IMPROVEMENTS TO

I-95 BETWEEN EXIT 133 AND EXIT 130

Interchange Modification Report Supplement to support the I-95 Rappahannock River Crossing Southbound Project

APPENDICES

VDOT | U.S. Department of Transportation Federal Highway Administration

AUGUST 2017

Appendix A – IMR Methodology Documentation

Meeting Minutes

Date: May 19, 2017

Date of Meeting: May 15, 2017

Time of Meeting: 2:00 PM

UPC Number: 101595

State Project Number: 0095-111-259, P101, R201, C501

Meeting Location: VDOT Central Office

Project: I-95 Rappahannock River Crossing Southbound

Meeting Description: Scoping of IMR Supplement for SB I-95 CD Lanes

Meeting Attendees:

Bill Arel	VDOT Fredericksburg District
David Beardsley	VDOT Central Office Traffic Engineering
Xeujun Fan	VDOT NOVA District Traffic Engineering
John Maddox	WRA
Krishna Potturi	VDOT Fredericksburg District
Suril Shah	VDOT APD
Michelle Shropshire	VDOT Fredericksburg District
Dana Trone	WRA
Rich Worssam	VDOT Location and Design Division

The purpose of this meeting was to discuss the scope of the Supplement to the *I-95 Interchange Modification Report – Improvements to I-95 between Exit 133 and 130* (hereinafter referred to as the I-95 IMR) that will be prepared for the revised concept for the I-95 Rappahannock River Crossing Southbound (SB I-95 CD lanes) project. The I-95 IMR Supplement will be prepared to document the operation of the revised RFP concept for the southbound I-95 CD lanes. The following is a summary of the discussions:

Traffic Volumes

- There are two available sources that could potentially be used as the basis of the IMR Supplement – the I-95 IMR or the recently prepared draft volumes for the I-95 Express Lanes Extension to Fredericksburg (FredEx) project currently under development.
- Based on a comparison of existing, No Build, and Build traffic volumes for the I-95 IMR and the FredEx projects, SB I-95 traffic forecasts are relatively similar; however, there are some differences in the ramp volumes between the two forecasts. The reasons for these differences is currently under review by the FredEx study team.
- The group agreed that in order to maintain consistency with the previously approved I-95 IMR, maintain the project schedule, and provide a comparison to the previously approved Preferred Alternative for the SB I-95 CD lanes, the I-95 IMR volumes would be used for the I-95 IMR Supplement.

Operations Model

- There are two available micro-simulation models that could potentially be used as the basis of the IMR Supplement – the I-95 IMR CORSIM model or the VISSIM model prepared for the FredEx project.
- VISSIM is superior to CORSIM for analyzing the detailed operational aspects of the signalized intersections along the arterials.
- A calibration memo for the VISSIM model for the FredEx project is currently under review by VDOT but has not yet been approved. The VISSIM model for the FredEx project does not include one intersection along Route 3 and

one intersection along Route 17 that are included in the I-95 IMR. Therefore, the VISSIM model would likely need to be expanded for consistency with the previously approved IMR.

- The group agreed that in order to maintain consistency with the previously approved I-95 IMR and provide a comparison to the previously approved Preferred Alternative in the I-95 IMR, the I-95 IMR CORSIM files would be used for the I-95 IMR Supplement.
- The HCS analysis from the I-95 IMR will also be updated to reflect the current concept for the SB I-95 CD lanes and provide a comparison to the previously preferred alternative for the SB I-95 CD lanes.

Assumptions for NB I-95 CD Lanes Concept

- Details regarding the configuration of the NB I-95 CD lanes are not know at this time and the availability and timing of funding is also not known.
- The currently preferred concept for the SB I-95 CD lanes includes the loop ramp in the northwest quadrant of the Route 17 interchange serving the westbound Route 17 to southbound I-95 movement; however, this loop ramp was eliminated in the Preferred Alternative included in the approved I-95 IMR.
- Two Build scenarios will be analyzed to document the operation of the current concept for the SB I-95 CD lanes:
    - Scenario 1 (Interim): New concept for the SB I-95 CD lanes only; no improvements to NB I-95. It should be noted that a direct comparison to the I-95 IMR will not be performed for this alternative since this scenario is not included in the IMR.
    - Scenario 2: New concept for the SB I-95 CD lanes plus the current concept for the NB I-95 CD lanes per the approved I-95 IMR. Minor modifications to the alignment of the ramps in the northwest quadrant of the Route 17 interchange (compared to the concept shown in the I-95 IMR) will be required since the loop ramp will remain for the WB Route 17 to SB I-95 movement.

Assumptions for FredEx

- Since the schedule and final configuration of the FredEx project is not known at this time, the assumptions for the FredEx project will remain as documented in the approved I-95 IMR which assumed that there would not be direct connections to and from the Express Lanes north of the Route 17 interchange.
- The future IMR for the FredEx project will document the operation of the terminus of the Express Lanes with the current concept for the SB I-95 CD lane improvements.

Measures of Effectiveness

- Measures of effectiveness (MOEs) to be documented in the I-95 IMR Supplement will be consistent with the MOEs included in the previously approved IMR. The model and analysis of the previously Preferred Alternative and other scenarios included in the I-95 IMR will not be rerun.
- The I-95 IMR Supplement will document a comparison between the previously Preferred Alternative and the current concept for the SB I-95 CD lanes.

Analysis Years and Scenarios

- Analysis will be performed for the AM and PM peak hour for both 2020 and 2040 Build conditions for two scenarios noted above.

Trone, Dana

From: Moore, Elliott (FHWA) <Elliott.Moore@dot.gov>
Sent: Friday, June 02, 2017 3:14 PM
To: Trone, Dana; Potturi, Krishna, PE (VDOT)
Cc: Maddox, John; Donovan, Erin
Subject: RE: UPC101595 - IMR Supplement

Hey Dana,

Yes, we'd like to leave the existing (previously approved) NB improvements in the supplement. We are okay with this approach since we already have an approved IMR. As of today, If VDOT were to want to move forward with the previously approved NB improvements, theoretically they could build the existing NB alternative since they have a FONSI for both SB and NB. I'll let Krishna weigh-in as well. Have a great weekend!

S. Elliott Moore, P.E.
Area Engineer for Fredericksburg and NoVA

FHWA - Virginia Division
400 N. 8th Street, Room 750
Richmond, VA 23219

(804) 775-3338 (desk)
(804) 775-3356 (fax)

http://www.fhwa.dot.gov/vadiv/

Print only if necessary

From: Trone, Dana [mailto:dtrone@wrallp.com]
Sent: Friday, June 02, 2017 2:50 PM
To: Moore, Elliott (FHWA) <Elliott.Moore@dot.gov>; Potturi, Krishna, PE (VDOT) <Krishna.Potturi@vdot.virginia.gov>
Cc: Maddox, John <JMaddox@wrallp.com>; Donovan, Erin <edonovan@wrallp.com>
Subject: RE: UPC101595 - IMR Supplement

Elliot/Krishna –

I want to confirm that I am interpreting your emails below correctly.

Per the emails, I understand that we will document Scenario 2 as noted in the attached meeting minutes and NOT Scenario 1 (which excludes the NB I-95 CD Lane improvements).

Please confirm that I am interpreting this correctly.

Thanks! Dana

From: Potturi, Krishna, PE (VDOT) [mailto:Krishna.Potturi@vdot.virginia.gov]
Sent: Thursday, June 01, 2017 10:10 AM
To: Shropshire, Michelle, PE (VDOT) <Michelle.Shropshire@VDOT.Virginia.gov>; Arel, William D., P.E. (VDOT) <William.Arel@VDOT.Virginia.gov>; Trone, Dana <dtrone@wrallp.com>; Maddox, John <JMaddox@wrallp.com>; Worssam, Richard C., P.E. (VDOT) <Richard.Worssam@VDOT.Virginia.gov>; Beardsley, David (VDOT) <David.Beardsley@vdot.virginia.gov>; Fan, Xuejun (VDOT) <Xuejun.Fan@vdot.virginia.gov>
Cc: Shah, Suril (VDOT) <Suril.Shah@vdot.virginia.gov>
Subject: FW: UPC101595 - IMR Supplement

FYI- Elliott is fine with our proposed approach on IMR supplement.

Scenario 2 according to our meeting minutes is as follows:
Scenario 2: New concept for the SB I-95 CD lanes plus the current concept for the NB I-95 CD lanes per the approved I-95 IMR. Minor modifications to the alignment of the ramps in the northwest quadrant of the Route 17 interchange (compared to the concept shown in the I-95 IMR) will be required since the loop ramp will remain for the WB Route 17 to SB I-95 movement.

Thanks,
Krishna.

From: Moore, Elliott (FHWA) [mailto:Elliott.Moore@dot.gov]
Sent: Friday, May 26, 2017 5:08 PM
To: Potturi, Krishna, PE (VDOT)
Subject: RE: UPC101595 - IMR Supplement

Hey Krishna,

I didn't hear back from my supervisor today, but I think we're going to be okay with Scenario #2 as described in the meeting minutes you sent. I'll touch base with you next week. Enjoy the long weekend.

S. Elliott Moore, P.E.
Area Engineer for Fredericksburg and NoVA

FHWA - Virginia Division
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(804) 775-3338 (desk)

(804) 775-3356 (fax)

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Print only if necessary

From: Potturi, Krishna, PE (VDOT) [mailto:Krishna.Potturi@vdot.virginia.gov]
Sent: Thursday, May 25, 2017 9:56 AM
To: Moore, Elliott (FHWA) <Elliott.Moore@dot.gov>
Cc: Arel, William D., P.E. (VDOT) <William.Arel@VDOT.Virginia.gov>; Shropshire, Michelle, PE (VDOT) <Michelle.Shropshire@VDOT.Virginia.gov>; Beardsley, David (VDOT) <David.Beardsley@vdot.virginia.gov>; Fan, Xuejun (VDOT) <Xuejun.Fan@vdot.virginia.gov>; 'Trone, Dana' <dtrone@wrallp.com>; 'Maddox, John' <JMaddox@wrallp.com>
Subject: UPC101595 - IMR Supplement

Elliott,

Please see attached the following documents:

- Meeting minutes from VDOT's scoping meeting with WRA
- Table comparing Fred Ex Traffic Volumes to the CD Lanes IMR volumes

As mentioned yesterday, the meeting minutes describe VDOT's suggested approach for the revision of IMR on the I-95 SB CD Lanes project.

Please let us know if you have any questions or concerns with this approach.

Thanks,
Krishna.

Krishna Potturi, PE
District Mega Projects Manager
VDOT Fredericksburg District
87 Deacon Road, Fredericksburg, VA 22405
Office (540)372-3596
Cell (540)907-9274

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WRA_Disclaimer_v20070222a

Appendix B - Design Criteria and Design Waivers

Geometric Design Criteria Table

Project No: 0095-111-259, PE-101 (UPC 101595)

No.	Design Criteria		Southbound I-95 Mainline Lanes	Existing I-95 Southbound/ I-95 Collector / Distributor Lanes	Route 17 Warrenton Road
1	Classification		Rural Principal Arterial (Interstate)	Rural Principal Arterial (Interstate)	Urban Other Principal Arterial
2	Geometric Design Standard		GS-1	GS-1	GS-5
3	Terrain		Rolling	Rolling	Rolling
4	Average Daily Traffic (ADT)	Current (2013)	N/A	75,800	64,700
		Opening Year (2020)	28,100	64,500	75,900
		Design (2040)	34,800	85,800	108,300
5	Speed	Posted	70	65	45
		Design	75	75	45
6	Design Vehicle		WB-67	WB-67	WB-67
7	Minimum Curve Radius		2215	2215	713
8	Superelevation	Standard	TC-5.11R	TC-5.11R	TC-5.11U
		Max Rate	8.0%	8.0%	4.0%
9	Maximum Grade		4.0%	4.0%	7.0%
10	Minimum Stopping Sight Distance		820	820	360
11	Vertical Design Criteria	"K" Crest	312	312	61
		"K" Sag	206	206	79
12	Lanes	Number	3	3	6
		Width	12	12	12
13	Paved Shoulder Width	Left	4	10 (Exist.)	8
		Right	12	10 (Exist.)	8
14	Max Slopes		2:1	2:1	2:1
15	Vertical Clearance		16.5	16.5	16.5

Note: **For VDOT Standard Geometric Criteria not listed in the table above, please see the appropriate Geometric Standard in Appendix A of the current VDOT Road Design Manual**

Supplemental Geometric Design Criteria Table - Ramps

Project No: 0095-111-259, PE-101 (UPC 101595)

No.	Design Criteria		Ramp A Route 3	Loop Ramps Route 3	Ramp A Route 17 @ Route 17
1	Classification		Interchange Ramp	Interchange Ramp	Interchange Ramp
2	Geometric Design Standard		GS-R	GS-R	GS-R
3	Terrain		Rolling	Rolling	Rolling
4	Design Speed		50	30	30
5	Design Vehicle		WB-67	WB-67	WB-67
6	Minimum Curve Radius		760	215	316
7	Superelevation	Standard	TC-5.11R	TC-5.11R	TC-5.11U
		Max Rate	8.0%	8.0%	4.0%
8	Maximum Grade		4.0%	7.0%	6.0%
9	Minimum Stopping Sight Distance		425	200	250
10	Vertical Design Criteria	"K" Crest	84	19	29
		"K" Sag	96	37	49
11	Lanes	Number	1	1	2
		Width	16	18*	12
12	Paved Shoulder Width	Left	4	4	4
		Right	8	8	8
13	Side Slopes	Max Slope	2:1	2:1	2:1
14	Vertical Clearance (see footnote)		16.5	16.5	16.5

Note: For VDOT Standard Geometric Criteria not listed in the table above, please see the appropriate Geometric
***Existing ramps are 18' in width. Matching existing design width.**

DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN/STRUCTURE & BRIDGE
DESIGN WAIVER REQUEST
(See IIM-LD-227 for the definition of Design Waiver)
Design Waiver Number: (For Use by NOVA Only)

To: William Arel, P.E. Date: 07/17/2017
District Location and Design Engineer

From: John Maddox, P.E.
Project Designer (L&D, S&B or Consultant)

Drop down Selection N/A Funding Source: RSTP

State Proj. Number: 0095-111-259 Federal Proj. Number: IM-5111(235)

County/City Fredericksburg District: Fredericksburg

Project Description: HB2.FY17 I-95 RAPPAHANNOCK RIVER CROSSING (SOUTHBOUND)

From: Mile Marker 135.3 UPC: 101595

To: Mile Marker 129.3, City of Fredericksburg

Functional Classification: INTERSTATE Minimum VDOT GS St'd: GS-1

Min. VDOT Standard: 10' LT / 10' RT VDOT Reference Location: RDM - p. A-11

Design Speed: 75 MPH Posted Speed: N/A (New Facility)

A Design Waiver is requested for the following:

- ☐ Ramp Geometrics
- ☑ Total Shoulder Width
- ☑ Paved Shoulder Width
- ☐ Curb and Gutter
- ☐ Minimum Radius
- ☐ Bike & Ped Accommodations Compliance (See IIM-LD-55 & RDM)
- ☐ Intersection Sight Distance
- ☐ Ditch Width
- ☐ Lane Shift/Tapers
- ☐ Buffer Strip Width
- ☐ Superelevation
- ☐ Other

Design Waiver request must address the following:

- Established design criteria versus proposed and existing criteria (including traffic data, design speed and posted speed)
- Reason the appropriate design criteria cannot be met
- Justification for the proposed criteria
- Any background information which documents, supports or justifies the request
- Any mitigation that will be provided to further support or justify the request
- Cost to meet standard versus project cost

Attach all supporting documentation to this exhibit including crash history (past three years).

VDOT Drop List by: _____ Date: _____
Drop Down Selection

Whitman Requardt & Associates
Richmond, Virginia
Roadway Engineer

Prepared By: John Maddox, P.E. Date: 07/17/2017
Consultant (P.E.'s Name and Company Name)

Note: The responsible person that prepares the request shall also electronically seal and digitally sign in the block above.

CC: Appropriate Assistant State Location and Design Engineer
Project Manager
State Geometric Design Engineer
State Structure and Bridge Engineer
Assistant State Traffic Engineer – Traffic Control Devices

Background and Description of Project

The project is located along I-95 between mile markers 129.3 and 135.3 in the City of Fredericksburg, Stafford County, and Spotsylvania County. The proposed project adds 3 I-95 southbound lanes in the existing median while converting the existing I-95 southbound lanes into collector-distributor (CD) lanes for local traffic. The mainline lanes will be diverted north of the Route 17 interchange (Exit 133) in the vicinity of Truslow Road and connect with the CD lanes south of the Route 3 interchange (Exit 130), thus reducing merge conflicts for through travelers on I-95 southbound. The project will include roadway and bridge improvements at Route 17 (Exit 133), construction of a new bridge over the Rappahannock River, and connection to ongoing interchange improvements at Route 3 (Exit 130).

The I-95 corridor through the project area was designed for future improvements in the median. The existing median width varies from 106 feet to 169 feet which provides space for future lanes and the potential to accommodate future Express Lanes. Widening into the median was selected as the design alternative because it will optimize the available existing right of way, limit impacts to the surrounding existing infrastructure, and minimize impacts on active traffic.

The existing I-95 southbound footprint generally consists of three 12 foot lanes, a 10 foot wide paved outside shoulder, and a 10 foot wide paved inside shoulder. The posted speed limit is 65 MPH along this corridor. The Route 3 and 17 interchanges currently have cloverleaf weaves on existing I-95 southbound. The weaves have lengths ranging from 450 feet to 685 feet. There are currently no existing CD facilities on I-95 southbound at both the Route 3 and Route 17 interchanges, but I-95 northbound does utilize a CD facility at Route 17.

Established Design Criteria

The proposed project design was established in accordance with AASHTO, FHWA, and VDOT design guidelines. The following documents were used in the development of the design criteria table:

- AASHTO, Green Book, 2011
- AASHTO, A Policy on Design Standards – Interstate System, 5th Edition, 2005
- AASHTO, Roadside Design Guide, 4th Edition, 2011
- VDOT, Road Design Manual, August 2016
- VDOT, Manual of the Structure and Bridge Division, Volume V, Part 2, 2011
- VDOT, Drainage Manual, July 2016
- VDOT, Guardrail Installation Training Manual, August 2017
- VDOT, Instructional and Informational Memoranda

These documents were used to develop the proposed design within the project limits. Where the design standards could not be met, appropriate design exceptions or waivers will be obtained. An overview of the criteria shown in **Table 1** reflects the selected standards for each roadway classification.

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Table 1: Design Criteria

Criteria	Southbound I-95 Mainline Lanes	Existing Southbound I-95 / Future I-95 SB C-D Road	Route 17 /Warrenton Road	I-95 Interchange Ramps
Functional Classification	Rural Principal Arterial Interstate GS-1	Rural Principal Arterial Interstate GS-1	Urban Other Principal Arterial GS-5	Interchange Ramp GS-R
Average Daily Traffic (ADT) 2040	34,800	85,800	108,300	4,100 - 38,600
Design Speed	75 MPH	75 MPH	45 MPH	30 - 50 MPH
Design Vehicle	WB-67	WB-67	WB-67	WB-67
Lane Width	12 ft	12 ft	12 ft	16 ft (One Lane Ramp) 24 ft (Two Lane Ramp)
Paved Shoulder Width	4 ft – 12 ft	10 ft (Existing)	8 ft or Curb and Gutter	8 ft Right – 4 ft Left
Superelevation Standard, Max Rate	TC-5.11R, 8% Max	TC-5.11R 8% Max	TC-5.11U, 4% Max	TC-5.11R, 8% Max
Min. Vertical Clearance	16.5 ft	16.5 ft	16.5 ft	16.5 ft
Max. Vertical Grade	4%	4%	7%	7% at 30 MPH 4% at 50 MPH

The design vehicle for the proposed roadway improvements is assumed to be an Interstate Semitrailer (WB-67).

Reason Design Criteria Cannot Be Met

The purpose of this Design Wavier is to request reduction of the inside left shoulder width below the minimum width required by VDOT standards when the mainline is 6 or more lanes.

The total inside left shoulder width for the I-95 southbound proposed mainline lanes is less than the 12 feet required by VDOT standards, and the paved inside left shoulder width proposed is less than the 10 feet required by VDOT standards. The VDOT Road Design Manual notes that the paved inside left shoulder should be equal to the paved right shoulder when the mainline facility is 6 or more lanes. The minimum total inside left shoulder width is proposed to be 8 feet, and the minimum paved inside left shoulder width is proposed to be 4 feet where the I-95 southbound mainline lanes have been realigned into the median. The inside left shoulder width has been reduced to provide space for potential future widening of Interstate 95 within the median along this corridor.

VDOT anticipates that a portion of the existing median beyond the proposed footprint of this alternative will be required for future improvements along this corridor. The additional space required for a full width inside left shoulder on this project would impact the space available for future projects and could significantly impact their scope of work at pinch points along the corridor.

Justification for the Proposed Criteria

It is recognized that total shoulder widths have a significant effect on both safety and traffic operations. AASHTO's *A Policy on Design Standards – Interstate System, 5th Edition, 2005*, maintains that by

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providing the minimum allowable outside and inside shoulder widths, the mainline lanes will have a functional recovery area for drivers on both sides of the travel way, and an outside shoulder that can accommodate stopped vehicles during emergencies. The separated 3 lane CD facility causes a direct reduction of traffic on the 3 I-95 southbound mainline lanes and presents a unique difference and opportunity to modify the general 6 lane facility described in the VDOT Road Design Manual. The CD lanes and mainline lanes on I-95 southbound will essentially function as 2 separate but parallel 3 lane facilities between their merge points north of Route 17 and south of Route 3. This segment will allow ample space for enforcement, maintenance, disabled vehicles, emergency responder access, and snow removal on the outside right shoulder within the confines of a 3 lane interstate facility. Providing a reduced inside left shoulder in this area of reduced traffic volumes will prevent significant site impacts, maintenance of traffic issues, and increased costs on future projects along the corridor.

The proposed 3 lane mainline facility was chosen primarily to provide a uniform lane distribution throughout the I-95 corridor. The 2040 PM peak hour volume from the IMR study of 3,270 vehicles on the mainline lanes is significantly lower than the capacity of this 3 lane section and lower than the traffic on the existing I-95 lanes in this area. Combined with the absence of merge points between Route 17 and Route 3, the mainline lanes will operate more safely and with higher capacity.

The reduced inside left paved shoulder width of 4 feet will also directly align with the proposed mainline lane bridges over the Rappahannock River Crossing and Route 17. The bridge structure proposes a 4 foot shoulder with 2 foot barrier offset. A design waiver for a reduced inside left shoulder width on the Rappahannock River Bridge was approved by VDOT in June 2017.

The proposed mainline lane design parallels the existing I-95 southbound lanes and does not contain any substandard horizontal or vertical curvature. Due to the controlled access of the new mainline lanes, merging will be primarily centralized at the beginning of the facility near Truslow Road and at the tie-in point south of Route 3. Both weaving movements will be isolated from traffic accessing the Virginia Welcome Center and local interchanges.

(Enter Crash Data discussion)

Mitigation Measures

The primary measure taken to improve the safety and functionality of the shoulder layout was to increase the outside right shoulder width by 2 feet. The proposed mainline lane facility provides a full width 14 foot paved outside right shoulder along the entire corridor. This includes the 10 foot requirement, 2 foot barrier offset, and 2 additional feet of width. This space will create additional room for enforcement, maintenance, disabled vehicles, emergency responder access, and snow removal.

The AASHTO (*Green Book, p. 4-10*) states that “Heavily traveled, high-speed highways and highways carrying large numbers of trucks should have useable shoulders at least 10 feet wide and preferably 12 feet wide.” Increasing the outside right shoulder width to the preferred value of 12 feet will help mitigate functionality lost by reducing the size of the inside left paved shoulder.

Another safety measure incorporated into the design to mitigate the reduced inside left paved shoulder width is the addition of embedded rumble strips to alert motorists as they are departing the travel way. This feature provides an added benefit to notify a road user of drifting and potentially preventing impact with barriers.

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Cost to Meet Standard Versus Project Cost

See Appendix A for breakdown of estimated costs required to meet design standards. (Not yet complete)

Crash Data

See Appendix B for crash data exhibit. (Not yet complete - Need VDOT to request table that displays past 3 years of information. I-95 SB between exits 130-133)

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DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN/STRUCTURE & BRIDGE
DESIGN WAIVER REQUEST
(See IIM-LD-227 for the definition of Design Waiver)
Design Waiver Number: N/A (For Use by NOVA Only)

To: Kendal R. Walus
State Structure and Bridge Engineer

Date: 06/23/2017

From: Abdoul Koura-Bodji
Project Designer (L&D, S&B or Consultant)

Locality Project Number N/A Funding Source: RSTP

State Proj. Number: 0095-111-259, B604 Federal Proj. Number: M-5111(235)

County/City Fredericksburg District: Fredericksburg

Project Description: HB2.FY17 I-95 RAPPAHANNOCK RIVER CROSSING (SOUTHBOUND)

From: Mile Marker 135.3 UPC: 101595

To: Mile Marker 129.3, City of Fredericksburg

Functional Classification: INTERSTATE Minimum VDOT GS St'd: GS-1

Min. VDOT Standard: 12 ft./ 12 ft. VDOT Reference Location: Vol 5-2,F-No. 06.02-2

Design Speed: 75 MPH Posted Speed: 65 MPH

A Design Waiver is requested for the following:

- ☐ Ramp Geometrics
- ☑ Total Shoulder Width
- ☑ Paved Shoulder Width
- ☐ Curb and Gutter
- ☐ Minimum Radius
- ☐ Bike & Ped Accommodations Compliance (See IIM-LD-55 & RDM)
- ☐ Intersection Sight Distance
- ☐ Ditch Width
- ☐ Lane Shift/Tapers
- ☐ Buffer Strip Width
- ☐ Superelevation
- ☐ Other

Design Waiver request must address the following:

- Established design criteria versus proposed and existing criteria (including traffic data, design speed and posted speed)
- Reason the appropriate design criteria cannot be met
- Justification for the proposed criteria
- Any background information which documents, supports or justifies the request
- Any mitigation that will be provided to further support or justify the request
- Cost to meet standard versus project cost

Attach all supporting documentation to this exhibit including crash history (past three years).

VDOT Approval by: _____ Date: _____
State Structure and Bridge Engineer

COMMONWEALTH OF VIRGINIA
ABDOUL N.
KOURA - BODJI
Lic. No. 041845
PROFESSIONAL ENGINEER

VDOT S&B Division
Fredericksburg, Virginia
Structural Engineer

Prepared By: Annette F. Adams Date: 06/26/2017
District Structure and Bridge Engineer

Note: The responsible person that prepares the request shall also electronically seal and digitally sign in the block above.

CC: Appropriate Assistant State Location and Design Engineer
Project Manager
State Geometric Design Engineer
State Structure and Bridge Engineer
Assistant State Traffic Engineer – Traffic Control Devices

DESIGN WAIVER REQUEST FOR SHOULDER WIDTH REDUCTION

Background and Description of Project

The project is located along I-95 between mile markers 135.3 and 129.3 in the City of Fredericksburg, Stafford County and Spotsylvania County. The project would add three lanes parallel to the I-95 southbound general purpose lanes between Truslow Road and 1.29 miles south of Route 3 (Exit 130). The proposed lanes would be designated as general purpose lanes and serve the through traffic while the existing general purpose lanes would be converted to collector-distributor lanes. The project would include associated roadway improvements at Route 17, construction of new bridge over Rappahannock River, construction of a new bridge over Route 17, and replacement of existing southbound and northbound general purpose lane bridges over Route 17. The total length of the project is approximately 6 miles.

The new bridge over Rappahannock River, is to be constructed between the existing I-95 southbound over Rappahannock River (Structure No. 2900, Structure ID. 18113), and I-95 northbound (Structure No. 2901, Structure ID. 18114) bridges.

The overall I-95 SB general purpose lanes and bridges over Rappahannock River and Rte. 17 the design data for the waiver are shown below:

Design Data (I-95 S)

Current ADT (2013):	75, 800	Design ADT (2040):	99, 700
Percent Trucks:	13	DDHV (2040):	99,700
Design Speed:	75 mph	Posted Speed:	65 mph
Design Criteria:	Shoulder Width		
Required Dimension:	12 feet / 12 feet	Proposed Dimension:	6 feet / 12 feet

Justifications the Design Exception

According to VDOT Structure and Bridge Design Manual, Volume 5, Part 2, File No. 06.02-1, for a freeway with 3 lanes through traffic, the required bridge curb to curb width is sixty (60) feet, which includes thirty-six (36) feet for the three (3) twelve (12) feet travel lanes and twelve (12) feet wide for each of the shoulder.
The project objectives in requesting this Design Exception are to minimize right way acquisition costs, because the properties in the mentioned vicinity are commercial. For that reason the new CD lanes were layout to be constructed in the VDOT right of way between the existing 95 northbound and 95 southbound, instead of passing on the outside (west) side of Rte. 95 southbound.

The current clear barrier-to-barrier spacing between the bridges on Rte. 95 southbound and Rte. 95 northbound is hundred sixty-four (164) feet.

The reduction of left (inside) shoulder is necessary for the following reasons:

1- To accommodate future northbound CD Lanes Bridge also scheduled to be constructed between the current proposed bridge and the existing Rte. 95 northbound

2- Provide enough spacing between the bridges to allow easy bridge safety inspections without installing costly permanent under bridge access systems.

3- Better align with the approach roadway width has four feet (4) paved inside shoulder.

The potential cost savings for the proposed bridge is as follow:

Bridge Construction……..…….……$2.4 million	
Permanent under Bridge Access Systems Cost…….……$ 2.0 million	
Total…….…….....…….…..…$4.4 million	

To avoid widening the bridge the proposal is to have inside shoulder on bridge reduced to six (6) feet instead of the required twelve (12) feet. The outside shoulder on the bridge will be kept at twelve (12) feet as required by the code.

Crash Data and Safety Implications.

The intent of the proposed new bridge is to alleviate congestion on Rte. 95 southbound, by adding new CD lanes bridge. Because of addition of new CD lanes, it will not be rational to evaluate the impact of the reduction of shoulder width using current traffic data on the existing 95 southbound. Thus no traffic crash data, and or subsequent analysis are provided.

In general the reduction for the inside shoulder on the bridge has potential for adverse safety impacts with respect to:

1. Space for emergency storage of disabled vehicles on the bridge on the inside shoulder.
2. Space for law enforcement activities on the bridge.
3. Space for storing snow that has been cleared from the travel lanes.
4. By not providing a stable, clear recovery area for drivers who have left the travel lane to avoid crashes.
5. Space to store and carry drainage during storms, preventing drainage from spreading onto the travel lanes.
6. Reduction of driver comfort by driving near a narrower shoulder.

Proposed Mitigation Measures

Converting existing 95 southbound to 95 southbound general purpose lanes and 95 southbound CD lanes will improve the congestion on this section of I-95 southbound by moving the traffic along quickly and efficiently and thus reducing congestion. This in turn will help substantially reduce the number of vehicular crashes because of the fluidity of the traffic in this section of the interstate. The project has also a potential of improving traffic flow even further south of the bridge and hence improving the overall safety concerns on I-95 southbound corridor.

The July 2007 edition of FHWA's Mitigation Strategies for Design Exceptions, under Table 22 of

Chapter 4, list a series of mitigation strategies for narrower bridges that help minimized the aforementioned safety impacts.

The list includes providing advance delineation of narrow inside shoulder to improve visibility of travel lanes.

Crashworthy railing on the bridge and approach guardrail on the roadway will help reduce crash severity if driver leaves the roadway.

Reflectors will be affixed on the guardrail and bridge rail to provide high-visibility rails and help maintain the traffic within the lane and through the bridge.

Appendix C –1: April 2016 IMR Build Alternative HCS and CORSIM Traffic Analysis Output Files

Intersection Analysis

- 2020 Build HCS2010 Intersection Analysis Summary
- 2020 Build Conditions HCS2010 Output
- 2040 Build HCS2010 Intersection Analysis Summary
- 2040 Build Conditions HCS2010 Output

HCS Mainline / Ramp Junctions Analysis

- 2020 Build Conditions
    - I-95 Mainline Analysis
    - I-95 Ramp Junctions
- 2040 Build Conditions
    - I-95 Mainline Analysis
    - I-95 Ramp Junctions

CORSIM Analysis

- 2020 Build Conditions
- 2040 Build Conditions

April 2016 IMR Build Alternative

2020 HCS Intersection Analysis

2020 Build HCS Intersection Analysis Summary (Sheet 1 of 2)

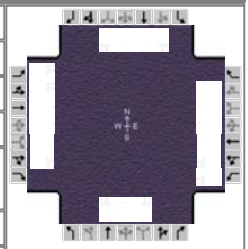
				AM Peak Hour														PM Peak Hour													
				2013		2020 No Build						2020 Build						2013		2020 No Build						2020 Build					
				Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection		Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection	
	Intersection	Approach	Movement	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
1	Route 3 / Mall Dr. / Central Park Blvd.	NB	Left	15.1	B	65.2	E	133.5	F	19.4	B	65.2	E	133.5	F	19.5	B	103.8	F	75.8	E	616.9	F	120.0	F	75.8	E	616.9	F	120.0	F
			Through			66.1	E					66.1	E							80.1	F					80.1	F				
			Right			151.0	F					151.0	F							885.6	F					885.6	F				
		SB	Left			69.0	E	87.1	F			69.9	E	98.5	F					72.3	E	326.4	F			72.3	E	326.4	F		
			Through			68.7	E					69.6	E							70.3	E					70.3	E				
			Right			91.5	F					105.6	F							544.0	F					544.0	F				
		EB	Left			63.3	E	13.7	B			63.3	E	18.4	B					69.3	E	67.6	E			69.3	E	68.7	E		
			Through			9.1	A					9.4	A							68.7	E					69.9	E				
			Right			0.1	A					0.1	A							43.4	D					43.4	D				
		WB	Left			66.8	E	11.5	B			69.1	E	11.1	B					60.5	E	19.3	B			60.5	E	19.3	B		
			Through			6.7	A					6.1	A							9.8	A					9.8	A				
			Right			8.8	A					8.2	A							14.1	B					14.1	B				
2	Route 3 / Carl D. Silver Pkwy	NB	Left	29.7	C	70.8	E	70.2	E	32.8	C	70.8	E	70.2	E	34.5	C	97.8	F	76.7	E	76.0	E	127.8	F	76.7	E	76.0	E	126.7	F
			Through			70.8	E					70.8	E							76.7	E					76.7	E				
			Right			69.6	E					69.6	E							75.2	E					75.2	E				
		SB	Left			59.1	E	58.3	E			63.7	E	63.0	E					160.0	F	139.9	F			181.1	F	160.1	F		
			Through			51.9	D					51.9	D							51.1	D					51.1	D				
			Right			53.6	D					52.5	D							80.3	F					58.9	E				
		EB	Left			63.0	E	27.2	C			63.0	E	29.6	C					63.6	E	14.9	B			63.6	E	14.8	B		
			Through			25.4	C					27.9	C							7.6	A					7.7	A				
			Right			24.4	C					24.4	C							5.7	A					5.7	A				
		WB	Left			69.5	E	36.0	D			69.5	E	34.8	C					75.9	E	189.4	F			52.1	D	185.4	F		
			Through			31.6	C					32.6	C							111.7	F					180.6	F				
			Right			45.3	D					39.4	D							419.3	F					211.9	F				
8	New Signal Route 3 / Ramp from SB I-95	NB	Left													28.1	C													67.0	E
			Through																												
			Right																												
		SB	Left											65.3	E													72.2	E		
			Through																												
			Right									65.3	E													72.2	F				
		EB	Left																												
			Through																												
			Right																												
		WB	Left											6.2	A													63.5	E		
			Through									6.2	A													63.5	F				
			Right																												
9	New Signal Route 3 / Ramp to NB I-95 (triple lefts)	NB	Left													25.6	C													19.5	B
			Through																												
			Right																												
		SB	Left																												
			Through																												
			Right																												
		EB	Left									37.6	D	22.0	C											62.0	E	21.5	C		
			Through									0.5	A													0.7	A				
			Right																												
		WB	Left											41.6	D													14.9	B		
			Through									41.6	D													14.9	B				
			Right																												
3	Route 3 / Gateway Blvd.	NB	Left	20.6	C	58.9	E	53.3	D	21.8	C	58.9	E	53.3	D	22.8	C	27.5	C	107.3	F	87.7	F	30.2	C	107.3	F	87.7	F	31.1	C
			Through			38.2	D					38.2	D							38.0	D					38.0	D				
			Right			41.3	D					41.3	D							59.3	E					59.3	E				
		SB	Left			48.7	D	49.7	D			48.7	D	49.7	D					48.7	D	48.9	D			48.7	D	48.9	D		
			Through			50.1	D					50.1	D							49.1	D					49.1	D				
			Right			50.1	D					50.1	D							49.1	D					49.1	D				
		EB	Left			47.4	D	26.5	C			47.4	D	27.9	C					47.1	D	29.5	C			47.1	D	32.1	C		
			Through			26.6	C					28.3	C							28.9	C					32.3	C				
			Right			23.8	C					23.8	C							30.3	C					30.3	C				
		WB	Left			46.1	D	8.6	A			46.1	D	10.8	B					54.4	D	12.6	B			54.4	D	13.1	B		
			Through			5.9	A					8.6	A							5.9	A					7.1	A				
			Right			3.1	A					3.1	A							0.0	A					0.0	A				

2020 Build HCS Intersection Analysis Summary (Sheet 2 of 2)

				AM Peak Hour														PM Peak Hour													
				2013		2020 No Build						2020 Build						2013		2020 No Build						2020 Build					
				Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection		Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection	
	Intersection	Approach	Movement	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
4	Route 17 / McLane Dr.	NB	Left	25.8	C	54.3	D	67.6	E	53.7	D	55.2	E	67.0	E	53.6	D	19.1	B	69.0	E	3.7	A	27.9	C	70.1	E	4.3	A	28.0	C
			Through			68.7	F					68.7	F							3.5	A					3.5	A				
			Right			1.2	A					1.2	A							0.0	A					0.1	A				
		SB	Left			53.8	D	37.5	D			53.8	D	37.8	D					68.0	E	46.6	D			68.0	E	46.6	D		
			Through			37.5	D					37.9	D							46.7	D					46.7	D				
			Right			17.7	B					17.7	B							14.2	B					14.2	B				
		EB	Left			32.5	C	32.5	C			32.8	C	32.8	C					46.7	D	46.7	D			46.7	D	46.7	D		
			Through			32.5	C					32.8	C							46.7	D					46.7	D				
			Right			32.5	C					32.8	C							46.7	D					46.7	D				
		WB	Left			33.3	C	33.3	C			33.2	C	33.2	C					48.1	D	48.1	D			48.1	D	48.1	D		
			Through			33.3	C					33.2	C							48.1	D					48.1	D				
			Right			33.3	C					33.2	C							48.1	D					48.1	D				
5	Route 17 /Sanford Dr.	NB	Left	36.4	D	65.2	E	105.9	F	53.2	D	65.2	E	105.9	F	38.0	D	291.7	F	115.2	F	3023.1	F	382.6	F	50.6	D	377.2	F	170.9	F
			Through			54.4	D					54.4	D							76.1	E					48.4	D				
			Right			126.2	F					126.2	F							3267.3	F					404.6	F				
		SB	Left			62.8	E	62.4	E			76.1	E	74.6	E					78.8	E	77.4	E			327.6	F	309.0	F		
			Through			62.6	E					73.5	E							59.7	E					71.1	E				
			Right			58.9	E					65.1	E							61.2	E					72.7	E				
		EB	Left			57.4	E	59.9	E			65.4	E	30.1	C					59.8	E	118.5	F			78.4	E	105.0	F		
			Through			60.2	F					30.0	C							120.4	F					106.6	F				
			Right			21.1	C					15.0	B							23.2	C					22.1	C				
		WB	Left			60.2	E	44.0	D			106.6	F	31.4	C					81.6	F	41.8	D			637.6	F	159.8	F		
			Through			45.0	D					13.4	B							38.8	D					25.9	C				
			Right			15.8	B					11.6	B							22.2	C					22.9	C				
7	New Signal Route 17 / Ramp F to SB I-95	NB	Left													3.8	A													5.4	A
			Through																												
			Right																												
		SB	Left																												
			Through																												
			Right																												
		EB	Left																												
			Through									4.0	A	4.0	A											5.0	A	5.0	A		
			Right																												
		WB	Left									62.7	E	3.7	A											75.7	E	5.7	A		
			Through									1.0	A													0.6	A				
			Right																												
6	Route 17 /Short St.	NB	Left	34.9	C	35.0	C	34.7	C	46.8	D	35.0	C	34.7	C	35.7	D	105.6	F	42.4	D	41.6	D	150.7	F	42.4	D	41.6	D	112.0	F
			Through			35.0	C					35.0	C							42.4	D					42.4	D				
			Right			31.4	C					31.4	C							39.2	D					39.2	D				
		SB	Left			40.9	D	40.9	D			40.9	D	40.9	D					44.9	D	44.9	D			44.9	D	44.9	D		
			Through			40.9	D					40.9	D							44.9	D					44.9	D				
			Right			40.9	D					40.9	D							44.9	D					44.9	D				
		EB	Left			77.5	F	73.1	E			53.7	D	51.2	D					243.5	F	228.5	F			177.6	F	165.6	F		
			Through			73.1	F					51.6	D							229.6	F					166.1	F				
			Right			22.3	C					22.3	C							20.1	C					20.1	C				
		WB	Left			20.5	C	22.3	C			19.4	B	19.0	B					21.7	C	16.3	B			21.7	C	14.9	B		
			Through			22.3	C					19.1	B							16.4	B					15.0	B				
			Right			22.4	C					18.8	B							16.1	B					14.6	B				

