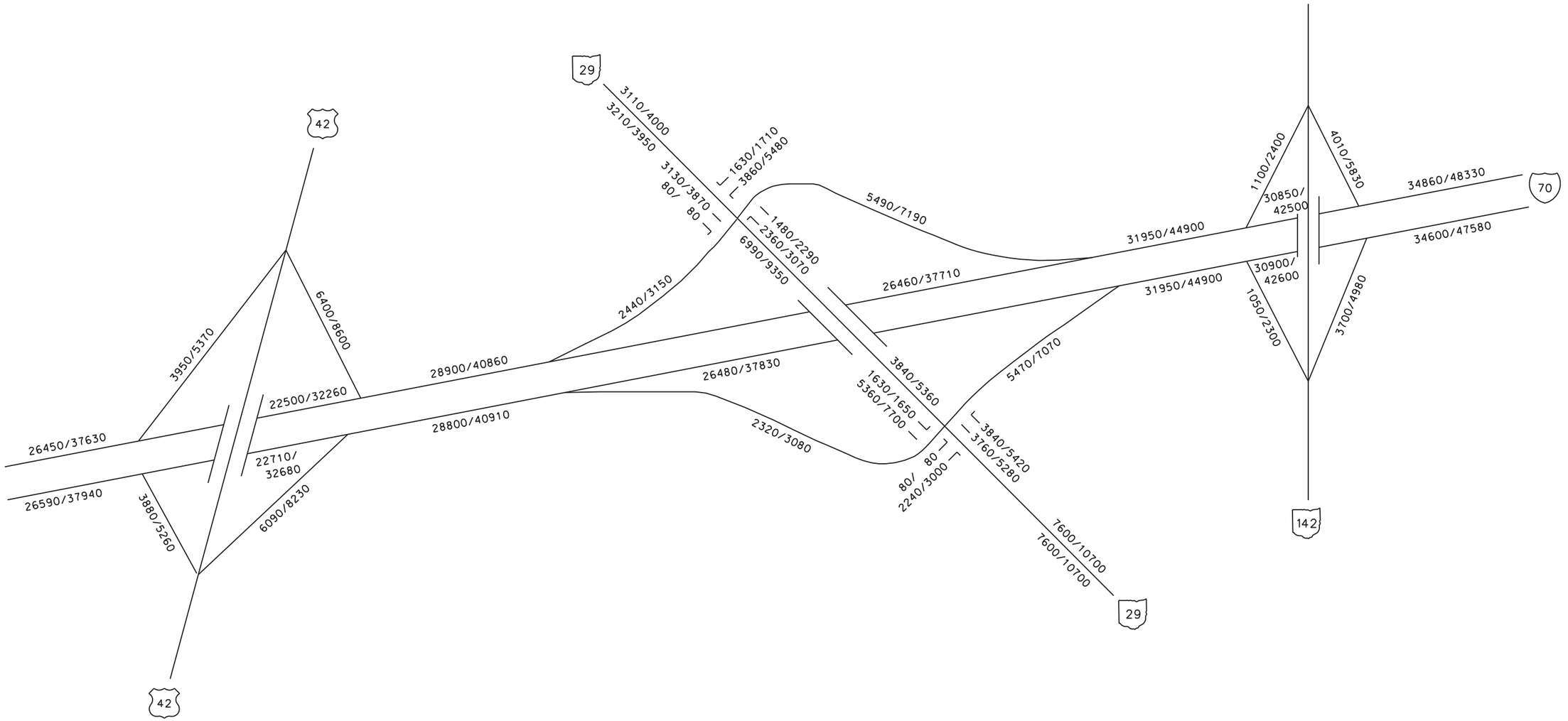
LAO

LAO:lo

c: J. McQuirt, OTS–P. Siddle, OTS–File

MAD–70–10.27
PID 83245
PLATE 1 OF 3

Build

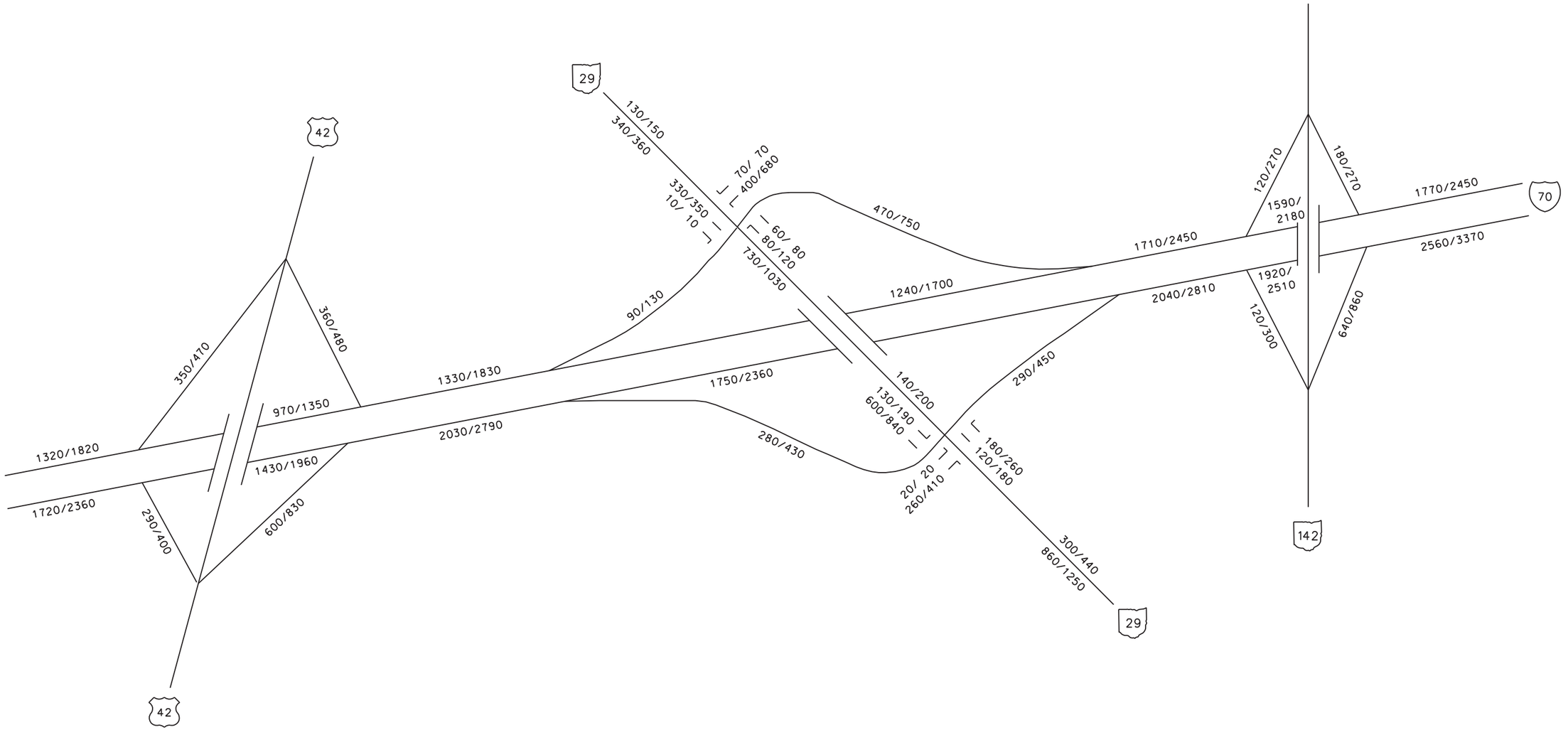


MAD–70–10.27 PID–83245 IMS	
2010/2030 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