HCS 2010 Signalized Intersection Results Summary

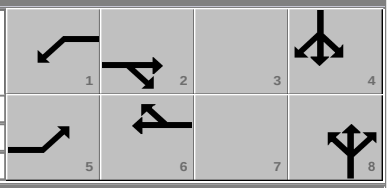
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{1_am} Rte 3 @ Central Pa	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	1_2020B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	280	2930	60	100	1280	30	10	30	170	10	10	90

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	27.5	62.5	10.5	14.0	9.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	35.0	105.0	18.0	88.0		21.0		16.0
Change Period, *(Y+Rc)*, s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway *(MAH)*, s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time *(g_s)*, s	14.5		6.7			18.0		10.7
Green Extension Time *(g_e)*, s	0.5	0.0	1.5	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.75			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate *(v)*, veh/h	292	3052	57	104	1027	337	10	31	160	10	10	85
Adjusted Saturation Flow Rate *(s)*, veh/h/ln	1740	1691	1594	1658	1810	1780	1810	1845	1563	1757	1696	1548
Queue Service Time *(g_s)*, s	12.5	0.0	0.0	4.7	6.0	7.4	0.8	2.5	16.0	0.9	0.5	8.7
Cycle Queue Clearance Time *(g_c)*, s	12.5	0.0	0.0	4.7	6.0	7.4	0.8	2.5	16.0	0.9	0.5	8.7
Capacity *(c)*, veh/h	631	3171	996	249	2816	895	181	184	156	121	233	106
Volume-to-Capacity Ratio *(X)*	0.463	0.962	0.057	0.419	0.365	0.377	0.058	0.169	1.026	0.086	0.045	0.802
Available Capacity *(c_a)*, veh/h	631	3171	996	249	2816	895	181	184	156	121	233	106
Back of Queue *(Q)*, veh/ln (50th percentile)	5.8	2.7	0.0	2.0	2.0	2.6	0.4	1.2	9.9	0.4	0.2	4.4
Overflow Queue *(Q_3)*, veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Queue Storage Ratio *(RQ)* (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay *(d_1)*, s/veh	63.1	0.0	0.0	68.7	5.8	7.1	65.2	65.9	72.0	69.8	69.6	73.4
Incremental Delay *(d_2)*, s/veh	0.2	9.4	0.1	0.4	0.3	1.1	0.0	0.2	79.0	0.1	0.0	32.1
Initial Queue Delay *(d_3)*, s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay *(d)*, s/veh	63.3	9.4	0.1	69.1	6.1	8.2	65.2	66.1	151.0	69.9	69.6	105.6
Level of Service (LOS)	E	A	A	E	A	A	E	E	F	E	E	F
Approach Delay, s/veh / LOS	13.8	B		11.1	B		133.5	F		98.5	F	
Intersection Delay, s/veh / LOS	19.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	2.4	B	1.1	A	0.8	A	0.6	A

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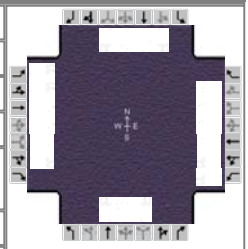
HCS 2010 Signalized Intersection Results Summary

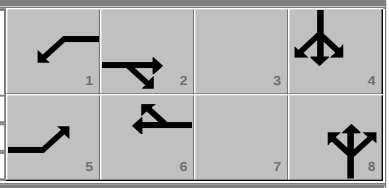
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{1_pm} Rte 3 @ Central Pa	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	1_2020B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	350	1820	110	540	2580	70	90	110	440	110	200	400

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	25.5	42.5	33.5	14.0	18.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	33.0	83.0	41.0	91.0		21.0		25.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time (g_s), s	18.6		27.1			18.0		22.0
Green Extension Time (g_e), s	0.4	0.0	4.6	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.02		0.78			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	365	1896	104	563	2078	682	94	115	418	115	208	379
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1675	1594	1757	1863	1828	1810	1900	1610	1792	1900	1610
Queue Service Time (g_s), s	16.6	62.1	9.6	25.1	26.1	30.4	8.4	9.9	16.0	10.2	8.7	20.0
Cycle Queue Clearance Time (g_c), s	16.6	62.1	9.6	25.1	26.1	30.4	8.4	9.9	16.0	10.2	8.7	20.0
Green Ratio (*g/C*)	0.16	0.46	0.46	0.21	0.51	0.51	0.09	0.09	0.09	0.12	0.12	0.12
Capacity (*c*), veh/h	558	2306	731	723	2827	898	170	179	152	211	447	189
Volume-to-Capacity Ratio (*X*)	0.653	0.822	0.142	0.777	0.735	0.760	0.550	0.641	2.756	0.544	0.466	2.002
Available Capacity (c_a), veh/h	558	2306	731	723	2827	898	170	179	152	211	447	189
Back of Queue (*Q*), veh/ln (50th percentile)	7.7	29.0	4.2	11.1	5.3	8.4	4.0	5.2	40.7	4.8	4.3	33.0
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	67.1	66.5	43.0	58.1	8.9	11.1	73.6	74.2	77.0	70.7	70.0	75.0
Incremental Delay (d_2), s/veh	2.2	3.5	0.4	2.5	0.9	3.0	2.2	5.9	808.6	1.6	0.3	469.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	69.3	69.9	43.4	60.5	9.8	14.1	75.8	80.1	885.6	72.3	70.3	544.0
Level of Service (LOS)	E	E	D	E	A	B	E	F	F	E	E	F
Approach Delay, s/veh / LOS	68.7	E		19.3	B		616.9	F		326.4	F	
Intersection Delay, s/veh / LOS	120.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	1.8	A	1.9	A	1.5	A	1.1	A

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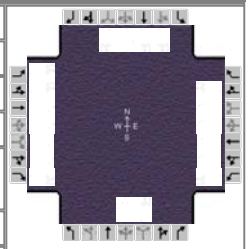
HCS 2010 Signalized Intersection Results Summary

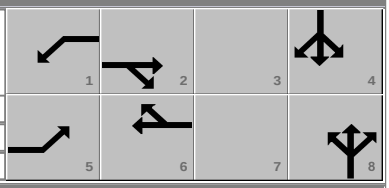
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{2_am} Rte 3 @ Carl D Silv	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	2_2020B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160	3260	10	20	1230	420	10	10	20	490	10	30

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	24.5	50.5	9.5	10.0	29.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		11.0		9.0
Phase Duration, s	32.0	90.0	17.0	75.0		17.0		36.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	9.0		3.8			3.9		23.6
Green Extension Time (g_e), s	0.2	0.0	2.4	0.0		0.0		0.6
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.50			0.00		0.14

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	3396	9	21	1281	438		21	19	510	10	25
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1708	1533	1774	1659	1579		1854	1464	1774	1900	1610
Queue Service Time (g_s), s	7.0	68.8	0.6	1.8	21.5	34.5		1.7	1.9	21.6	0.7	2.0
Cycle Queue Clearance Time (g_c), s	7.0	68.8	0.6	1.8	21.5	34.5		1.7	1.9	21.6	0.7	2.0
Green Ratio (*g/C*)	0.16	0.53	0.53	0.08	0.44	0.44		0.08	0.08	0.20	0.20	0.20
Capacity (*c*), veh/h	571	3630	815	133	2903	691		139	110	699	374	317
Volume-to-Capacity Ratio (*X*)	0.292	0.936	0.012	0.157	0.441	0.633		0.150	0.171	0.731	0.028	0.079
Available Capacity (c_a), veh/h	571	3630	815	133	2903	691		116	110	699	374	317
Back of Queue (*Q*), veh/ln (50th percentile)	3.2	24.4	0.2	0.8	8.9	14.2		0.8	0.7	10.1	0.3	0.8
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	62.9	22.0	24.4	69.3	32.1	35.0		70.6	69.3	60.3	51.9	52.4
Incremental Delay (d_2), s/veh	0.1	6.0	0.0	0.2	0.5	4.4		0.2	0.3	3.4	0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	63.0	27.9	24.4	69.5	32.6	39.4		70.8	69.6	63.7	51.9	52.5
Level of Service (LOS)	E	C	C	E	C	D		E	E	E	D	D
Approach Delay, s/veh / LOS	29.6	C		34.8	C		70.2	E		63.0	E	
Intersection Delay, s/veh / LOS	34.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	2.0	A	1.2	A	0.6	A	1.4	A

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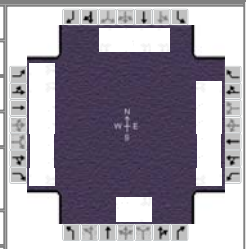
HCS 2010 Signalized Intersection Results Summary

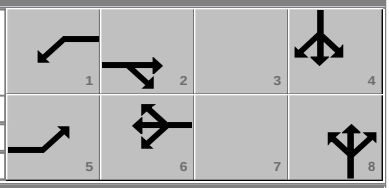
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{2_pm} Rte 3 @ Carl D Silv	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	2_2020B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	2060	10	40	3100	760	20	10	30	970	10	220

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.5	43.5	9.5	10.0	36.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	1.3	3.0		11.0		9.0
Phase Duration, s	42.0	93.0	17.0	68.0		17.0		43.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	15.8		2.0			4.9		40.5
Green Extension Time (g_e), s	0.5	0.0	6.4	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.87			0.04		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	313	2146	9	42	3229	792		31	28	1010	10	198
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1691	1610	1723	1708	1610		1768	1579	1810	1900	1610
Queue Service Time (g_s), s	13.8	15.7	0.1	0.0	63.0	63.0		2.9	2.9	38.5	0.7	18.4
Cycle Queue Clearance Time (g_c), s	13.8	15.7	0.1	0.0	63.0	63.0		2.9	2.9	38.5	0.7	18.4
Green Ratio (*g/C*)	0.21	0.52	0.52	0.31	0.37	0.37		0.07	0.07	0.23	0.23	0.23
Capacity (*c*), veh/h	744	3502	833	208	2532	597		125	111	820	430	365
Volume-to-Capacity Ratio (*X*)	0.420	0.613	0.011	0.200	1.275	1.327		0.250	0.252	1.233	0.024	0.543
Available Capacity (c_a), veh/h	744	3502	833	208	2532	597		104	111	820	430	365
Back of Queue (*Q*), veh/ln (50th percentile)	6.4	3.5	0.1	1.6	49.3	51.7		1.3	1.2	30.9	0.4	7.7
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	63.5	6.9	5.6	51.9	53.5	53.5		76.3	74.8	65.8	51.1	58.0
Incremental Delay (d_2), s/veh	0.1	0.8	0.0	0.2	127.1	158.4		0.4	0.4	115.3	0.0	0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	63.6	7.7	5.7	52.1	180.6	211.9		76.7	75.2	181.1	51.1	58.9
Level of Service (LOS)	E	A	A	D	F	F		E	E	F	D	E
Approach Delay, s/veh / LOS	14.8	B		185.4	F		76.0	E		160.1	F	
Intersection Delay, s/veh / LOS	126.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	1.5	A	2.2	B	0.6	A	2.5	B

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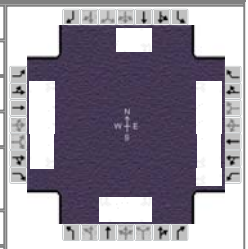
HCS 2010 Signalized Intersection Results Summary

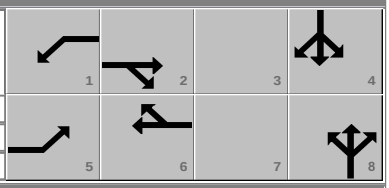
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{3_am} Rte 3 @ Gateway E	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	3_2020B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	1580	350	110	1760	10	260	10	120	10	5	20

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.2
Queue Clearance Time (g_s), s	4.4		5.5			18.6		3.7
Green Extension Time (g_e), s	0.0	0.0	2.4	0.0		0.1		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.71			1.00		0.34

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	1646	330	115	1833	9	271	10	114	10	26	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1661	
Queue Service Time (g_s), s	2.4	30.2	17.0	3.5	17.9	0.1	16.6	0.5	7.4	0.7	1.7	
Cycle Queue Clearance Time (g_c), s	2.4	30.2	17.0	3.5	17.9	0.1	16.6	0.5	7.4	0.7	1.7	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	109	
Volume-to-Capacity Ratio (*X*)	0.228	0.718	0.472	0.333	0.847	0.013	0.821	0.030	0.402	0.078	0.238	
Available Capacity (c_a), veh/h	183	2292	699	344	2165	727	330	350	282	134	109	
Back of Queue (*Q*), veh/ln (50th percentile)	1.1	12.1	6.5	1.5	2.5	0.0	8.6	0.2	2.8	0.3	0.7	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	47.2	26.3	21.5	45.9	4.3	3.0	44.7	38.1	41.0	48.7	49.7	
Incremental Delay (d_2), s/veh	0.2	2.0	2.3	0.2	4.3	0.0	14.2	0.0	0.3	0.1	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.4	28.3	23.8	46.1	8.6	3.1	58.9	38.2	41.3	48.7	50.1	
Level of Service (LOS)	D	C	C	D	A	A	E	D	D	D	D	
Approach Delay, s/veh / LOS	27.9	C		10.8	B		53.3	D		49.7	D	
Intersection Delay, s/veh / LOS	22.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	1.6	A	1.6	A	1.1	A	0.5	A

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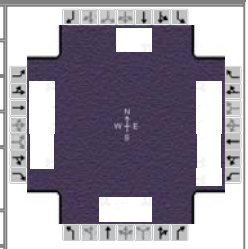
HCS 2010 Signalized Intersection Results Summary

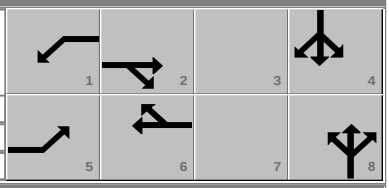
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{3_pm} Rte 3 @ Gateway E	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	3_2020B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1830	500	240	1650	0	330	5	230	10	5	5

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.0
Queue Clearance Time (g_s), s	3.8		10.0			23.0		2.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	31	1906	486	250	1719	0	344	5	228	10	10	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1743	
Queue Service Time (g_s), s	1.8	37.9	28.8	8.0	14.0	0.0	21.0	0.3	16.3	0.7	0.6	
Cycle Queue Clearance Time (g_c), s	1.8	37.9	28.8	8.0	14.0	0.0	21.0	0.3	16.3	0.7	0.6	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	115	
Volume-to-Capacity Ratio (*X*)	0.171	0.832	0.695	0.726	0.794	0.000	1.042	0.015	0.808	0.078	0.091	
Available Capacity (c_a), veh/h	183	2292	699	344	2165	727	330	350	282	134	115	
Back of Queue (*Q*), veh/ln (50th percentile)	0.8	15.5	11.3	3.6	2.2	0.0	14.8	0.1	7.3	0.3	0.3	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	46.9	28.6	24.7	47.8	4.0	0.0	46.5	38.0	44.6	48.7	49.0	
Incremental Delay (d_2), s/veh	0.2	3.7	5.6	6.5	3.1	0.0	60.8	0.0	14.8	0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.1	32.3	30.3	54.4	7.1	0.0	107.3	38.0	59.3	48.7	49.1	
Level of Service (LOS)	D	C	C	D	A		F	D	E	D	D	
Approach Delay, s/veh / LOS	32.1	C		13.1	B		87.7	F		48.9	D	
Intersection Delay, s/veh / LOS	31.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	1.8	A	1.6	A	1.4	A	0.5	A

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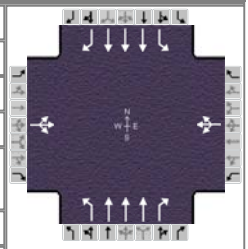
HCS 2010 Signalized Intersection Results Summary

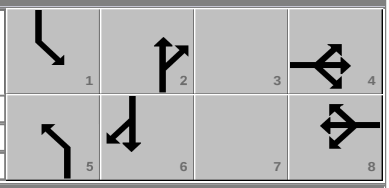
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{4_am} Rte 17 @ McLane I	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	4_2020B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



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	10	10	40	5	10	40	2570	60	30	2090	30

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	60.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	68.0	17.0	68.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		4.2		5.2	4.9		4.1	
Green Extension Time (g_e), s		0.2		0.2	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		42			57		42	2677	59	31	2177	29
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1528			1446		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			1.0		2.9	63.0	0.2	2.1	52.1	1.3
Cycle Queue Clearance Time (g_c), s		2.2			3.2		2.9	63.0	0.2	2.1	52.1	1.3
Green Ratio (*g/C*)		0.32			0.32		0.09	0.48	0.48	0.10	0.48	0.48
Capacity (*c*), veh/h		494			476		161	2412	750	174	2412	750
Volume-to-Capacity Ratio (*X*)		0.084			0.120		0.259	1.110	0.079	0.180	0.903	0.039
Available Capacity (c_a), veh/h		494			476		161	2412	750	174	2412	750
Back of Queue (*Q*), veh/ln (50th percentile)		1.0			1.3		1.3	21.4	0.1	1.0	21.6	0.5
Queue Storage Ratio (*RQ*) (50th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		32.8			33.2		54.9	12.5	1.0	53.6	31.8	17.6
Incremental Delay (d_2), s/veh		0.0			0.0		0.3	56.2	0.2	0.2	6.1	0.1
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		32.8			33.2		55.2	68.7	1.2	53.8	37.9	17.7
Level of Service (LOS)		C			C		E	F	A	D	D	B
Approach Delay, s/veh / LOS	32.8	C		33.2	C		67.0	E		37.8	D	
Intersection Delay, s/veh / LOS	53.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.6	A	0.6	A	2.0	B	1.7	A

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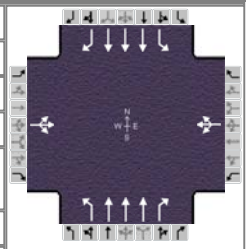
HCS 2010 Signalized Intersection Results Summary

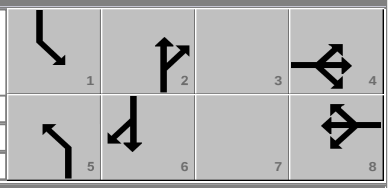
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{4_pm} Rte 17 @ McLane I	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	4_2020B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	5	10	40	5	20	30	2180	40	10	2730	20

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	90.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	98.0	17.0	98.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		3.9		7.5	4.7		2.9	
Green Extension Time (g_e), s		0.2		0.2	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		26			68		31	2271	39	10	2844	19
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1537			1461		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			3.7		2.7	9.5	0.0	0.9	89.3	0.8
Cycle Queue Clearance Time (g_c), s		1.9			5.5		2.7	9.5	0.0	0.9	89.3	0.8
Green Ratio (*g/C*)		0.26			0.26		0.08	0.58	0.58	0.08	0.58	0.58
Capacity (*c*), veh/h		401			388		130	2893	900	141	2893	900
Volume-to-Capacity Ratio (*X*)		0.065			0.175		0.239	0.785	0.043	0.074	0.983	0.021
Available Capacity (c_a), veh/h		401			388		130	2893	900	141	2893	900
Back of Queue (*Q*), veh/ln (50th percentile)		0.8			2.2		1.2	1.5	0.0	0.4	38.3	0.3
Queue Storage Ratio (*RQ*) (50th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		46.7			48.1		69.7	1.2	0.0	67.9	33.5	14.2
Incremental Delay (d_2), s/veh		0.0			0.1		0.3	2.2	0.1	0.1	13.2	0.0
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		46.7			48.1		70.1	3.5	0.1	68.0	46.7	14.2
Level of Service (LOS)		D			D		E	A	A	E	D	B
Approach Delay, s/veh / LOS	46.7	D		48.1	D		4.3	A		46.6	D	
Intersection Delay, s/veh / LOS	28.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.5	A	0.6	A	1.8	A	2.1	B

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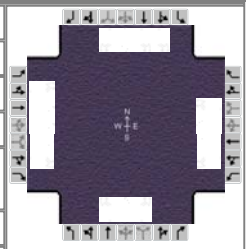
HCS 2010 Signalized Intersection Results Summary

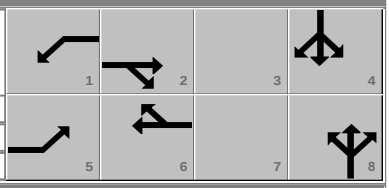
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{5_am} Rte 17 @ Sanford I	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	5_2020B_AM_Optimized MajorChange.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	2110	20	210	660	210	60	10	170	160	70	20

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	15.0	55.5	5.0	11.0	7.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		9.0
Phase Duration, s	12.5	75.5	22.5	85.5		18.0		14.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		2.9
Queue Clearance Time (g_s), s	2.8		18.2			14.7		8.3
Green Extension Time (g_e), s	1.5	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	10	2198	19	219	688	203	63	10	152	167	73	19
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1659	1548	1740	1739	1548	1740	1827	1548	1689	1827	1548
Queue Service Time (g_s), s	0.8	49.0	0.8	16.2	12.8	7.6	4.4	0.7	12.7	6.3	5.0	1.5
Cycle Queue Clearance Time (g_c), s	0.8	49.0	0.8	16.2	12.8	7.6	4.4	0.7	12.7	6.3	5.0	1.5
Green Ratio (*g/C*)	0.04	0.52	0.52	0.13	0.60	0.60	0.10	0.10	0.10	0.07	0.07	0.07
Capacity (*c*), veh/h	67	2603	810	228	2087	953	147	183	155	234	134	83
Volume-to-Capacity Ratio (*X*)	0.156	0.844	0.023	0.961	0.329	0.213	0.425	0.057	0.982	0.712	0.546	0.225
Available Capacity (c_a), veh/h	67	2603	810	228	2087	953	147	183	155	234	134	83
Back of Queue (*Q*), veh/ln (50th percentile)	0.4	19.7	0.3	10.3	5.1	2.7	2.3	0.3	7.9	3.2	2.9	0.7
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	60.5	26.5	15.0	56.2	13.0	11.1	56.5	53.9	58.4	59.2	58.4	58.9
Incremental Delay (d_2), s/veh	4.9	3.6	0.1	50.5	0.4	0.5	8.7	0.6	67.8	16.9	15.1	6.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	65.4	30.0	15.0	106.6	13.4	11.6	65.2	54.4	126.2	76.1	73.5	65.1
Level of Service (LOS)	E	C	B	F	B	B	E	D	F	E	E	E
Approach Delay, s/veh / LOS	30.1	C		31.4	C		105.9	F		74.6	E	
Intersection Delay, s/veh / LOS	38.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.6	B	3.3	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	1.4	A	0.9	A	0.9	A

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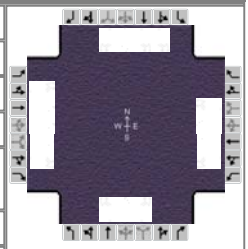
HCS 2010 Signalized Intersection Results Summary

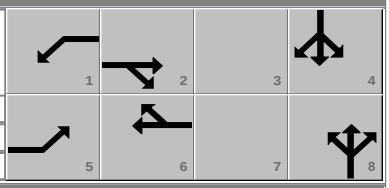
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{5_pm} Rte 17 @ Sanford I	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	5_2020B_PM_Optimized MajorChange.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	2620	50	240	660	200	40	10	680	370	20	10

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.5	63.5	6.5	35.0	10.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		9.0
Phase Duration, s	14.0	85.0	16.0	87.0		42.0		17.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		2.8
Queue Clearance Time (g_s), s	2.9		12.5			39.0		14.0
Green Extension Time (g_e), s	2.7	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.93		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	10	2729	48	250	688	200	42	10	622	385	21	9
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1659	1548	1740	1739	1548	1740	1827	1548	1689	1827	1548
Queue Service Time (g_s), s	0.9	77.5	2.6	10.5	19.8	11.6	3.1	0.7	37.0	12.0	1.7	0.9
Cycle Queue Clearance Time (g_c), s	0.9	77.5	2.6	10.5	19.8	11.6	3.1	0.7	37.0	12.0	1.7	0.9
Green Ratio (*g/C*)	0.04	0.48	0.48	0.07	0.50	0.50	0.23	0.23	0.23	0.08	0.08	0.08
Capacity (*c*), veh/h	71	2411	750	114	1728	789	381	422	358	253	143	97
Volume-to-Capacity Ratio (*X*)	0.147	1.132	0.064	2.189	0.398	0.254	0.109	0.025	1.737	1.521	0.146	0.097
Available Capacity (c_a), veh/h	71	2411	750	114	1728	789	381	422	358	253	143	97
Back of Queue (*Q*), veh/ln (50th percentile)	0.5	45.8	1.0	22.6	8.5	4.5	1.4	0.3	48.7	14.2	0.9	0.4
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	74.1	41.3	21.9	74.8	25.2	22.1	50.0	48.3	61.5	74.0	69.0	70.7
Incremental Delay (d_2), s/veh	4.4	65.3	0.2	562.9	0.7	0.8	0.6	0.1	343.1	253.6	2.1	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	78.4	106.6	22.1	637.6	25.9	22.9	50.6	48.4	404.6	327.6	71.1	72.7
Level of Service (LOS)	E	F	C	F	C	C	D	D	F	F	E	E
Approach Delay, s/veh / LOS	105.0	F		159.8	F		377.2	F		309.0	F	
Intersection Delay, s/veh / LOS	170.9						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	2.6	B	3.3	C	3.1	C
Bicycle LOS Score / LOS	2.0	B	1.4	A	1.6	A	1.2	A

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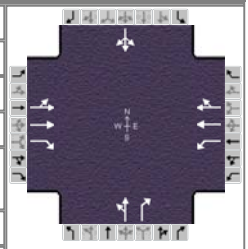
HCS 2010 Signalized Intersection Results Summary

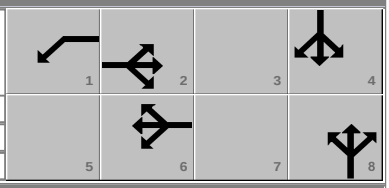
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{6_am} Rte 17 @ Short St	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	6_2020B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	1060	60	20	1020	5	100	0	10	5	0	10

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	32.5	19.0	10.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		40.0	17.0	57.0		26.0		17.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.6			6.9		2.8
Green Extension Time (g_e), s		0.0	0.0	0.0		0.1		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	580	535	57	21	534	533		104	9		16	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1815	1679	1579	1810	1863	1859		1810	1563		1672	
Queue Service Time (g_s), s	11.0	30.4	2.4	0.6	19.3	19.3		4.9	0.5		0.8	
Cycle Queue Clearance Time (g_c), s	31.6	30.4	2.4	0.6	19.3	19.3		4.9	0.5		0.8	
Green Ratio (*g/C*)	0.35	0.35	0.35	0.48	0.52	0.52		0.21	0.21		0.12	
Capacity (*c*), veh/h	627	588	553	299	969	920		380	328		201	
Volume-to-Capacity Ratio (*X*)	0.925	0.911	0.104	0.070	0.552	0.579		0.274	0.029		0.078	
Available Capacity (c_a), veh/h	627	588	553	299	969	920		344	328		167	
Back of Queue (*Q*), veh/ln (50th percentile)	16.9	15.3	1.0	0.2	8.4	8.5		2.2	0.2		0.3	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	32.1	31.0	21.9	19.4	16.8	16.2		34.8	31.4		40.9	
Incremental Delay (d_2), s/veh	21.6	20.6	0.4	0.0	2.3	2.7		0.1	0.0		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	53.7	51.6	22.3	19.4	19.1	18.8		35.0	31.4		40.9	
Level of Service (LOS)	D	D	C	B	B	B		C	C		D	
Approach Delay, s/veh / LOS	51.2	D		19.0	B		34.7	C		40.9	D	
Intersection Delay, s/veh / LOS	35.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.5	A	1.4	A	0.7	A	0.5	A

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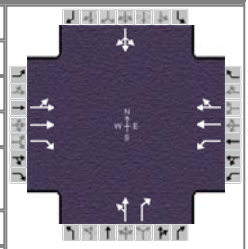
HCS 2010 Signalized Intersection Results Summary

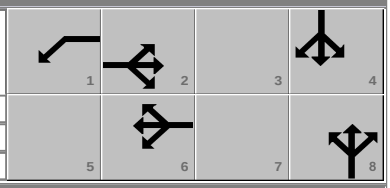
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{6_pm} Rte 17 @ Short St	Analysis Year	2020 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	6_2020B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	1810	90	10	940	5	80	5	30	5	5	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.0	43.5	16.0	11.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		51.0	18.0	69.0		23.0		18.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.3			6.8		3.2
Green Extension Time (g_e), s		0.0	0.0	0.0		0.1		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	993	903	85	10	493	492		89	28		21	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1847	1695	1548	1757	1863	1859		1815	1610		1723	
Queue Service Time (g_s), s	16.0	46.0	3.7	0.3	16.5	16.5		4.8	1.6		1.2	
Cycle Queue Clearance Time (g_c), s	43.5	46.0	3.7	0.3	16.5	16.5		4.8	1.6		1.2	
Green Ratio (*g/C*)	0.42	0.42	0.42	0.54	0.58	0.58		0.16	0.16		0.12	
Capacity (*c*), veh/h	763	709	647	265	1084	1039		297	263		204	
Volume-to-Capacity Ratio (*X*)	1.301	1.274	0.132	0.039	0.455	0.473		0.298	0.107		0.102	
Available Capacity (c_a), veh/h	763	709	647	265	1084	1039		264	263		172	
Back of Queue (*Q*), veh/ln (50th percentile)	50.6	44.5	1.4	0.1	7.0	7.1		2.2	0.7		0.5	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	32.8	32.0	19.7	21.7	13.7	13.1		42.2	39.2		44.9	
Incremental Delay (d_2), s/veh	144.8	134.1	0.4	0.0	1.4	1.5		0.2	0.1		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	177.6	166.1	20.1	21.7	15.0	14.6		42.4	39.2		44.9	
Level of Service (LOS)	F	F	C	C	B	B		D	D		D	
Approach Delay, s/veh / LOS	165.6	F		14.9	B		41.6	D		44.9	D	
Intersection Delay, s/veh / LOS	112.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.1	B	1.3	A	0.7	A	0.5	A

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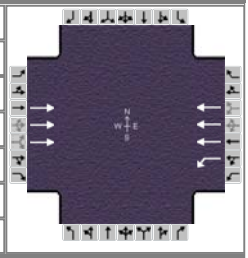
HCS 2010 Signalized Intersection Results Summary

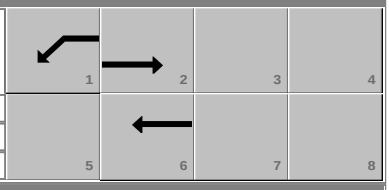
General Information				Intersection Information	
Agency	Michael Baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Intersection	7-AM-Ramp F	Analysis Year	2020 Build	Analysis Period	1> 7:00
File Name	7_2020B_AM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1370		120	2550							

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.3	103.7	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				
Case Number		8.3	2.0	4.0				
Phase Duration, s		111.2	18.8	130.0				
Change Period, ($Y+R_c$), s		7.5	7.5	7.5				
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				
Queue Clearance Time (g_s), s			11.2					
Green Extension Time (g_e), s		0.0	0.2	0.0				
Phase Call Probability			0.99					
Max Out Probability			0.00					

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2		1	6							
Adjusted Flow Rate (*v*), veh/h		1489		130	2772							
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1725		1810	1725							
Queue Service Time (g_s), s		10.6		9.2	8.6							
Cycle Queue Clearance Time (g_c), s		10.6		9.2	8.6							
Green Ratio (*g/C*)		0.80		0.09	0.94							
Capacity (*c*), veh/h		4129		157	4877							
Volume-to-Capacity Ratio (*X*)		0.361		0.831	0.568							
Available Capacity (c_a), veh/h		4129		327	4877							
Back of Queue (*Q*), veh/ln (50th percentile)		3.0		4.4	0.2							
Queue Storage Ratio (*RQ*) (50th percentile)		0.00		0.00	0.00							
Uniform Delay (d_1), s/veh		3.7		58.4	0.5							
Incremental Delay (d_2), s/veh		0.2		4.3	0.5							
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0							
Control Delay (*d*), s/veh		4.0		62.7	1.0							
Level of Service (LOS)		A		E	A							
Approach Delay, s/veh / LOS	4.0	A		3.7	A		0.0			0.0		
Intersection Delay, s/veh / LOS	3.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.8	A	0.5	A	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.3	A	2.1	B				

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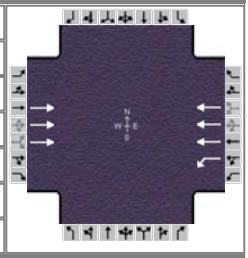
HCS 2010 Signalized Intersection Results Summary

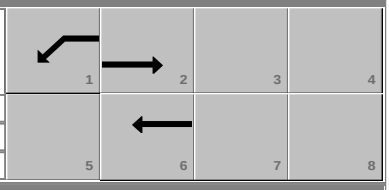
General Information				Intersection Information	
Agency	Michael Baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.92
Intersection	7-PM-Ramp F	Analysis Year	2020 Build	Analysis Period	1> 7:00
File Name	7_2020B_PM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1630		150	2040							

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	16.5	128.5	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				
Case Number		8.3	2.0	4.0				
Phase Duration, s		136.0	24.0	160.0				
Change Period, ($Y+R_c$), s		7.5	7.5	7.5				
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				
Queue Clearance Time (g_s), s			16.2					
Green Extension Time (g_e), s		0.0	0.3	0.0				
Phase Call Probability			1.00					
Max Out Probability			0.00					

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2		1	6							
Adjusted Flow Rate (*v*), veh/h		1772		163	2217							
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1725		1810	1725							
Queue Service Time (g_s), s		16.4		14.2	5.6							
Cycle Queue Clearance Time (g_c), s		16.4		14.2	5.6							
Green Ratio (*g/C*)		0.80		0.10	0.95							
Capacity (*c*), veh/h		4157		186	4933							
Volume-to-Capacity Ratio (*X*)		0.426		0.875	0.450							
Available Capacity (c_a), veh/h		4157		492	4933							
Back of Queue (*Q*), veh/ln (50th percentile)		5.2		6.8	0.1							
Queue Storage Ratio (*RQ*) (50th percentile)		0.00		0.00	0.00							
Uniform Delay (d_1), s/veh		4.7		70.7	0.3							
Incremental Delay (d_2), s/veh		0.3		5.0	0.3							
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0							
Control Delay (*d*), s/veh		5.0		75.7	0.6							
Level of Service (LOS)		A		E	A							
Approach Delay, s/veh / LOS	5.0	A		5.7	A		0.0			0.0		
Intersection Delay, s/veh / LOS	5.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.8	A	0.5	A	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.5	A	1.8	A				

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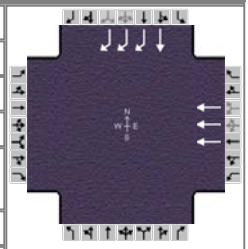
HCS 2010 Signalized Intersection Results Summary

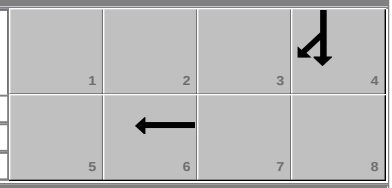
General Information				Intersection Information	
Agency	Michael Baker Jr			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Intersection	SB ramp and WB Rt 3 Alt 1	Analysis Year	2020 Build_not Opt	Analysis Period	1> 7:00
File Name	8_2020B_AM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					1050						0	620

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	28.7	0.0	0.0	0.0	0.0
Yellow	0.0	4.0	0.0	0.0	0.0	0.0
Red	0.0	1.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				126.3				33.7
Change Period, ($Y+R_c$), s				5.0				5.0
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								26.6
Green Extension Time (g_e), s				0.0				2.2
Phase Call Probability								1.00
Max Out Probability								0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					6						4	14
Adjusted Flow Rate (*v*), veh/h					1141						0	674
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1725						1900	1425
Queue Service Time (g_s), s					11.0						0.0	24.6
Cycle Queue Clearance Time (g_c), s					11.0						0.0	24.6
Green Ratio (*g/C*)					0.76						0.18	0.18
Capacity (*c*), veh/h					3923						341	767
Volume-to-Capacity Ratio (*X*)					0.291						0.000	0.878
Available Capacity (c_a), veh/h					3923						1663	3741
Back of Queue (*Q*), veh/ln (50th percentile)					3.8						0.0	9.0
Queue Storage Ratio (*RQ*) (50th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					6.0						0.0	63.9
Incremental Delay (d_2), s/veh					0.2						0.0	1.3
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					6.2						0.0	65.3
Level of Service (LOS)					A							E
Approach Delay, s/veh / LOS	0.0			6.2		A	0.0			65.3		E
Intersection Delay, s/veh / LOS	28.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.0	A	2.9	C
Bicycle LOS Score / LOS			1.1	A			1.6	A

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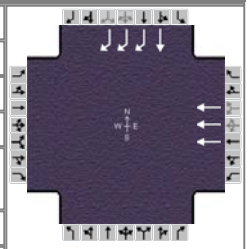
HCS 2010 Signalized Intersection Results Summary

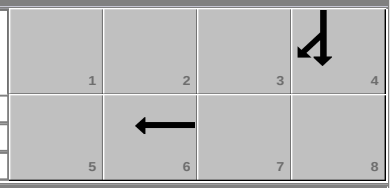
General Information				Intersection Information	
Agency	Michael Baker Jr			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.92
Intersection	SB Ramp and WB Rt 3 Alt	Analysis Year	2020 Build_not opt	Analysis Period	1> 7:00
File Name	8_2020B_PM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					2330						0	1570

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	71.0	0.0	0.0	0.0	0.0
Yellow	0.0	4.5	0.0	0.0	0.0	0.0
Red	0.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				91.5				78.5
Change Period, ($Y+R_c$), s				7.5				7.5
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								73.0
Green Extension Time (g_e), s				0.0				0.0
Phase Call Probability								1.00
Max Out Probability								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					6						4	14
Adjusted Flow Rate (*v*), veh/h					2533						0	1707
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1691						1900	1357
Queue Service Time (g_s), s					84.0						0.0	71.0
Cycle Queue Clearance Time (g_c), s					84.0						0.0	71.0
Green Ratio (*g/C*)					0.49						0.42	0.42
Capacity (*c*), veh/h					2507						794	1700
Volume-to-Capacity Ratio (*X*)					1.010						0.000	1.004
Available Capacity (c_a), veh/h					2507						794	1700
Back of Queue (*Q*), veh/ln (50th percentile)					39.1						0.0	27.3
Queue Storage Ratio (*RQ*) (50th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					43.0						0.0	49.5
Incremental Delay (d_2), s/veh					20.5						0.0	22.7
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					63.5						0.0	72.2
Level of Service (LOS)					F							F
Approach Delay, s/veh / LOS	0.0			63.5		E	0.0			72.2		E
Intersection Delay, s/veh / LOS	67.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.0	A	2.9	C
Bicycle LOS Score / LOS			1.9	A			3.3	C

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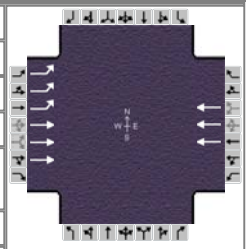
HCS 2010 Signalized Intersection Results Summary

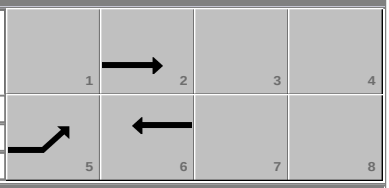
General Information				Intersection Information	
Agency	Michael Baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Intersection	9-AM	Analysis Year	2020 Build not Opt	Analysis Period	1> 7:00
File Name	9_2020B_AM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	2320	1680			890							