N

MAD–70–10.27
PID 83245
PLATE 2 OF 3

Build

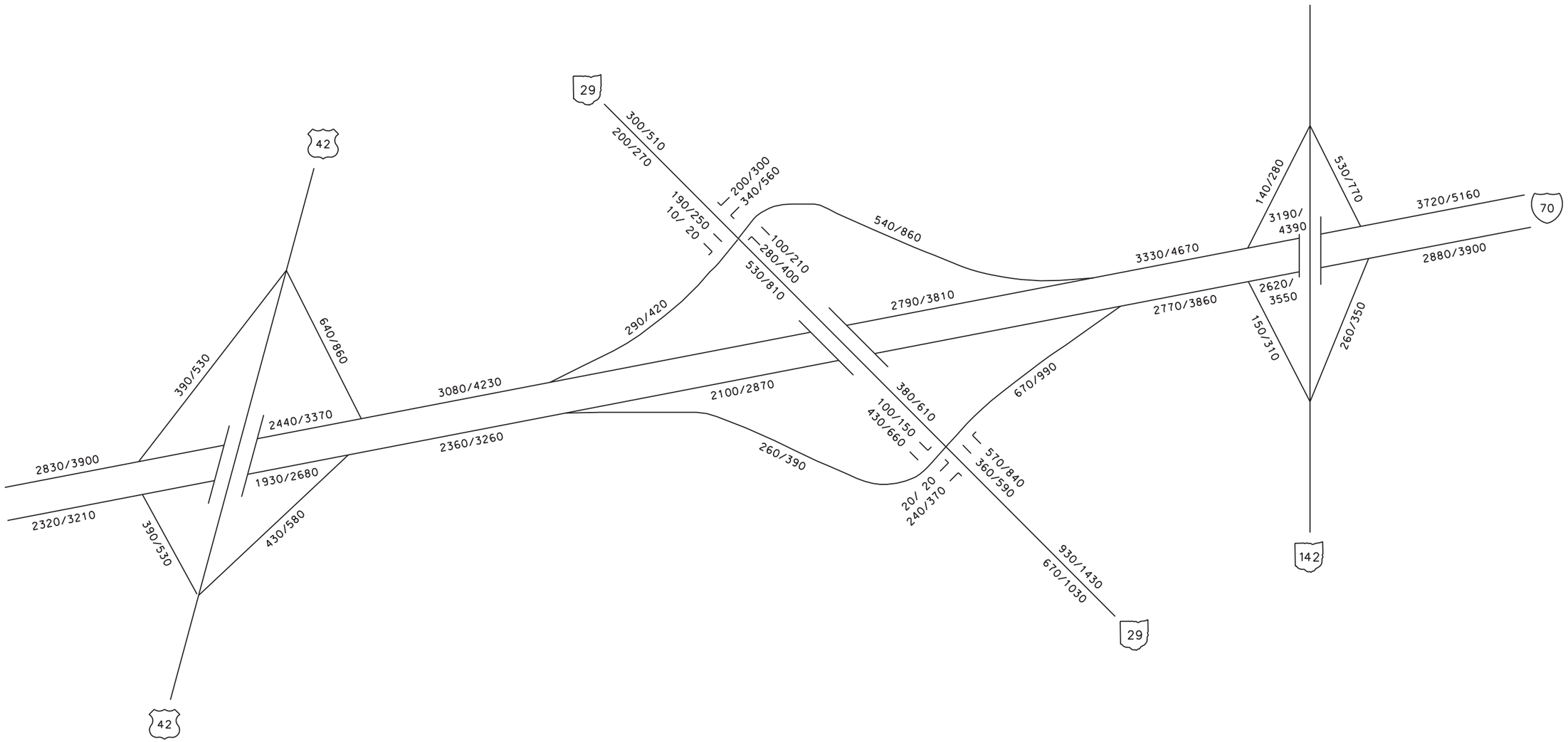


MAD–70–10.27 PID–83245 IMS	
2010/2030 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

N

MAD–70–10.27
PID 83245
PLATE 3 OF 3

Build



MAD–70–10.27 PID–83245 IMS	
2010/2030 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
NOVEMBER 8, 2007	NOT TO SCALE

N

2020 Traffic Count Comparison to 2010 Certified Traffic Volumes

	2020 ODOT Count			2010 Certified Traffic			2020 Count Higher
Location	ADT	AM	PM	ADT	AM	PM	than 2017 Count?
EB I-70, East of SR 29 (Oct 2021)	30783	2101	2453	31950	2040	2770	Yes
WB I-70, East of SR 29 (Oct 2021)	31182	1947	2714	31950	1710	3330	Yes
EB I-70 off-ramp to SR 29	1277	181	146	2320	280	260	Yes
EB I-70 on-ramp from SR 29	3627	269	472	5470	290	670	Yes
WB I-70 off-ramp to SR 29	3545	324	327	5490	470	540	Yes
WB I-70 on-ramp from SR 29	1348	106	130	2440	90	290	Yes
NB SR 29, Noth of I-70	2433	141	318	3110	130	300	Yes
SB SR 29, North of I-70	2400	292	180	3210	340	200	Yes
NB SR 29, South or WB I-70 ramps	2718	189	298	3840	140	380	

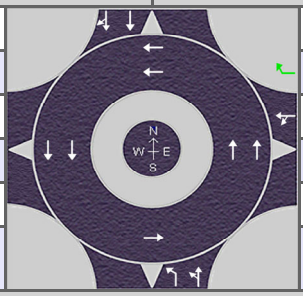
APPENDIX D

INTERSECTION ANALYSIS

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	AM Peak
Project Description	Original IMS Build



Site Information

Intersection	WB Ramp at SR 29
E/W Street Name	WB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.76
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	1	1	0	0	0	2	0
Lane Assignment							LT		L		LT		T		TR	
Volume (V), veh/h					0	680	0	70	0	120	80		0		350	10
Percent Heavy Vehicles, %					0	8	3	10	0	13	10		0		2	12
Flow Rate (v_{PCE}), pc/h					0	966	0	101	0	178	116		0		470	15
Right-Turn Bypass	None				Non-Yielding				None				None			
Conflicting Lanes					2				1				2			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.3276		4.5436	4.5436		4.6453	4.3276	
Follow-Up Headway (s)					2.5352		2.5352	2.5352		2.6667	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					966	101	156	138		228	257	
Entry Volume, veh/h					894	92	139	124		223	251	
Circulating Flow (v_c), pc/h	1436			294			0			1144		
Exiting Flow (v_{ex}), pc/h	0			193			116			1436		
Capacity (c_{pce}), pc/h					1106		1420	1420		471	537	
Capacity (c), veh/h					1024		1270	1270		461	525	
v/c Ratio (x)					0.87		0.11	0.10		0.48	0.48	

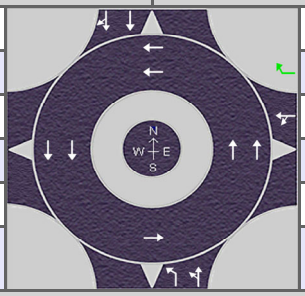
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					26.2		3.7	3.6		17.3	15.4	
Lane LOS					D	A	A	A		C	C	
95% Queue, veh					11.9		0.4	0.3		2.6	2.6	
Approach Delay, s/veh				23.8			3.7			16.3		
Approach LOS				C			A			C		
Intersection Delay, s/veh | LOS	18.7						C					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	PM Peak
Project Description	Original IMS Build