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	87.0	58.0	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		8.3				
Phase Duration, s	94.5	160.0		65.5				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	75.7							
Green Extension Time (g_e), s	11.2	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	0.12							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6							
Adjusted Flow Rate (*v*), veh/h	2522	1826			967							
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1643							
Queue Service Time (g_s), s	73.7	4.4			24.9							
Cycle Queue Clearance Time (g_c), s	73.7	4.4			24.9							
Green Ratio (*g/C*)	0.54	0.95			0.36							
Capacity (*c*), veh/h	2729	4698			1788							
Volume-to-Capacity Ratio (*X*)	0.924	0.389			0.541							
Available Capacity (c_a), veh/h	3279	4698			1788							
Back of Queue (*Q*), veh/ln (50th percentile)	30.1	0.1			10.3							
Queue Storage Ratio (*RQ*) (50th percentile)	1.95	0.00			0.00							
Uniform Delay (d_1), s/veh	33.5	0.3			40.4							
Incremental Delay (d_2), s/veh	4.1	0.2			1.2							
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0							
Control Delay (*d*), s/veh	37.6	0.5			41.6							
Level of Service (LOS)	D	A			D							
Approach Delay, s/veh / LOS	22.0	C		41.6	D		0.0			0.0		
Intersection Delay, s/veh / LOS	25.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.8	C	3.2	C	3.5	D
Bicycle LOS Score / LOS	2.9	C	1.0	A				

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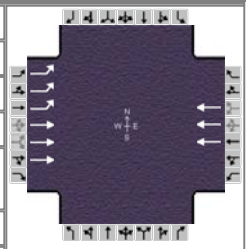
HCS 2010 Signalized Intersection Results Summary

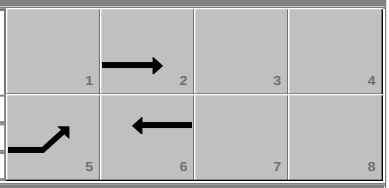
General Information				Intersection Information	
Agency	Michael baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.92
Intersection	9-PM	Analysis Year	2020 Build not Opt	Analysis Period	1> 7:00
File Name	9_2020B_PM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1080	2100			1315							

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	44.0	111.0	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		8.3				
Phase Duration, s	51.5	170.0		118.5				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	40.5							
Green Extension Time (g_e), s	3.5	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6							
Adjusted Flow Rate (*v*), veh/h	1174	2283			1429							
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1643							
Queue Service Time (g_s), s	38.5	6.5			24.1							
Cycle Queue Clearance Time (g_c), s	38.5	6.5			24.1							
Green Ratio (*g/C*)	0.26	0.96			0.65							
Capacity (*c*), veh/h	1299	4712			3219							
Volume-to-Capacity Ratio (*X*)	0.904	0.484			0.444							
Available Capacity (c_a), veh/h	4385	4712			3219							
Back of Queue (*Q*), veh/ln (50th percentile)	16.4	0.2			9.0							
Queue Storage Ratio (*RQ*) (50th percentile)	1.07	0.00			0.00							
Uniform Delay (d_1), s/veh	61.0	0.3			14.4							
Incremental Delay (d_2), s/veh	1.0	0.4			0.4							
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0							
Control Delay (*d*), s/veh	62.0	0.7			14.9							
Level of Service (LOS)	E	A			B							
Approach Delay, s/veh / LOS	21.5	C		14.9	B		0.0			0.0		
Intersection Delay, s/veh / LOS	19.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.8	C	3.2	C	3.5	D
Bicycle LOS Score / LOS	2.4	B	1.3	A				

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April 2016 IMR Build Alternative

2040 HCS Intersection Analysis

2040 Build HCS Intersection Analysis Summary (Sheet 1 of 2)

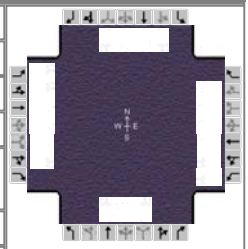
				AM Peak Hour																PM Peak Hour															
				2013		2020 No Build		2040 No Build						2040 Build						2013		2020 No Build		2040 No Build						2040 Build					
				Intersection		Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection		Intersection		Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection	
	Intersection	Approach	Movement	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
1	Route 3 / Mall Dr. / Central Park Blvd.	NB	Left	15.1	B	19.4	B	65.2	E	229.4	F	78.1	E	65.2	E	229.4	F	78.7	E	103.8	F	120.0	F	82.7	F	852.0	F	169.1	F	82.7	F	852.0	F	170.8	F
			Through					66.5	E					66.5	E									98.6	F					98.6	F				
			Right					269.4	F					269.4	F									1224.0	F					1224.0	F				
		SB	Left					69.0	E	116.3	F			70.9	E	167.1	F							79.9	E	479.9	F			79.9	E	479.9	F		
			Through					68.9	E					70.8	E									72.3	E					72.3	E				
			Right					130.2	F					195.4	F									813.0	F					813.0	F				
		EB	Left					65.8	E	96.9	F			65.8	E	95.8	F							78.1	E	90.0	F			78.1	E	96.9	F		
			Through					101.7	F					100.4	F									95.0	F					103.4	F				
			Right					0.1	A					0.1	A									44.9	D					44.9	D				
		WB	Left					67.6	E	12.1	B			70.7	E	11.2	B							79.8	E	29.5	C			79.8	E	29.5	C		
			Through					7.1	A					5.9	A									15.8	B					15.8	B				
			Right					9.8	A					8.6	A									30.1	C					30.1	C				
2	Route 3 / Carl D. Silver Pkwy	NB	Left	29.7	C	32.8	C	71.5	E	70.9	E	72.9	E	77.0	E	76.7	E	73.0	E	97.8	F	127.8	F	77.5	E	76.7	E	224.9	F	77.5	E	76.7	E	225.5	F
			Through					71.5	E					77.0	E									77.5	E					77.5	E				
			Right					70.3	E					76.3	E									75.9	E					75.9	E				
		SB	Left					63.1	E	61.7	E			70.7	F	69.4	E							291.4	F	254.7	F			330.8	F	283.3	F		
			Through					51.9	D					50.4	D									51.4	D					51.4	D				
			Right					54.3	D					51.0	D									157.6	F					66.3	E				
		EB	Left					63.8	E	89.5	F			61.8	E	98.7	F							65.6	E	16.5	B			65.6	E	16.6	B		
			Through					91.1	F					91.4	F									9.2	A					9.5	A				
			Right					24.7	C					23.5	C									5.7	A					5.7	A				
		WB	Left					70.0	E	43.9	D			68.6	E	40.0	D							76.6	E	337.0	F			63.6	E	336.5	F		
			Through					33.6	C					35.0	D									239.4	F					331.1	F				
			Right					67.3	E					52.2	D									630.1	F					372.7	F				
8	New Signal Route 3 / Ramp from SB I-95	NB	Left															29.8	C															206.9	F
			Through																																
			Right																																
		SB	Left													60.3	E															214.6	F		
			Through																																
			Right											60.3	E															214.6	F				
		EB	Left																																
			Through																																
			Right																																
		WB	Left																																
			Through											10.2	B	10.2	B													194.7	F	194.7	F		
			Right																																
9	New Signal Route 3 / Ramp to NB I-95 (triple lefts)	NB	Left															33.5	C															21.1	C
			Through																																
			Right																																
		SB	Left																																
			Through																																
			Right																																
		EB	Left											41.1	D	24.6	C													55.5	E	19.9	B		
			Through											0.7	A															1.0	A				
			Right																																
		WB	Left																																
			Through											74.6	E	74.6	E													24.0	C	24.0	C		
			Right																																
3	Route 3 / Gateway Blvd.	NB	Left	20.6	C	21.8	C	86.7	F	74.9	E	26.9	C	89.7	F	74.9	E	38.6	D	27.5	C	30.2	C	186.7	F	150.0	F	43.8	D	186.7	F	150.0	F	54.3	D
			Through					38.2	D					38.2	D									38.0	D					38.0	D				
			Right					42.0	D					42.0	D									97.6	F					97.6	F				
		SB	Left					48.7	D	50.3	D			48.7	D	50.3	D							48.7	D	48.9	D			48.7	D	48.9	D		
			Through					50.7	D					50.7	D									49.1	D					49.1	D				
			Right					50.7	D					50.7	D									49.1	D					49.1	D				
		EB	Left					47.4	D	29.8	C			47.4	D	33.6	C							47.4	D	36.9	D			47.4	D	54.6	D		
			Through					30.1	C					34.8	C									36.0	D					58.5	F				
			Right					26.7	C					26.7	C									39.3	D					39.3	D				
		WB	Left					46.6	D	12.1	B			46.6	D	36.5	D							69.7	E	18.1	B			69.7	E	26.3	C		
			Through					9.4	A					36.0	F									9.1	A					20.1	C				
			Right					3.1	A					3.1	A									0.0	A					0.0	A				

2040 Build HCS Intersection Analysis Summary (Sheet 2 of 2)

				AM Peak Hour																PM Peak Hour															
				2013		2020 No Build		2040 No Build						2040 Build						2013		2020 No Build		2040 No Build						2040 Build					
				Intersection		Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection		Intersection		Intersection		Movement		Approach		Intersection		Movement		Approach		Intersection	
	Intersection	Approach	Movement	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
4	Route 17 / McLane Dr.	NB	Left	25.8	C	53.7	D	54.8	D	271.8	F	218.0	F	56.1	E	268.0	F	216.3	F	19.1	B	27.9	C	69.5	E	61.3	E	144.1	F	71.3	E	60.8	E	143.3	F
			Through					277.8	F					277.8	F									61.8	F					61.8	F				
			Right					1.2	A					1.4	A									0.1	A					0.1	A				
		SB	Left					54.2	D	158.9	F			54.2	D	158.9	F							68.5	E	213.8	F			68.5	E	213.8	F		
			Through					162.2	F					162.2	F									216.0	F					216.0	F				
			Right					17.9	B					17.9	B									14.4	B					14.4	B				
		EB	Left					33.1	C	33.1	C			33.1	C	33.1	C							47.1	D	47.1	D			47.1	D	47.1	D		
			Through					33.1	C					33.1	C									47.1	D					47.1	D				
			Right					33.1	C					33.1	C									47.1	D					47.1	D				
		WB	Left					33.7	C	33.7	C			33.7	C	33.7	C							49.3	D	49.3	D			49.3	D	49.3	D		
			Through					33.7	C					33.7	C									49.3	D					49.3	D				
			Right					33.7	C					33.7	C									49.3	D					49.3	D				
5	Route 17 /Sanford Dr.	NB	Left	36.4	D	53.2	D	76.8	E	204.1	F	241.8	F	97.5	F	285.2	F	91.3	F	291.7	F	382.6	F	82.6	F	2690.1	F	486.7	F	92.6	F	741.8	F	272.5	F
			Through					54.4	D					56.5	E									69.7	E					72.0	E				
			Right					267.0	F					378.4	F									2870.7	F					787.0	F				
		SB	Left					74.1	E	72.1	E			237.4	F	200.1	F							121.2	F	116.8	F			444.8	F	418.2	F		
			Through					70.4	E					145.8	F									59.4	E					70.0	E				
			Right					61.3	E					87.3	F									60.3	E					70.2	E				
		EB	Left					44.6	D	96.1	F			72.5	E	50.3	D							64.4	E	318.8	F			83.2	F	218.8	F		
			Through					97.2	F					50.5	F									324.8	F					222.8	F				
			Right					14.0	B					10.7	B									23.6	C					17.6	B				
		WB	Left					574.8	F	361.5	F			524.4	F	107.9	F							288.6	F	152.1	F			227.9	F	61.9	E		
			Through					373.2	F					11.2	B									147.6	F					13.4	B				
			Right					27.6	C					10.9	B									24.7	C					11.3	B				
7	New Signal Route 17 / Ramp F to SB I-95	NB	Left															8.8	A															6.8	A
			Through																																
			Right																																
		SB	Left																																
			Through																																
			Right																																
		EB	Left																																
			Through											5.7	A	5.7	A													8.4	A	8.4	A		
			Right																																
		WB	Left											61.5	E	10.1	B													73.3	E	5.9	A		
			Through											8.3	A															2.2	A				
			Right																																
6	Route 17 /Short St.	NB	Left	34.9	C	46.8	D	35.7	D	35.2	D	128.4	F	35.7	D	35.2	D	80.2	F	105.6	F	150.7	F	43.3	D	42.4	D	276.0	F	43.3	D	42.4	D	219.5	F
			Through					35.7	D					35.7	D									43.3	D					43.3	D				
			Right					31.6	C					31.6	C									39.5	D					39.5	D				
		SB	Left					41.3	D	41.3	D			41.3	D	41.3	D							44.9	D	44.9	D			44.9	D	44.9	D		
			Through					41.3	D					41.3	D									44.9	D					44.9	D				
			Right					41.3	D					41.3	D									44.9	D					44.9	D				
		EB	Left					246.2	F	231.6	F			147.8	F	137.5	F							451.7	F	425.2	F			354.4	F	331.9	F		
			Through					234.3	F					137.5	F									431.6	F					337.9	F				
			Right					22.5	C					22.5	C									20.7	C					20.7	C				
		WB	Left					20.5	C	36.7	D			20.5	C	24.3	C							21.8	C	20.7	C			21.8	C	17.4	B		
			Through					34.6	C					24.2	C									20.7	C					17.5	B				
			Right					39.1	D					24.6	C									20.7	C					17.2	B				

HCS 2010 Signalized Intersection Results Summary

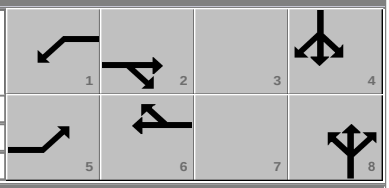
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{1_am} Rte 3 @ Central Pa	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	1_2040B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	360	3740	70	130	1630	40	10	40	220	10	20	110

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	27.5	63.5	10.5	14.0	8.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	35.0	106.0	18.0	89.0		21.0		15.0
Change Period, *(Y+Rc)*, s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway *(MAH)*, s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time *(g_s)*, s	18.3		8.2			18.0		12.0
Green Extension Time *(g_e)*, s	0.5	0.0	1.3	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate *(v)*, veh/h	375	3896	68	135	1310	429	10	42	213	10	21	106
Adjusted Saturation Flow Rate *(s)*, veh/h/ln	1740	1691	1594	1658	1810	1778	1810	1845	1563	1757	1696	1548
Queue Service Time *(g_s)*, s	16.3	0.0	0.0	6.2	8.1	10.1	0.8	3.3	16.0	0.9	0.9	10.0
Cycle Queue Clearance Time *(g_c)*, s	16.3	0.0	0.0	6.2	8.1	10.1	0.8	3.3	16.0	0.9	0.9	10.0
Capacity *(c)*, veh/h	631	3203	1006	249	2850	906	181	184	156	110	212	97
Volume-to-Capacity Ratio *(X)*	0.595	1.216	0.067	0.545	0.460	0.474	0.058	0.226	1.359	0.095	0.098	1.098
Available Capacity *(c_a)*, veh/h	631	3203	1006	249	2850	906	181	184	156	110	212	97
Back of Queue *(Q)*, veh/ln (50th percentile)	7.6	29.8	0.0	2.7	2.4	3.3	0.4	1.6	15.0	0.4	0.4	7.2
Overflow Queue *(Q_3)*, veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Queue Storage Ratio *(RQ)* (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay *(d_1)*, s/veh	64.8	0.0	0.0	69.4	5.4	6.9	65.2	66.3	72.0	70.7	70.7	75.0
Incremental Delay *(d_2)*, s/veh	1.1	100.4	0.1	1.3	0.5	1.7	0.0	0.2	197.4	0.1	0.1	120.4
Initial Queue Delay *(d_3)*, s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay *(d)*, s/veh	65.8	100.4	0.1	70.7	5.9	8.6	65.2	66.5	269.4	70.9	70.8	195.4
Level of Service (LOS)	E	F	A	E	A	A	E	E	F	E	E	F
Approach Delay, s/veh / LOS	95.8	F		11.2	B		229.4	F		167.1	F	
Intersection Delay, s/veh / LOS	78.7						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	2.9	C	1.3	A	0.9	A	0.6	A

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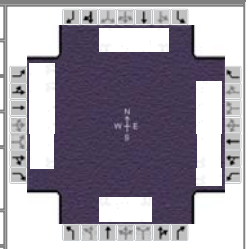
HCS 2010 Signalized Intersection Results Summary

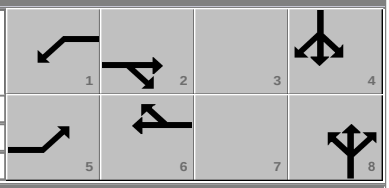
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{1_pm} Rte 3 @ Central Pa	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	1_2040B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	2310	140	680	3280	90	110	140	550	140	250	510

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	25.5	42.5	33.5	14.0	18.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	33.0	83.0	41.0	91.0		21.0		25.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time (g_s), s	23.4		36.0			18.0		22.0
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	458	2406	135	708	2637	873	115	146	532	146	260	494
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1675	1594	1757	1863	1827	1810	1900	1610	1792	1900	1610
Queue Service Time (g_s), s	21.4	78.0	12.6	34.0	59.0	66.1	10.4	12.8	16.0	13.3	11.0	20.0
Cycle Queue Clearance Time (g_c), s	21.4	78.0	12.6	34.0	59.0	66.1	10.4	12.8	16.0	13.3	11.0	20.0
Green Ratio (*g/C*)	0.16	0.46	0.46	0.21	0.51	0.51	0.09	0.09	0.09	0.12	0.12	0.12
Capacity (*c*), veh/h	558	2306	731	723	2827	898	170	179	152	211	447	189
Volume-to-Capacity Ratio (*X*)	0.821	1.044	0.185	0.979	0.933	0.973	0.673	0.816	3.512	0.692	0.583	2.606
Available Capacity (c_a), veh/h	558	2306	731	723	2827	898	170	179	152	211	447	189
Back of Queue (*Q*), veh/ln (50th percentile)	10.4	42.1	5.6	16.6	11.7	20.6	5.3	7.4	55.0	6.6	5.5	47.2
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	69.2	72.0	44.3	61.3	12.0	14.6	74.5	75.6	77.0	72.0	71.0	75.0
Incremental Delay (d_2), s/veh	8.9	31.4	0.6	18.5	3.8	15.5	8.2	23.0	1147.0	7.9	1.3	738.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	78.1	103.4	44.9	79.8	15.8	30.1	82.7	98.6	1224.0	79.9	72.3	813.0
Level of Service (LOS)	E	F	D	E	B	C	F	F	F	E	E	F
Approach Delay, s/veh / LOS	96.9	F		29.5	C		852.0	F		479.9	F	
Intersection Delay, s/veh / LOS	170.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	2.1	B	2.2	B	1.8	A	1.2	A

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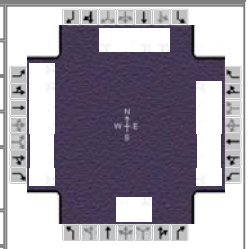
HCS 2010 Signalized Intersection Results Summary

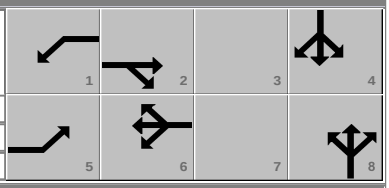
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{2_am} Rte 3 @ Carl D Silv	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	2_2040B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	4120	20	30	1550	560	20	10	30	630	10	40

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	27.1	50.5	9.5	5.1	31.3	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	1.3	3.0		11.0		9.0
Phase Duration, s	34.6	92.6	17.0	75.0		12.1		38.3
Change Period, *(Y+Rc)*, s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway *(MAH)*, s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time *(g_s)*, s	10.7		2.0			5.1		30.6
Green Extension Time *(g_e)*, s	0.3	0.0	3.6	0.0		0.0		0.6
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.48			0.06		0.78

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate *(v)*, veh/h	208	4292	20	31	1615	583		31	29	656	10	35
Adjusted Saturation Flow Rate *(s)*, veh/h/ln	1757	1708	1533	1774	1659	1579		1839	1464	1774	1900	1610
Queue Service Time *(g_s)*, s	8.7	87.6	1.3	0.0	28.9	52.7		2.7	3.1	28.6	0.7	2.8
Cycle Queue Clearance Time *(g_c)*, s	8.7	87.6	1.3	0.0	28.9	52.7		2.7	3.1	28.6	0.7	2.8
Capacity *(c)*, veh/h	628	3741	840	178	2903	691		82	65	749	401	340
Volume-to-Capacity Ratio *(X)*	0.332	1.147	0.024	0.176	0.556	0.845		0.381	0.447	0.877	0.026	0.104
Available Capacity *(c_a)*, veh/h	628	3741	840	178	2903	691		115	110	806	432	366
Back of Queue *(Q)*, veh/ln (50th percentile)	4.0	46.3	0.5	1.2	11.9	22.8		1.3	1.2	14.0	0.3	1.2
Overflow Queue *(Q_3)*, veh/ln	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Queue Storage Ratio *(RQ)* (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay *(d_1)*, s/veh	61.7	21.6	23.4	68.5	34.3	40.1		75.9	74.5	61.1	50.1	50.9
Incremental Delay *(d_2)*, s/veh	0.1	69.8	0.1	0.2	0.8	12.1		1.1	1.8	9.6	0.0	0.0
Initial Queue Delay *(d_3)*, s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay *(d)*, s/veh	61.8	91.4	23.5	68.6	35.0	52.2		77.0	76.3	70.7	50.1	51.0
Level of Service (LOS)	E	F	C	E	D	D		E	E	E	D	D
Approach Delay, s/veh / LOS	89.7	F		40.0	D		76.7	E		69.4	E	
Intersection Delay, s/veh / LOS	73.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	2.4	B	1.4	A	0.6	A	1.6	A

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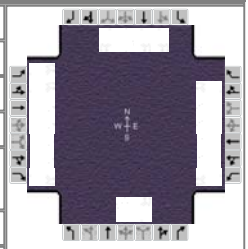
HCS 2010 Signalized Intersection Results Summary

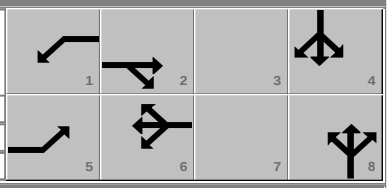
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{2_pm} Rte 3 @ Carl D Silv	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	2_2040B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	380	2590	20	50	3920	970	30	10	40	1240	20	280

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.5	43.5	9.5	10.0	36.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	1.3	3.0		11.0		9.0
Phase Duration, s	42.0	93.0	17.0	68.0		17.0		43.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	19.8		2.0			6.0		40.5
Green Extension Time (g_e), s	0.7	0.0	7.2	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.97			0.26		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	396	2698	20	52	4083	1010		42	39	1292	21	260
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1691	1610	1723	1708	1610		1761	1579	1810	1900	1610
Queue Service Time (g_s), s	17.8	27.7	0.3	0.0	63.0	63.0		3.9	4.0	38.5	1.5	25.4
Cycle Queue Clearance Time (g_c), s	17.8	27.7	0.3	0.0	63.0	63.0		3.9	4.0	38.5	1.5	25.4
Green Ratio (*g/C*)	0.21	0.52	0.52	0.31	0.37	0.37		0.07	0.07	0.23	0.23	0.23
Capacity (*c*), veh/h	744	3502	833	189	2532	597		124	111	820	430	365
Volume-to-Capacity Ratio (*X*)	0.532	0.770	0.024	0.275	1.613	1.693		0.335	0.346	1.576	0.048	0.714
Available Capacity (c_a), veh/h	744	3502	833	189	2532	597		104	111	820	430	365
Back of Queue (*Q*), veh/ln (50th percentile)	8.3	4.7	0.1	2.2	75.8	78.3		1.8	1.6	48.0	0.7	11.0
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	65.2	7.8	5.6	63.3	53.5	53.5		76.9	75.3	65.8	51.4	60.7
Incremental Delay (d_2), s/veh	0.4	1.7	0.1	0.3	277.6	319.2		0.6	0.7	265.1	0.0	5.6
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	65.6	9.5	5.7	63.6	331.1	372.7		77.5	75.9	330.8	51.4	66.3
Level of Service (LOS)	E	A	A	E	F	F		E	E	F	D	E
Approach Delay, s/veh / LOS	16.6	B		336.5	F		76.7	E		283.3	F	
Intersection Delay, s/veh / LOS	225.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	1.8	A	2.6	B	0.6	A	3.1	C

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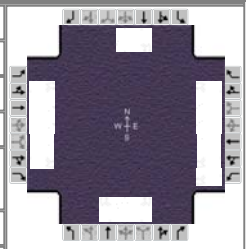
HCS 2010 Signalized Intersection Results Summary

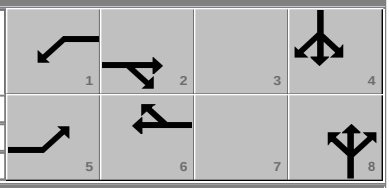
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{3_am} Rte 3 @ Gateway E	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	3_2040B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	1930	430	140	2160	10	310	10	140	10	5	30

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.3
Queue Clearance Time (g_s), s	4.4		6.5			22.4		4.4
Green Extension Time (g_e), s	0.0	0.0	2.4	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.91			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	2010	414	146	2250	9	323	10	134	10	36	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1646	
Queue Service Time (g_s), s	2.4	41.3	22.9	4.5	51.5	0.1	20.4	0.5	8.9	0.7	2.4	
Cycle Queue Clearance Time (g_c), s	2.4	41.3	22.9	4.5	51.5	0.1	20.4	0.5	8.9	0.7	2.4	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	108	
Volume-to-Capacity Ratio (*X*)	0.228	0.877	0.591	0.424	1.039	0.013	0.978	0.030	0.476	0.078	0.337	
Available Capacity (c_a), veh/h	183	2292	699	344	2165	727	330	350	282	134	108	
Back of Queue (*Q*), veh/ln (50th percentile)	1.1	17.1	8.8	1.9	8.1	0.0	13.0	0.2	3.4	0.3	1.0	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	47.2	29.6	23.1	46.3	5.5	3.0	46.3	38.1	41.6	48.7	50.1	
Incremental Delay (d_2), s/veh	0.2	5.1	3.6	0.3	30.5	0.0	43.4	0.0	0.5	0.1	0.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.4	34.8	26.7	46.6	36.0	3.1	89.7	38.2	42.0	48.7	50.7	
Level of Service (LOS)	D	C	C	D	F	A	F	D	D	D	D	
Approach Delay, s/veh / LOS	33.6	C		36.5	D		74.9	E		50.3	D	
Intersection Delay, s/veh / LOS	38.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	1.8	A	1.8	A	1.3	A	0.6	A

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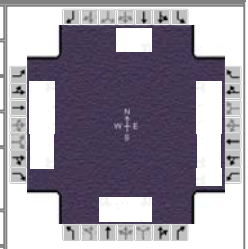
HCS 2010 Signalized Intersection Results Summary

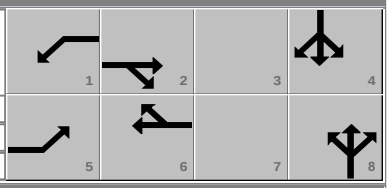
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{3_pm} Rte 3 @ Gateway E	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	3_2040B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	2270	600	290	2030	0	400	5	280	10	5	5

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.0
Queue Clearance Time (g_s), s	4.4		11.9			23.0		2.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	2365	591	302	2115	0	417	5	280	10	10	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1743	
Queue Service Time (g_s), s	2.4	52.0	38.8	9.9	41.3	0.0	21.0	0.3	20.8	0.7	0.6	
Cycle Queue Clearance Time (g_c), s	2.4	52.0	38.8	9.9	41.3	0.0	21.0	0.3	20.8	0.7	0.6	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	115	
Volume-to-Capacity Ratio (*X*)	0.228	1.032	0.844	0.878	0.977	0.000	1.263	0.015	0.992	0.078	0.091	
Available Capacity (c_a), veh/h	183	2292	699	344	2165	727	330	350	282	134	115	
Back of Queue (*Q*), veh/ln (50th percentile)	1.1	26.0	16.1	5.1	4.9	0.0	22.1	0.1	11.9	0.3	0.3	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	47.2	31.0	27.4	48.6	5.5	0.0	46.5	38.0	46.4	48.7	49.0	
Incremental Delay (d_2), s/veh	0.2	27.5	11.9	21.0	14.6	0.0	140.2	0.0	51.2	0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.4	58.5	39.3	69.7	20.1	0.0	186.7	38.0	97.6	48.7	49.1	
Level of Service (LOS)	D	F	D	E	C		F	D	F	D	D	
Approach Delay, s/veh / LOS	54.6	D		26.3	C		150.0	F		48.9	D	
Intersection Delay, s/veh / LOS	54.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	2.1	B	1.8	A	1.6	A	0.5	A

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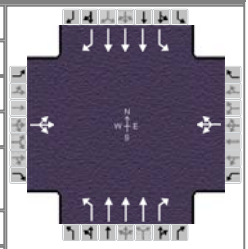
HCS 2010 Signalized Intersection Results Summary

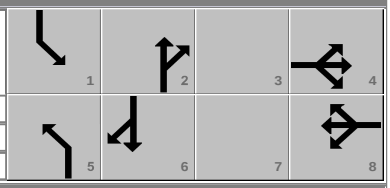
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{4_am} Rte 17 @ McLane I	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	4_2040B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	10	10	50	5	20	60	3670	90	40	2960	40

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	60.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	68.0	17.0	68.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		4.9		6.5	6.4		4.9	
Green Extension Time (g_e), s		0.2		0.2	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.10		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		52			78		63	3823	91	42	3083	40
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1487			1458		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			1.6		4.4	63.0	0.3	2.9	63.0	1.8
Cycle Queue Clearance Time (g_c), s		2.9			4.5		4.4	63.0	0.3	2.9	63.0	1.8
Green Ratio (*g/C*)		0.32			0.32		0.09	0.48	0.48	0.10	0.48	0.48
Capacity (*c*), veh/h		485			478		161	2412	750	174	2412	750
Volume-to-Capacity Ratio (*X*)		0.107			0.163		0.389	1.585	0.121	0.239	1.278	0.053
Available Capacity (c_a), veh/h		485			478		161	2412	750	174	2412	750
Back of Queue (*Q*), veh/ln (50th percentile)		1.2			1.8		2.0	68.1	0.2	1.3	53.2	0.7
Queue Storage Ratio (*RQ*) (50th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		33.0			33.6		55.5	12.5	1.0	53.9	33.5	17.7
Incremental Delay (d_2), s/veh		0.0			0.1		0.6	265.3	0.3	0.3	128.7	0.1
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		33.1			33.7		56.1	277.8	1.4	54.2	162.2	17.9
Level of Service (LOS)		C			C		E	F	A	D	F	B
Approach Delay, s/veh / LOS	33.1	C		33.7	C		268.0	F		158.9	F	
Intersection Delay, s/veh / LOS	216.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.6	A	0.6	A	2.7	B	2.2	B

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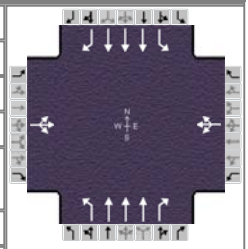
HCS 2010 Signalized Intersection Results Summary

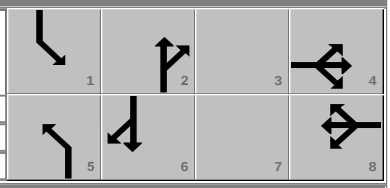
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{4_pm} Rte 17 @ McLane I	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	4_2040B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



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	5	10	60	10	30	50	3110	60	20	3890	30

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	90.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	98.0	17.0	98.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		4.9		10.7	6.6		3.8	
Green Extension Time (g_e), s		0.3		0.3	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.12		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		36			104		52	3240	59	21	4052	29
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1442			1478		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			5.7		4.6	93.0	0.0	1.8	93.0	1.3
Cycle Queue Clearance Time (g_c), s		2.9			8.7		4.6	93.0	0.0	1.8	93.0	1.3
Green Ratio (*g/C*)		0.26			0.26		0.08	0.58	0.58	0.08	0.58	0.58
Capacity (*c*), veh/h		382			392		130	2893	900	141	2893	900
Volume-to-Capacity Ratio (*X*)		0.095			0.266		0.399	1.120	0.066	0.147	1.401	0.032
Available Capacity (c_a), veh/h		382			392		130	2893	900	141	2893	900
Back of Queue (*Q*), veh/ln (50th percentile)		1.2			3.4		2.1	17.1	0.0	0.8	85.1	0.5
Queue Storage Ratio (*RQ*) (50th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		47.0			49.2		70.6	2.5	0.0	68.3	33.5	14.3
Incremental Delay (d_2), s/veh		0.0			0.1		0.7	59.3	0.1	0.2	182.5	0.1
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		47.1			49.3		71.3	61.8	0.1	68.5	216.0	14.4
Level of Service (LOS)		D			D		E	F	A	E	F	B
Approach Delay, s/veh / LOS	47.1	D		49.3	D		60.8	E		213.8	F	
Intersection Delay, s/veh / LOS	143.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.5	A	0.7	A	2.3	B	2.7	B

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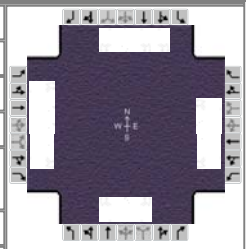
HCS 2010 Signalized Intersection Results Summary

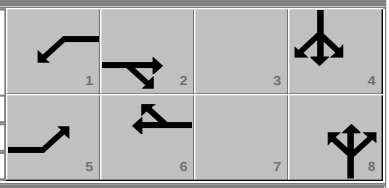
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{5_am} Rte 17 @ Sanford I	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	5_2040B_AM_Optimized_MajorChange.xus				
Project Description	I-95 Interchange Modification Report				



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	2950	30	280	910	310	90	10	230	230	100	30

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.0	65.5	5.0	9.0	5.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		9.0
Phase Duration, s	12.5	85.5	16.5	89.5		16.0		12.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		2.9
Queue Clearance Time (g_s), s	3.5		13.0			13.0		9.4
Green Extension Time (g_e), s	1.3	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	21	3073	29	292	948	307	94	10	215	240	104	29
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1659	1548	1740	1739	1548	1740	1827	1548	1689	1827	1548
Queue Service Time (g_s), s	1.5	78.0	1.0	11.0	18.0	11.4	6.9	0.7	11.0	7.0	7.4	2.4
Cycle Queue Clearance Time (g_c), s	1.5	78.0	1.0	11.0	18.0	11.4	6.9	0.7	11.0	7.0	7.4	2.4
Green Ratio (*g/C*)	0.04	0.60	0.60	0.08	0.63	0.63	0.08	0.08	0.08	0.06	0.06	0.06
Capacity (*c*), veh/h	67	2986	929	147	2194	1000	120	155	131	182	105	60
Volume-to-Capacity Ratio (*X*)	0.311	1.029	0.031	1.981	0.432	0.307	0.778	0.067	1.638	1.317	0.988	0.490
Available Capacity (c_a), veh/h	67	2986	929	147	2194	1000	120	155	131	182	105	60
Back of Queue (*Q*), veh/ln (50th percentile)	0.9	35.5	0.4	23.9	7.0	4.0	4.3	0.4	15.9	7.5	5.9	1.4
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	60.8	26.0	10.6	59.5	12.2	10.2	59.5	55.7	59.5	61.5	61.3	61.3
Incremental Delay (d_2), s/veh	11.7	24.5	0.1	464.9	0.6	0.8	38.0	0.8	318.9	175.9	84.6	26.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	72.5	50.5	10.7	524.4	12.8	10.9	97.5	56.5	378.4	237.4	145.8	87.3
Level of Service (LOS)	E	F	B	F	B	B	F	E	F	F	F	F
Approach Delay, s/veh / LOS	50.3	D		108.9	F		285.2	F		200.1	F	
Intersection Delay, s/veh / LOS	91.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.6	B	3.3	C	3.1	C
Bicycle LOS Score / LOS	2.2	B	1.8	A	1.0	A	1.1	A

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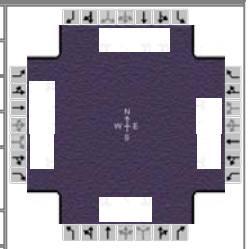
HCS 2010 Signalized Intersection Results Summary

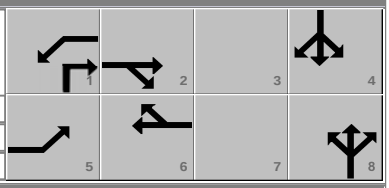
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{5_pm} Rte 17 @ Sanford I	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	5_2040B_PM_Optimized_MajorChange.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	3660	70	340	890	270	50	10	950	510	30	10

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	23.0	74.5	5.0	9.0	12.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		9.0
Phase Duration, s	12.5	94.5	30.5	112.5		16.0		19.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		2.8
Queue Clearance Time (g_s), s	2.9		27.0			13.0		16.0
Green Extension Time (g_e), s	2.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	10	3813	69	354	927	273	52	10	903	531	31	9
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1659	1548	1740	1739	1548	1740	1827	1548	1689	1827	1548
Queue Service Time (g_s), s	0.9	87.0	3.4	25.0	20.0	11.3	4.7	0.9	11.0	14.0	2.5	0.9
Cycle Queue Clearance Time (g_c), s	0.9	87.0	3.4	25.0	20.0	11.3	4.7	0.9	11.0	14.0	2.5	0.9
Green Ratio (*g/C*)	0.03	0.54	0.54	0.16	0.66	0.66	0.07	0.07	0.23	0.09	0.09	0.09
Capacity (*c*), veh/h	54	2706	842	272	2283	1035	98	126	348	296	166	116
Volume-to-Capacity Ratio (*X*)	0.192	1.409	0.082	1.303	0.406	0.264	0.532	0.083	2.593	1.797	0.189	0.081
Available Capacity (c_a), veh/h	54	2706	842	272	2283	1035	98	126	348	296	166	116
Back of Queue (*Q*), veh/ln (50th percentile)	0.5	81.0	1.3	23.3	8.0	4.1	2.6	0.4	84.3	21.4	1.3	0.4
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	75.5	36.5	17.4	67.5	12.9	10.7	73.5	70.7	62.0	73.0	67.5	68.9
Incremental Delay (d_2), s/veh	7.7	186.3	0.2	160.4	0.5	0.6	19.2	1.3	725.0	371.8	2.5	1.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	83.2	222.8	17.6	227.9	13.4	11.3	92.6	72.0	787.0	444.8	70.0	70.2
Level of Service (LOS)	F	F	B	F	B	B	F	E	F	F	E	E
Approach Delay, s/veh / LOS	218.8	F		61.9	E		741.8	F		418.2	F	
Intersection Delay, s/veh / LOS	272.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.6	B	3.3	C	3.1	C
Bicycle LOS Score / LOS	2.6	B	1.8	A	2.1	B	1.4	A

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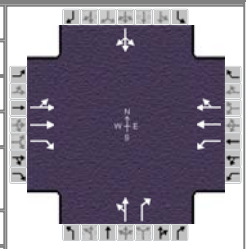
HCS 2010 Signalized Intersection Results Summary

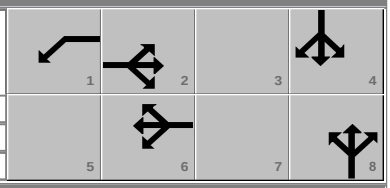
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	AM Peak Hour	PHF	0.96
Intersection	{6_am} Rte 17 @ Short St	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	6_2040B_AM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	1400	70	20	1350	5	130	0	20	5	0	20

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	32.5	19.0	10.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		40.0	17.0	57.0		26.0		17.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.6			8.6		3.4
Green Extension Time (g_e), s		0.0	0.0	0.0		0.2		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	765	704	68	21	706	705		135	20		26	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1811	1679	1579	1810	1863	1860		1810	1563		1646	
Queue Service Time (g_s), s	11.9	35.0	2.9	0.6	29.3	29.3		6.6	1.0		1.4	
Cycle Queue Clearance Time (g_c), s	32.5	35.0	2.9	0.6	29.3	29.3		6.6	1.0		1.4	
Green Ratio (*g/C*)	0.35	0.35	0.35	0.48	0.52	0.52		0.21	0.21		0.12	
Capacity (*c*), veh/h	625	588	553	280	969	921		380	328		198	
Volume-to-Capacity Ratio (*X*)	1.224	1.198	0.123	0.074	0.729	0.766		0.356	0.060		0.132	
Available Capacity (c_a), veh/h	625	588	553	280	969	921		344	328		165	
Back of Queue (*Q*), veh/ln (50th percentile)	34.7	30.8	1.1	0.2	13.2	13.4		2.9	0.4		0.6	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	33.3	32.5	22.1	20.4	19.4	18.6		35.5	31.6		41.2	
Incremental Delay (d_2), s/veh	114.5	105.0	0.5	0.0	4.8	6.1		0.2	0.0		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	147.8	137.5	22.5	20.5	24.2	24.6		35.7	31.6		41.3	
Level of Service (LOS)	F	F	C	C	C	C		D	C		D	
Approach Delay, s/veh / LOS	137.5	F		24.3	C		35.2	D		41.3	D	
Intersection Delay, s/veh / LOS	80.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.7	A	0.7	A	0.5	A