Site Information

Intersection	WB Ramp at SR 29
E/W Street Name	WB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.79
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	1	1	0	0	0	2	0
Lane Assignment							LT		L		LT		T		TR	
Volume (V), veh/h					0	560	0	300	0	400	210		0		250	20
Percent Heavy Vehicles, %					0	38	3	14	0	12	14		0		9	23
Flow Rate (v_{PCE}), pc/h					0	978	0	433	0	567	303		0		345	31
Right-Turn Bypass	None				Non-Yielding				None				None			
Conflicting Lanes					2				1				2			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.3276		4.5436	4.5436		4.6453	4.3276	
Follow-Up Headway (s)					2.5352		2.5352	2.5352		2.6667	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					978	433	461	409		177	199	
Entry Volume, veh/h					709	380	409	363		161	181	
Circulating Flow (v_c), pc/h	1323			870			0			1545		
Exiting Flow (v_{ex}), pc/h	0			598			303			1323		
Capacity (c_{pce}), pc/h					678		1420	1420		326	382	
Capacity (c), veh/h					491		1260	1260		296	347	
v/c Ratio (x)					1.44		0.32	0.29		0.54	0.52	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					233.1		5.8	5.4		28.4	23.8	
Lane LOS					F	A	A	A		D	C	
95% Queue, veh					34.8		1.4	1.2		3.0	2.9	
Approach Delay, s/veh				151.8			5.7			25.9		
Approach LOS				F			A			D		
Intersection Delay, s/veh | LOS	81.0						F					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	2030 AM
Project Description	Original IMS Build

Site Information

Intersection	I-70 EB at SR 29
E/W Street Name	EB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.89
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	1	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment	LT		R						T		TR		LT		T	
Volume (V), veh/h	0	20	0	410					0		180	260	0	190	840	
Percent Heavy Vehicles, %	0	0	0	24					0		31	22	0	5	15	
Flow Rate (v_{PCE}), pc/h	0	22	0	571					0		265	356	0	224	1085	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)	4.6453	4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)	2.6667	2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h	22	571					292	329		615	694	
Entry Volume, veh/h	18	465					232	262		544	613	
Circulating Flow (v_c), pc/h	1309			287			246			0		
Exiting Flow (v_{ex}), pc/h	580			0			287			1656		
Capacity (c_{pce}), pc/h	405	467					1135	1135		1420	1420	
Capacity (c), veh/h	329	380					903	903		1255	1255	
v/c Ratio (x)	0.05	1.22					0.26	0.29		0.43	0.49	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh	11.8	152.7					6.6	7.1		7.2	8.0	
Lane LOS	B	F					A	A		A	A	
95% Queue, veh	0.2	19.5					1.0	1.2		2.2	2.8	
Approach Delay, s/veh	147.5						6.9			7.6		
Approach LOS	F						A			A		
Intersection Delay, s/veh | LOS	39.1						E					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	PM Peak
Project Description	Original IMS Build

Site Information

Intersection	I-70 EB at SR 29
E/W Street Name	EB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.78
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	1	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment	LT		R						T		TR		LT		T	
Volume (V), veh/h	0	20	0	370					0		590	840	0	150	660	
Percent Heavy Vehicles, %	0	0	0	22					0		16	15	0	8	34	
Flow Rate (v_{PCE}), pc/h	0	26	0	579					0		877	1238	0	208	1134	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)	4.6453	4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)	2.6667	2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h	26	579					994	1121		631	711	
Entry Volume, veh/h	22	479					861	971		488	551	
Circulating Flow (v_c), pc/h	1342			903			234			0		
Exiting Flow (v_{ex}), pc/h	1446			0			903			1713		
Capacity (c_{pce}), pc/h	393	454					1148	1148		1420	1420	
Capacity (c), veh/h	325	376					994	994		1099	1099	
v/c Ratio (x)	0.07	1.28					0.87	0.98		0.44	0.50	

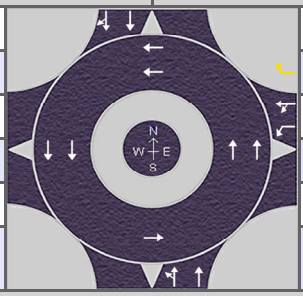
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh	12.2	173.4					26.0	43.5		8.1	9.0	
Lane LOS	B	F					D	E		A	A	
95% Queue, veh	0.2	21.4					11.5	17.7		2.3	2.9	
Approach Delay, s/veh	166.4						35.3			8.6		
Approach LOS	F						E			A		
Intersection Delay, s/veh | LOS	46.5						E					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	AM Peak
Project Description	Revised Build



Site Information

Intersection	WB Ramp at SR 29
E/W Street Name	WB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.76
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	1	1	0	0	0	2	0	0	0	2	0
Lane Assignment					L		LT		LT		T		T		TR	
Volume (V), veh/h					0	680	0	70	0	120	80		0		350	10
Percent Heavy Vehicles, %					0	8	0	10	0	13	10		0		2	12
Flow Rate (v_{PCE}), pc/h					0	966	0	101	0	178	116		0		470	15
Right-Turn Bypass	None				Yielding				None				None			
Conflicting Lanes					2				1				2			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)				4.6453	4.3276	4.9763	4.5436	4.5436		4.6453	4.3276	
Follow-Up Headway (s)				2.6667	2.5352	2.6087	2.5352	2.5352		2.6667	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h				512	454	101	138	156		228	257	
Entry Volume, veh/h				474	420	92	124	139		223	251	
Circulating Flow (v_c), pc/h	1436			294			0			1144		
Exiting Flow (v_{ex}), pc/h	0			193			116			1436		
Capacity (c_{pce}), pc/h				1030	1106	1226	1420	1420		471	537	
Capacity (c), veh/h				954	1024	1115	1270	1270		461	525	
v/c Ratio (x)				0.50	0.41	0.08	0.10	0.11		0.48	0.48	

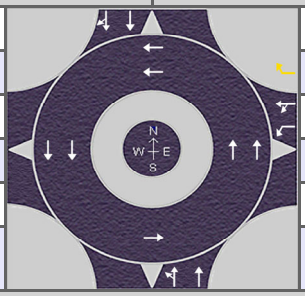
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh				9.9	8.0	3.9	3.6	3.7		17.3	15.4	
Lane LOS				A	A	A	A	A		C	C	
95% Queue, veh				2.8	2.0	0.3	0.3	0.4		2.6	2.6	
Approach Delay, s/veh				8.5			3.7			16.3		
Approach LOS				A			A			C		
Intersection Delay, s/veh | LOS	9.9						A					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	PM Peak
Project Description	Revised Build



Site Information

Intersection	WB Ramp at SR 29
E/W Street Name	WB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.79
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	1	1	0	0	0	2	0	0	0	2	0
Lane Assignment					L		LT		LT		T		T		TR	
Volume (V), veh/h					0	560	0	300	0	400	210		0		250	20
Percent Heavy Vehicles, %					0	38	0	14	0	12	14		0		9	23
Flow Rate (v_{PCE}), pc/h					0	978	0	433	0	567	303		0		345	31
Right-Turn Bypass	None				Yielding				None				None			
Conflicting Lanes					2				1				2			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)				4.6453	4.3276	4.9763	4.5436	4.5436		4.6453	4.3276	
Follow-Up Headway (s)				2.6667	2.5352	2.6087	2.5352	2.5352		2.6667	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h				518	460	433	409	461		177	199	
Entry Volume, veh/h				376	333	380	363	409		161	181	
Circulating Flow (v_c), pc/h	1323			870			0			1545		
Exiting Flow (v_{ex}), pc/h	0			598			303			1323		
Capacity (c_{pce}), pc/h				606	678	1013	1420	1420		326	382	
Capacity (c), veh/h				439	491	889	1260	1260		296	347	
v/c Ratio (x)				0.85	0.68	0.43	0.29	0.32		0.54	0.52	