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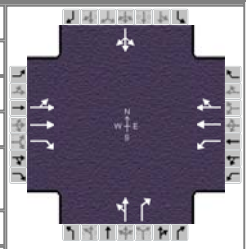
HCS 2010 Signalized Intersection Results Summary

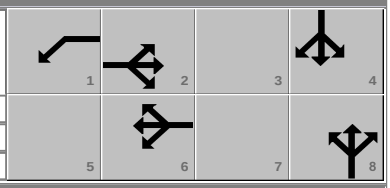
General Information				Intersection Information	
Agency	Baker			Duration, h	0.25
Analyst	ZPH, CRD update	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction		Time Period	PM Peak Hour	PHF	0.96
Intersection	{6_pm} Rte 17 @ Short St	Analysis Year	2040 Build w/ Exist Timings	Analysis Period	1> 7:00
File Name	6_2040B_PM_NotOpt.xus				
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	2370	120	20	1210	5	110	5	40	5	5	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.0	43.5	16.0	11.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		51.0	18.0	69.0		23.0		18.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.6			8.6		3.2
Green Extension Time (g_e), s		0.0	0.0	0.0		0.2		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.01		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	1298	1181	117	21	633	632		120	39		21	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1845	1695	1548	1757	1863	1860		1813	1610		1723	
Queue Service Time (g_s), s	16.0	46.0	5.2	0.6	23.7	23.7		6.6	2.3		1.2	
Cycle Queue Clearance Time (g_c), s	43.5	46.0	5.2	0.6	23.7	23.7		6.6	2.3		1.2	
Green Ratio (*g/C*)	0.42	0.42	0.42	0.54	0.58	0.58		0.16	0.16		0.12	
Capacity (*c*), veh/h	763	709	647	265	1084	1040		297	263		204	
Volume-to-Capacity Ratio (*X*)	1.702	1.666	0.180	0.079	0.584	0.608		0.404	0.146		0.102	
Available Capacity (c_a), veh/h	763	709	647	265	1084	1040		264	263		172	
Back of Queue (*Q*), veh/ln (50th percentile)	88.0	78.4	2.0	0.2	10.2	10.2		3.0	0.9		0.5	
Queue Storage Ratio (*RQ*) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	32.8	32.0	20.1	21.8	15.2	14.6		43.0	39.4		44.9	
Incremental Delay (d_2), s/veh	321.6	305.9	0.6	0.0	2.3	2.6		0.3	0.1		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	354.4	337.9	20.7	21.8	17.5	17.2		43.3	39.5		44.9	
Level of Service (LOS)	F	F	C	C	B	B		D	D		D	
Approach Delay, s/veh / LOS	331.9	F		17.4	B		42.4	D		44.9	D	
Intersection Delay, s/veh / LOS	219.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.6	B	1.5	A	0.7	A	0.5	A

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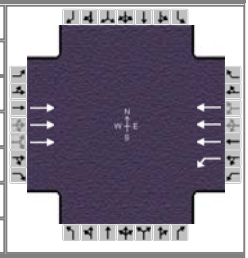
HCS 2010 Signalized Intersection Results Summary

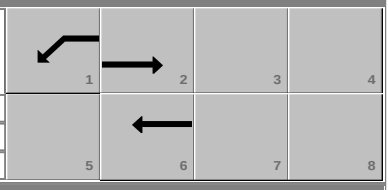
General Information				Intersection Information	
Agency	Michael Baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Intersection	7-AM-Ramp F	Analysis Year	2040 Build	Analysis Period	1> 7:00
File Name	7_2040B_AM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1890		150	4290							

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	13.7	101.3	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				
Case Number		8.3	2.0	4.0				
Phase Duration, s		108.8	21.2	130.0				
Change Period, ($Y+R_c$), s		7.5	7.5	7.5				
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				
Queue Clearance Time (g_s), s			13.5					
Green Extension Time (g_e), s		0.0	0.2	0.0				
Phase Call Probability			1.00					
Max Out Probability			0.00					

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2		1	6							
Adjusted Flow Rate (*v*), veh/h		2054		163	4663							
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1725		1810	1725							
Queue Service Time (g_s), s		18.9		11.5	68.2							
Cycle Queue Clearance Time (g_c), s		18.9		11.5	68.2							
Green Ratio (*g/C*)		0.78		0.11	0.94							
Capacity (*c*), veh/h		4034		190	4877							
Volume-to-Capacity Ratio (*X*)		0.509		0.857	0.956							
Available Capacity (c_a), veh/h		4034		327	4877							
Back of Queue (*Q*), veh/ln (50th percentile)		5.7		5.5	2.8							
Queue Storage Ratio (*RQ*) (50th percentile)		0.00		0.00	0.00							
Uniform Delay (d_1), s/veh		5.2		57.2	2.2							
Incremental Delay (d_2), s/veh		0.5		4.3	6.1							
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0							
Control Delay (*d*), s/veh		5.7		61.5	8.3							
Level of Service (LOS)		A		E	A							
Approach Delay, s/veh / LOS	5.7	A		10.1	B		0.0			0.0		
Intersection Delay, s/veh / LOS	8.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.8	A	0.5	A	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.6	A	3.1	C				

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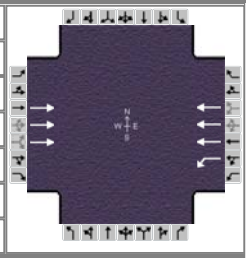
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	Michael Baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.92
Intersection	7-PM-Ramp F	Analysis Year	2040 Build	Analysis Period	1> 7:00
File Name	7_2040B_PM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		2220		200	3630							

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	21.3	123.7	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				
Case Number		8.3	2.0	4.0				
Phase Duration, s		131.2	28.8	160.0				
Change Period, ($Y+R_c$), s		7.5	7.5	7.5				
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				
Queue Clearance Time (g_s), s			20.9					
Green Extension Time (g_e), s		0.0	0.4	0.0				
Phase Call Probability			1.00					
Max Out Probability			0.00					

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2		1	6							
Adjusted Flow Rate (*v*), veh/h		2413		217	3946							
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1725		1810	1725							
Queue Service Time (g_s), s		31.7		18.9	24.1							
Cycle Queue Clearance Time (g_c), s		31.7		18.9	24.1							
Green Ratio (*g/C*)		0.77		0.13	0.95							
Capacity (*c*), veh/h		4001		241	4933							
Volume-to-Capacity Ratio (*X*)		0.603		0.902	0.800							
Available Capacity (c_a), veh/h		4001		492	4933							
Back of Queue (*Q*), veh/ln (50th percentile)		10.8		9.1	0.7							
Queue Storage Ratio (*RQ*) (50th percentile)		0.00		0.00	0.00							
Uniform Delay (d_1), s/veh		7.7		68.3	0.7							
Incremental Delay (d_2), s/veh		0.7		5.0	1.4							
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0							
Control Delay (*d*), s/veh		8.4		73.3	2.2							
Level of Service (LOS)		A		E	A							
Approach Delay, s/veh / LOS	8.4	A		5.9	A		0.0			0.0		
Intersection Delay, s/veh / LOS	6.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	0.5	A	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.8	A	2.8	C				

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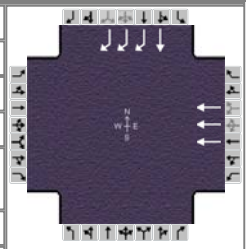
HCS 2010 Signalized Intersection Results Summary

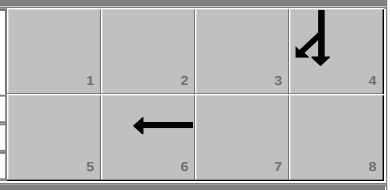
General Information				Intersection Information	
Agency	Michael Baker Jr			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Intersection	SB ramp and WB Rt 3 Alt 1	Analysis Year	2040 Build_not Opt	Analysis Period	1> 7:00
File Name	8_2040B_AM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					1300						0	835

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	37.9	0.0	0.0	0.0	0.0
Yellow	0.0	4.0	0.0	0.0	0.0	0.0
Red	0.0	1.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				117.1				42.9
Change Period, ($Y+R_c$), s				5.0				5.0
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								34.9
Green Extension Time (g_e), s				0.0				3.0
Phase Call Probability								1.00
Max Out Probability								0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					6						4	14
Adjusted Flow Rate (*v*), veh/h					1413						0	908
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1725						1900	1425
Queue Service Time (g_s), s					18.0						0.0	32.9
Cycle Queue Clearance Time (g_c), s					18.0						0.0	32.9
Green Ratio (*g/C*)					0.70						0.24	0.24
Capacity (*c*), veh/h					3625						450	1014
Volume-to-Capacity Ratio (*X*)					0.390						0.000	0.895
Available Capacity (c_a), veh/h					3625						1663	3741
Back of Queue (*Q*), veh/ln (50th percentile)					6.7						0.0	11.9
Queue Storage Ratio (*RQ*) (50th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					9.9						0.0	59.1
Incremental Delay (d_2), s/veh					0.3						0.0	1.2
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					10.2						0.0	60.3
Level of Service (LOS)					B							E
Approach Delay, s/veh / LOS	0.0			10.2		B	0.0			60.3		E
Intersection Delay, s/veh / LOS	29.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.0	A	2.9	C
Bicycle LOS Score / LOS			1.3	A			2.0	A

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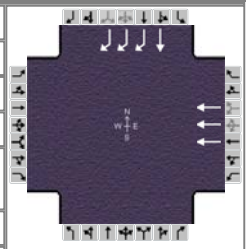
HCS 2010 Signalized Intersection Results Summary

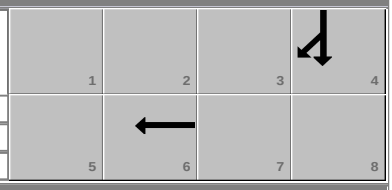
General Information				Intersection Information	
Agency	Michael Baker Jr			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.92
Intersection	SB Ramp and WB Rt 3 Alt	Analysis Year	2040 Build_not opt	Analysis Period	1> 7:00
File Name	8_2040B_PM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					1955						0	3070

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	100.0	0.0	0.0	0.0	0.0
Yellow	0.0	4.5	0.0	0.0	0.0	0.0
Red	0.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				62.5				107.5
Change Period, ($Y+R_c$), s				7.5				7.5
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								102.0
Green Extension Time (g_e), s				0.0				0.0
Phase Call Probability								1.00
Max Out Probability								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					6						4	14
Adjusted Flow Rate (*v*), veh/h					2125						0	3337
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1691						1900	1357
Queue Service Time (g_s), s					55.0						0.0	100.0
Cycle Queue Clearance Time (g_c), s					55.0						0.0	100.0
Green Ratio (*g/C*)					0.32						0.59	0.59
Capacity (*c*), veh/h					1642						1118	2395
Volume-to-Capacity Ratio (*X*)					1.294						0.000	1.393
Available Capacity (c_a), veh/h					1642						1118	2395
Back of Queue (*Q*), veh/ln (50th percentile)					44.2						0.0	71.5
Queue Storage Ratio (*RQ*) (50th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					57.5						0.0	35.0
Incremental Delay (d_2), s/veh					137.2						0.0	179.6
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					194.7						0.0	214.6
Level of Service (LOS)					F							F
Approach Delay, s/veh / LOS	0.0			194.7		F	0.0			214.6		F
Intersection Delay, s/veh / LOS	206.9						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.0	A	2.9	C
Bicycle LOS Score / LOS			1.7	A			6.0	F

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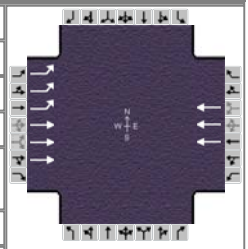
HCS 2010 Signalized Intersection Results Summary

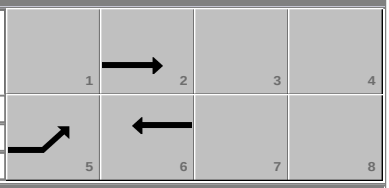
General Information				Intersection Information	
Agency	Michael Baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.92
Intersection	9-AM	Analysis Year	2040 Build not Opt	Analysis Period	1> 7:00
File Name	9_2040B_AM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	2990	2060			1090							

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	104.5	40.5	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		8.3				
Phase Duration, s	112.0	160.0		48.0				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	104.0							
Green Extension Time (g_e), s	0.5	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	1.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6							
Adjusted Flow Rate (*v*), veh/h	3250	2239			1185							
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1643							
Queue Service Time (g_s), s	102.0	6.2			37.8							
Cycle Queue Clearance Time (g_c), s	102.0	6.2			37.8							
Green Ratio (*g/C*)	0.65	0.95			0.25							
Capacity (*c*), veh/h	3278	4698			1249							
Volume-to-Capacity Ratio (*X*)	0.992	0.477			0.949							
Available Capacity (c_a), veh/h	3279	4698			1249							
Back of Queue (*Q*), veh/ln (50th percentile)	42.1	0.2			17.5							
Queue Storage Ratio (*RQ*) (50th percentile)	2.73	0.00			0.00							
Uniform Delay (d_1), s/veh	27.3	0.3			58.7							
Incremental Delay (d_2), s/veh	13.7	0.3			15.8							
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0							
Control Delay (*d*), s/veh	41.1	0.7			74.6							
Level of Service (LOS)	D	A			E							
Approach Delay, s/veh / LOS	24.6		C	74.6		E	0.0			0.0		
Intersection Delay, s/veh / LOS	33.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.9	C	3.2	C	3.5	D
Bicycle LOS Score / LOS	3.5	D	1.1	A				

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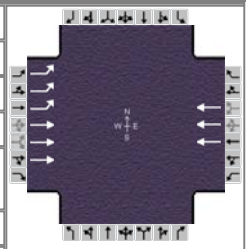
HCS 2010 Signalized Intersection Results Summary

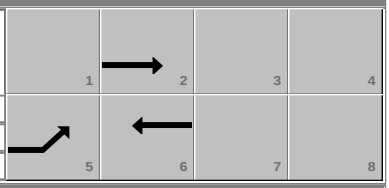
General Information				Intersection Information	
Agency	Michael baker Jr.			Duration, h	0.25
Analyst	ZPH	Analysis Date	Apr 29, 2014	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.92
Intersection	9-PM	Analysis Year	2040 Build not Opt	Analysis Period	1> 7:00
File Name	9_2040B_PM_NotOpt.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1390	2610			1605							

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	56.1	98.9	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		8.3				
Phase Duration, s	63.6	170.0		106.4				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	51.1							
Green Extension Time (g_e), s	5.0	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6							
Adjusted Flow Rate (*v*), veh/h	1511	2837			1745							
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1643							
Queue Service Time (g_s), s	49.1	10.2			38.9							
Cycle Queue Clearance Time (g_c), s	49.1	10.2			38.9							
Green Ratio (*g/C*)	0.33	0.96			0.58							
Capacity (*c*), veh/h	1655	4712			2869							
Volume-to-Capacity Ratio (*X*)	0.913	0.602			0.608							
Available Capacity (c_a), veh/h	4385	4712			2869							
Back of Queue (*Q*), veh/ln (50th percentile)	20.7	0.3			15.2							
Queue Storage Ratio (*RQ*) (50th percentile)	1.35	0.00			0.00							
Uniform Delay (d_1), s/veh	54.6	0.4			23.0							
Incremental Delay (d_2), s/veh	0.9	0.6			1.0							
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0							
Control Delay (*d*), s/veh	55.5	1.0			24.0							
Level of Service (LOS)	E	A			C							
Approach Delay, s/veh / LOS	19.9	B		24.0	C		0.0			0.0		
Intersection Delay, s/veh / LOS	21.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.8	C	3.2	C	3.5	D
Bicycle LOS Score / LOS	2.9	C	1.4	A				

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April 2016 IMR Build Alternative

2020 HCS Mainline / Ramp Junction Analysis

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*06/2014*	Jurisdiction	*Segment 1*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4100*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.826*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1759*	pc/h/ln
S	*66.4*	mph
D = v_p / S	*26.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*06/2014*	Jurisdiction	*Segment 1*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3890*	veh/h	Peak-Hour Factor, PHF	*0.98*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1561*	pc/h/ln
S	*68.5*	mph
D = v_p / S	*22.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*06/2014*	Jurisdiction	*Segment 1*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*2630*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1197*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*17.1*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*06/2014*	Jurisdiction	*Segment 1*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4970*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2062*	pc/h/ln
S	*61.4*	mph
D = v_p / S	*33.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*Rest Area to Route 3*
Date Performed	*06/2014*	Jurisdiction	*Segment 2*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*2710*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1195*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*17.1*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*Rest Area to Route 3*
Date Performed	*06/2014*	Jurisdiction	*Segment 2*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4800*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1971*	pc/h/ln
S	*63.1*	mph
D = v_p / S	*31.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*Between Rt 3 and Rt 17*
Date Performed	*06/2014*	Jurisdiction	*Segment2&3*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3500*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.826*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1455*	pc/h/ln
S	*69.2*	mph
D = v_p / S	*21.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*Route 3 to River*
Date Performed	*06/2014*	Jurisdiction	*Segment 2 & 3*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3090*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1253*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*17.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*North of US 17*
Date Performed	*06/2014*	Jurisdiction	*Segment 4*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*6020*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.826*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2639*	pc/h/ln
S	*46.0*	mph
D = v_p / S	*57.4*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*North of US 17*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3880*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1624*	pc/h/ln
S	*67.9*	mph
D = v_p / S	*23.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*North of US17*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3090*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1363*	pc/h/ln
S	*69.7*	mph
D = v_p / S	*19.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*North of US17*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*6340*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2604*	pc/h/ln
S	*47.1*	mph
D = v_p / S	*55.2*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-1 NB 95 to EB 3
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM peak	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	775
Freeway Volume, V_F	4100
Ramp Volume, V_R	290
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1000 ft

V_D = 2320 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4100	0.94	Rolling	14	0	0.826	1.00	5278
Ramp	290	0.84	Rolling	14	0	0.826	1.00	418
UpStream								
DownStream	2320	0.98	Rolling	14	0	0.826	1.00	2864

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.609 using Equation (Exhibit 13-7)

V_{12} = 3377 pc/h

V_3 or V_{av34} 1901 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5278	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4860	Exhibit 13-8	7200	No
V_R	418	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3377	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.271 (Exhibit 13-12)

S_R= 62.4 mph (Exhibit 13-12)

S_0= 73.3 mph (Exhibit 13-12)

S = 65.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-1 95 NB to Rt 3 EB
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM peak	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	775
Freeway Volume, V_F	3890
Ramp Volume, V_R	260
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1000 ft

V_D = 1080 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3890	0.98	Rolling	12	0	0.847	1.00	4684
Ramp	260	1.00	Rolling	12	0	0.847	1.00	307
UpStream								
DownStream	1080	0.98	Rolling	12	0	0.847	1.00	1300

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.629 using Equation (Exhibit 13-7)

V_{12} = 3059 pc/h

V_3 or V_{av34} 1625 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4684	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4377	Exhibit 13-8	7200	No
V_R	307	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3059	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.261 (Exhibit 13-12)

S_R= 62.7 mph (Exhibit 13-12)

S_0= 74.4 mph (Exhibit 13-12)

S = 66.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-4 Off Ramp to US 17
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	3090
Ramp Volume, V_R	840
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 2500 ft

V_D = 530 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3090	0.96	Rolling	18	0	0.787	1.00	4088
Ramp	840	0.88	Rolling	18	0	0.787	1.00	1212
UpStream								
DownStream	530	0.95	Rolling	18	0	0.787	1.00	709

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 2506 pc/h

V_3 or V_{av34} 1582 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4088	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2876	Exhibit 13-8	7200	No
V_R	1212	Exhibit 13-10	4200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2506	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 9.2 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.342 (Exhibit 13-12)

S_R= 60.4 mph (Exhibit 13-12)

S_0= 74.5 mph (Exhibit 13-12)

S = 65.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-4 Off Ramp to US 17
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	6340
Ramp Volume, V_R	1030
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 2500 ft

V_D = 2280 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6340	0.97	Rolling	13	0	0.837	1.00	7811
Ramp	1030	0.98	Rolling	13	0	0.837	1.00	1256
UpStream								
DownStream	2280	0.95	Rolling	13	0	0.837	1.00	2868

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 6582.14 (Equation 13-12 or 13-13)

P_{FD} = 0.594 using Equation (Exhibit 13-7)

V_{12} = 5151 pc/h

V_3 or V_{av34} 2660 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7811	Exhibit 13-8	7200	Yes
$V_{FO} = V_F - V_R$	6555	Exhibit 13-8	7200	No
V_R	1256	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	5151	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 45.5 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.346 (Exhibit 13-12)

S_R= 60.3 mph (Exhibit 13-12)

S_0= 70.3 mph (Exhibit 13-12)

S = 63.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-7 Off Ramp to US 17
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp
- ☐ Yes ☐ On
- ☑ No ☐ Off
- L_{up} = ft
- V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	3500
Ramp Volume, V_R	1410
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp
- ☑ Yes ☑ On
- ☐ No ☐ Off
- L_{down} = 1700 ft
- V_D = 670 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3500	0.97	Grade	14	0	0.935	1.00	3861
Ramp	1410	0.86	Grade	14	0	0.935	1.00	1754
UpStream								
DownStream	670	0.99	Grade	14	0	0.935	1.00	724

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 2702 pc/h

V_3 or V_{av34} 1159 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3861	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2107	Exhibit 13-8	7200	No
V_R	1754	Exhibit 13-10	4400	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2702	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 10.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.261 (Exhibit 13-12)

S_R= 62.7 mph (Exhibit 13-12)

S_0= 76.2 mph (Exhibit 13-12)

S = 66.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-7 Off Ramp to US 17
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	3090
Ramp Volume, V_R	1140
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1700 ft

V_D = 670 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3090	0.97	Grade	12	0	0.943	1.00	3377
Ramp	1140	0.95	Grade	12	0	0.943	1.00	1272
UpStream								
DownStream	670	0.94	Grade	12	0	0.943	1.00	756

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 2219 pc/h

V_3 or V_{av34} 1158 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3377	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2105	Exhibit 13-8	7200	No
V_R	1272	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2219	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 6.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.217 (Exhibit 13-12)

S_R= 63.9 mph (Exhibit 13-12)

S_0= 76.2 mph (Exhibit 13-12)

S = 67.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-9OffRamp to Rte 3CD/RestArea
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	2250
Ramp Volume, V_R	690
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 900 ft

V_D = 1040 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2250	0.96	Level	18	0	0.917	1.00	2555
Ramp	690	0.95	Level	18	0	0.917	1.00	792
UpStream								
DownStream	1040	0.90	Level	18	0	0.917	1.00	1260

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 1585 pc/h

V_3 or V_{av34} 970 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2555	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	1763	Exhibit 13-8	7200	No
V_R	792	Exhibit 13-10	4400	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1585	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 1.3 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.174 (Exhibit 13-12)

S_R= 65.1 mph (Exhibit 13-12)

S_0= 76.8 mph (Exhibit 13-12)

S = 69.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-9OffRamp to Rte 3CD/RestArea
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	5310
Ramp Volume, V_R	2290
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 900 ft

V_D = 1590 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5310	0.97	Level	13	0	0.939	1.00	5830
Ramp	2290	0.95	Level	13	0	0.939	1.00	2567
UpStream								
DownStream	1590	0.95	Level	13	0	0.939	1.00	1782

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 4035 pc/h

V_3 or V_{av34} 1795 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5830	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3263	Exhibit 13-8	7200	No
V_R	2567	Exhibit 13-10	4400	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4035	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 22.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.334 (Exhibit 13-12)

S_R= 60.6 mph (Exhibit 13-12)

S_0= 73.7 mph (Exhibit 13-12)

S = 64.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr,, Inc.	Junction	M-10 On Ramp from Rest Area
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2600	
	Ramp Volume, V_R: 110	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2600	0.96	Level	18	0	0.917	1.00	2952
Ramp	110	0.96	Level	18	0	0.917	1.00	125
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

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

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

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 1753 pc/h

V_3 or V_{av34} 1199 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1753 pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3077	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1878	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 16.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.277 (Exibit 13-11)

S_R= 62.2 mph (Exhibit 13-11)

S_0= 67.5 mph (Exhibit 13-11)

S = 64.2 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr,, Inc.	Junction	M-10 On Ramp from Rest Area
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4610	
	Ramp Volume, V_R: 190	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4610	0.97	Level	13	0	0.939	1.00	5061
Ramp	190	0.97	Level	13	0	0.939	1.00	209
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 3005 pc/h

V_3 or V_{av34} 2056 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 3005 pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5270	Exhibit 13-8		No

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3214	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 26.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.348 (Exibit 13-11)

S_R= 60.2 mph (Exhibit 13-11)

S_0= 64.4 mph (Exhibit 13-11)

S = 61.8 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-11 Off Ramp to US 17
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	500	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3470	V_D =	veh/h
		Ramp Volume, V_R	670		
		Freeway Free-Flow Speed, S_{FF}	65.0		
		Ramp Free-Flow Speed, S_{FR}	60.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3470	0.99	Grade	14	0	0.935	1.00	3750
Ramp	670	0.99	Grade	14	0	0.935	1.00	724
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3750 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3750	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3026	Exhibit 13-8	4700	No
V_R	724	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3750	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.168 (Exhibit 13-12)

S_R= 61.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 61.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-11 Off Ramp to US 17
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☑ No ☐ Off		☑ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h		V_D = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	1750
Ramp Volume, V_R	550
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1750	0.94	Grade	12	0	0.943	1.00	1973
Ramp	550	0.94	Grade	12	0	0.943	1.00	620
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1973 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1973	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1353	Exhibit 13-8	4700	No
V_R	620	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1973	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 16.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.159 (Exhibit 13-12)

S_R= 61.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 61.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-12 Off Ramp to US 17 EB
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 400 ft

V_u = 900 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	2080
Ramp Volume, V_R	130
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2080	0.86	Grade	14	0	0.935	1.00	2588
Ramp	130	0.86	Grade	14	0	0.935	1.00	162
UpStream	900	0.99	Grade	14	0	0.935	1.00	973
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2588 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2588	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2426	Exhibit 13-8	4600	No
V_R	162	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2588	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 24.5 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.118 (Exhibit 13-12)

S_R= 57.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 57.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-12 Off Ramp to US 17 EB
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 400 ft

V_u = 600 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	1690
Ramp Volume, V_R	200
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1690	0.95	Grade	12	0	0.943	1.00	1886
Ramp	200	0.95	Grade	12	0	0.943	1.00	223
UpStream	600	0.94	Grade	12	0	0.943	1.00	677
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1886 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1886	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	1663	Exhibit 13-8	4600	No
V_R	223	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1886	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 18.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.123 (Exhibit 13-12)

S_R= 57.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 57.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-15 Off Ramp to Rest Area
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	840
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 750 ft

V_D = 110 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	840	0.95	Level	18	0	0.917	1.00	964
Ramp	110	0.96	Level	18	0	0.917	1.00	125
UpStream								
DownStream	110	0.96	Level	18	0	0.917	1.00	125

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 964 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	964	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	839	Exhibit 13-8	4700	No
V_R	125	Exhibit 13-10	2200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	964	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 8.0 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.114 (Exhibit 13-12)

S_R= 62.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-15 Off Ramp to Rest Area
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	2890
Ramp Volume, V_R	190
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 750 ft

V_D = 190 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2890	0.95	Level	13	0	0.939	1.00	3240
Ramp	190	0.97	Level	13	0	0.939	1.00	209
UpStream								
DownStream	190	0.97	Level	13	0	0.939	1.00	209

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3240 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3240	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3031	Exhibit 13-8	4700	No
V_R	209	Exhibit 13-10	2200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3240	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.122 (Exhibit 13-12)

S_R= 62.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-16 Off Ramp to Rest Area
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1200 ft

V_u = 110 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	840
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	840	0.95	Level	18	0	0.917	1.00	964
Ramp	110	0.96	Level	18	0	0.917	1.00	125
UpStream	110	0.96	Level	18	0	0.917	1.00	125
DownStream								

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 964 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	964	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	839	Exhibit 13-8	4700	No
V_R	125	Exhibit 13-10	2200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	964	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 10.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.114 (Exhibit 13-12)

S_R= 62.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-16 Off Ramp to Rest Area
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1200 ft

V_u = 190 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	2890
Ramp Volume, V_R	190
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2890	0.95	Level	13	0	0.939	1.00	3240
Ramp	190	0.97	Level	13	0	0.939	1.00	209
UpStream	190	0.97	Level	13	0	0.939	1.00	209
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3240 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3240	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3031	Exhibit 13-8	4700	No
V_R	209	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3240	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.122 (Exhibit 13-12)

S_R= 62.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-17 NB 95 to WB 3
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM peak	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	1500 ft	Deceleration Lane Length L_D	1200	L_{down} =	ft
V_u =	340 veh/h	Freeway Volume, V_F	3810	V_D =	veh/h
		Ramp Volume, V_R	310		
		Freeway Free-Flow Speed, S_{FF}	70.0		
		Ramp Free-Flow Speed, S_{FR}	60.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3810	0.94	Rolling	14	0	0.826	1.00	4904
Ramp	310	0.84	Rolling	14	0	0.826	1.00	447
UpStream	340	0.98	Rolling	14	0	0.826	1.00	420
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.617 using Equation (Exhibit 13-7)

V_{12} = 3196 pc/h

V_3 or V_{av34} 1708 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4904	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4457	Exhibit 13-8	7200	No
V_R	447	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3196	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 20.9 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.143 (Exhibit 13-12)

S_R= 66.0 mph (Exhibit 13-12)

S_0= 74.0 mph (Exhibit 13-12)

S = 68.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-17 NB 95 to WB 3
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM peak	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1500 ft

V_u = 300 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1200
Freeway Volume, V_F	3630
Ramp Volume, V_R	540
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3630	0.94	Rolling	14	0	0.826	1.00	4673
Ramp	540	0.84	Rolling	14	0	0.826	1.00	778
UpStream	300	0.98	Rolling	14	0	0.826	1.00	370
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.607 using Equation (Exhibit 13-7)

V_{12} = 3144 pc/h

V_3 or V_{av34} 1529 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4673	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3895	Exhibit 13-8	7200	No
V_R	778	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3144	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 20.5 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.173 (Exhibit 13-12)

S_R= 65.2 mph (Exhibit 13-12)

S_0= 74.7 mph (Exhibit 13-12)

S = 68.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-3 On Ramp from US 17
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 3500 ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = 2570 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 4890	
	Ramp Volume, V_R: 1130	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4890	0.92	Rolling	14	0	0.826	1.00	6431
Ramp	1130	0.91	Rolling	14	0	0.826	1.00	1503
UpStream	2570	0.99	Rolling	14	0	0.826	1.00	3141
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 3894 pc/h

V_3 or V_{av34} 2537 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 3894 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7934	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5397	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 40.6 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 1.082 (Exibit 13-11)

S_R= 39.7 mph (Exhibit 13-11)

S_0= 62.0 mph (Exhibit 13-11)

S = 44.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-3 On Ramp from US 17
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 3500 ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = 1150 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3150	
	Ramp Volume, V_R: 730	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3150	0.94	Rolling	12	0	0.847	1.00	3954
Ramp	730	0.93	Rolling	12	0	0.847	1.00	926
UpStream	1150	0.94	Rolling	12	0	0.847	1.00	1444
DownStream								

Estimation of v_{12} — Merge Areas

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

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

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 2394 pc/h

V_3 or V_{av34} 1560 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2394 pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4880	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3320	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 24.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.329 (Exibit 13-11)

S_R= 60.8 mph (Exhibit 13-11)

S_0= 66.2 mph (Exhibit 13-11)

S = 62.4 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-4 On Ramp from US 17
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 900 ft

V_u = 690 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	580
Deceleration Lane Length L_D	
Freeway Volume, V_F	1560
Ramp Volume, V_R	1040
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1560	0.96	Level	18	0	0.917	1.00	1771
Ramp	1040	0.90	Level	18	0	0.917	1.00	1260
UpStream	690	0.95	Level	18	0	0.917	1.00	792
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 983 pc/h

V_3 or V_{av34} 788 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1012 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3031	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2272	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 6.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.049 (Exibit 13-11)

S_R= 68.6 mph (Exhibit 13-11)

S_0= 69.1 mph (Exhibit 13-11)

S = 68.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-4 On Ramp from US 17
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 900 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 2290 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3020	
	Ramp Volume, V_R: 1590	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3020	0.97	Level	13	0	0.939	1.00	3316
Ramp	1590	0.95	Level	13	0	0.939	1.00	1782
UpStream	2290	0.95	Level	13	0	0.939	1.00	2567
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 1840 pc/h

V_3 or V_{av34} 1476 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1894 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5098	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3676	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.165 (Exibit 13-11)

S_R= 65.4 mph (Exhibit 13-11)

S_0= 66.7 mph (Exhibit 13-11)

S = 65.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	SB
Agency or Company	Michael Baker Jr, Inc	Junction	M-6 Rt 3 EB to 95 SB
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	AM peak	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	1300	☑ No	☐ Off
L_{up} =	1000 ft	Deceleration Lane Length L_D		L_{down} =	ft
V_u =	580 veh/h	Freeway Volume, V_F	2390	V_D =	veh/h
		Ramp Volume, V_R	350		
		Freeway Free-Flow Speed, S_{FF}	70.0		
		Ramp Free-Flow Speed, S_{FR}	50.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2390	0.93	Rolling	18	0	0.787	1.00	3264
Ramp	350	0.80	Rolling	18	0	0.787	1.00	556
UpStream	580	0.91	Rolling	18	0	0.787	1.00	809
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1607.68 (Equation 13-6 or 13-7)

P_{FM} = 0.576 using Equation (Exhibit 13-6)

V_{12} = 1879 pc/h

V_3 or V_{av34} 1385 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes,V_{12a} = 1879 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3820	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2435	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 16.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.236 (Exibit 13-11)

S_R= 63.4 mph (Exhibit 13-11)

S_0= 66.8 mph (Exhibit 13-11)

S = 64.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	SB
Agency or Company	Michael Baker Jr, inc	Junction	M-6 Rt 3 EB to 95 SB
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM peak	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	1300	☑ No ☐ Off
L_{up} =	1000 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	820 veh/h	Freeway Volume, V_F	4170	V_D = veh/h
		Ramp Volume, V_R	700	
		Freeway Free-Flow Speed, S_{FF}	70.0	
		Ramp Free-Flow Speed, S_{FR}	50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4170	0.97	Rolling	13	0	0.837	1.00	5137
Ramp	700	0.93	Rolling	13	0	0.837	1.00	899
UpStream	820	0.95	Rolling	13	0	0.837	1.00	1031
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2081.90 (Equation 13-6 or 13-7)

P_{FM} = 0.546 using Equation (Exhibit 13-6)

V_{12} = 2803 pc/h

V_3 or V_{av34} 2334 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes,V_{12a} = 2935 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6036	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3834	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 26.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.371 (Exibit 13-11)

S_R= 59.6 mph (Exhibit 13-11)

S_0= 63.9 mph (Exhibit 13-11)

S = 61.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-7 On Ramp from Rte 3 CD Road
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 1700 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 1410 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 2090	
	Ramp Volume, V_R: 2800	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2090	0.97	Rolling	14	0	0.826	1.00	2607
Ramp	2800	0.99	Grade	14	0	0.935	1.00	3026
UpStream	1410	0.86	Rolling	14	0	0.826	1.00	1984
DownStream								

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = 1447 pc/h

V_3 or V_{av34} 1160 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1489 pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5633	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4515	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.368 (Exibit 13-11)

S_R= 59.7 mph (Exhibit 13-11)

S_0= 67.8 mph (Exhibit 13-11)

S = 61.1 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-7 On Ramp from Rte 3 CD Road
Date Performed	10/23/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 1700 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 1140 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1950	
	Ramp Volume, V_R: 1200	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1950	0.97	Rolling	12	0	0.847	1.00	2372
Ramp	1200	0.94	Grade	12	0	0.943	1.00	1353
UpStream	1140	0.95	Rolling	12	0	0.847	1.00	1416
DownStream								

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = 1316 pc/h

V_3 or V_{av34} 1056 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1355 pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3725	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2708	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 9.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.070 (Exibit 13-11)

S_R= 68.0 mph (Exhibit 13-11)

S_0= 68.1 mph (Exhibit 13-11)

S = 68.1 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-11 On Ramp to I-95 NB CD Rd
Date Performed	11/12/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	130
Deceleration Lane Length L_D	
Freeway Volume, V_F	1410
Ramp Volume, V_R	670
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 400 ft

V_D = 130 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1410	0.86	Grade	14	0	0.935	1.00	1754
Ramp	670	0.99	Grade	14	0	0.935	1.00	724
UpStream								
DownStream	130	0.86	Grade	14	0	0.935	1.00	162

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1754 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2478	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2478	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.352 (Exibit 13-11)

S_R= 53.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 53.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-11 On Ramp to I-95 NB CD Rd
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☑ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☑ Off
L_{up} = ft	Acceleration Lane Length, L_A: 130	L_{down} = 400 ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = 200 veh/h
	Freeway Volume, V_F: 1140	
	Ramp Volume, V_R: 550	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1140	0.95	Grade	12	0	0.943	1.00	1272
Ramp	550	0.94	Grade	12	0	0.943	1.00	620
UpStream								
DownStream	200	0.95	Grade	12	0	0.943	1.00	223

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1272 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1892	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1892	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 19.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.331 (Exibit 13-11)

S_R= 54.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 54.0 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-14 On Ramp from I-95 SB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 180 ft	Acceleration Lane Length, L_A: 500	L_{down} = ft
V_u = 200 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 890	
	Ramp Volume, V_R: 200	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	890	0.95	Level	18	0	0.917	1.00	1021
Ramp	200	0.90	Level	18	0	0.917	1.00	242
UpStream	200	0.90	Level	18	0	0.917	1.00	242
DownStream								

Estimation of v_{12} — Merge Areas

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1021 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1263	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1385	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.277 (Exibit 13-11)

S_R= 55.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.0 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-14 On Ramp from I-95 SB
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 180 ft	Acceleration Lane Length, L_A: 500	L_{down} = ft
V_u = 150 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2290	
	Ramp Volume, V_R: 600	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2290	0.95	Level	13	0	0.939	1.00	2567
Ramp	600	0.95	Level	13	0	0.939	1.00	673
UpStream	150	0.95	Level	13	0	0.939	1.00	168
DownStream								

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2567 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3240	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3548	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.397 (Exibit 13-11)

S_R= 52.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 52.9 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-15 On Ramp from Rest Area
Date Performed	11/1/2013	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 750 ft

V_u = 110 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1400
Deceleration Lane Length L_D	
Freeway Volume, V_F	730
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	730	0.95	Level	18	0	0.917	1.00	838
Ramp	110	0.96	Level	18	0	0.917	1.00	125
UpStream	110	0.96	Level	18	0	0.917	1.00	125
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 838 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	963	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	963	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 4.2 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.163 (Exibit 13-11)

S_R= 61.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-15 On Ramp from Rest Area
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 750 ft	Acceleration Lane Length, L_A: 1400	L_{down} = ft
V_u = 270 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3460	
	Ramp Volume, V_R: 270	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3460	0.95	Level	13	0	0.939	1.00	3879
Ramp	270	0.97	Level	13	0	0.939	1.00	296
UpStream	270	0.97	Level	13	0	0.939	1.00	296
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3879 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4175	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4175	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.407 (Exibit 13-11)

S_R= 55.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZPH, CRD update
Agency/Company	Michael Baker Jr, Inc
Date Performed	10/23/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	W-4 SB weave at Rt 3
Weaving Segment Location	
Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	950ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2240	0.96	18	0	2.5	2.0	0.787	1.00	2963
V_{RF}	150	0.88	18	0	2.5	2.0	0.787	1.00	216
V_{FR}	580	0.91	18	0	2.5	2.0	0.787	1.00	809
V_{RR}	0	0.90	18	0	2.5	2.0	0.787	1.00	0
V_{NW}	2963							V =	3141
V_W	1025								
VR	0.257								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1025 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1184 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	355 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1539 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	3141 veh/h	Weaving intensity factor, W	0.331
Weaving segment capacity, c_w	6551 veh/h	Weaving segment speed, S	57.4 mph
Weaving segment v/c ratio	0.479	Average weaving speed, S_W	56.3 mph
Weaving segment density, D	17.4 pc/mi/ln	Average non-weaving speed, S_{NW}	57.8 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	5127 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZPH, CRD update
Agency/Company	Michael Baker Jr, Inc
Date Performed	10/23/2013
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	W-4 SB 95 at RT 3 weave
Weaving Segment Location	
Analysis Year	2020 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	950ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3980	0.97	13	0	2.5	2.0	0.837	1.00	4903
V_{RF}	290	0.96	13	0	2.5	2.0	0.837	1.00	361
V_{FR}	820	0.95	13	0	2.5	2.0	0.837	1.00	1031
V_{RR}	0	0.90	13	0	2.5	2.0	0.837	1.00	0
V_{NW}	4903							V =	5268
V_W	1392								
VR	0.221								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1392 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1551 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	755 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2306 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	5268 veh/h	Weaving intensity factor, W	0.455
Weaving segment capacity, c_w	7059 veh/h	Weaving segment speed, S	52.5 mph
Weaving segment v/c ratio	0.746	Average weaving speed, S_W	52.8 mph
Weaving segment density, D	30.0 pc/mi/ln	Average non-weaving speed, S_{NW}	52.4 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	4753 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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April 2016 IMR Build Alternative

2040 HCS Mainline / Ramp Junction Analysis

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*11/12/2013*	Jurisdiction	*Segment 1*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3390*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.826*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1455*	pc/h/ln
S	*69.2*	mph
D = v_p / S	*21.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 1*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*5540*	veh/h	Peak-Hour Factor, PHF	*0.98*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2224*	pc/h/ln
S	*57.8*	mph
D = v_p / S	*38.5*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 1*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3750*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1707*	pc/h/ln
S	*67.0*	mph
D = v_p / S	*25.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*South of Route 3*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 1*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*5410*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2245*	pc/h/ln
S	*57.3*	mph
D = v_p / S	*39.2*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*Between Rt 3 and Rt 17*
Date Performed	*11/12/2013*	Jurisdiction	*Segment2&3*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*2660*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.826*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1106*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.8*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*Route 3 to River*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 2 & 3*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4550*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1845*	pc/h/ln
S	*65.2*	mph
D = v_p / S	*28.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*Rest Area to Route 3*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 2*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3690*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1627*	pc/h/ln
S	*67.9*	mph
D = v_p / S	*24.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*Rest Area to Route 3*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 2*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4930*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2025*	pc/h/ln
S	*62.1*	mph
D = v_p / S	*32.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*North of US 17*
Date Performed	*11/12/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*5670*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.826*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2486*	pc/h/ln
S	*50.8*	mph
D = v_p / S	*48.9*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 NB*
Agency or Company	*BAKER*	From/To	*North of US 17*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*5380*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2251*	pc/h/ln
S	*57.2*	mph
D = v_p / S	*39.4*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*North of US17*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4250*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1874*	pc/h/ln
S	*64.7*	mph
D = v_p / S	*29.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*ZPH, CRD update*	Highway/Direction of Travel	*I-95 SB*
Agency or Company	*BAKER*	From/To	*North of US17*
Date Performed	*10/22/2013*	Jurisdiction	*Segment 4*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Build Condition*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*6950*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2854*	pc/h/ln
S	*38.3*	mph
D = v_p / S	*74.6*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-1 NB 95 to EB 3
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM peak	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	775
Freeway Volume, V_F	3390
Ramp Volume, V_R	340
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 1500 ft

V_D = 390 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3390	0.94	Rolling	14	0	0.826	1.00	4364
Ramp	340	0.84	Rolling	14	0	0.826	1.00	490
UpStream								
DownStream	390	0.98	Rolling	14	0	0.826	1.00	482

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 581.38 (Equation 13-12 or 13-13)

P_{FD} = 0.628 using Equation (Exhibit 13-7)

V_{12} = 2924 pc/h

V_3 or V_{av34} 1440 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4364	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3874	Exhibit 13-8	7200	No
V_R	490	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2924	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 22.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.277 (Exhibit 13-12)

S_R= 62.2 mph (Exhibit 13-12)

S_0= 75.1 mph (Exhibit 13-12)

S = 66.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-1 95 NB to Rt 3 EB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM peak	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	775
Freeway Volume, V_F	5540
Ramp Volume, V_R	300
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 1500 ft

V_D = 690 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5540	0.98	Rolling	12	0	0.847	1.00	6671
Ramp	300	1.00	Rolling	12	0	0.847	1.00	354
UpStream								
DownStream	690	0.98	Rolling	12	0	0.847	1.00	831

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 1032.08 (Equation 13-12 or 13-13)

P_{FD} = 0.577 using Equation (Exhibit 13-7)

V_{12} = 3999 pc/h

V_3 or V_{av34} 2672 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6671	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	6317	Exhibit 13-8	7200	No
V_R	354	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3999	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.265 (Exhibit 13-12)

S_R= 62.6 mph (Exhibit 13-12)

S_0= 70.3 mph (Exhibit 13-12)

S = 65.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-4 Off Ramp to US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp
- ☐ Yes ☐ On
- ☑ No ☐ Off
- L_{up} = ft
- V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	4250
Ramp Volume, V_R	1140
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp
- ☑ Yes ☐ On
- ☐ No ☑ Off
- L_{down} = 2500 ft
- V_D = 890 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4250	0.96	Rolling	18	0	0.787	1.00	5622
Ramp	1140	0.88	Rolling	18	0	0.787	1.00	1645
UpStream								
DownStream	890	0.95	Rolling	18	0	0.787	1.00	1190

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 3435 pc/h

V_3 or V_{av34} 2187 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5622	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3977	Exhibit 13-8	7200	No
V_R	1645	Exhibit 13-10	4200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3435	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 17.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.381 (Exhibit 13-12)

S_R= 59.3 mph (Exhibit 13-12)

S_0= 72.2 mph (Exhibit 13-12)

S = 63.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-4 Off Ramp to US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	6950
Ramp Volume, V_R	1390
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 2500 ft

V_D = 2620 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6950	0.97	Rolling	13	0	0.837	1.00	8562
Ramp	1390	0.98	Rolling	13	0	0.837	1.00	1695
UpStream								
DownStream	2620	0.95	Rolling	13	0	0.837	1.00	3296

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 4785 pc/h

V_3 or V_{av34} 3777 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 5862 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

	Actual	Capacity		LOS F?
V_F	8562	Exhibit 13-8	7200	Yes
$V_{FO} = V_F - V_R$	6867	Exhibit 13-8	7200	No
V_R	1695	Exhibit 13-10	4200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4785	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.1 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.386 (Exhibit 13-12)

S_R= 59.2 mph (Exhibit 13-12)

S_0= 70.2 mph (Exhibit 13-12)

S = 62.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-7 Off Ramp to US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp
- ☐ Yes ☐ On
- ☑ No ☐ Off
- L_{up} = ft
- V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	2660
Ramp Volume, V_R	1990
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp
- ☑ Yes ☑ On
- ☐ No ☐ Off
- L_{down} = 1700 ft
- V_D = 3450 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2660	0.97	Grade	14	0	0.935	1.00	2934
Ramp	1990	0.86	Grade	14	0	0.935	1.00	2476
UpStream								
DownStream	3450	0.99	Grade	14	0	0.935	1.00	3729

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 2682 pc/h

V_3 or V_{av34} 252 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2934	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	458	Exhibit 13-8	7200	No
V_R	2476	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2682	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 10.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.326 (Exhibit 13-12)

S_R= 60.9 mph (Exhibit 13-12)

S_0= 76.8 mph (Exhibit 13-12)

S = 62.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-7 Off Ramp to US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	4550
Ramp Volume, V_R	1610
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1700 ft

V_D = 1450 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4550	0.97	Grade	12	0	0.943	1.00	4972
Ramp	1610	0.95	Grade	12	0	0.943	1.00	1796
UpStream								
DownStream	1450	0.94	Grade	12	0	0.943	1.00	1635

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 3225 pc/h

V_3 or V_{av34} 1747 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4972	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3176	Exhibit 13-8	7200	No
V_R	1796	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3225	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 15.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.265 (Exhibit 13-12)

S_R= 62.6 mph (Exhibit 13-12)

S_0= 73.9 mph (Exhibit 13-12)

S = 66.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-9OffRamp to Rte 3CD/RestArea
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	3110
Ramp Volume, V_R	890
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 900 ft
V_D = 1470 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3110	0.96	Level	18	0	0.917	1.00	3531
Ramp	890	0.95	Level	18	0	0.917	1.00	1021
UpStream								
DownStream	1470	0.90	Level	18	0	0.917	1.00	1780

Merge Areas

Estimation of v_{12}

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

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

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 0.450 using Equation (Exhibit 13-7)
V_{12} = 2150 pc/h
V_3 or V_{av34} 1381 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3531	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2510	Exhibit 13-8	7200	No
V_R	1021	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2150	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 6.2 (pc/mi/ln)
LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.195 (Exhibit 13-12)
S_R= 64.5 mph (Exhibit 13-12)
S_0= 75.3 mph (Exhibit 13-12)
S = 68.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	D-9OffRamp to Rte 3CD/RestArea
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	5560
Ramp Volume, V_R	2950
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 900 ft

V_D = 2620 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5560	0.97	Level	13	0	0.939	1.00	6105
Ramp	2950	0.95	Level	13	0	0.939	1.00	3307
UpStream								
DownStream	2620	0.95	Level	13	0	0.939	1.00	2937

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 using Equation (Exhibit 13-7)

V_{12} = 4566 pc/h

V_3 or V_{av34} 1539 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6105	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	2798	Exhibit 13-8	7200	No
V_R	3307	Exhibit 13-10	4400	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4566	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.401 (Exhibit 13-12)

S_R= 58.8 mph (Exhibit 13-12)

S_0= 74.7 mph (Exhibit 13-12)

S = 62.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-11 Off Ramp to US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	225	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4400	V_D =	veh/h
		Ramp Volume, V_R	950		
		Freeway Free-Flow Speed, S_{FF}	65.0		
		Ramp Free-Flow Speed, S_{FR}	60.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4400	0.99	Grade	14	0	0.935	1.00	4756
Ramp	950	0.99	Grade	14	0	0.935	1.00	1027
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4756 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4756	Exhibit 13-8	4700	Yes
$V_{FO} = V_F - V_R$	3729	Exhibit 13-8	4700	No
V_R	1027	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4756	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 43.1 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.195 (Exhibit 13-12)

S_R= 60.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 60.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-11 Off Ramp to US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	225	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2220	V_D =	veh/h
		Ramp Volume, V_R	770		
		Freeway Free-Flow Speed, S_{FF}	65.0		
		Ramp Free-Flow Speed, S_{FR}	60.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2220	0.94	Grade	12	0	0.943	1.00	2503
Ramp	770	0.94	Grade	12	0	0.943	1.00	868
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2503 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2503	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1635	Exhibit 13-8	4700	No
V_R	868	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2503	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.181 (Exhibit 13-12)

S_R= 60.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 60.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-12 Off Ramp to US 17 EB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 400 ft

V_u = 950 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	2940
Ramp Volume, V_R	170
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2940	0.86	Grade	14	0	0.935	1.00	3658
Ramp	170	0.86	Grade	14	0	0.935	1.00	212
UpStream	950	0.99	Grade	14	0	0.935	1.00	1027
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3658 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3658	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3446	Exhibit 13-8	4600	No
V_R	212	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3658	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.122 (Exhibit 13-12)

S_R= 57.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 57.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-12 Off Ramp to US 17 EB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 400 ft

V_u = 770 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	2380
Ramp Volume, V_R	250
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2380	0.95	Grade	12	0	0.943	1.00	2656
Ramp	250	0.95	Grade	12	0	0.943	1.00	279
UpStream	770	0.94	Grade	12	0	0.943	1.00	868
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2656 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2656	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2377	Exhibit 13-8	4600	No
V_R	279	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2656	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.128 (Exhibit 13-12)

S_R= 57.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 57.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-15 Off Ramp to Rest Area
Date Performed	6/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	1090
Ramp Volume, V_R	150
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 750 ft

V_D = 150 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1090	0.95	Grade	18	0	0.917	1.00	1251
Ramp	150	0.96	Grade	18	0	0.917	1.00	170
UpStream								
DownStream	150	0.96	Level	18	0	0.917	1.00	170

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1251 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1251	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1081	Exhibit 13-8	4700	No
V_R	170	Exhibit 13-10	2200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1251	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 10.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.118 (Exhibit 13-12)

S_R= 62.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-15 Off Ramp to Rest Area
Date Performed	6/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	3730
Ramp Volume, V_R	270
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 750 ft

V_D = 270 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3730	0.97	Grade	13	0	0.939	1.00	4095
Ramp	270	0.97	Grade	13	0	0.939	1.00	296
UpStream								
DownStream	270	0.97	Level	13	0	0.939	1.00	296

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4095 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4095	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3799	Exhibit 13-8	4700	No
V_R	296	Exhibit 13-10	2200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4095	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.130 (Exhibit 13-12)

S_R= 62.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-16 Off Ramp to Rest Area
Date Performed	6/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1200 ft

V_u = 150 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	1090
Ramp Volume, V_R	150
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1090	0.95	Level	18	0	0.917	1.00	1251
Ramp	150	0.96	Level	18	0	0.917	1.00	170
UpStream	150	0.96	Level	18	0	0.917	1.00	170
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1251 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1251	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1081	Exhibit 13-8	4700	No
V_R	170	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1251	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 10.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.118 (Exhibit 13-12)

S_R= 62.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr., Inc.	Junction	D-16 Off Ramp to Rest Area
Date Performed	6/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1200 ft

V_u = 270 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	3730
Ramp Volume, V_R	270
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3730	0.97	Level	12	0	0.943	1.00	4076
Ramp	270	0.97	Level	12	0	0.943	1.00	295
UpStream	270	0.97	Level	12	0	0.943	1.00	295
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4076 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4076	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3781	Exhibit 13-8	4700	No
V_R	295	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4076	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.130 (Exhibit 13-12)

S_R= 62.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-17 NB 95 to WB 3
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM peak	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1500 ft

V_u = 340 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1200
Freeway Volume, V_F	3050
Ramp Volume, V_R	390
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3050	0.94	Rolling	14	0	0.826	1.00	3926
Ramp	390	0.84	Rolling	14	0	0.826	1.00	562
UpStream	340	0.98	Rolling	14	0	0.826	1.00	420
DownStream								

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.636 using Equation (Exhibit 13-7)

V_{12} = 2701 pc/h

V_3 or V_{av34} 1225 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3926	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3364	Exhibit 13-8	7200	No
V_R	562	Exhibit 13-10	2200	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2701	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 16.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Speed Determination

D_s = 0.154 (Exhibit 13-12)

S_R= 65.7 mph (Exhibit 13-12)

S_0= 75.9 mph (Exhibit 13-12)

S = 68.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	NB
Agency or Company	Michael Baker Jr, Inc	Junction	D-17 NB 95 to WB 3
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM peak	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1500 ft

V_u = 300 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1200
Freeway Volume, V_F	5240
Ramp Volume, V_R	690
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5240	0.94	Rolling	14	0	0.826	1.00	6745
Ramp	690	0.84	Rolling	14	0	0.826	1.00	994
UpStream	300	0.98	Rolling	14	0	0.826	1.00	370
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.546 using Equation (Exhibit 13-7)

V_{12} = 4132 pc/h

V_3 or V_{av34} 2613 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6745	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5751	Exhibit 13-8	7200	No
V_R	994	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4132	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.192 (Exhibit 13-12)

S_R= 64.6 mph (Exhibit 13-12)

S_0= 70.5 mph (Exhibit 13-12)

S = 66.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-3 On Ramp from US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 3500 ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = 3450 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 4120	
	Ramp Volume, V_R: 1550	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4120	0.92	Rolling	14	0	0.826	1.00	5419
Ramp	1550	0.91	Rolling	14	0	0.826	1.00	2061
UpStream	3450	0.99	Rolling	14	0	0.826	1.00	4217
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 3281 pc/h

V_3 or V_{av34} 2138 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 3281 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7480	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5342	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 39.9 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 1.036 (Exibit 13-11)

S_R= 41.0 mph (Exhibit 13-11)

S_0= 64.1 mph (Exhibit 13-11)

S = 45.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-3 On Ramp from US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 3500 ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = 700 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 4390	
	Ramp Volume, V_R: 990	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4390	0.94	Rolling	12	0	0.847	1.00	5511
Ramp	990	0.93	Rolling	12	0	0.847	1.00	1256
UpStream	700	0.94	Rolling	12	0	0.847	1.00	879
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 3337 pc/h

V_3 or V_{av34} 2174 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 3337 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6767	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4593	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 34.5 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.606 (Exibit 13-11)

S_R= 53.0 mph (Exhibit 13-11)

S_0= 64.0 mph (Exhibit 13-11)

S = 56.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-4 On Ramp from US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 900 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 890 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2200	
	Ramp Volume, V_R: 1470	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2200	0.96	Level	18	0	0.917	1.00	2498
Ramp	1470	0.90	Level	18	0	0.917	1.00	1780
UpStream	890	0.95	Level	18	0	0.917	1.00	1021
DownStream								

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = 1386 pc/h

V_3 or V_{av34} 1112 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1427 pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4278	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3207	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 13.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.108 (Exibit 13-11)

S_R= 67.0 mph (Exhibit 13-11)

S_0= 67.9 mph (Exhibit 13-11)

S = 67.2 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-4 On Ramp from US 17
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 900 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 2950 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2620	
	Ramp Volume, V_R: 2320	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2620	0.97	Level	13	0	0.939	1.00	2877
Ramp	2320	0.95	Level	13	0	0.939	1.00	2601
UpStream	2950	0.95	Level	13	0	0.939	1.00	3307
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 1597 pc/h

V_3 or V_{av34} 1280 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1644 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5478	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4245	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 21.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.283 (Exibit 13-11)

S_R= 62.1 mph (Exhibit 13-11)

S_0= 67.4 mph (Exhibit 13-11)

S = 63.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	SB
Agency or Company	Michael Baker Jr, Inc	Junction	M-6 Rt 3 EB to 95 SB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM peak	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	1300	☑ No	☐ Off
		Deceleration Lane Length L_D			
		Freeway Volume, V_F	3300		
L_{up} =	1000 ft	Ramp Volume, V_R	450	L_{down} =	ft
		Freeway Free-Flow Speed, S_{FF}	70.0		
V_u =	720 veh/h	Ramp Free-Flow Speed, S_{FR}	50.0	V_D =	veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3300	0.93	Rolling	18	0	0.787	1.00	4506
Ramp	450	0.80	Rolling	18	0	0.787	1.00	714
UpStream	720	0.91	Rolling	18	0	0.787	1.00	1005
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1907.28 (Equation 13-6 or 13-7)

P_{FM} = 0.557 using Equation (Exhibit 13-6)

V_{12} = 2508 pc/h

V_3 or V_{av34} 1998 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2574 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5220	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3288	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.295 (Exibit 13-11)

S_R= 61.7 mph (Exhibit 13-11)

S_0= 64.8 mph (Exhibit 13-11)

S = 62.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	ZPH, CRD update	Freeway/Dir of Travel	SB
Agency or Company	Michael Baker Jr, inc	Junction	M-6 Rt 3 EB to 95 SB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM peak	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 1000 ft	Acceleration Lane Length, L_A: 1300	L_{down} = ft
V_u = 1020 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4520	
	Ramp Volume, V_R: 890	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4520	0.97	Rolling	13	0	0.837	1.00	5568
Ramp	890	0.93	Rolling	13	0	0.837	1.00	1144
UpStream	1020	0.95	Rolling	13	0	0.837	1.00	1283
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2226.57 (Equation 13-6 or 13-7)

P_{FM} = 0.536 using Equation (Exhibit 13-6)

V_{12} = 2987 pc/h

V_3 or V_{av34} 2581 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 3181 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6712	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4325	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.5 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.486 (Exibit 13-11)

S_R= 56.4 mph (Exhibit 13-11)

S_0= 62.9 mph (Exhibit 13-11)

S = 58.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-7 On Ramp from Rte 3 CD Road
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 1700 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 2740 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 670	
	Ramp Volume, V_R: 3450	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	670	0.97	Rolling	14	0	0.826	1.00	836
Ramp	3450	0.99	Grade	14	0	0.935	1.00	3729
UpStream	2740	0.86	Rolling	14	0	0.826	1.00	3855
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 464 pc/h

V_3 or V_{av34} 372 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 477 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4565	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4206	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 20.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.273 (Exibit 13-11)

S_R= 62.4 mph (Exhibit 13-11)

S_0= 70.0 mph (Exhibit 13-11)

S = 62.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB
Agency or Company	Michael Baker Jr., Inc.	Junction	M-7 On Ramp from Rte 3 CD Road
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 1700 ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = 1990 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2940	
	Ramp Volume, V_R: 1450	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2940	0.97	Rolling	12	0	0.847	1.00	3576
Ramp	1450	0.94	Grade	12	0	0.943	1.00	1635
UpStream	1990	0.95	Rolling	12	0	0.847	1.00	2472
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 1985 pc/h

V_3 or V_{av34} 1591 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2043 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5211	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3678	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.166 (Exibit 13-11)

S_R= 65.4 mph (Exhibit 13-11)

S_0= 66.3 mph (Exhibit 13-11)

S = 65.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr,, Inc.	Junction	M-10 On Ramp from Rest Area
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3690	
	Ramp Volume, V_R: 150	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3690	0.96	Level	18	0	0.917	1.00	4190
Ramp	150	0.96	Level	18	0	0.917	1.00	170
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 2488 pc/h

V_3 or V_{av34} 1702 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2488 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4360	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2658	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.5 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.307 (Exibit 13-11)

S_R= 61.4 mph (Exhibit 13-11)

S_0= 65.7 mph (Exhibit 13-11)

S = 63.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB
Agency or Company	Michael Baker Jr,, Inc.	Junction	M-10 On Ramp from Rest Area
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 580	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4930	
	Ramp Volume, V_R: 270	
	Freeway Free-Flow Speed, S_{FF}: 70.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4930	0.97	Level	13	0	0.939	1.00	5413
Ramp	270	0.97	Level	13	0	0.939	1.00	296
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 3214 pc/h

V_3 or V_{av34} 2199 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 3214 pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5709	Exhibit 13-8		No

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3510	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.382 (Exibit 13-11)

S_R= 59.3 mph (Exhibit 13-11)

S_0= 63.9 mph (Exhibit 13-11)

S = 61.0 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-11 On Ramp to I-95 NB CD Rd
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	130
Deceleration Lane Length L_D	
Freeway Volume, V_F	1990
Ramp Volume, V_R	950
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 400 ft

V_D = 170 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1990	0.86	Grade	14	0	0.935	1.00	2476
Ramp	950	0.99	Grade	14	0	0.935	1.00	1027
UpStream								
DownStream	170	0.86	Grade	14	0	0.935	1.00	212

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2476 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3503	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3503	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 31.5 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.435 (Exibit 13-11)

S_R= 52.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 52.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 NB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-11 On Ramp to I-95 NB CD Rd
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	130
Deceleration Lane Length L_D	
Freeway Volume, V_F	1610
Ramp Volume, V_R	770
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 400 ft

V_D = 250 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1610	0.95	Grade	12	0	0.943	1.00	1796
Ramp	770	0.94	Grade	12	0	0.943	1.00	868
UpStream								
DownStream	250	0.95	Grade	12	0	0.943	1.00	279

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1796 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2664	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2664	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 25.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.361 (Exibit 13-11)

S_R= 53.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 53.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-14 On Ramp from I-95 SB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 180 ft	Acceleration Lane Length, L_A: 300	L_{down} = ft
V_u = 200 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 890	
	Ramp Volume, V_R: 200	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	890	0.95	Level	18	0	0.917	1.00	1021
Ramp	200	0.90	Level	18	0	0.917	1.00	242
UpStream	200	0.90	Level	18	0	0.917	1.00	242
DownStream								

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1021 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1263	Exhibit 13-8		No

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1385	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 13.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.301 (Exibit 13-11)

S_R= 54.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 54.6 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-14 On Ramp from I-95 SB
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 180 ft	Acceleration Lane Length, L_A: 500	L_{down} = ft
V_u = 200 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2950	
	Ramp Volume, V_R: 780	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2950	0.96	Level	13	0	0.939	1.00	3273
Ramp	780	0.96	Level	13	0	0.939	1.00	865
UpStream	200	0.96	Level	13	0	0.939	1.00	222
DownStream								

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3273 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4138	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4530	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 34.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.623 (Exibit 13-11)

S_R= 48.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 48.8 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-15 On Ramp from Rest Area
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 750 ft	Acceleration Lane Length, L_A: 1400	L_{down} = ft
V_u = 150 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 940	
	Ramp Volume, V_R: 150	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	940	0.95	Level	18	0	0.917	1.00	1079
Ramp	150	0.96	Level	18	0	0.917	1.00	170
UpStream	150	0.96	Level	18	0	0.917	1.00	170
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1079 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1249	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1249	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 6.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.167 (Exibit 13-11)

S_R= 61.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CRD	Freeway/Dir of Travel	I-95 SB CD Road
Agency or Company	Michael Baker Jr,. Inc.	Junction	M-15 On Ramp from Rest Area
Date Performed	06/2014	Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 750 ft	Acceleration Lane Length, L_A: 130	L_{down} = ft
V_u = 270 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3460	
	Ramp Volume, V_R: 270	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 60.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3460	0.95	Level	13	0	0.939	1.00	3879
Ramp	270	0.97	Level	13	0	0.939	1.00	296
UpStream	270	0.97	Level	13	0	0.939	1.00	296
DownStream								

Estimation of v_{12}

Merge Areas

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3879 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4175	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4175	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 37.1 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.559 (Exibit 13-11)

S_R= 52.1 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 52.1 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZPH, CRD update
Agency/Company	Michael Baker Jr, Inc
Date Performed	06/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	W-4 SB weave at Rt 3
Weaving Segment Location	
Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	950ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3120	0.96	18	0	2.5	2.0	0.787	1.00	4128
V_{RF}	180	0.88	18	0	2.5	2.0	0.787	1.00	260
V_{FR}	720	0.91	18	0	2.5	2.0	0.787	1.00	1005
V_{RR}	0	0.90	18	0	2.5	2.0	0.787	1.00	0
V_{NW}	4128							V =	4247
V_W	1265								
VR	0.235								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1265 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1424 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	595 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2019 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	4247 veh/h	Weaving intensity factor, W	0.410
Weaving segment capacity, c_w	6608 veh/h	Weaving segment speed, S	54.3 mph
Weaving segment v/c ratio	0.643	Average weaving speed, S_W	54.0 mph
Weaving segment density, D	24.8 pc/mi/ln	Average non-weaving speed, S_{NW}	54.4 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	4893 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZPH, CRD update
Agency/Company	Michael Baker Jr, Inc
Date Performed	06/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	W-4 SB 95 at RT 3 weave
Weaving Segment Location	
Analysis Year	2040 Build Condition

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	950ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4180	0.97	13	0	2.5	2.0	0.837	1.00	5150
V_{RF}	340	0.96	13	0	2.5	2.0	0.837	1.00	423
V_{FR}	1020	0.95	13	0	2.5	2.0	0.837	1.00	1283
V_{RR}	0	0.90	13	0	2.5	2.0	0.837	1.00	0
V_{NW}	5150							V =	5738
V_W	1706								
VR	0.249								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1706 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1865 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	805 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2670 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	5738 veh/h	Weaving intensity factor, W	0.511
Weaving segment capacity, c_w	6986 veh/h	Weaving segment speed, S	50.0 mph
Weaving segment v/c ratio	0.821	Average weaving speed, S_W	51.4 mph
Weaving segment density, D	34.3 pc/mi/ln	Average non-weaving speed, S_{NW}	49.5 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	5042 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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April 2016 IMR Build Alternative

2020 CORSIM Analysis

2020 Build AM CORSIM Results

Interstate 95 Northbound AM

	Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segments									
Mainline Actual Volumes	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Mainline Simulated Volumes	3,504	3,504	3,505	3,505	3,495	3,495	3,492	3,492	3,492	3,493	3,496	3,497	3,497	3,500	3,498	3,497
Ramp Actual Volumes		765 ft	300	1,100 ft	310											I-95 Bridge
Ramp Simulated Volumes			297 Ramp I		316 Ramp K											
Distance	449	6,345	398	1,312	1,175	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
Speed	67.2	66.7	66.1	66.0	66.3	66.3	66.2	66.2	66.1	66.0	66.0	65.9	65.9	65.8	65.8	65.3
Density	21.3	19.7	19.2	15.0	17.5	17.6	17.6	17.6	17.6	17.6	17.7	17.7	17.7	17.7	17.7	17.8
	2	1	16	13	14	19	6	7	8	24	30	25	31	26	32	27 33

	Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segments									
Actual Volumes	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Simulated Volumes	3,504	3,504	3,505	3,505	3,495	3,495	3,492	3,492	3,492	3,493	3,496	3,497	3,497	3,500	3,498	3,497
		765 ft	270 297	847 ft	280 316											I-95 Bridge
Distance	449	6,345	398	1,312	1,175	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
3 Lane 3 Speed	67.2	66.9	66.5	66.5	66.4	66.3	66.3	66.2	66.2	66.1	66.0	65.9	65.9	65.9	65.8	66.1
Lane 3 Density	19.5	18.3	16.8	16.6	16.6	16.6	16.6	16.6	16.7	16.6	16.6	16.7	16.6	16.6	16.6	14.9
2 Lane 2 Speed	67.2	67.3	66.9	66.7	66.7	66.7	66.6	66.5	66.5	66.4	66.3	66.3	66.2	66.2	66.2	66.3
Lane 2 Density	21.9	20.8	20.0	19.3	19.1	19.0	19.0	19.1	19.0	19.1	19.1	19.0	19.1	19.1	19.1	18.3
1 Lane 1 Speed	67.2	66.3	65.0	65.4	65.9	65.9	65.8	65.7	65.7	65.6	65.6	65.5	65.5	65.4	65.4	63.9
Lane 1 Density	22.5	21.7	20.9	17.5	16.9	17.0	17.1	17.1	17.1	17.2	17.3	17.4	17.4	17.5	17.5	20.4
9 Ramp Speed		56.5		63.6												
Ramp Density		0.6		4.1												
	2	1	16	13	14	19	6	7	8	24	30	25	31	26	32	27 33

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10
Freeway	Ramp

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build AM CORSIM Results

Interstate 95 Northbound AM

		Freeway Segment	Ramp/Weave	Freeway Segments		Ramp/Weave	Freeway Segment
Mainline	Actual Volumes	3					3
		2 3,500	3,500	2,090	4,890	6,020	2 6,020
	Simulated Volumes	1 3,497	3,497	2,096	4,980	6,094	1 6,078
Ramp	Actual Volumes		9 800 ft	1,410	2,800	1,130	
	Simulated Volumes			1,402	2,884	1,114	
		I-95 Bridge		To Route 17 Ramps	Ramps from CD Road	Ramps B and D	
	Distance	2,789	1,320	1,258	4,879	1,653	2,319
	Speed	65.3	62.1	66.6	61.2	50.1	61.0
	Density	17.8	15.6	10.5	18.8	33.7	33.2
		27	33	28	34	37	51 52

		Freeway Segment	Ramp/Weave	Freeway Segments		Ramp/Weave	Freeway Segment
		3					3
Actual Volumes		2 3,500	3,500	2,090	4,890	6,020	2 6,020
Simulated Volumes		1 3,497	3,497	2,096	4,980	6,094	1 6,078
			9 800 ft	1,620		1,130	
				1,402		1,114	
		I-95 Bridge		To Route 17 Ramps	Ramps from CD Road	Ramps B and D	
	Distance	2,789	1,320	1,258	4,879	1,653	2,319
3 Lane 3	Speed	66.1	67.4	67.7	67.2	65.6	64.4
	Density	14.9	10.6	10.8	16.2	25.4	32.5
2 Lane 2	Speed	66.3	65.2	67.3	64.6	57.0	60.4
	Density	18.3	13.8	12.7	24.2	36.2	33.8
1 Lane 1	Speed	63.9	58.8	64.2	56.7	39.3	58.2
	Density	20.4	26.1	7.9	35.5	54.7	33.4
9 Ramp	Speed		60.4			40.1	
	Density		5.8			5.2	
		27	33	28	34	37	51 52

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build AM CORSIM Results

Interstate 95 Southbound AM

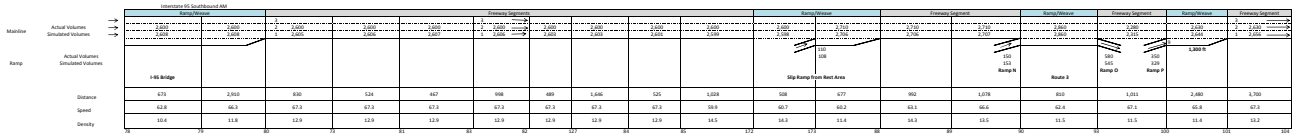
		Freeway Segment	Ramp/Weave			Freeway Segment	Ramp/Weave			
Mainline	Actual Volumes	3								
		2 3,090	3,090	2,250	2,250	1,560	2,600	2,600	2,600	2,600
	Simulated Volumes	1 3,091	3,089	2,258	2,256	1,588	2,606	2,608	2,609	2,608
Ramp	Actual Volumes		9 960 ft		9					
	Simulated Volumes			840 832		690 668	1,040 1,018			
				Ramps E & G	**Route 17**	**To CD Road**	**Ramps F & H**			**I-95 Bridge**
	Distance	4,643	715	1,069	1,335	974	1,076	625	716	673
	Speed	59.3	66.3	67.5	65.4	67.0	61.6	65.9	61.3	62.8
	Density	17.7	11.6	8.4	8.6	7.9	8.5	7.9	9.3	10.4
		57	278	279	280	281 287	233	283	78	79

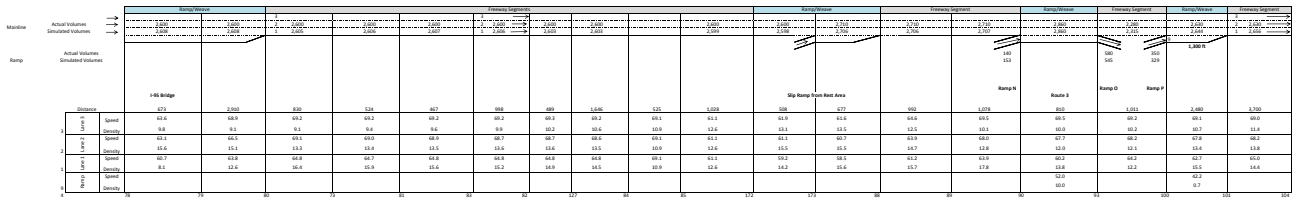
			Freeway Segment	Ramp/Weave			Freeway Segment	Ramp/Weave			
Mainline	Actual Volumes		3								
			2 3,090	3,090	2,250	2,250	1,560	2,600	2,600	2,600	2,600
	Simulated Volumes		1 3,091	3,089	2,258	2,256	1,588	2,606	2,608	2,609	2,608
Ramp	Actual Volumes			9 960 ft		9					
	Simulated Volumes				840 832		690 668	1,040 1,018			
					Ramps E & G	**Route 17**	**To CD Road**	**Ramps F & H**			**I-95 Bridge**
	Distance		4,643	715	1,069	1,335	974	1,076	625	716	673
3	Lane 3	Speed	59.3	67.5	69.3	68.7	68.7	68.7	65.7	61.7	63.6
		Density	16.2	11.9	8.4	6.9	7.0	7.0	8.5	9.5	9.8
2	Lane 2	Speed	59.5	66.0	66.1	69.0	69.2	69.3	62.9	60.9	63.1
		Density	18.4	15.0	16.8	8.0	8.3	8.4	15.0	12.9	15.6
1	Lane 1	Speed	59.3	64.7	68.1	62.6	63.3	63.6	60.9	58.1	60.7
		Density	18.5	12.8	1.3	17.3	8.4	9.5	0.5	7.4	8.1
9	Ramp	Speed		64.9		64.2		54.5	69.2		
		Density		1.7		2.3		13.8	8.5		
4			57	278	279	280	281 287	233	283	78	79

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build AM CORSIM Results





Freeway Density	Weave/Ramp Density	Freeway, Weave, and Ramp Density Coloring
Above 45	Above 43	Density Above 26
35 to 45	35 to 43	Density Above 35
26 to 35	28 to 35	Density Above 43
18 to 26	20 to 28	
11 to 18	10 to 20	
0 to 11	0 to 10	

2020 Build AM CORSIM Results

Interstate 95 Northbound AM - CD Lane

		Freeway Segment		Ramp/Weave								Freeway Segment						
CD Lane	Actual Volume	2,320	2,320	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470	3,470
	Simulated Volume	2,278	2,274	3,567	3,538	3,537	3,541	3,565	3,568	3,574	3,575	3,558	3,544	3,538	3,535	3,533	3,531	3,529
Ramp	Actual Volume		1,150															
	Simulated Volume		1,253															
			Ramp L															
	Distance	97	141	318	196	1,966	273	508	662	808	626	827	769	593	663	637	674	2,796
	Speed	41.7	45.5	51.4	55.6	55.1	54.2	56.1	56.9	49.7	34.8	48.0	54.5	55.6	55.3	55.3	55.3	54.9
	Density	13.6	13.5	17.2	15.9	16.4	21.9	21.2	20.9	24.0	36.7	37.0	32.5	31.8	31.9	31.9	31.9	32.2
		108	86	17	5	12	11	209	72	71	70	66	114	117	119	120	123	124	125

		Freeway Segment		Ramp/Weave								Freeway Segment						
CD Lane	Actual Volume	2320	2320	3,470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470
	Simulated Volume	2,278	2,274	3,567	3,538	3,537	3,541	3,565	3,568	3,574	3,575	3,558	3,544	3,538	3,535	3,533	3,531	3,529
Ramp	Actual Volume		1,150															
	Simulated Volume		1,253															
			Ramp L															
	Distance	97	141	318	196	1,966	273	508	662	808	626	827	769	593	663	637	674	2,796
Lane 1	Speed	38.8	45.6	50.8	55.2	54.8	51.8	54.7	56.1	57.6	35.1	46.5	54.5	54.9	54.6	54.7	54.6	54.6
	Density	0.1	9.6	17.7	20.6	10.7	30.2	27.7	24.3	12.0	20.8	37.9	31.7	31.1	31.0	30.9	30.7	30.1
Lane 2	Speed	40.7	45.0	51.9	55.4	53.0	55.4	56.6	57.2	44.7	29.8	49.5	54.5	56.3	56.1	56.0	56.0	55.2
	Density	20.7	17.9	14.9	16.9	27.6	21.3	21.1	22.9	41.1	59.8	36.1	33.3	32.5	32.8	33.0	33.1	34.2
Lane 3	Speed	42.1	46.1	52.4	55.7	56.7	57.7	57.9										
	Density	18.0	15.5	12.9	14.0	15.3	14.2	14.8										
Ramp	Speed	42.5	45.3	51.0	56.5	58.4												
	Density	15.7	7.0	23.2	12.0	10.8												
		108	86	17	5	12	11	209	72	71	70	66	114	117	119	120	123	124	125

2020 Build AM CORSIM Results

Intersate 95 Northbound AM - CD Lane

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	3,470	3,470	670	2,080	2,080	2,080	1,950
	Simulated Volume	3,529	3,539	678	2,078	2,078	2,078	1,898
Ramp	Actual Volume		2,800	1,410				130
	Simulated Volume		2,861	1,400				179
			To Mainline	**From Northbound I-95 Mainline (left entrance)**				**To Route 17 southbound**
	Distance	2,796	1,542	435	585	373	280	388
	Speed	54.9	53.1	56.8	55.4	57.7	54.2	50.2
	Density	32.2	33.4	11.9	12.5	12.0	12.8	18.9
		124	125 129	76	74	77	75	126