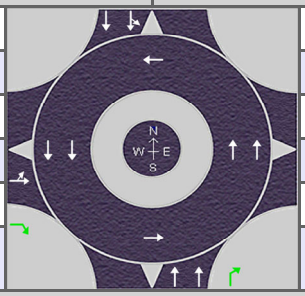
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh				44.8	24.8	9.2	5.4	5.8		28.4	23.8	
Lane LOS				E	C	A	A	A		D	C	
95% Queue, veh				8.5	5.0	2.2	1.2	1.4		3.0	2.9	
Approach Delay, s/veh				26.2			5.7			25.9		
Approach LOS				D			A			D		
Intersection Delay, s/veh | LOS	19.0						C					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess& Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	2030 AM
Project Description	Revised Build



Site Information

Intersection	I-70 EB at SR 29
E/W Street Name	EB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.89
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment			LT						T		T		LT		T	
Volume (V), veh/h	0	20	0	410					0		180	260	0	190	840	
Percent Heavy Vehicles, %	0	0	0	24					0		31	22	0	5	15	
Flow Rate (v_{PCE}), pc/h	0	22	0	571					0		265	356	0	224	1085	
Right-Turn Bypass	Non-Yielding				None				Non-Yielding				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)		2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		22	571				125	140	356	615	694	
Entry Volume, veh/h		22	460				95	107	292	544	613	
Circulating Flow (v_c), pc/h	1309			287			246			0		
Exiting Flow (v_{ex}), pc/h	224			0			287			1085		
Capacity (c_{pce}), pc/h		467					1135	1135		1420	1420	
Capacity (c), veh/h		467					867	867		1255	1255	
v/c Ratio (x)		0.05					0.11	0.12		0.43	0.49	

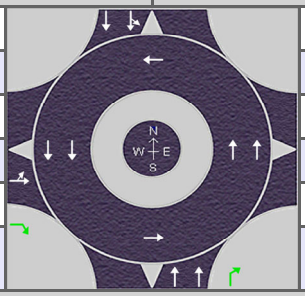
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		8.3					5.2	5.4		7.2	8.0	
Lane LOS		A	A				A	A	A	A	A	
95% Queue, veh		0.1					0.4	0.4		2.2	2.8	
Approach Delay, s/veh	0.4						2.2			7.6		
Approach LOS	A						A			A		
Intersection Delay, s/veh | LOS	4.7						A					

HCS7 Roundabouts Report

General Information

Analyst	RMK
Agency or Co.	Burgess & Niple
Date Performed	10/21/2021
Analysis Year	2030
Time Analyzed	PM Peak
Project Description	Revised Build



Site Information

Intersection	I-70 EB at SR 29
E/W Street Name	EB I-70
N/S Street Name	SR 29
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.78
Jurisdiction	

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	0
Lane Assignment			LT						T		T		LT		T	
Volume (V), veh/h	0	20	0	370					0		590	840	0	150	660	
Percent Heavy Vehicles, %	0	0	0	22					0		16	15	0	8	34	
Flow Rate (v_{PCE}), pc/h	0	26	0	579					0		877	1238	0	208	1134	
Right-Turn Bypass	Non-Yielding				None				Non-Yielding				None			
Conflicting Lanes	2								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.3276					4.5436	4.5436		4.5436	4.5436	
Follow-Up Headway (s)		2.5352					2.5352	2.5352		2.5352	2.5352	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		26	579				412	465	1238	631	711	
Entry Volume, veh/h		26	475				355	401	1077	488	551	
Circulating Flow (v_c), pc/h	1342			903			234			0		
Exiting Flow (v_{ex}), pc/h	208			0			903			1134		
Capacity (c_{pce}), pc/h		454					1148	1148		1420	1420	
Capacity (c), veh/h		454					989	989		1099	1099	
v/c Ratio (x)		0.06					0.36	0.41		0.44	0.50	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		8.7					7.5	8.1		8.1	9.0	
Lane LOS		A	A				A	A	A	A	A	
95% Queue, veh		0.2					1.6	2.0		2.3	2.9	
Approach Delay, s/veh	0.5						3.2			8.6		
Approach LOS	A						A			A		
Intersection Delay, s/veh | LOS	4.5						A					