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	3470	3470	670	2080	2080	2080	1,950
	Simulated Volume	3,529	3,539	678	2,078	2,078	2,078	1,898
Ramp	Actual Volume		2800	1,410				130
	Simulated Volume		2,861	1,400				179
			To Mainline	**From Northbound I-95 Mainline (left entrance)**				**To Route 17 southbound**
	Distance	2,796	1,542	435	585	373	280	388
Lane 1	Speed	54.6	51.7	56.8	59.3	59.0	53.8	50.1
	Density	30.1	38.4	11.9	6.4	3.5	21.0	21.6
Lane 2	Speed	55.2	55.1		55.5	57.7	54.4	50.4
	Density	34.2	28.4		17.1	19.5	14.0	16.1
Lane 3	Speed				53.5	57.4		
	Density				13.9	13.0		
Ramp	Speed							
	Density							
		124	125 129	76	74	77	75	126

2020 Build AM CORSIM Results

Interstate 95 Southbound AM - Part 1

			Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane	Actual Volume		840	840	840	840	350
	Simulated Volume		832	833	833	832	337
Ramp	Actual Volume						490
	Simulated Volume						495
							Ramp E **To Ramp G**
		Distance	729	94	294	134	266
		Speed	49.6	49.2	43.1	38.9	39.5
		Density	8.4	5.6	8.9	10.7	8.5
			279	199	222	216	210 200

				Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane	Actual Volume			840	840	840	840	350
	Simulated Volume			832	833	833	832	337
Ramp	Actual Volume							490
	Simulated Volume							495
								Ramp E **To Ramp G**
			Distance	729	94	294	134	266
		Lane 1	Speed	50.5	49.5	43.1	39.3	39.5
			Density	5.4	8.2	10.2	8.6	8.5
		Lane 2	Speed	49.1	49.0	42.7	38.7	
			Density	11.4	8.7	8.3	12.8	
				279	199	222	216	210 200

2020 Build AM CORSIM Results

CD Road Southbound AM - Part 2

		Freeway Segment			Ramp/Weave		Freeway Segment			
CD Lane	Actual Volume	690	690	690	840	840	840	840	840	840
	Simulated Volume	667	667	667	809	809	810	809	809	809
	Actual Volume			150						
	Simulated Volume			142						
				From Rt 17						
	Distance	117	216	377	292	358	544	742	674	1,003
	Speed	49.7	49.7	49.1	47.4	54.7	58.3	58.8	58.9	59.1
	Density	4.5	6.0	6.8	5.7	6.1	6.9	6.9	6.9	6.8
		203	214	231	202	220	201	185	184	183	177

		Freeway Segment			Ramp/Weave		Freeway Segment			
CD Lane	Actual Volume	690	690	690	840	840	840	840	840	840
	Simulated Volume	667	667	667	809	809	810	809	809	809
				142						
				From Rt 17						
	Distance	117	216	377	292	358	544	742	674	1,003
Lane 1	Speed	51.4	52.0	50.3	36.7	56.5	58.3	58.7	58.8	59.0
	Density	2.3	1.1	0.8	0.2	6.2	8.0	7.2	6.5	6.0
Lane	Speed	51.4	49.5	49.0	50.4	54.2	58.3	59.0	59.1	59.1
	Density	2.3	10.3	12.8	11.9	6.9	5.9	6.6	7.2	7.7
Lane 3	Speed				40.5	50.0				
	Density				5.0	1.7				
Ramp	Speed									
	Density									
		203	214	231	202	220	201	185	184	183	177

2020 Build AM CORSIM Results

Southbound CD Road - Part 2

CD Lane		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
	Actual Volume	840	840	840	840	840	840	570	570	840	840	840	840	840	840	360
	Simulated Volume	808	808	808	808	807	807	704	703	813	813	814	704	704	703	672
	Actual Volume							270	270				270			480
	Simulated Volume							103	109				110			31
							To Rest Area			**From Rest Area**			**Slip Ramp to I-95**			**To Carl D Silver Pkwy**
	Distance	1,436	1,020	306	520	341	402	760	574	1,554	500	1,025	499	689	387	742
	Speed	59.1	59.2	59.1	59.1	59.1	58.7	59.2	59.3	59.4	59.2	59.2	59.3	59.4	56.2	54.5
	Density	6.8	6.8	6.8	6.8	6.8	5.0	5.9	5.9	4.9	6.9	6.9	5.9	5.9	4.2	6.2
		177	178	179	180	181	182	223	146	149	151	152	153	163	165	170	164

CD Lane		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
	Actual Volume	840	840	840	840	840	840	570	570	840	840	840	840	840	840	360
	Simulated Volume	808	808	808	808	807	807	704	703	813	813	814	704	704	703	672
								103	109				110			480
																31
							To Rest Area			**From Rest Area**			**Slip Ramp to I-95**			**To Carl D Silver Pkwy**
	Distance	1,436	1,020	306	520	341	402	760	574	1,554	500	1,025.0	499	689	387	742
Lane 1	Speed	59.3	59.4	59.4	59.5	59.6	59.9	60.2	60.3	60.5	60.3	60.1	60.1	60.1	57.0	55.2
	Density	5.5	5.8	5.9	5.9	5.8	4.3	4.2	4.4	5.9	5.8	6.0	6.1	6.1	6.0	6.3
Lane 2	Speed	59.1	59.0	58.9	58.9	58.8	58.8	58.7	58.6	58.5	58.4	58.4	58.5	58.6	55.3	53.7
	Density	8.2	7.8	7.7	7.8	7.8	19.1	7.7	7.5	7.6	8.0	7.8	5.8	5.8	6.0	6.1
Lane 3	Speed						54.8			65.0						
	Density						1.6			0.1						
Ramp	Speed															
	Density															
		177	178	179	180	181	182	223	146	149	151	152	153	163	165	170	164

2020 Build PM CORSIM Results

Interstate 95 Northbound PM

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segments											
Mainline	Actual Volumes	3 / 2										3 / 2					3 / 2
	Simulated Volumes	1 3,890	3,890	3,633	3,632	3,096	3,095	3,096	3,096	3,093	3,093	1 3,091	3,091	3,092	3,092	3,092	1 3,091
Ramp	Actual Volumes		765 ft (9)	260 (9)	847 ft (9)	540 (9)											I-95 Bridge
	Simulated Volumes			257 Ramp I		536 Ramp K											
Distance		449	6,259	1,048	847	1,047	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
Speed		67.4	67.1	66.6	65.2	66.9	66.9	66.8	66.8	66.7	66.7	66.6	66.6	66.6	66.6	66.5	66.3
Density		20.1	18.6	15.5	13.9	15.4	15.4	15.5	15.5	15.4	15.5	15.5	15.5	15.5	15.5	15.5	15.5
		2	1	16	13	14	19	6	7	8	24	30	25	31	26	32	27 33

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segments											
	Actual Volumes	3 / 2										3 / 2					3 / 2
	Simulated Volumes	1 3,890	3,890	3,633	3,632	3,096	3,095	3,096	3,096	3,093	3,093	1 3,091	3,091	3,092	3,092	3,092	1 3,091
			765 ft (9)	270 (9)	847 ft (9)	280 (9)											I-95 Bridge
				257 Ramp I		536 Ramp K											
Distance		449	6,259	1,048	847	1,047	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
3 Lane 3	Speed	67.4	67.2	67.3	67.1	66.9	66.8	66.7	66.7	66.7	66.7	66.7	66.7	66.6	66.6	66.6	66.8
	Density	18.5	17.3	15.8	14.3	14.3	14.2	14.2	14.2	14.3	14.3	14.3	14.3	14.3	14.3	14.3	13.0
2 Lane 2	Speed	67.5	67.6	66.5	67.8	67.8	67.7	67.6	67.6	67.5	67.4	67.3	67.3	67.3	67.3	67.3	67.4
	Density	20.7	19.7	17.4	15.7	16.0	16.2	16.3	16.4	16.4	16.3	16.3	16.3	16.4	16.3	16.3	15.8
1 Lane 1	Speed	67.3	66.6	65.6	66.2	66.0	66.0	66.0	66.0	66.0	65.9	65.9	65.8	65.8	65.7	65.7	65.1
	Density	21.2	20.4	13.1	16.1	16.0	15.8	15.8	15.8	15.7	15.8	15.8	15.8	15.8	15.8	15.8	17.8
9 Ramp	Speed		59.4		56.5												
	Density		0.6		9.6												
		2	1	16	13	14	19	6	7	8	24	30	25	31	26	32	27 33

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

Interstate 95 Northbound PM

		Freeway Segments	Ramp/Weave	Freeway Segments	Ramp/Weave		Freeway Segments
Mainline	Actual Volumes	3,090	3,090	2,000	3,150	3,880	3 / 2 / 3,880
	Simulated Volumes	3,091	3,090	2,097	3,249	3,904	1 / 3,906
Ramp	Actual Volumes		9				
	Simulated Volumes		800 ft	1,090	1,150	730	
		I-95 Bridge		993 Ramps A & C	1,151 Ramps B & D From CD Road	656 Ramps B and D	
	Distance	2,789	1,320	1,258	4,879	1,653	2,319
	Speed	66.3	64.4	66.7	65.4	63.2	65.7
	Density	15.5	13.3	10.5	11.4	17.1	19.8
		27 / 33		28	34 / 37		51 / 52

			Freeway Segments	Ramp/Weave	Freeway Segments	Ramp/Weave		Freeway Segments
	Actual Volumes		3,090	3,090	2,000	3,150	3,880	3 / 2 / 3,880
	Simulated Volumes		3,091	3,090	2,097	3,249	3,904	1 / 3,906
				9				
				800 ft	1,620	1,150	730	
			I-95 Bridge		993 Ramps A & C	1,151 Ramps B & D From CD Road	656	
	Distance		2,789	1,320	1,258	4,879	1,653	2,319
3	Lane 3	Speed	66.8	67.8	67.8	67.9	67.9	67.9
		Density	13.0	9.8	10.0	11.3	13.7	15.9
2	Lane 2	Speed	67.4	66.8	67.9	67.4	66.3	66.8
		Density	15.8	12.4	11.8	15.6	19.8	20.9
1	Lane 1	Speed	65.1	61.9	64.2	62.9	59.1	63.2
		Density	17.8	21.5	9.6	20.7	27.1	22.7
9	Ramp	Speed		62.6			50.8	
		Density		4.3			1.3	
				33	28	34 / 37		51 / 52

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

Interstate 95 Southbound PM

		Freeway Segment	Ramp/Weave			Freeway Segment	Ramp/Weave			
Mainline	Actual Volumes	3								
		2 6,340	6,340	5,310	5,310	3,030	4,800	4,800	4,800	4,800
	Simulated Volumes	1 6,326	6,330	5,315	5,311	3,220	4,707	4,708	4,709	4,706
Ramp	Actual Volumes		9 960 ft	9	9	9				
	Simulated Volumes			1,030 1,015 Ramp E & G	Route 17	2,280 2,091 To CD Road 1,770		From CD Road		I-95 Bridge
Distance		1,065.0	5,018.0	1,069.0	606.0	974.0	1,076.0	943.0	673.0	2,910.0
Speed		63.1	59.0	54.2	55.7	64.5	61.3	64.6	57.9	57.1
Density		34.7	34.8	32.8	27.0	16.6	15.4	14.6	19.0	25.0
		124 278	279	280		281 287	233	283	78	79

			Freeway Segment	Ramp/Weave			Freeway Segment	Ramp/Weave			
Mainline	Actual Volumes		3								
			2 6,340	6,340	5,310	5,310	3,030	4,800	4,800	4,800	4,800
	Simulated Volumes		1 6,326	6,330	5,315	5,311	3,220	4,707	4,708	4,709	4,706
Ramp	Actual Volumes			9 960 ft	9	9	9				
	Simulated Volumes				1,030 1,015 Ramp E & G	Route 17	2,280 To CD Road 1,770		From CD Road		I-95 Bridge
Distance			1,065.0	5,018.0	1,069.0	606.0	974.0	1,076.0	943.0	673.0	2,910.0
3	Lane 3	Speed	62.5	62.6	65.6	66.6	67.2	67.1	63.1	59.4	60.0
		Density	33.5	29.6	19.2	19.5	19.9	20.0	25.7	23.7	22.8
2	Lane 2	Speed	63.3	60.6	59.9	61.0	64.2	64.8	62.2	54.4	56.8
		Density	33.6	34.8	28.8	23.4	20.4	19.8	9.2	29.9	28.4
1	Lane 1	Speed	62.5	55.4	46.6	48.7	59.7	62.0	56.1	55.7	54.9
		Density	33.9	40.8	50.0	44.0	9.6	11.3	0.6	2.1	25.7
9	Ramp	Speed		52.7		52.4		54.4	65.7	59.9	56.9
		Density		2.2		8.3		20.7	17.6	21.5	5.4
4	Ramp	Speed						51.2	67.0	66.0	
		Density						5.1	19.7	4.1	
			124 278	279	280		281 287	233	283	78	79

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

Interstate 95 Southbound PM

		Ramp/Weave		Freeway Segments								Ramp/Weave		Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
Mainline	Actual Volumes	3		3															3
		2 4,800	4,800	2 4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,990	4,990	4,990	4,990	5,280	4,460	5,160	2 5,160
	Simulated Volumes	1 4,706	4,707	1 4,711	4,709	4,709	4,708	4,706	4,706	4,709	4,710	4,706	4,883	4,884	4,884	5,147	4,212	4,868	1 4,877
Ramp	Actual Volumes											190			290		820 700	9 1,300 ft	
	Simulated Volumes											173					935 656		
		I-95 Bridge										Slip Ramp from Rest Stop			Ramp N	Route 3	Ramp O Ramp P		
	Distance	2,910.0	830.0	524.0	467.0	998.0	489.0	1,646.0	525.0	525.0	1,044.0	508.0	672.0	992.0	1,078.0	810.0	1,011.0	2,480.0	3,700.0
	Speed	57.1	64.2	64.9	65.1	65.1	65.1	65.1	65.1	65.1	57.9	58.2	62.5	58.7	60.1	59.3	65.2	62.7	64.9
	Density	25.0	24.5	24.2	24.1	24.1	24.1	24.1	24.1	24.1	27.1	26.9	19.5	27.7	27.1	21.7	21.5	22.0	25.0
		78	79	80	73	81	83	82	127	84	85	113	118	119	89	90	93	100	101	104

		Ramp/Weave		Freeway Segments								Ramp/Weave		Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
Mainline	Actual Volumes	3																	3
		2 4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,990	4,990	4,990	4,990	5,280	4,460	5,160	2 5,160
	Simulated Volumes	4,706	4,707	4,711	4,709	4,709	4,708	4,706	4,706		4,710	4,706	4,883	4,884	4,884	5,147	4,212	4,868	1 4,877
Ramp	Actual Volumes											190			140		820 700	9 1,300 ft	
	Simulated Volumes											173			263		935 656		
		I-95 Bridge										Slip Ramp from Rest Stop			Ramp N	Route 3	Ramp O Ramp P		
	Distance	2,910.0	830.0	524.0	467.0	998.0	489.0	1,646.0	525.0	525.0	1,044.0	508.0	672.0	992.0	1,078.0	810.0	1,011.0	2,480.0	3,700.0
3	Lane 3 Speed	60.0	66.5	66.3	66.3	66.2	66.0	66.0	65.9	65.7	57.9	58.1	63.7	59.9	62.2	67.1	67.2	66.2	66.0
	Lane 3 Density	22.8	22.0	22.9	23.2	23.4	23.7	23.7	23.9	24.1	27.5	27.5	25.3	26.2	22.9	21.2	21.5	22.6	24.1
2	Lane 2 Speed	56.8	65.1	65.7	65.8	65.8	65.8	65.7	65.7	65.7	57.9	58.7	63.0	59.3	61.3	65.0	66.1	65.1	65.7
	Lane 2 Density	28.4	24.6	25.0	25.0	25.0	25.0	24.9	24.9	24.1	27.5	28.3	26.2	27.9	26.1	22.7	22.4	25.2	25.8
1	Lane 1 Speed	54.9	61.4	62.9	63.2	63.2	63.4	63.6	63.7	65.7	57.9	57.8	60.9	57.1	57.7	58.3	62.3	58.9	63.2
	Lane 1 Density	25.7	26.8	24.6	24.2	23.9	23.7	23.6	23.5	24.1	27.5	25.1	26.1	29.0	32.2	23.4	20.7	28.2	25.2
9	Ramp Speed	56.9														45.3		42.5	
	Ramp Density	5.4														19.6		1.7	
	Ramp Speed																		
	Ramp Density																		
4		78	79	80	73	81	83	82	127	84	85	113	118	119	89	90	93	100	101	104

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

CD Road Northbound PM

		Freeway Segment		Ramp/Weave			Ramp/Weave					Freeway Segment					Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	1080	1080	1750	1080	1750	1080	1750	1080	1750	1080	1750	1080	1750	1080	1750	1750	550
	Simulated Volume	1,161	1,161	1,765	1,765	1,765	1,762	1,756	1,748	1,737	1,719	1,716	1,716	1,717	1,718	1,722	1,750	604
Ramp	Actual Volume		670															1200 1140
	Simulated Volume		604															1146 993
			Ramp L															To I-95 NB
	Distance	97.0	141.0	318.0	196.0	1,966.0	696.0	545.0	917.0	1,665.0	769.0	593.0	663.0	637.0	674.0	2,796.0	1,542.0	461.0
	Speed	37.3	41.8	49.9	55.0	56.7	52.8	50.3	55.2	56.5	56.3	56.3	56.3	56.2	56.2	55.8	55.2	57.1
	Density	7.8	7.5	8.8	8.0	7.9	11.1	13.7	15.8	15.3	15.2	15.3	15.3	15.3	15.3	15.6	15.9	10.6
		55	87	190	180	12	185	184	183	182	195	196	170	110	129	166	198	208 188

		Freeway Segment		Ramp/Weave			Ramp/Weave					Freeway Segment					Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1690	1690
	Simulated Volume	1,1607	1,1611	1,765	1,765	1,765	1,762	1,756	1,748	1,737	1,719	1,716	1,716	1,717	1,718	1,722	1,750	604
Ramp	Actual Volume																	
	Simulated Volume		604														1,146	993
			Ramp L															To I-95 NB
	Distance	97.0	141.0	318.0	196.0	1,966.0	696.0	545.0	917.0	1,665.0	769.0	593.0	663.0	637.0	674.0	2,796.0	1,542.0	461.0
Lane 1	Speed	28.9	43.1	49.4	56.1	56.9	56.1	49.9	54.6	55.8	55.6	55.5	55.5	55.5	55.3	55.8	54.4	57.1
	Density	0.0	4.8	8.5	10.6	3.7	2.9	11.1	18.2	16.7	16.1	16.0	15.8	15.7	15.6	14.3	19.6	10.6
Lane 2	Speed	37.2	41.7	48.6	55.2	56.2	50.9	49.4	56.1	57.3	57.2	57.2	57.1	57.1	57.1	55.8	56.5	
	Density	10.7	9.5	7.9	7.7	13.3	21.5	18.2	13.4	13.8	14.4	14.5	14.7	14.9	15.0	16.9	12.2	
Lane 3	Speed	37.4	41.9	48.6	53.9	56.9	56.2	54.3										
	Density	10.3	9.0	7.5	7.0	8.4	8.9	5.6										
Ramp	Speed	37.2	40.5	51.9	54.0	57.5												
	Density	10.3	4.4	11.5	6.7	5.7												
		55	87	190	180	12	185	184	183	182	195	196	170	110	129	166	198	208 188

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

CD Road Northbound PM

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	1 1750 →	1750	550	1690	1690	1690	1 1490 →
	Simulated Volume	2 1,722 →	1,750	604	1,596	1,595	1,594	2 1,347 →
Ramp	Actual Volume			1200 1140				200
	Simulated Volume			1146 993				247
				To I-95 NB	**From Northbound I-95 Mainline (left entrance)**			**To Route 17 southbound**
	Distance	2,796.0	1,542.0	461.0	534.0	408.0	280.0	355.0
	Speed	55.8	55.2	57.1	58.8	58.4	54.8	51.3
	Density	15.6	15.9	10.6	9.0	9.1	9.7	13.1
		166	198	208	188	186	189	187 205

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	1 1080 →	1690	1690	1690	1690	1690	1 1490 →
	Simulated Volume	2 1,722 →	1,750	604	1,596	1,595	1,594	2 1,347 →
Ramp	Actual Volume			1200 1140				
	Simulated Volume		1,146	1146 993			200	
				To I-95 NB	**From Northbound I-95 Mainline (left entrance)**		247	**To Route 17 southbound**
	Distance	2,796.0	1,542.0	461.0	534.0	408.0	280.0	355.0
Lane 1	Speed	55.8	54.4	57.1	59.6	59.2	54.2	51.0
	Density	14.3	19.6	10.6	6.3	4.5	15.7	15.6
Lane 2	Speed	55.8	56.5		58.6	58.3	55.3	51.8
	Density	16.9	12.2		12.7	14.6	8.9	10.6
Lane 3	Speed				58.6	58.3		
	Density				8.1	8.2		
Ramp	Speed							
	Density							
		166	198	208	188	186	189	187 205

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

CD Road Northbound PM - Part 1

			Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane	Actual Volume		1030	1030	1030	1030	480
	Simulated Volume		1,028	1,033	1,033	1,033	487
Ramp	Actual Volume						550
	Simulated Volume						546
							To Ramp E
		Distance	729	94	294	134	266
		Speed	45.3	45.4	40.4	36.6	39.1
		Density	13.3	9.7	15.0	17.4	12.5
			279	199	222	216	210

200

Interstate 95 Southbound PM - CD Road: Part 1

			Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane	Actual Volume		1030	1030	1030	1030	480
	Simulated Volume		1,028	1,033	1,033	1,033	487
Ramp	Actual Volume						550
	Simulated Volume						546
							To Ramp E
		Distance	729	94	294	134	266
	Lane 1	Speed	45.8	45.2	39.3	37.8	39.1
		Density	12.3	12.1	12.3	12.8	12.5
	Lane 2	Speed	44.7	45.5	41.1	36.0	
		Density	10.4	10.7	11.9	15.2	
			279	199	222	216	210

200

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

CD Road Northbound PM - Part 2

		Freeway Segment			Ramp/Weave		Freeway Segment				
CD Lane	Actual Volume	1 2290 →	2290	2290	2890	2890	2890	2890	2890	2890	1 2890 →
	Simulated Volume	2 2,087 →	2,087	2,087	2,439	2,438	2,438	2,439	2,441	2,441	2 2,442 →
Ramps	Actual Volume			600							
	Simulated Volume			351							
				From Rt 17							
Distance		117	216	377	292	358	544	742	674	1003	1436
Speed		48.9	48.7	46.8	45.6	53.2	57.6	58.0	57.6	57.4	57.2
Density		14.2	19.2	22.3	17.8	18.9	21.2	21.0	21.2	21.3	21.4
		203	214	231	202	220	201	179	177	176	168 169

		Freeway Segment			Ramp/Weave		Freeway Segment				
CD Lane	Actual Volume	1 2290 →	2290	2290	2890	2890	2890	2890	2890	2890	1 2890 →
	Simulated Volume	2 2,087 →	2,087	2,087	2,439	2,438	2,438	2,439	2,441	2,441	2 2,442 →
Ramps	Actual Volume			600							
	Simulated Volume			351							
				From Rt 17							
Distance		117	216	377	292	358	544	742	674	1003	1436
Lane 1	Speed	49.4	50.7	49.7	37.1	54.5	57.2	57.6	57.2	57.2	57.3
	Density	12.8	6.7	4.2	1.0	18.3	23.6	21.8	20.6	19.8	19.2
Lane 2	Speed	49.4	48.3	46.5	47.7	53.0	58.0	58.4	58.0	57.6	57.1
	Density	12.8	30.7	40.4	37.1	22.0	18.8	20.3	21.8	22.7	23.6
Lane 3	Speed				41.2	49.9					
	Density				15.3	5.5					
Ramp	Speed										
	Density										
		203	214	231	202	220	201	179	177	176	168 169

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2020 Build PM CORSIM Results

CD Road Northbound PM - Part 2

		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	2890	2890	2890	2890	2890	2890	2700	2700	2890	2890	2890	2700	2700	2700	2330
	Simulated Volume	2,442	2,440	2,441	2,440	2,441	2,439	2,273	2,274	2,464	2,463	2,463	2,283	2,281	2,281	1,941
Ramps	Actual Volume							190	190				190			370
	Simulated Volume							166	190				180			340
								To Rest Area		**From Rest Area**			**Slip Ramp to I-95**			**To Carl D Silver Pkwy**
	Distance	1436	1020	306	520	341	402	760	574	1554	500	1025	499	689	387	742
	Speed	57.2	57.0	56.9	56.9	56.9	56.8	57.1	57.1	56.9	56.7	56.8	56.8	56.9	54.4	48.4
	Density	21.4	21.4	21.4	21.4	21.4	15.6	19.9	19.9	15.6	21.7	21.7	20.1	20.0	14.0	21.2

203 168 169 171 173 174 175 223 57 58 60 61 62 68 70 91 69

		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	2890	2890	2890	2890	2890	2890	2700	2700	2890	2890	2890	2700	2700	2700	2330
	Simulated Volume	2,442	2,440	2,441	2,440	2,441	2,439	2,273	2,274	2,464	2,463	2,463	2,283	2,281	2,281	1,941
Ramps	Actual Volume							190	190				190			370
	Simulated Volume							166	190				180			340
								To Rest Area		**From Rest Area**			**Slip Ramp to I-95**			**To Carl D Silver Pkwy**
	Distance	1436	1020	306	520	341	402	760	574	1554	500	1025	499	689	387	742
Lane 1	Speed	57.3	57.3	57.2	57.2	57.3	57.6	58.0	57.9	57.6	57.6	57.3	56.7	56.7	54.5	48.6
	Density	19.2	19.5	20.0	20.0	19.9	17.6	17.6	18.3	21.3	21.1	22.3	23.1	22.7	18.1	20.3
Lane 2	Speed	57.1	56.8	56.7	56.7	56.6	56.5	56.5	56.4	56.1	55.8	56.2	57.0	57.2	53.8	48.2
	Density	23.6	23.2	22.9	22.9	23.0	19.1	22.2	21.5	21.6	22.3	21.1	17.1	17.3	18.5	19.8
Lane 3	Speed						53.3			62.5						
	Density						2.6			0.4						
Ramp	Speed															
	Density															

203 168 169 171 173 174 175 223 57 58 60 61 62 68 70 91 69

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

April 2016 IMR Build Alternative

2040 CORSIM Analysis

2040 Build AM CORSIM Results

Interstate 95 Northbound AM

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment										
Mainline	Actual Volumes	3 / 2 3,390	3,390	3,050	3,050	2,660	2,660	2,660	2,660	2,660	2,660	3 / 2 2,660	2,660	2,660	2,660	2,660
	Simulated Volumes	1 3,386	3,386	3,015	3,015	2,634	2,632	2,634	2,636	2,636	2,634	1 2,636	2,635	2,635	2,637	2,638	2,639
Ramp	Actual Volumes		765 ft	9 340	9 847 ft	9 390											I-95 Bridge
	Simulated Volumes			371 Ramp I		381 Ramp K											
	Distance	449	6,345	398	1,312	1,175	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
	Speed	67.7	67.3	67.0	66.8	67.3	67.2	67.2	67.1	67.0	67.0	66.9	66.9	66.9	66.8	66.8	66.1
	Density	17.4	16.1	15.0	11.8	13.0	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.2	13.3
		2	1	16	13	14	19	6	7	8	24	30	25	31	26	32	27	33

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment										
	Actual Volumes	3 / 2 3,390	3,390	3,050	3,050	2,660	2,660	2,660	2,660	2,660	2,660	3 / 2 2,660	2,660	2,660	2,660	2,660
	Simulated Volumes	1 3,386	3,386	3,015	3,015	2,634	2,632	2,634	2,636	2,636	2,634	1 2,636	2,635	2,635	2,637	2,638	2,639
			765 ft	9 270	9 847 ft	9 280											I-95 Bridge
				371		381											
	Distance	449	6,345	398	1,312	1,175	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
3	Lane 3 Speed	67.8	67.8	67.6	67.6	67.5	67.4	67.3	67.3	67.2	67.3	67.1	67.1	67.1	67.1	67.0	67.4
	Lane 3 Density	15.7	14.4	12.2	12.2	12.1	12.0	12.0	12.0	12.0	11.9	12.0	11.9	11.9	11.9	11.9	9.2
2	Lane 2 Speed	67.8	68.0	67.8	67.6	67.6	67.6	67.5	67.4	67.3	67.3	67.2	67.1	67.1	67.1	67.1	67.6
	Lane 2 Density	18.0	16.9	15.6	14.9	14.7	14.8	14.8	14.8	14.8	14.8	14.7	14.7	14.7	14.8	14.7	13.6
1	Lane 1 Speed	67.7	66.9	65.8	66.3	66.7	66.7	66.7	66.6	66.6	66.5	66.5	66.5	66.5	66.4	66.4	64.2
	Lane 1 Density	18.6	18.2	17.1	13.1	12.3	12.4	12.4	12.5	12.5	12.6	12.7	12.7	12.8	12.8	12.8	17.2
9	Ramp Speed		57.3		63.9												
	Ramp Density		0.8		5.0												
		2	1	16	13	14	19	6	7	8	24	30	25	31	26	32	27	33

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Interstate 95 Northbound AM

			Ramp/Weave	Freeway Segments	Ramp/Weave		Freeway Segments
		3					3
Mainline	Actual Volumes	2 2,660	2,660	670	4,120	5,670	2 5,670
	Simulated Volumes	1 2,639	2,641	650	3,622	5,346	1 5,335
Ramp	Actual Volumes		9 800 ft	1,990	3,450	1,550	
	Simulated Volumes			1,991	2,972	1,724	
		I-95 Bridge		To Route 17 Ramps	Ramps from CD Road	Ramps B and D	
	Distance	2,789	1,320	1,258	4,879	1,653	2,319
	Speed	66.1	59.8	67.9	64.4	48.3	63.9
	Density	13.3	12.2	3.2	13.0	30.7	27.8
		27	33	28	34	37	51 52

			Ramp/Weave	Freeway Segments	Ramp/Weave		Freeway Segments
		3					3
	Actual Volumes	2 2,660	2,660	670	4,120	5,670	2 5,670
	Simulated Volumes	1 2,639	2,641	650	3,622	5,346	1 5,335
			9 800 ft	1,620	3,450	1,550	
				1,991	2,972	1,724	
		I-95 Bridge		To Route 17 Ramps	Ramps from CD Road	Ramps B and D	
	Distance	2,789	1,320	1,258	4,879	1,653	2,319
3 Lane 3	Speed	67.4	68.9	69.6	70.5	66.8	67.7
	Density	9.2	3.3	3.3	7.3	16.6	24.7
2 Lane 2	Speed	67.6	64.6	68.6	67.7	57.9	63.6
	Density	13.6	6.1	4.4	16.4	31.3	28.9
1 Lane 1	Speed	64.2	57.6	63.4	61.6	38.7	61.1
	Density	17.2	27.8	1.9	29.0	55.2	29.9
9 Ramp	Speed		59.9			38.0	
	Density		6.9			7.6	
		27	33	28	34	37	51 52

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Interstate 95 Southbound AM

		Freeway Segment	Ramp/Weave			Freeway Segment	Ramp/Weave			
Mainline	Actual Volumes	3 / 2 4,250	4,250	3,110	3,110	2,220	3,690	3,690	3,690	3,690
	Simulated Volumes	1 4,251	4,250	3,197	3,197	2,296	3,657	3,656	3,657	3,655
Ramp	Actual Volumes		9 960 ft		9					
	Simulated Volumes			1,140 / 1,052		890 / 901	1,470 / 1,361			
				Ramps E & G	Route 17	To CD Road	Ramps F & H			I-95 Bridge
	Distance	4,643.0	715.0	1,069.0	1,335.0	974.0	1,076.0	625.0	716.0	673.0
	Speed	58.7	65.3	66.1	64.3	65.7	61.3	65.2	60.6	62.0
	Density	24.6	16.2	12.1	12.4	11.7	11.9	11.2	13.1	14.7
		57	278	279	280	281	287	233	283	78 79

			Freeway Segment	Ramp/Weave			Freeway Segment	Ramp/Weave			
Mainline	Actual Volumes		3 / 2 4,250	4,250	3,110	3,110	2,220	3,690	3,690	3,690	3,690
	Simulated Volumes		1 4,251	4,250	3,197	3,197	2,296	3,657	3,656	3,657	3,655
Ramp	Actual Volumes			9 960 ft		9					
	Simulated Volumes				1,140 / 1,052		890 / 901	1,470 / 1,361			
					Ramps E & G	Route 17	To CD Road	Ramps F & H			I-95 Bridge
	Distance		4,643.0	715.0	1,069.0	1,335.0	974.0	1,076.0	625.0	716.0	673.0
3	Lane 3	Speed	58.7	66.3	68.3	68.0	67.9	67.9	64.5	61.0	62.9
		Density	23.1	17.1	12.3	10.4	10.4	10.5	11.8	13.4	14.1
2	Lane 2	Speed	58.7	64.6	64.1	68.1	68.4	68.7	62.1	60.1	62.3
		Density	25.3	20.9	23.0	11.7	12.3	12.4	20.6	17.9	21.0
1	Lane 1	Speed	58.7	64.0	66.8	60.9	61.1	62.2	61.1	57.4	60.1
		Density	25.4	16.9	2.6	23.3	12.3	13.4	0.8	10.2	12.0
9	Ramp	Speed		65.0		63.3		54.5	68.6		
		Density		2.2		4.3		18.4	12.4		
4			57	278	279	280	281	287	233	283	78 79

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Interstate 95 Southbound AM

		Ramp/Weave		Freeway Segments									Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
Mainline	Actual Volumes	3								3									3
		2 3,690	3,690	3,690	3,690	3,690	3,690	3,690	2	3,690	3,690	3,840	3,840	3,840	4,020	3,840	3,750	2 3,750	3,750
	Simulated Volumes	1 3,655	3,655	3,658	3,659	3,658	3,659	3,658	3,657	3,661	1 3,660	3,664	3,821	3,823	3,824	3,996	3,787	1 3,616	1 3,617
Ramp	Actual Volumes												150		180		720	9 450	
	Simulated Volumes												157		172		710	330	
		I-95 Bridge										Slip Ramp from Rest Area			Ramp N	Route 3	Ramp O	Ramp P	1,300 ft
	Distance	673.0	2,910.0	830.0	524.0	467.0	998.0	489.0	1,646.0	525.0	1,028.0	508.0	677.0	992.0	1,078.0	810.0	1,011.0	2,480.0	3,700.0
	Speed	62.0	62.2	65.4	65.7	65.8	65.9	66.0	66.0	66.0	58.9	59.3	59.1	61.5	64.9	60.9	65.7	64.9	66.1
	Density	14.7	17.6	18.6	18.6	18.5	18.5	18.5	18.5	18.5	20.7	20.6	16.3	20.7	19.6	16.4	16.7	15.8	18.2
		78	79	80	73	81	83	82	127	84	85	172	173	88	89	90	93	100	101 104

		Freeway Segments										Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
Mainline	Actual Volumes	3		3														3
		2 3,690	3,690	2 3,690	3,690	3,690	3,690	3,690	3,690	3,690	3,690	3,840	3,840	3,840	4,020	3,840	3,750	2 3,750
	Simulated Volumes	1 3,655	3,655	1 3,658	3,659	3,658	3,659	3,658	3,657		3,660	3,664	3,821	3,823	3,824	3,996	3,787	1 3,616	1 3,617
Ramp	Actual Volumes												150		140		720	9 450	
	Simulated Volumes												157		172		710	330	
		I-95 Bridge										Slip Ramp from Rest Area			Ramp N	Route 3	Ramp O	Ramp P	1,300 ft
	Distance	673.0	2,910.0	830.0	524.0	467.0	998.0	489.0	1,646.0	525.0	1,028.0	508.0	677.0	992.0	1,078.0	810.0	1,011.0	2,480.0	3,700.0
3	Lane 3 Speed	62.9	67.4	68.2	68.2	68.1	68.0	67.9	67.8	67.6	59.7	59.9	60.5	63.1	68.2	68.4	67.8	67.7	67.5
	Lane 3 Density	14.1	14.1	14.9	15.4	15.8	16.2	16.6	17.0	17.4	20.0	20.4	20.5	19.2	15.8	15.7	16.1	16.6	17.1
2	Lane 2 Speed	62.3	61.9	67.5	67.5	67.4	67.2	67.1	67.0	67.6	59.7	59.5	59.6	62.2	66.4	66.1	66.7	66.6	66.8
	Lane 2 Density	21.0	22.8	19.7	19.6	19.7	19.6	19.5	19.3	17.4	20.0	21.6	21.7	20.8	18.5	17.3	17.4	18.6	18.7
1	Lane 1 Speed	60.1	57.5	61.5	62.1	62.4	62.9	63.1	63.5	67.6	59.7	58.5	57.4	59.5	61.7	58.8	62.6	61.7	64.2
	Lane 1 Density	12.0	18.0	21.3	20.6	20.1	19.7	19.4	19.1	17.4	20.0	19.7	21.9	22.2	24.7	18.7	16.5	19.8	18.8
9	Ramp Speed															48.7		42.9	
	Ramp Density															14.0		0.8	
4		78	79	80	73	81	83	82	127	84	85	172	173	88	89	90	93	100	101 104

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Northbound AM - CD Lane

		Freeway Segment		Ramp/Weave								Freeway Segment						
CD Lane	Actual Volume	2,990	2,990	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400
	Simulated Volume	2,456	2,458	3,769	3,774	3,776	3,808	3,812	3,818	3,825	3,821	3,802	3,791	3,784	3,780	3,777	3,773	3,768
Ramp	Actual Volume		1,410															
	Simulated Volume		1,312															
			Ramp L															
	Distance	97.0	141.0	318.0	196.0	1,966.0	273.0	508.0	662.0	808.0	626.0	827.0	769.0	593.0	663.0	637.0	674.0	2,796.0
	Speed	41.2	45.0	50.9	55.2	54.4	53.6	55.8	56.9	48.0	32.4	46.9	54.1	55.4	55.1	55.1	55.2	54.8
	Density	14.9	14.7	18.5	17.1	17.8	23.7	22.8	22.4	26.6	42.1	40.5	35.0	34.1	34.3	34.3	34.2	34.4
		108	86	17	5	12	11	209	72	71	70	66	114	117	119	120	123	124	125

		Freeway Segment		Ramp/Weave								Freeway Segment						
CD Lane	Actual Volume	2,990	2,990	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400
	Simulated Volume	2,456	2,458	3,769	3,774	3,776	3,808	3,812	3,818	3,825	3,821	3,802	3,791	3,784	3,780	3,777		
Ramp	Actual Volume		1410															
	Simulated Volume		1,312															
			Ramp L															
	Distance	97.0	141.0	318.0	196.0	1,966.0	273.0	508.0	662.0	808.0	626.0	827.0	769.0	593.0	663.0	637.0	674.0	2,796.0
Lane 1	Speed	37.8	44.6	49.7	54.8	54.0	50.8	54.3	56.1	56.8	32.5	45.1	53.7	54.6	54.3	54.5	54.5	54.7
	Density	0.1	10.4	19.0	22.0	11.7	31.8	28.7	25.3	13.4	24.2	40.7	33.6	32.8	32.9	32.7	32.7	32.0
Lane 2	Speed	39.6	44.3	51.5	54.3	51.8	54.8	56.2	57.0	42.2	27.1	48.8	54.4	56.1	55.9	55.6	55.7	54.9
	Density	22.8	19.7	16.4	18.1	29.4	23.3	23.1	24.7	45.1	68.3	40.2	36.4	35.4	35.7	35.9	35.7	36.8
Lane 3	Speed	41.9	46.0	52.6	55.4	56.4	57.5	57.8										
	Density	19.7	16.9	14.0	15.2	16.7	15.9	16.6										
Ramp	Speed	42.6	45.4	50.5	56.7	58.4												
	Density	17.0	7.6	24.7	13.1	11.8												
		108	86	17	5	12	11	209	72	71	70	66	114	117	119	120	123	124	125

Freeway Density
45 and Above
35 to 45
26 to 35
18 to 26
11 to 18
0 to 11

Weave/Ramp Density
43 and Above
35 to 43
28 to 35
20 to 28
10 to 20
0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Northbound AM - CD road

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	4,400	4,400	950	2,940	2,940	2,940	2,770
	Simulated Volume	3,768	3,773	816	2,802	2,795	2,786	2,499
Ramp	Actual Volume		3,450	1990				170
	Simulated Volume		2,957	1,986				287
			To Northbound I-95 Mainline	**From Northbound I-95 Mainline (left entrance)**				**To Route 17 southbound**
	Distance	2,796.0	1,542.0	435.0	585.0	373.0	280.0	388.0
	Speed	54.8	52.7	56.3	49.0	42.2	33.8	26.1
	Density	34.4	35.9	14.5	19.8	27.1	34.8	60.2
		124	125 129	76	74	77		75 126

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	4,400	4,400	950	2,940	2,940	2,940	2,770
	Simulated Volume		3,773	816	2,802	2,795	2,786	2,499
Ramp	Actual Volume		3,450	1,990				170
	Simulated Volume		2,957	1,986				287
			To Northbound I-95 Mainline	**From Northbound I-95 Mainline (left entrance)**				**To Route 17 southbound**
	Distance	2,796.0	1,542.0	435.0	585.0	373.0	280.0	388.0
Lane 1	Speed	54.7	50.9	56.3	57.2	53.4	35.1	29.0
	Density	32.0	41.9	14.5	9.0	6.1	40.6	48.7
Lane 2	Speed	54.9	55.2		50.0	44.0	30.6	23.5
	Density	36.8	29.9		23.4	31.8	34.9	46.1
Lane 3	Speed				45.4	38.5		
	Density				24.5	27.7		
Ramp	Speed							
	Density							
		124	125 129	76	74	77		75 126

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Southbound AM - CD Road: Part 1

		Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	1,140	1,140	1,140	1,140	440
	Simulated Volume	1,040	1,040	1,039	1,039	407
Ramp	Actual Volume					700
	Simulated Volume					631
						Ramp E **To Ramp G**
Distance		729.0	94.0	294.0	134.0	266.0
Speed		49.2	48.8	42.8	38.6	39.1
Density		10.6	7.1	11.2	13.4	10.4
		279	199	222	216	210 200

			Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane		Actual Volume	1,390	1,390	1,390	1,390	600
		Simulated Volume	1,040	1,040	1,039	1,039	407
Ramp		Actual Volume					700
		Simulated Volume					631
							Ramp E **To Ramp G**
		Distance	729.0	94.0	294.0	134.0	266.0
Lane 1		Speed	50.2	49.1	42.4	39.0	39.1
		Density	7.6	10.7	13.2	10.4	10.4
Lane 2		Speed	48.6	48.5	42.7	38.4	
		Density	13.6	10.6	10.0	16.5	
			279	199	222	216	210 200

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Southbound AM - CD Road: Part 2

		Freeway Segment			Ramp/Weave		Freeway Segment				
CD Lane	Actual Volume	890	890	890	1,090	1,090	1,090	1,090	1,090	1,090	1,090
	Simulated Volume	903	903	903	1,085	1,085	1,085	1,083	1,084	1,085	1,086
	Actual Volume			200							
	Simulated Volume			183							
				From Rt 17							
	Distance	117	216	377	292	358	544	742	674	1,003	1,436
	Speed	49.7	49.7	48.9	47.1	54.2	57.9	58.5	58.7	58.8	58.9
	Density	6.1	8.1	9.2	7.7	8.3	9.4	9.3	9.2	9.2	9.2
		203	214	231	202	220	201	185	184	183	177	178

		Freeway Segment			Ramp/Weave		Freeway Segment				
CD Lane	Actual Volume	890	890	890	1,090	1,090	1,090	1,090	1,090	1,090	1,090
	Simulated Volume	903	903	903	1,085	1,085	1,085	1,083	1,084	1,085	1,086
				183							
				From Rt 17							
	Distance	117	216	377	292	358	544	742	674	1,003	1,436
Lane 1	Speed	51.2	51.8	50.2	36.9	55.9	57.9	58.5	58.7	58.9	59.3
	Density	4.1	2.0	1.4	0.3	8.1	10.5	9.4	8.7	8.1	7.6
Lane 2	Speed	51.2	49.4	48.8	50.0	53.8	57.9	58.6	58.7	58.8	58.6
	Density	4.1	13.6	17.1	15.9	9.5	8.3	9.1	9.8	10.4	10.8
Lane 3	Speed				41	50					
	Density				7	2					
Ramp	Speed										
	Density										
		203	214	231	202	220	201	185	184	183	177	178

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build AM CORSIM Results

Southbound AM - CD Road: Part 2

		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	1,090	1,090	1,090	1,090	1,090	1090	940	940	1,090	1,090	1,090	940	940	940	840
	Simulated Volume	1,086	1,088	1,089	1,088	1,088	1,089	942	941	1,091	1,092	1,091	936	938	941	840
	Actual Volume							150	150				150			100
	Simulated Volume							147	150				155			101
							To Rest Area			From Rest Area			Slip Ramp to I-95			To Carl D Silver Pkwy
	Distance	1,436	1,020	306	520	341	402	760	574	1,554	500	1025	499	689	387	742
	Speed	58.9	58.9	58.8	58.8	58.8	58.4	59.0	59.0	59.1	58.9	58.9	59.1	59.1	56.1	54.2
	Density	9.2	9.2	9.2	9.2	9.3	6.8	8.0	8.0	6.7	9.3	9.3	7.9	8.0	5.6	7.7
		177	178	179	180	181	182	223	146	149	151	152	153	163	165	170	164

		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	1,090	1,090	1,090	1,090	1,090	1,090	940	940	1,090	1,090	1,090	940	940	940	840
	Simulated Volume	1,086	1,088	1,089	1,088	1,088	1,089	942	941	1,091	1,092	1,091	936	938	941	840
								150	150				155			100
								147	150				155			101
							To Rest Area			From Rest Area			Slip Ramp to I-95			To Carl D Silver Pkwy
	Distance	1,436	1,020	306	520	341	402	760	574	1,554	500	1025	499	689	387	742
Lane 1	Speed	59.3	59.3	59.2	59.3	59.3	59.6	60.0	60.1	60.2	60.0	59.7	59.7	59.6	56.7	54.9
	Density	7.6	8.2	8.4	8.4	8.3	6.3	6.1	6.3	8.4	8.2	8.7	8.9	8.8	7.7	8.0
Lane 2	Speed	58.6	58.6	58.5	58.5	58.4	58.4	58.4	58.3	58.1	58.0	58.1	58.3	58.4	55.2	53.5
	Density	10.8	10.3	10.1	10.1	10.2	19.1	9.9	9.7	9.9	10.4	9.9	7.0	7.1	7.5	7.5
Lane 3	Speed						54			65						
	Density						2			0						
Ramp	Speed															
	Density															
		177	178	179	180	181	182	223	146	149	151	152	153	163	165	170	164

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

Interstate 95 Northbound PM

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment											
Mainline	Actual Volumes	3										3					
		2 5,540	5,540	5,240	5,240	4,550	4,550	4,550	4,550	4,550	4,550	2 4,550	4,550	4,550	4,550	4,550	4,550
	Simulated Volumes	1 5,537	5,536	5,234	5,234	4,544	4,543	4,546	4,545	4,543	4,543	1 4,539	4,539	4,538	4,539	4,540	4,541
Ramp	Actual Volumes		765 ft 9	9 300	9 847 ft 9	690											
	Simulated Volumes			302		689											
				Ramp I		Ramp K											I-95 Bridge
	Distance	449	6,259	1,048	847	1,047	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
	Speed	66.0	65.7	65.1	64.2	65.7	65.7	65.6	65.5	65.5	65.4	65.3	65.3	65.3	65.3	65.2	64.7
	Density	29.3	27.0	22.8	20.4	23.1	23.1	23.1	23.1	23.1	23.1	23.2	23.2	23.2	23.2	23.2	23.4
		2 1	16 13			14 19	6 7	8 24	30 25	31	26 32	27 33					

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment											
	Actual Volumes	3										3					
		2 5,540	5,540	5,240	5,240	4,550	4,550	4,550	4,550	4,550	4,550	2 4,550	4,550	4,550	4,550	4,550	4,550
	Simulated Volumes	1 5,537	5,536	5,234	5,234	4,544	4,543	4,546	4,545	4,543	4,543	1 4,539	4,539	4,538	4,539	4,540	4,541
			765 ft 9	9 270	9 847 ft 9	280											
				302		689											
				Ramp I		Ramp K											I-95 Bridge
	Distance	449	6,259	1,048	847	1,047	1,177	490	1,008	901	1,671	779	623	669	652	677	2,789
3	Lane 3 Speed	66.2	66.0	65.9	65.9	65.6	65.5	65.4	65.4	65.4	65.3	65.2	65.2	65.2	65.1	65.1	65.4
	Lane 3 Density	27.8	26.3	23.9	22.5	22.4	22.3	22.3	22.4	22.3	22.3	22.4	22.4	22.4	22.4	22.4	20.3
2	Lane 2 Speed	66.0	66.2	65.0	66.5	66.6	66.5	66.5	66.3	66.2	66.1	66.0	65.9	65.9	65.9	65.9	65.9
	Lane 2 Density	29.8	28.1	25.0	23.0	23.3	23.6	23.8	23.9	24.0	24.1	24.1	24.0	24.0	24.0	24.0	23.6
1	Lane 1 Speed	66.0	65.2	63.8	65.1	64.7	65.0	65.0	64.9	64.9	64.8	64.8	64.8	64.7	64.7	64.7	63.1
	Lane 1 Density	30.3	29.2	18.5	23.4	23.5	23.2	23.1	23.0	23.0	23.0	23.0	23.1	23.1	23.2	23.2	26.3
9	Ramp Speed		57.2		55.1												
	Ramp Density		0.7		12.7												
		2 1	16 13			14 19	6 7	8 24	30 25	31	26 32	27 33					

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

Interstate 95 Northbound PM

		Freeway Segment		Ramp/Weave	Freeway Segments	Ramp/Weave		Freeway Segments
								3
Mainline	Actual Volumes	4,550	4,550	4,550	2,940	4,390	5,380	2 5,380
	Simulated Volumes	4,540	4,541	4,544	3,022	4,263	5,012	1 5,012
Ramp	Actual Volumes			9 800 ft	1,610	1,450	990	
	Simulated Volumes		I-95 Bridge		1,523 To Route 17 Ramps	1,241 Ramps from CD Road	749 Ramps B and D	
	Distance	677	2,789	1,320	1,258	4,879	1,653	2,319
	Speed	65.2	64.7	60.8	65.5	64.1	61.3	64.2
	Density	23.2	23.4	20.7	15.4	15.3	22.7	26.0
		33	27	33	28	34	37	51 52

				Ramp/Weave	Freeway Segments	Ramp/Weave		Freeway Segments
								3
	Actual Volumes		4,550	4,550	2,940	4,390	5,380	2 5,380
	Simulated Volumes		4,540	4,541	4,544	3,022	4,263	5,012	1 5,012
					9 800 ft	1,620		990	
						1,523		749	
	Distance		677	2,789	1,320	1,258	4,879	1,653	2,319
3	Lane 3	Speed	65.1	65.4	66.9	66.9	66.7	66.3	66.2
		Density	22.4	20.3	15.3	15.8	17.4	20.5	23.2
2	Lane 2	Speed	65.9	65.9	64.2	66.7	66.1	64.4	65.1
		Density	24.0	23.6	19.1	17.4	21.4	26.1	27.2
1	Lane 1	Speed	64.7	63.1	56.4	62.1	61.0	56.3	61.7
		Density	23.2	26.3	33.7	12.9	25.1	33.5	27.8
9	Ramp	Speed			59.5			50.2	
		Density			6.7			1.7	
			33	27	33	28	34	37	51 52

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

Interstate 95 Southbound PM

		Freeway Segment	Ramp/Weave								
Mainline	Actual Volumes	3								3	
		2 6,950	6,950	5,560	5,560	2,610	4,930	4,930	4,930	2 4,930	4,930
	Simulated Volumes	1 6,303	6,225	4,974	4,978	2,610	4,019	4,019	4,019	1 4,018	4,019
Ramp	Actual Volumes		9 960 ft	9	9						
	Simulated Volumes		960 ft	1,390 1,250		2,950 2,368	2,320 1,408				
				Ramps E & G	Route 17	To CD Road	Ramps F & H			I-95 Bridge	
	Distance	1,065.0	5,018.0	1,069.0	606.0	974.0	1,076.0	943.0	673.0	2,910.0	830.0
	Speed	49.1	34.8	39.5	47.5	62.0	59.7	63.6	58.3	58.1	64.4
	Density	51.3	60.2	42.3	29.8	14.1	13.5	12.6	16.2	21.0	20.8
		124	278	279	280	281	287	233	283	78	79

			Freeway Segment	Ramp/Weave								
Mainline	Actual Volumes		3								3	
			2 6,950	6,950	5,560	5,560	2,610	4,930	4,930	4,930	2 4,930	4,930
	Simulated Volumes		1 6,303	6,225	4,974	4,978	2,610	4,019	4,019	4,019	1 4,018	4,019
Ramp	Actual Volumes			9 960 ft	9	9	9					
	Simulated Volumes				1,390 1,250		2,950 2,368	2,320 1,408				
					Ramps E & G	Route 17	To CD Road	Ramps F & H			I-95 Bridge	
	Distance		1,065.0	5,018.0	1,069.0	606.0	974.0	1,076.0	943.0	673.0	2,910.0	830.0
3	Lane 3	Speed	45.5	48.0	59.4	63.8	66.6	66.8	61.4	59.6	60.6	66.3
		Density	41.0	43.3	24.4	21.9	20.5	20.0	23.3	18.4	19.6	18.9
2	Lane 2	Speed	49.3	37.1	45.1	50.7	58.5	60.4	62.1	55.4	58.1	65.9
		Density	42.7	54.7	33.9	21.0	15.2	14.9	8.3	25.2	22.9	20.7
1	Lane 1	Speed	45.5	26.3	29.7	39.3	55.3	59.1	56.7	55.8	56.1	61.4
		Density	43.9	73.7	67.4	53.1	6.4	8.2	0.5	1.8	21.7	22.9
9	Ramp	Speed		27.8		48.8		54.3	64.1			
		Density		4.1		8.9		19.4	11.8			
4			124	278	279	280	281	287	233	283	78	79

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

Interstate 95 Southbound PM

		Ramp/Weave		Freeway Segments									Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
Mainline	Actual Volumes			3															3
		4,930	4,930	2 4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	5,200	5,200	5,200	5,540	4,520	5,410	2 5,410
	Simulated Volumes	4,018	4,019	1 4,029	4,030	4,034	4,035	4,035	4,036	4,038	4,040	4,036	4,213	4,213	4,212	4,502	5,607	4,307	1 4,322
Ramp	Actual Volumes												270		340		1,020	890	1,300 ft
	Simulated Volumes												177		290		896	701	
		I-95 Bridge										Slip Ramp from Rest Area			Ramp N	Route 3	Ramp O	Ramp P	
	Distance	2,910.0	830.0	524.0	467.0	998.0	489.0	1,646.0	525.0	525.0	1,044.0	508.0	672.0	992.0	1,078.0	810.0	1,011.0	2,480.0	3,700.0
	Speed	58.1	64.4	65.1	65.3	65.3	65.3	65.4	65.5	65.5	58.6	59.2	63.1	59.1	60.6	58.7	65.2	62.5	65.1
	Density	21.0	20.8	20.6	20.6	20.6	20.6	20.6	20.6	20.6	23.0	22.7	16.7	23.8	23.2	19.2	18.4	19.6	22.2
		78	79	80	73	81	83	82	127	84	85	113	118	119	89	90	93	100	101	104

		Ramp/Weave		Freeway Segments									Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
Mainline	Actual Volumes			3															3
		4,930	4,930	2 4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	4,930	5,200	5,200	5,200	5,540	4,520	5,410	2 5,410
	Simulated Volumes	4,018	4,019	1 4,029	4,030	4,034	4,035	4,035	4,036		4,040	4,036	4,213	4,213	4,212	4,502	5,607	4,307	1 4,322
Ramp	Actual Volumes														610	140	1,020	890	1,300 ft
	Simulated Volumes														0	290	896	701	
		I-95 Bridge										Slip Ramp from Rest Area				Ramp N	Route 3	Ramp O	Ramp P
	Distance	2,910.0	830.0	524.0	467.0	998.0	489.0	1,646.0	525.0		1,044.0	508.0	672.0	992.0	1,078.0	810.0	1,011.0	2,480.0	3,700.0
3	Lane 3 Speed	60.6	66.3	66.2	66.2	66.0	65.9	65.9	65.9	65.8	57.9	58.7	64.3	59.8	62.4	67.0	67.0	66.3	66.1
	Lane 3 Density	19.6	18.9	19.5	19.7	19.8	19.9	20.0	20.1	20.2	22.9	22.7	21.0	21.8	19.0	17.8	18.1	19.1	20.6
2	Lane 2 Speed	58.1	65.9	66.5	66.4	66.4	66.5	66.5	66.4	65.8	57.9	59.8	64.1	60.0	61.9	65.2	66.4	65.5	66.2
	Lane 2 Density	22.9	20.7	21.5	21.5	21.6	21.6	21.6	21.6	20.2	22.9	24.4	22.7	24.3	22.4	19.4	19.2	22.4	23.3
1	Lane 1 Speed	56.1	61.4	62.8	63.1	63.3	63.5	63.7	63.9	65.8	57.9	58.8	61.2	57.7	58.4	57.9	62.3	58.4	63.0
	Lane 1 Density	21.7	22.9	20.9	20.6	20.4	20.2	20.0	19.9	20.2	22.9	21.0	22.5	25.1	28.0	20.6	18.0	25.8	22.6
9	Ramp Speed															45.1		42.6	
	Ramp Density															18.9		1.7	
4		78	79	80	73	81	83	82	127	84	85	113	118	119	89	90	93	100	101	104

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

CD Road Northbound PM

		Freeway Segment		Ramp/Weave			Ramp/Weave		Freeway Segment							
CD Lane	Actual Volume	1,390	1,390	2,069	2,069	2,069	2,069	2,069	2,069	2,069	2,069	2,069	2,069	2,069	2,069	2,069
	Simulated Volume	1,225	1,225	1,905	1,905	1,905	1,903	1,896	1,887	1,875	1,858	1,858	1,860	1,862	1,865	1,872
Ramp	Actual Volume		679													
	Simulated Volume		679													
			Ramp L													
	Distance	97	141	318	196	1,966	696	545	917	1,665	769	593	663	637	674	2,796
	Speed	37.2	41.6	49.7	54.8	56.5	52.5	49.3	54.8	56.4	56.3	56.2	56.2	56.3	56.3	55.7
	Density	8.2	7.9	9.6	8.7	8.6	12.1	15.0	17.2	16.5	16.5	16.5	16.6	16.6	16.6	16.9
		55	87	190	180	12	185	184	183	182	195	196	170	110	129	166 198

		Freeway Segment		Ramp/Weave			Ramp/Weave		Freeway Segment							
CD Lane	Actual Volume	1390	1390	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4	2069.4
	Simulated Volume	1225.3	1225	1905	1905	1905	1903	1896	1887	1875	1858	1858	1860	1862	1865	1872
Ramp	Actual Volume		679													
	Simulated Volume		679													
			Ramp L													
	Distance	97	141	318	196	1,966	696	545	917	1,665	769	593	663	637	674	2,796
Lane 1	Speed	28.8	42.7	49.1	55.9	56.5	55.6	48.7	54.0	55.7	55.5	55.4	55.4	55.4	55.5	55.8
	Density	0.0	5.2	9.2	11.7	4.1	3.3	12.2	19.7	18.0	17.4	17.2	17.1	17.0	16.9	15.5
Lane 2	Speed	36.9	41.5	48.5	55.0	55.9	50.6	48.3	55.7	57.3	57.1	57.1	57.1	57.1	57.1	55.6
	Density	11.5	10.1	8.3	8.5	14.6	23.3	20.1	14.7	15.1	15.7	15.9	16.0	16.1	16.3	18.4
Lane 3	Speed	37.3	41.8	48.7	53.7	56.7	56.0	54.3								
	Density	10.9	9.5	7.9	7.4	8.9	9.6	6.0								
Ramp	Speed	37.2	40.5	51.6	54.1	57.4										
	Density	10.6	4.6	12.9	7.1	6.0										
		55	87	190	180	12	185	184	183	182	195	196	170	110	129	166 198

Freeway Density
45 and Above
35 to 45
26 to 35
18 to 26
11 to 18
0 to 11

Weave/Ramp Density
43 and Above
35 to 43
28 to 35
20 to 28
10 to 20
0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

CD Road Northbound PM

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	2,069	2,069	619	2,380	2,380	2,380	2,130
	Simulated Volume	1,872	1,903	655	2,179	2,178	2,176	1,866
Ramp	Actual Volume			1450 / 1610				250
	Simulated Volume			1,249 / 1,525				311
				To I-95 NB	**From Northbound I-95 Mainline (left entrance)**			**To Route 17 southbound**
	Distance	2,796	1,542	461	534	408	280	355
	Speed	55.7	55.1	57.1	58.6	58.1	54.2	50.6
	Density	16.9	17.3	11.5	12.4	12.5	13.4	18.4
		166	198	208	188	186	189	187	205

		Freeway Segment	Ramp/Weave	Freeway Segment	Ramp/Weave			Freeway Segment
CD Lane	Actual Volume	2069.4	2069.4	619.4	2229.4	2229.4	2229.4	2130
	Simulated Volume	1,872	1,903	655	2,179	2,178	2,176	1,866
Ramp	Actual Volume			1450 / 1610				250
	Simulated Volume			1,249 / 1,525				311
				To I-95 NB	**From Northbound I-95 Mainline (left entrance)**			**To Route 17 southbound**
	Distance	2,796	1,542	461	534	408	280	355
Lane 1	Speed	55.8	54.3	57.1	59.4	59.0	53.3	49.9
	Density	15.5	21.2	11.5	7.7	5.8	20.6	20.9
Lane 2	Speed	55.6	56.5		58.1	57.6	55.1	51.4
	Density	18.4	13.3		16.6	18.9	13.8	15.9
Lane 3	Speed				58.7	58.3		
	Density				12.9	12.7		
Ramp	Speed							
	Density							
		166	198	208	188	186	189	187	205

2040 Build PM CORSIM Results

CD Road Southbound PM - Part 1

		Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	1,390	1,390	1,390	1,390	600
	Simulated Volume	1,130	1,109	1,104	1,097	479
Ramp	Actual Volume					790
	Simulated Volume					617
						Ramp E To Ramp G
Distance		729.0	94.0	294.0	134.0	266.0
Speed		18.8	16.2	15.0	13.7	38.0
Density		48.1	36.1	48.0	53.4	12.6
		279	199	222	216	210 200

			Freeway Segment			Ramp/Weave	Freeway Segment
CD Lane		Actual Volume	1,390	1,390	1,390	1,390	600
		Simulated Volume	1,130	1,109	1,104	1,097	479
Ramp		Actual Volume					790
		Simulated Volume					617
							Ramp E To Ramp G
		Distance	729.0	94.0	294.0	134.0	266.0
Lane 1		Speed	18.8	15.0	12.4	23.3	38.0
		Density	30.2	35.6	40.8	20.9	12.6
Lane 2		Speed	18.6	16.5	18.1	10.7	
		Density	29.7	34.5	29.0	56.7	
			279	199	222	216	210 200

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

CD Road Southbound PM - Part 2

		Freeway Segment			Ramp/Weave		Freeway Segment			
CD Lane	Actual Volume	2,950	2,950	2,950	3,409	3,409	3,409	3,409	3,730	3,730
	Simulated Volume	2,366	2,363	2,359	2,818	2,814	2,805	2,791	2,773	2,757
	Actual Volume			459						
	Simulated Volume			459						
				From Rt 17						
	Distance	117	216	377	292	358	544	742	674	1003
	Speed	47.5	47.2	44.3	42.1	46.6	49.0	47.3	45.3	43.5
	Density	16.6	22.5	26.7	22.5	25.8	30.4	32.5	35.1	38.3
		203	214	231	202	220	201	179	177	176	168

		Freeway Segment			Ramp/Weave		Freeway Segment			
CD Lane	Actual Volume	2,950	2,950	2,950	3,409	3,409	3,409	3,409	3,730	3,730
	Simulated Volume	2,366	2,363	2,359	2,818	2,814	2,805	2,791	2,773	2,757
				458.9						
				459						
				From Rt 17						
	Distance	117	216	377	292	358	544	742	674	1003
Lane 1	Speed	48.7	49.6	47.6	32.0	47.6	48.7	46.6	44.3	42.6
	Density	15.2	8.8	6.3	2.3	22.9	30.5	29.6	29.1	29.0
Lane 2	Speed	48.7	46.6	43.9	44.0	46.6	49.4	48.0	46.1	44.3
	Density	15.2	35.1	46.9	43.8	29.4	26.6	29.3	32.0	34.1
Lane 3	Speed				39.1	43.7				
	Density				20.8	8.0				
Ramp	Speed									
	Density									
		203	214	231	202	220	201	179	177	176	168

Freeway Density	Weave/Ramp Density
45 and Above	43 and Above
35 to 45	35 to 43
26 to 35	28 to 35
18 to 26	20 to 28
11 to 18	10 to 20
0 to 11	0 to 10

Freeway, Weave, and Ramp Density Coloring

Density Above	75
Density Above	55
Density Above	43

2040 Build PM CORSIM Results

CD Road Southbound PM - Part 2

		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	3,730	3,730	3,730	3,730	3,730	3,730	3,460	3,460	3,730	3,730	3,730	3,460	3,460	3,460	2,980
	Simulated Volume	2,735	2,700	2,673	2,665	2,651	2,643	2,440	2,410	2,657	2,584	2,561	2,330	2,305	2,269	1,926
	Actual Volume							270	270				270			480
	Simulated Volume							203	247				25			342
							To Rest Area			From Rest Area			Slip Ramp to I-95			To Carl D Silver Pkwy
	Distance	1436	1020	306	520	341	402	760	574	1554	500	1025	499	689	387	742
	Speed	41.8	40.0	38.6	36.1	33.8	32.1	29.6	28.0	25.4	19.2	16.8	14.6	13.2	11.9	8.1
	Density	42.1	45.5	47.9	51.3	55.6	43.8	65.3	70.6	59.9	97.6	107.5	118.0	131.9	99.7	159.2
		168	169	171	173	174	175	223	57	58	60	61	62	68	70	91	69

		Freeway Segment					Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment		Ramp/Weave	Freeway Segment	Ramp/Weave	Freeway Segment
CD Lane	Actual Volume	3,730	3,730	3,730	3,730	3,730	3,730	3,460	3,460	3,730	3,730	3,730	3,460	3,460	3,460	2,980
	Simulated Volume	2,735	2,700	2,673	2,665	2,651	2,643	2,440	2,410	2,657	2,584	2,561	2,330	2,305	2,269	1,926
								270	270				270			480
								203	247				25			342
							To Rest Area			From Rest Area			Slip Ramp to I-95			To Carl D Silver Pkwy
	Distance	1436	1020	306	520	341	402	760	574	1554	500	1025	499	689	387	742
Lane 1	Speed	41.1	39.2	38.2	35.7	34.1	32.4	30.9	29.1	25.2	18.6	16.1	15.1	14.0	11.0	7.5
	Density	29.2	31.0	32.3	34.7	36.5	34.3	35.4	37.9	49.3	67.0	77.9	84.6	90.8	85.7	121.9
Lane 2	Speed	42.4	40.6	39.0	36.5	33.6	31.6	28.8	27.3	25.1	19.8	17.5	14.1	12.4	11.3	8.6
	Density	35.8	36.2	36.8	38.9	41.7	19.1	46.2	47.4	51.3	66.9	73.4	73.8	81.8	89.6	115.4
Lane 3	Speed						45			37						
	Density						3			2						
Ramp	Speed															
	Density															
		168	169	171	173	174	175	223	57	58	60	61	62	68	70	91	69

Freeway Density
45 and Above
35 to 45
26 to 35
18 to 26
11 to 18
0 to 11

Weave/Ramp Density
43 and Above
35 to 43
28 to 35
20 to 28
10 to 20
0 to 10

Freeway, Weave, and Ramp Density Coloring	
Density Above	75
Density Above	55
Density Above	43

Appendix C-2: Modified Build Alternative HCS and CORSIM Traffic Analysis Output Files

Intersection Analysis

- 2020 Build HCS2010 Intersection Analysis Summary
- 2020 Build Conditions HCS2010 Output
- 2040 Build HCS2010 Intersection Analysis Summary
- 2040 Build Conditions HCS2010 Output

HCS Mainline / Ramp Junctions Analysis

- 2020 Build Conditions
    - I-95 Mainline Analysis
    - I-95 Ramp Junctions
- 2040 Build Conditions
    - I-95 Mainline Analysis
    - I-95 Ramp Junctions

CORSIM Analysis

- 2020 Build Conditions
- 2040 Build Conditions

Modified Build Alternative

2020 HCS Intersection Analysis

	Intersection	Approach	Movement	AM Peak Hour 2020 Modified Build Movement Delay(s)	AM Movement LOS	AM Approach Delay(s)	AM Approach LOS	AM Intersection Delay(s)	AM Intersection LOS	PM Peak Hour 2020 Modified Build Movement Delay(s)	PM Movement LOS	PM Approach Delay(s)	PM Approach LOS	PM Intersection Delay(s)	PM Intersection LOS
1	Route 3/Mall Drive/Central Park Boulevard	NB	Left	65.2	E	133.5	F	19.5	B	75.8	E	616.9	F	120.0	F
			Through	66.1	E					80.1	F				
			Right	151.0	F					885.6	F				
		SB	Left	69.9	E	98.5	F			72.3	E	326.4	F		
			Through	69.6	E					70.3	E				
			Right	105.6	F					544.0	F				
		EB	Left	63.3	E	13.8	B			69.3	E	68.7	E		
			Through	9.4	A					69.9	E				
			Right	0.1	A					43.4	D				
		WB	Left	69.1	E	11.1	B			60.5	E	19.3	B		
			Through	6.1	A					9.8	A				
			Right	8.2	A					14.1	B				
2	Route 3/Carl D. Silver Parkway	NB	Left	70.8	E	70.2	E	34.3	C	76.7	E	76.0	E	105.4	F
			Through												
			Right	69.6	E					75.2	E				
		SB	Left	63.7	E	63.0	E			181.1	F	160.1	F		
			Through	51.9	D					51.1	D				
			Right	52.5	D					58.9	E				
		EB	Left	63.0	E	29.6	C			63.6	E	14.8	B		
			Through	27.9	C					7.7	A				
			Right	24.4	C					5.7	A				
		WB	Left	69.5	E	34.2	C			52.1	D	144.4	F		
			Through	31.8	C					129.0	F				
			Right	39.4	D					211.9	F				
3	New Signal Route 3/Ramp from SB I-95	NB	Left	-	-	-	-	27.7	C	-	-	-	-	48.0	D
			Through												
			Right												
		SB	Left	-	-	65.3	E			-	-	72.2	E		
			Through												
			Right	65.3	E					72.2	F				
		EB	Left	-	-	-	-			-	-	-	-		
			Through												
			Right												
		WB	Left	-	-	5.5	A			-	-	31.7	C		
			Through	5.5	A					31.7	C				
			Right	-	-					-	-				
4	New Signal Route 3/Ramp to NB I-95 (triple lefts)	NB	Left	-	-	-	-	138.2	F	-	-	-	-	20.0	C
			Through												
			Right												
		SB	Left	-	-	-	-			-	-	-	-		
			Through												
			Right												
		EB	Left	37.6	D	22.0	C			62.0	E	21.5	C		
			Through	0.5	A					0.7	A				
			Right	-	-					-	-				
		WB	Left	-	-	366.0	F			-	-	17.6	B		
			Through	40.4	D					14.2	B				
			Right	618.0	F					24.1	C				
5	Route 3/Gateway Boulevard	NB	Left	58.9	E	53.3	D	22.8	C	107.3	F	87.7	F	31.1	C
			Through	38.2	D					38.0	D				
			Right	41.3	D					59.3	E				
		SB	Left	48.7	D	49.7	D			48.7	D	48.9	D		
			Through	50.1	D					49.1	D				
			Right												
		EB	Left	47.4	D	27.9	C			47.1	D	32.1	C		
			Through	28.3	C					32.3	C				
			Right	23.8	C					30.3	C				
		WB	Left	46.1	D	10.8	B			54.4	D	13.1	B		
			Through	8.6	A					7.1	A				
			Right	3.1	A					0.0	A				

Notes: All results from HCS 2010. Intersections 1 ,2, 3, 4, 5, major movement is E-W.

Intersection		Approach	Movement	AM Peak Hour						PM Peak Hour					
				2020 Modified Build						2020 ModifiedBuild					
				Movement		Approach		Intersection		Movement		Approach		Intersection	
				Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS
6	Route 17/McLane Drive	NB	Left	55.2	E	67.0	E	53.6	D	70.1	E	4.3	A	28.0	C
			Through	68.7	E					3.5	A				
			Right	1.2	A					0.1	A				
		SB	Left	53.8	D	37.8	D			68.0	E	46.6	D		
			Through	37.9	D					46.7	D				
			Right	17.7	B					14.2	B				
		EB	Left	32.8	C	32.8	C			46.7	D	46.7	D		
			Through												
			Right												
		WB	Left	33.4	C	33.4	C			48.2	D	48.2	D		
			Through												
			Right												
7	Route 17/Sanford Drive	NB	Left	63.8	E	63.7	E	30.9	C	50.8	D	89.4	F	93.5	F
			Through												
			Right	63.6	E					92.6	F				
		SB	Left	74.3	E	73.4	E			308.1	F	290.9	F		
			Through	73.5	E					71.1	E				
			Right	65.1	E					72.7	E				
		EB	Left	20.1	C	22.5	C			29.2	C	37.9	D		
			Through	22.2	C					36.8	D				
			Right	23.8	C					41.5	D				
		WB	Left	106.6	F	31.3	C			637.6	F	159.8	F		
			Through	13.4	B					25.9	C				
			Right	11.7	B					22.9	C				
9	Route 17/Short Street	NB	Left	35.0	C	34.7	C	35.7	D	42.4	D	41.6	D	112.0	F
			Through												
			Right	31.4	C					39.2	D				
		SB	Left	40.9	D	40.9	D			44.9	D	44.9	D		
			Through												
			Right												
		EB	Left	53.7	D	51.2	D			177.6	F	165.6	F		
			Through	51.6	D					166.1	F				
			Right	22.3	C					20.1	C				
		WB	Left	19.4	B	19.0	B			21.7	C	14.9	B		
			Through	19.1	B					15.0	B				
			Right	18.8	B					14.6	B				

Notes: All results from HCS 2010. Intersections 7, 9 major movement is E-W; Intersection 6 major movement is N-S.

Intersection		Approach	Movement	Storage (ft)	50th Percentile Queue Length (ft)			
					AM Peak Hour		PM Peak Hour	
					2020 Modified Build	2040 Modified Build	2020 Modified Build	2040 Modified Build
1	Route 3/Mall Drive/Central Park Boulevard	NB	Left	425	9.8	9.8	101.2	131.7
			Through	425	30.4	40.8	128.9	186.1
			Right	150	252.8	384.4	1017.7	1373.9
		SB	Left	250	10.4	10.5	122.0	166.7
			Through	2750	5.5	11.2	107.2	137.5
			Right	250	114.2	186.8	825.0	1179.0
		EB	Left	475	145.0	191.4	191.4	259.9
			Through	900	69.8	756.3	741.2	1078.0
			Right	900	0.8	0.9	105.7	139.9
		WB	Left	675	52.7	69.8	277.8	414.4
			Through	825	51.2	61.5	135.1	296.4
			Right	675	67.7	85.0	210.9	515.4
2	Route 3/Carl D. Silver Parkway	NB	Left	50	20.5	31.0	34.3	46.1
			Through					
			Right	50	19.8	31.1	30.1	41.7
		SB	Left	475	256.8	385.6	773.6	1199.7
			Through	1250	8.6	8.6	8.8	17.8
			Right	495	20.9	29.8	192.0	275.3
		EB	Left	250	80.4	101.9	160.7	207.6
			Through	800	615.6	1254.9	89.8	119.8
			Right	250	6.2	13.3	1.5	3.1
		WB	Left	400	20.7	30.6	41.8	55.9
			Through	3675	223.7	298.6	1117.3	1778.0
			Right	650	361.2	578.3	1292.0	1958.3
3	New Signal Route 3/Ramp from SB I-95	NB	Left	-	-	-	-	-
			Through					
			Right					
		SB	Left	-	-	-	-	-
			Through					
			Right	500	224.7	298.4	710.6	1860.1
		EB	Left	-	-	-	-	-
			Through					
			Right					
		WB	Left	-	-	-	-	-
			Through	1725	50.9	87.1	385.2	424.2
			Right	-	-	-	-	-
4	New Signal Route 3/Ramp to NB I-95 (triple lefts)	NB	Left	-	-	-	-	-
			Through					
			Right					
		SB	Left	-	-	-	-	-
			Through					
			Right					
		EB	Left	575	781.7	1093.4	426.8	538.2
			Through	1725	2.8	3.9	4.1	6.5
			Right	-	-	-	-	-
		WB	Left	-	-	-	-	-
			Through	825	261.3	419.2	225.9	375.8
			Right	825	2850.0	4142.6	512.0	1135.3
5	Route 3/Gateway Boulevard	NB	Left	400	217.3	327.9	374.2	557.7
			Through	4500	6.0	6.0	3.0	3.0
			Right	400	73.8	88.8	189.9	308.8
		SB	Left	650	7.4	7.4	7.4	7.4
			Through	650	17.9	25.3	7.0	7.0
			Right					
		EB	Left	350	27.6	27.6	20.5	27.6
			Through	3675	309.9	437.7	395.6	664.5
			Right	450	168.2	229.3	293.8	418.2
		WB	Left	275	37.6	48.3	92.7	129.8
			Through	375	67.4	215.5	58.0	129.5
			Right	375	0.8	0.8	0.0	0.0

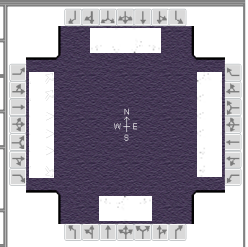
Notes: All results from HCS 2010. Intersections 1 ,2, 3, 4, 5, major movement is E-W.

Intersection		Approach	Movement	Storage (ft)	50th Percentile Queue Length (ft)			
					AM Peak Hour		PM Peak Hour	
					2020 Modified Build	2040 Modified Build	2020 Modified Build	2040 Modified Build
6	Route 17/McLane Drive	NB	Left	200	33.3	50.6	31.7	53.6
			Through	845	553.0	1758.1	39.0	440.0
			Right	845	2.5	4.0	0.6	0.9
		SB	Left	300	24.5	32.9	10.3	20.8
			Through	1000	558.2	1373.8	988.1	2194.8
			Right	1000	12.6	17.2	8.0	12.5
		EB	Left	35	24.7	31.2	21.0	29.7
			Through					
			Right					
		WB	Left	800	34.6	47.9	56.5	89.1
			Through					
			Right					
7	Route 17/Sanford Drive	NB	Left	425	68.0	113.5	45.8	78.1
			Through					
			Right	400	69.2	125.9	395.9	805.2
		SB	Left	850	82.4	187.3	358.0	542.3
			Through	475	74.3	152.6	22.9	33.8
			Right	360	19.0	35.5	10.8	10.4
		EB	Left	580	4.9	8.8	6.8	5.9
			Through	845	300.7	412.6	596.1	1013.0
			Right	845	210.6	431.7	620.4	1125.9
		WB	Left	275	266.2	615.7	582.4	600.1
			Through	2750	130.8	180.2	219.3	206.4
			Right	400	74.0	103.5	116.5	105.7
9	Route 17/Short Street	NB	Left	1000	53.9	71.5	54.3	75.1
			Through					
			Right	100	4.6	9.7	16.3	22.5
		SB	Left	35	8.7	14.6	13.0	13.0
			Through					
			Right					
		EB	Left	2750	483.3	992.2	1265.4	2200.8
			Through	2750	390.9	789.6	1131.4	1990.6
			Right	275	24.3	29.0	36.7	51.2
		WB	Left	150	6.2	6.2	3.0	6.1
			Through	3000	214.1	334.3	178.8	258.4
			Right	3000	212.3	335.1	176.5	255.9

Notes: All results from HCS 2010. Intersections 7, 9 major movement is E-W; Intersection 6 major movement is N-S.

HCS 2010 Signalized Intersection Results Summary

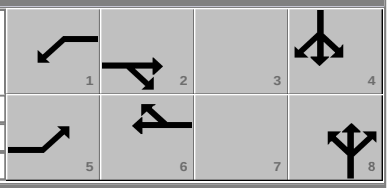
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Central Park Bl…	File Name	1 - Route 3 at Central Park - 2020 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	280	2930	60	100	1280	30	10	30	170	10	10	90

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	27.5	62.5	10.5	14.0	9.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	35.0	105.0	18.0	88.0		21.0		16.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time (g_s), s	14.5		6.7			18.0		10.7
Green Extension Time (g_e), s	0.5	0.0	1.5	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.75			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	292	3052	57	104	1027	337	10	31	160	10	10	85
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1691	1594	1658	1810	1780	1810	1845	1563	1757	1696	1548
Queue Service Time (g_s), s	12.5	0.0	0.0	4.7	6.0	7.4	0.8	2.5	16.0	0.9	0.5	8.7
Cycle Queue Clearance Time (g_c), s	12.5	0.0	0.0	4.7	6.0	7.4	0.8	2.5	16.0	0.9	0.5	8.7
Green Ratio (*g/C*)	0.18	0.62	0.62	0.08	0.52	0.52	0.10	0.10	0.10	0.07	0.07	0.07
Capacity (*c*), veh/h	631	3171	996	249	2816	895	181	184	156	121	233	106
Volume-to-Capacity Ratio (*X*)	0.463	0.962	0.057	0.419	0.365	0.377	0.058	0.169	1.026	0.086	0.045	0.802
Back of Queue (*Q*), ft/ln (50 th percentile)	145	69.8	0.8	52.7	51.2	67.7	9.8	30.4	252.8	10.4	5.5	114.2
Back of Queue (*Q*), veh/ln (50 th percentile)	5.8	2.7	0.0	2.0	2.0	2.6	0.4	1.2	9.9	0.4	0.2	4.4
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	63.1	0.0	0.0	68.7	5.8	7.1	65.2	65.9	72.0	69.8	69.6	73.4
Incremental Delay (d_2), s/veh	0.2	9.4	0.1	0.4	0.3	1.1	0.0	0.2	79.0	0.1	0.0	32.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	63.3	9.4	0.1	69.1	6.1	8.2	65.2	66.1	151.0	69.9	69.6	105.6
Level of Service (LOS)	E	A	A	E	A	A	E	E	F	E	E	F
Approach Delay, s/veh / LOS	13.8	B		11.1	B		133.5	F		98.5	F	
Intersection Delay, s/veh / LOS	19.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	2.4	B	1.1	A	0.8	A	0.6	A

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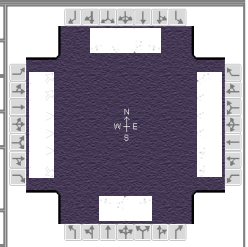
HCS 2010 Signalized Intersection Results Summary

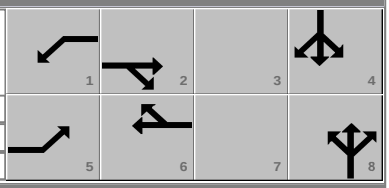
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Central Park Bl…	File Name	1 - Route 3 at Central Park - 2020 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	350	1820	110	540	2580	70	90	110	440	110	200	400

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	25.5	42.5	33.5	14.0	18.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	33.0	83.0	41.0	91.0		21.0		25.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time (g_s), s	18.6		27.1			18.0		22.0
Green Extension Time (g_e), s	0.4	0.0	4.6	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.02		0.78			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	365	1896	104	563	2078	682	94	115	418	115	208	379
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1675	1594	1757	1863	1828	1810	1900	1610	1792	1900	1610
Queue Service Time (g_s), s	16.6	62.1	9.6	25.1	26.1	30.4	8.4	9.9	16.0	10.2	8.7	20.0
Cycle Queue Clearance Time (g_c), s	16.6	62.1	9.6	25.1	26.1	30.4	8.4	9.9	16.0	10.2	8.7	20.0
Green Ratio (*g/C*)	0.16	0.46	0.46	0.21	0.51	0.51	0.09	0.09	0.09	0.12	0.12	0.12
Capacity (*c*), veh/h	558	2306	731	723	2827	898	170	179	152	211	447	189
Volume-to-Capacity Ratio (*X*)	0.653	0.822	0.142	0.777	0.735	0.760	0.550	0.641	2.756	0.544	0.466	2.002
Back of Queue (*Q*), ft/ln (50 th percentile)	191.4	741.2	105.7	277.8	135.1	210.9	101.2	128.9	1017.7	122	107.2	825
Back of Queue (*Q*), veh/ln (50 th percentile)	7.7	29.0	4.2	11.1	5.3	8.4	4.0	5.2	40.7	4.8	4.3	33.0
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	67.1	66.5	43.0	58.1	8.9	11.1	73.6	74.2	77.0	70.7	70.0	75.0
Incremental Delay (d_2), s/veh	2.2	3.5	0.4	2.5	0.9	3.0	2.2	5.9	808.6	1.6	0.3	469.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	69.3	69.9	43.4	60.5	9.8	14.1	75.8	80.1	885.6	72.3	70.3	544.0
Level of Service (LOS)	E	E	D	E	A	B	E	F	F	E	E	F
Approach Delay, s/veh / LOS	68.7	E		19.3	B		616.9	F		326.4	F	
Intersection Delay, s/veh / LOS	120.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	1.8	A	1.9	A	1.5	A	1.1	A

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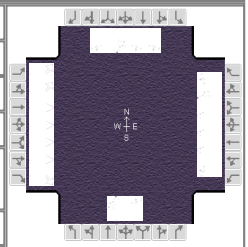
HCS 2010 Signalized Intersection Results Summary

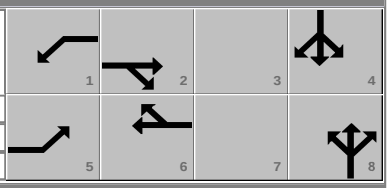
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Carl D Silver P…	File Name	2 - Route 3 at Carl D Silver - 2020 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160	3260	10	20	1230	420	10	10	20	490	10	30

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	24.5	50.5	9.5	10.0	29.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		11.0		9.0
Phase Duration, s	32.0	90.0	17.0	75.0		17.0		36.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	9.0		3.8			3.9		23.6
Green Extension Time (g_e), s	0.2	0.0	2.4	0.0		0.0		0.6
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.50			0.00		0.14

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	3396	9	21	1281	438		21	19	510	10	25
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1708	1533	1774	1827	1579		1854	1464	1774	1900	1610
Queue Service Time (g_s), s	7.0	68.8	0.6	1.8	19.1	34.5		1.7	1.9	21.6	0.7	2.0
Cycle Queue Clearance Time (g_c), s	7.0	68.8	0.6	1.8	19.1	34.5		1.7	1.9	21.6	0.7	2.0
Green Ratio (*g/C*)	0.16	0.53	0.53	0.08	0.44	0.44		0.08	0.08	0.20	0.20	0.20
Capacity (*c*), veh/h	571	3630	815	133	3197	691		139	110	699	374	317
Volume-to-Capacity Ratio (*X*)	0.292	0.936	0.012	0.157	0.401	0.633		0.150	0.171	0.731	0.028	0.079
Back of Queue (*Q*), ft/ln (50 th percentile)	80.4	615.6	6.2	20.7	223.7	361.2		20.5	19.8	256.8	8.6	20.9
Back of Queue (*Q*), veh/ln (50 th percentile)	3.2	24.4	0.2	0.8	8.7	14.2		0.8	0.7	10.1	0.3	0.8
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	62.9	22.0	24.4	69.3	31.4	35.0		70.6	69.3	60.3	51.9	52.4
Incremental Delay (d_2), s/veh	0.1	6.0	0.0	0.2	0.4	4.4		0.2	0.3	3.4	0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	63.0	27.9	24.4	69.5	31.8	39.4		70.8	69.6	63.7	51.9	52.5
Level of Service (LOS)	E	C	C	E	C	D		E	E	E	D	D
Approach Delay, s/veh / LOS	29.6	C		34.2	C		70.2	E		63.0	E	
Intersection Delay, s/veh / LOS	34.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	2.0	A	1.2	A	0.6	A	1.4	A

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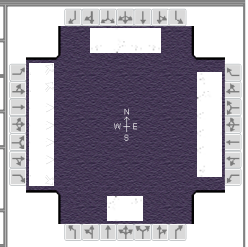
HCS 2010 Signalized Intersection Results Summary

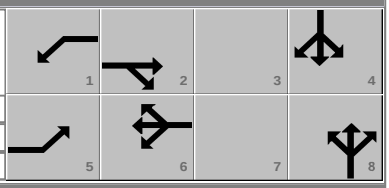
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Carl D Silver P…	File Name	2 - Route 3 at Carl D Silver - 2020 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	2060	10	40	3100	760	20	10	30	970	10	220

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.5	43.5	9.5	10.0	36.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	1.3	3.0		11.0		9.0
Phase Duration, s	42.0	93.0	17.0	68.0		17.0		43.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	15.8		2.0			4.9		40.5
Green Extension Time (g_e), s	0.5	0.0	6.4	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.87			0.04		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	313	2146	9	42	3229	792		31	28	1010	10	198
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1691	1610	1723	1881	1610		1768	1579	1810	1900	1610
Queue Service Time (g_s), s	13.8	15.7	0.1	0.0	63.0	63.0		2.9	2.9	38.5	0.7	18.4
Cycle Queue Clearance Time (g_c), s	13.8	15.7	0.1	0.0	63.0	63.0		2.9	2.9	38.5	0.7	18.4
Green Ratio (*g/C*)	0.21	0.52	0.52	0.31	0.37	0.37		0.07	0.07	0.23	0.23	0.23
Capacity (*c*), veh/h	744	3502	833	208	2789	597		125	111	820	430	365
Volume-to-Capacity Ratio (*X*)	0.420	0.613	0.011	0.200	1.158	1.327		0.250	0.252	1.233	0.024	0.543
Back of Queue (*Q*), ft/ln (50 th percentile)	160.7	89.8	1.5	41.8	1117.3	1292		34.3	30.1	773.6	8.8	192
Back of Queue (*Q*), veh/ln (50 th percentile)	6.4	3.5	0.1	1.6	44.3	51.7		1.3	1.2	30.9	0.4	7.7
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	63.5	6.9	5.6	51.9	53.5	53.5		76.3	74.8	65.8	51.1	58.0
Incremental Delay (d_2), s/veh	0.1	0.8	0.0	0.2	75.5	158.4		0.4	0.4	115.3	0.0	0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	63.6	7.7	5.7	52.1	129.0	211.9		76.7	75.2	181.1	51.1	58.9
Level of Service (LOS)	E	A	A	D	F	F		E	E	F	D	E
Approach Delay, s/veh / LOS	14.8	B		144.4	F		76.0	E		160.1	F	
Intersection Delay, s/veh / LOS	105.4						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	1.5	A	2.2	B	0.6	A	2.5	B

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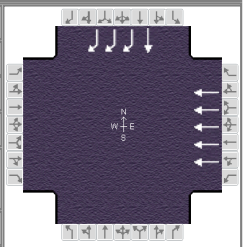
HCS 2010 Signalized Intersection Results Summary

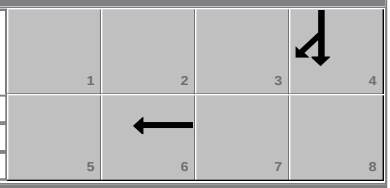
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	WB Rte 3 @ I-95 SB Off…	File Name	3 - Route 3 at I-95 SB Off-Ramp - 2020 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					1050						0	620

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	28.7	0.0	0.0	0.0	0.0
Yellow	0.0	4.0	0.0	0.0	0.0	0.0
Red	0.0	1.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				126.3				33.7
Change Period, ($Y+R_c$), s				5.0				5.0
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								26.6
Green Extension Time (g_e), s				0.0				2.2
Phase Call Probability								1.00
Max Out Probability								0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					6						4	14
Adjusted Flow Rate (*v*), veh/h					1141						0	674
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1725						1900	1425
Queue Service Time (g_s), s					5.9						0.0	24.6
Cycle Queue Clearance Time (g_c), s					5.9						0.0	24.6
Green Ratio (*g/C*)					0.76						0.18	0.18
Capacity (*c*), veh/h					6539						341	767
Volume-to-Capacity Ratio (*X*)					0.175						0.000	0.878
Back of Queue (*Q*), ft/ln (50 th percentile)					50.9						0	224.7
Back of Queue (*Q*), veh/ln (50 th percentile)					2.0						0.0	9.0
Queue Storage Ratio (*RQ*) (50 th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					5.4						0.0	63.9
Incremental Delay (d_2), s/veh					0.1						0.0	1.3
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					5.5						0.0	65.3
Level of Service (LOS)					A							E
Approach Delay, s/veh / LOS	0.0			5.5		A	0.0			65.3		E
Intersection Delay, s/veh / LOS	27.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.3	B	3.5	D
Bicycle LOS Score / LOS			0.9	A			1.6	A

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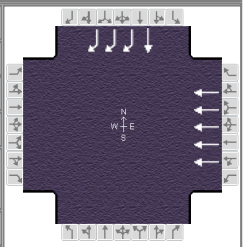
HCS 2010 Signalized Intersection Results Summary

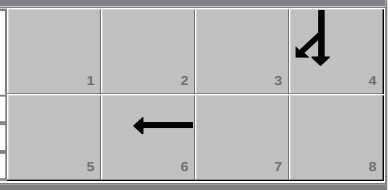
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	WB Rte 3 @ I-95 SB Off…	File Name	3 - Route 3 at I-95 SB Off-Ramp - 2020 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					2330						0	1570

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	71.0	0.0	0.0	0.0	0.0
Yellow	0.0	4.5	0.0	0.0	0.0	0.0
Red	0.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				91.5				78.5
Change Period, ($Y+R_c$), s				7.5				7.5
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								73.0
Green Extension Time (g_e), s				0.0				0.0
Phase Call Probability								1.00
Max Out Probability								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					6						4	14
Adjusted Flow Rate (*v*), veh/h					2533						0	1707
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1691						1900	1357
Queue Service Time (g_s), s					36.8						0.0	71.0
Cycle Queue Clearance Time (g_c), s					36.8						0.0	71.0
Green Ratio (*g/C*)					0.49						0.42	0.42
Capacity (*c*), veh/h					4179						794	1700
Volume-to-Capacity Ratio (*X*)					0.606						0.000	1.004
Back of Queue (*Q*), ft/ln (50 th percentile)					385.2						0	710.6
Back of Queue (*Q*), veh/ln (50 th percentile)					15.2						0.0	27.3
Queue Storage Ratio (*RQ*) (50 th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					31.1						0.0	49.5
Incremental Delay (d_2), s/veh					0.7						0.0	22.7
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					31.7						0.0	72.2
Level of Service (LOS)					C							F
Approach Delay, s/veh / LOS	0.0			31.7	C		0.0			72.2	E	
Intersection Delay, s/veh / LOS	48.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.3	B	3.5	D
Bicycle LOS Score / LOS			1.3	A			3.3	C

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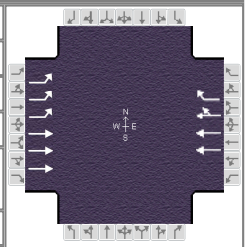
HCS 2010 Signalized Intersection Results Summary

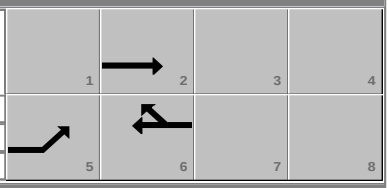
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ I-95 NB On-Ra…	File Name	4 - Route 3 at I-95 NB On-Ramp - 2020 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	2320	1680			890	1150						

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	87.0	58.0	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		7.3				
Phase Duration, s	94.5	160.0		65.5				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	75.7							
Green Extension Time (g_e), s	11.2	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	0.12							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	2522	1826			967	1250						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1810	1533						
Queue Service Time (g_s), s	73.7	4.4			22.1	58.0						
Cycle Queue Clearance Time (g_c), s	73.7	4.4			22.1	58.0						
Green Ratio (*g/C*)	0.54	0.95			0.36	0.36						
Capacity (*c*), veh/h	2729	4698			1969	556						
Volume-to-Capacity Ratio (*X*)	0.924	0.389			0.491	2.247						
Back of Queue (*Q*), ft/ln (50 th percentile)	781.7	2.8			261.3	2850						
Back of Queue (*Q*), veh/ln (50 th percentile)	30.1	0.1			10.0	109.6						
Queue Storage Ratio (*RQ*) (50 th percentile)	1.95	0.00			0.00	0.00						
Uniform Delay (d_1), s/veh	33.5	0.3			39.5	51.0						
Incremental Delay (d_2), s/veh	4.1	0.2			0.9	567.1						
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	37.6	0.5			40.4	618.0						
Level of Service (LOS)	D	A			D	F						
Approach Delay, s/veh / LOS	22.0	C		366.0	F		0.0			0.0		
Intersection Delay, s/veh / LOS	138.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.8	C	3.3	C	3.5	D
Bicycle LOS Score / LOS	2.9	C	1.7	A				

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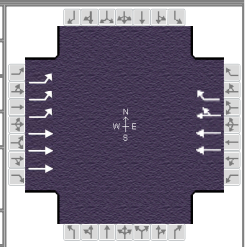
HCS 2010 Signalized Intersection Results Summary

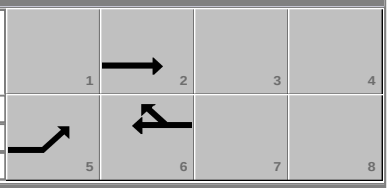
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ I-95 NB On-Ra…	File Name	4 - Route 3 at I-95 NB On-Ramp - 2020 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1080	2100			1315	670						

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	44.0	111.0	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		7.3				
Phase Duration, s	51.5	170.0		118.5				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	40.5							
Green Extension Time (g_e), s	3.5	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	1174	2283			1429	728						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1810	1533						
Queue Service Time (g_s), s	38.5	6.5			21.1	53.4						
Cycle Queue Clearance Time (g_c), s	38.5	6.5			21.1	53.4						
Green Ratio (*g/C*)	0.26	0.96			0.65	0.65						
Capacity (*c*), veh/h	1299	4712			3545	1001						
Volume-to-Capacity Ratio (*X*)	0.904	0.484			0.403	0.727						
Back of Queue (*Q*), ft/ln (50 th percentile)	426.8	4.1			225.9	512						
Back of Queue (*Q*), veh/ln (50 th percentile)	16.4	0.2			8.7	19.7						
Queue Storage Ratio (*RQ*) (50 th percentile)	1.07	0.00			0.00	0.00						
Uniform Delay (d_1), s/veh	61.0	0.3			13.9	19.5						
Incremental Delay (d_2), s/veh	1.0	0.4			0.3	4.6						
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	62.0	0.7			14.2	24.1						
Level of Service (LOS)	E	A			B	C						
Approach Delay, s/veh / LOS	21.5	C		17.6	B		0.0			0.0		
Intersection Delay, s/veh / LOS	20.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.8	C	3.3	C	3.5	D
Bicycle LOS Score / LOS	2.4	B	1.7	A				

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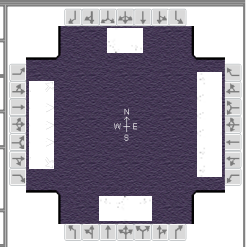
HCS 2010 Signalized Intersection Results Summary

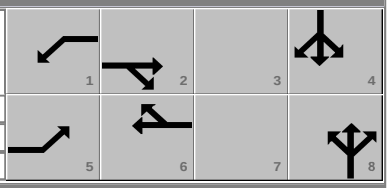
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Gateway Blvd/…	File Name	5 - Route 3 at Gateway - 2020 Modified Build AM.…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	1580	350	110	1760	10	260	10	120	10	5	20

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.2
Queue Clearance Time (g_s), s	4.4		5.5			18.6		3.7
Green Extension Time (g_e), s	0.0	0.0	2.4	0.0		0.1		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.71			1.00		0.34

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	1646	330	115	1833	9	271	10	114	10	26	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1661	
Queue Service Time (g_s), s	2.4	30.2	17.0	3.5	17.9	0.1	16.6	0.5	7.4	0.7	1.7	
Cycle Queue Clearance Time (g_c), s	2.4	30.2	17.0	3.5	17.9	0.1	16.6	0.5	7.4	0.7	1.7	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	109	
Volume-to-Capacity Ratio (*X*)	0.228	0.718	0.472	0.333	0.847	0.013	0.821	0.030	0.402	0.078	0.238	
Back of Queue (*Q*), ft/ln (50 th percentile)	27.6	309.9	168.2	37.6	67.4	0.8	217.3	6	73.8	7.4	17.9	
Back of Queue (*Q*), veh/ln (50 th percentile)	1.1	12.1	6.5	1.5	2.5	0.0	8.6	0.2	2.8	0.3	0.7	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	47.2	26.3	21.5	45.9	4.3	3.0	44.7	38.1	41.0	48.7	49.7	
Incremental Delay (d_2), s/veh	0.2	2.0	2.3	0.2	4.3	0.0	14.2	0.0	0.3	0.1	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.4	28.3	23.8	46.1	8.6	3.1	58.9	38.2	41.3	48.7	50.1	
Level of Service (LOS)	D	C	C	D	A	A	E	D	D	D	D	
Approach Delay, s/veh / LOS	27.9	C		10.8	B		53.3	D		49.7	D	
Intersection Delay, s/veh / LOS	22.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	1.6	A	1.6	A	1.1	A	0.5	A

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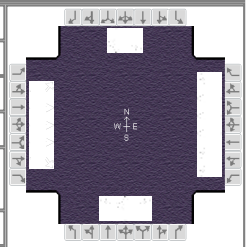
HCS 2010 Signalized Intersection Results Summary

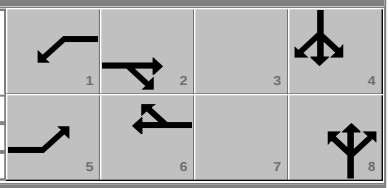
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Gateway Blvd/…	File Name	5 - Route 3 at Gateway - 2020 Modified Build PM.…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1830	500	240	1650	0	330	5	230	10	5	5

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.0
Queue Clearance Time (g_s), s	3.8		10.0			23.0		2.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	31	1906	486	250	1719	0	344	5	228	10	10	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1743	
Queue Service Time (g_s), s	1.8	37.9	28.8	8.0	14.0	0.0	21.0	0.3	16.3	0.7	0.6	
Cycle Queue Clearance Time (g_c), s	1.8	37.9	28.8	8.0	14.0	0.0	21.0	0.3	16.3	0.7	0.6	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	115	
Volume-to-Capacity Ratio (*X*)	0.171	0.832	0.695	0.726	0.794	0.000	1.042	0.015	0.808	0.078	0.091	
Back of Queue (*Q*), ft/ln (50 th percentile)	20.5	395.6	293.8	92.7	58	0	374.2	3	189.9	7.4	7	
Back of Queue (*Q*), veh/ln (50 th percentile)	0.8	15.5	11.3	3.6	2.2	0.0	14.8	0.1	7.3	0.3	0.3	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	46.9	28.6	24.7	47.8	4.0	0.0	46.5	38.0	44.6	48.7	49.0	
Incremental Delay (d_2), s/veh	0.2	3.7	5.6	6.5	3.1	0.0	60.8	0.0	14.8	0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.1	32.3	30.3	54.4	7.1	0.0	107.3	38.0	59.3	48.7	49.1	
Level of Service (LOS)	D	C	C	D	A		F	D	E	D	D	
Approach Delay, s/veh / LOS	32.1	C		13.1	B		87.7	F		48.9	D	
Intersection Delay, s/veh / LOS	31.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	1.8	A	1.6	A	1.4	A	0.5	A

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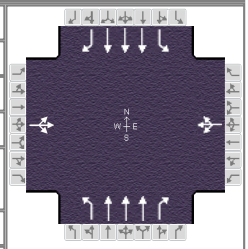
HCS 2010 Signalized Intersection Results Summary

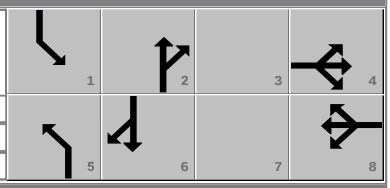
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ McLane Dr	File Name	6 - Route 17 at McLane - 2020 Modified Build AM.…		
Project Description	I-95 Interchange Modification Report				



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	10	10	40	5	10	40	2570	60	30	2090	30

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	60.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	68.0	17.0	68.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		4.2		5.6	4.9		4.1	
Green Extension Time (g_e), s		0.2		0.2	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		42			57		42	2677	59	31	2177	29
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1520			1432		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			1.4		2.9	63.0	0.2	2.1	52.1	1.3
Cycle Queue Clearance Time (g_c), s		2.2			3.6		2.9	63.0	0.2	2.1	52.1	1.3
Green Ratio (*g/C*)		0.32			0.32		0.09	0.48	0.48	0.10	0.48	0.48
Capacity (*c*), veh/h		492			472		161	2412	750	174	2412	750
Volume-to-Capacity Ratio (*X*)		0.085			0.121		0.259	1.110	0.079	0.180	0.903	0.039
Back of Queue (*Q*), ft/ln (50 th percentile)		24.7			34.6		33.3	553	2.5	24.5	558.2	12.6
Back of Queue (*Q*), veh/ln (50 th percentile)		1.0			1.3		1.3	21.4	0.1	1.0	21.6	0.5
Queue Storage Ratio (*RQ*) (50 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		32.8			33.3		54.9	12.5	1.0	53.6	31.8	17.6
Incremental Delay (d_2), s/veh		0.0			0.0		0.3	56.2	0.2	0.2	6.1	0.1
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		32.8			33.4		55.2	68.7	1.2	53.8	37.9	17.7
Level of Service (LOS)		C			C		E	F	A	D	D	B
Approach Delay, s/veh / LOS	32.8	C		33.4	C		67.0	E		37.8	D	
Intersection Delay, s/veh / LOS	53.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.6	A	0.6	A	2.0	B	1.7	A

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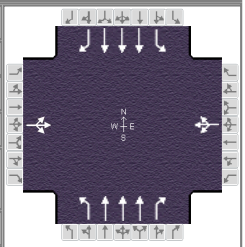
HCS 2010 Signalized Intersection Results Summary

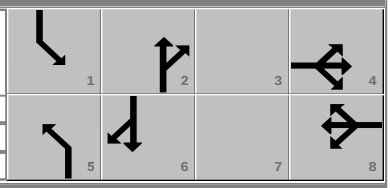
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ McLane Dr	File Name	6 - Route 17 at McLane - 2020 Modified Build PM…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	5	10	40	5	20	30	2180	40	10	2730	20

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	90.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	98.0	17.0	98.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		3.9		7.7	4.7		2.9	
Green Extension Time (g_e), s		0.2		0.2	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		26			68		31	2271	39	10	2844	19
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1529			1456		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			3.8		2.7	9.5	0.0	0.9	89.3	0.8
Cycle Queue Clearance Time (g_c), s		1.9			5.7		2.7	9.5	0.0	0.9	89.3	0.8
Green Ratio (*g/C*)		0.26			0.26		0.08	0.58	0.58	0.08	0.58	0.58
Capacity (*c*), veh/h		399			387		130	2893	900	141	2893	900
Volume-to-Capacity Ratio (*X*)		0.065			0.175		0.239	0.785	0.043	0.074	0.983	0.021
Back of Queue (*Q*), ft/ln (50 th percentile)		21			56.5		31.7	39	0.6	10.3	988.1	8
Back of Queue (*Q*), veh/ln (50 th percentile)		0.8			2.2		1.2	1.5	0.0	0.4	38.3	0.3
Queue Storage Ratio (*RQ*) (50 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		46.7			48.1		69.7	1.2	0.0	67.9	33.5	14.2
Incremental Delay (d_2), s/veh		0.0			0.1		0.3	2.2	0.1	0.1	13.2	0.0
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		46.7			48.2		70.1	3.5	0.1	68.0	46.7	14.2
Level of Service (LOS)		D			D		E	A	A	E	D	B
Approach Delay, s/veh / LOS	46.7	D		48.2	D		4.3	A		46.6	D	
Intersection Delay, s/veh / LOS	28.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.5	A	0.6	A	1.8	A	2.1	B

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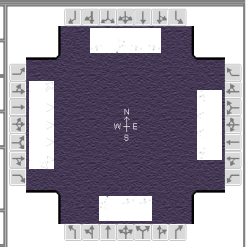
HCS 2010 Signalized Intersection Results Summary

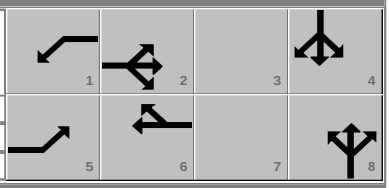
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Sanford Dr/St…	File Name	7 - Route 17 at Sanford - 2020 Modified Build AM.…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	2110	20	210	660	220	60	10	170	160	70	20

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	15.0	55.5	5.0	11.0	7.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.3	4.0	2.0	3.0		11.0		9.0
Phase Duration, s	12.5	75.5	22.5	85.5		18.0		14.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (MAH), s	2.8	0.0	2.8	0.0		3.1		2.9
Queue Clearance Time (g_s), s	2.0		18.2			8.9		8.1
Green Extension Time (g_e), s	1.9	0.0	0.0	0.0		0.1		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.97		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	10	1665	552	219	688	214		73	152	167	73	19
Adjusted Saturation Flow Rate (s), veh/h/ln	1740	1827	1816	1740	1739	1548		1752	1370	1740	1827	1548
Queue Service Time (g_s), s	0.0	27.1	27.1	16.2	12.8	8.0		5.2	6.9	6.1	5.0	1.5
Cycle Queue Clearance Time (g_c), s	0.0	27.1	27.1	16.2	12.8	8.0		5.2	6.9	6.1	5.0	1.5
Green Ratio (g/C)	0.45	0.52	0.52	0.13	0.60	0.60		0.10	0.10	0.07	0.07	0.07
Capacity (c), veh/h	426	2867	950	228	2087	953		175	274	241	134	83
Volume-to-Capacity Ratio (X)	0.024	0.581	0.581	0.961	0.329	0.224		0.416	0.555	0.692	0.546	0.225
Back of Queue (Q), ft/ln (50 th percentile)	4.9	300.7	310.6	266.2	130.8	74		68	69.2	82.4	74.3	19
Back of Queue (Q), veh/ln (50 th percentile)	0.2	11.7	12.0	10.3	5.1	2.9		2.6	2.7	3.2	2.9	0.7
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	19.9	21.2	21.2	56.2	13.0	11.2		56.7	55.7	59.1	58.4	58.9
Incremental Delay (d_2), s/veh	0.1	0.9	2.6	50.5	0.4	0.5		7.1	7.9	15.1	15.1	6.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	20.1	22.1	23.8	106.6	13.4	11.7		63.8	63.6	74.3	73.5	65.1
Level of Service (LOS)	C	C	C	F	B	B		E	E	E	E	E
Approach Delay, s/veh / LOS	22.5	C		31.3	C		63.7	E		73.4	E	
Intersection Delay, s/veh / LOS	30.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.6	B	3.6	D	3.1	C
Bicycle LOS Score / LOS	1.4	A	1.4	A	0.9	A	0.9	A

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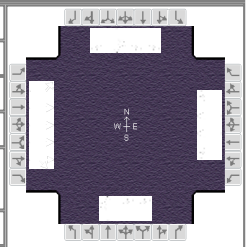
HCS 2010 Signalized Intersection Results Summary

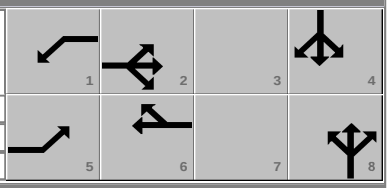
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Sanford Dr/St…	File Name	7 - Route 17 at Sanford - 2020 Modified Build PM….		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	2620	50	240	660	200	40	10	680	370	20	10

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.5	63.5	6.5	35.0	10.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.3	4.0	2.0	3.0		11.0		9.0
Phase Duration, s	14.0	85.0	16.0	87.0		42.0		17.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	2.0		12.5			38.1		14.0
Green Extension Time (g_e), s	3.1	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.85		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	10	2088	689	250	688	200		52	622	385	21	9
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1827	1804	1740	1739	1548		1757	1370	1740	1827	1548
Queue Service Time (g_s), s	0.0	50.8	51.0	10.5	19.8	11.6		3.8	36.1	12.0	1.7	0.9
Cycle Queue Clearance Time (g_c), s	0.0	50.8	51.0	10.5	19.8	11.6		3.8	36.1	12.0	1.7	0.9
Green Ratio (*g/C*)	0.42	0.48	0.48	0.07	0.50	0.50		0.23	0.23	0.08	0.08	0.08
Capacity (*c*), veh/h	381	2655	874	114	1728	789		406	634	261	143	97
Volume-to-Capacity Ratio (*X*)	0.027	0.787	0.788	2.189	0.398	0.254		0.128	0.981	1.477	0.146	0.097
Back of Queue (*Q*), ft/ln (50 th percentile)	6.8	596.1	620.4	582.4	219.3	116.5		45.8	395.9	358	22.9	10.8
Back of Queue (*Q*), veh/ln (50 th percentile)	0.3	23.1	24.0	22.6	8.5	4.5		1.8	15.3	13.9	0.9	0.4
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	29.1	34.4	34.4	74.8	25.2	22.1		50.2	61.2	74.0	69.0	70.7
Incremental Delay (d_2), s/veh	0.1	2.4	7.1	562.9	0.7	0.8		0.7	31.5	234.1	2.1	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	29.2	36.8	41.5	637.6	25.9	22.9		50.8	92.6	308.1	71.1	72.7
Level of Service (LOS)	C	D	D	F	C	C		D	F	F	E	E
Approach Delay, s/veh / LOS	37.9	D		159.8	F		89.4	F		290.9	F	
Intersection Delay, s/veh / LOS	93.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	2.6	B	3.6	D	3.1	C
Bicycle LOS Score / LOS	1.6	A	1.4	A	1.6	A	1.2	A

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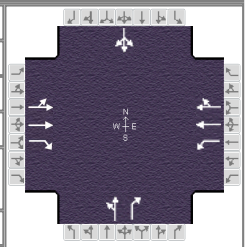
HCS 2010 Signalized Intersection Results Summary

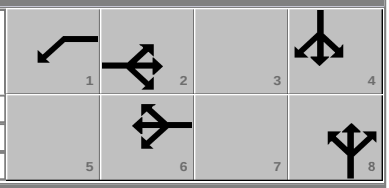
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Short St	File Name	9 - Route 17 at Short - 2020 Modified Build AM.xus		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	1060	60	20	1020	5	100	0	10	5	0	10

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	32.5	19.0	10.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		40.0	17.0	57.0		26.0		17.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.6			6.9		2.8
Green Extension Time (g_e), s		0.0	0.0	0.0		0.1		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	580	535	57	21	534	533		104	9		16	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1815	1679	1579	1810	1863	1859		1810	1563		1672	
Queue Service Time (g_s), s	11.0	30.4	2.4	0.6	19.3	19.3		4.9	0.5		0.8	
Cycle Queue Clearance Time (g_c), s	31.6	30.4	2.4	0.6	19.3	19.3		4.9	0.5		0.8	
Green Ratio (*g/C*)	0.35	0.35	0.35	0.48	0.52	0.52		0.21	0.21		0.12	
Capacity (*c*), veh/h	627	588	553	299	969	920		380	328		201	
Volume-to-Capacity Ratio (*X*)	0.925	0.911	0.104	0.070	0.552	0.579		0.274	0.029		0.078	
Back of Queue (*Q*), ft/ln (50 th percentile)	483.3	390.9	24.3	6.2	214.1	212.3		53.9	4.6		8.7	
Back of Queue (*Q*), veh/ln (50 th percentile)	16.9	15.3	1.0	0.2	8.4	8.5		2.2	0.2		0.3	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	32.1	31.0	21.9	19.4	16.8	16.2		34.8	31.4		40.9	
Incremental Delay (d_2), s/veh	21.6	20.6	0.4	0.0	2.3	2.7		0.1	0.0		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	53.7	51.6	22.3	19.4	19.1	18.8		35.0	31.4		40.9	
Level of Service (LOS)	D	D	C	B	B	B		C	C		D	
Approach Delay, s/veh / LOS	51.2	D		19.0	B		34.7	C		40.9	D	
Intersection Delay, s/veh / LOS	35.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.5	A	1.4	A	0.7	A	0.5	A

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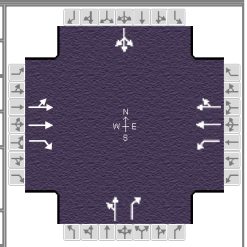
HCS 2010 Signalized Intersection Results Summary

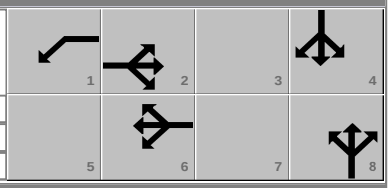
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2020 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Short St	File Name	9 - Route 17 at Short - 2020 Modified Build PM.xus		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	1810	90	10	940	5	80	5	30	5	5	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.0	43.5	16.0	11.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		51.0	18.0	69.0		23.0		18.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.3			6.8		3.2
Green Extension Time (g_e), s		0.0	0.0	0.0		0.1		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	993	903	85	10	493	492		89	28		21	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1847	1695	1548	1757	1863	1859		1815	1610		1723	
Queue Service Time (g_s), s	16.0	46.0	3.7	0.3	16.5	16.5		4.8	1.6		1.2	
Cycle Queue Clearance Time (g_c), s	43.5	46.0	3.7	0.3	16.5	16.5		4.8	1.6		1.2	
Green Ratio (*g/C*)	0.42	0.42	0.42	0.54	0.58	0.58		0.16	0.16		0.12	
Capacity (*c*), veh/h	763	709	647	265	1084	1039		297	263		204	
Volume-to-Capacity Ratio (*X*)	1.301	1.274	0.132	0.039	0.455	0.473		0.298	0.107		0.102	
Back of Queue (*Q*), ft/ln (50 th percentile)	1265.4	1131.4	36.7	3	178.8	176.5		54.3	16.3		13	
Back of Queue (*Q*), veh/ln (50 th percentile)	50.6	44.5	1.4	0.1	7.0	7.1		2.2	0.7		0.5	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	32.8	32.0	19.7	21.7	13.7	13.1		42.2	39.2		44.9	
Incremental Delay (d_2), s/veh	144.8	134.1	0.4	0.0	1.4	1.5		0.2	0.1		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	177.6	166.1	20.1	21.7	15.0	14.6		42.4	39.2		44.9	
Level of Service (LOS)	F	F	C	C	B	B		D	D		D	
Approach Delay, s/veh / LOS	165.6	F		14.9	B		41.6	D		44.9	D	
Intersection Delay, s/veh / LOS	112.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.1	B	1.3	A	0.7	A	0.5	A

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Modified Build Alternative

2040 HCS Intersection Analysis

	Intersection	Approach	Movement	AM Peak Hour 2040 Modified Build Movement Delay(s)	AM Movement LOS	AM Approach Delay(s)	AM Approach LOS	AM Intersection Delay(s)	AM Intersection LOS	PM Peak Hour 2040 Modified Build Movement Delay(s)	PM Movement LOS	PM Approach Delay(s)	PM Approach LOS	PM Intersection Delay(s)	PM Intersection LOS
1	Route 3/Mall Drive/Central Park Boulevard	NB	Left	65.2	E	229.4	F	78.7	E	82.7	F	852.0	F	170.8	F
			Through	66.5	E					98.6	F				
			Right	269.4	F					1224.0	F				
		SB	Left	70.9	E	167.1	F			79.9	E	479.9	F		
			Through	70.8	E					72.3	E				
			Right	195.4	F					813.0	F				
		EB	Left	65.8	E	95.8	F			78.1	E	96.9	F		
			Through	100.4	F					103.4	F				
			Right	0.1	A					44.9	D				
		WB	Left	70.7	E	11.2	B			79.8	E	29.5	C		
			Through	5.9	A					15.8	B				
			Right	8.6	A					30.1	C				
2	Route 3/Carl D. Silver Parkway	NB	Left	71.5	E	70.9	E	83.6	F	77.5	E	76.7	E	198.1	F
			Through												
			Right	70.3	E					75.9	E				
		SB	Left	83.7	F	81.6	F			330.8	F	283.3	F		
			Through	51.9	D					51.4	D				
			Right	52.8	D					66.3	E				
		EB	Left	63.8	E	106.1	F			65.6	E	16.6	B		
			Through	108.5	F					9.5	A				
			Right	24.7	C					5.7	A				
		WB	Left	68.6	E	39.1	D			63.6	E	283.7	F		
			Through	33.8	C					264.5	F				
			Right	52.2	D					372.7	F				
3	New Signal Route 3/Ramp from SB I-95	NB	Left	-	-	-	-	28.9	C	-	-	-	-	152.2	F
			Through												
			Right												
		SB	Left	-	-	60.3	E			-	-	214.6	F		
			Through												
			Right	60.3	E					214.6	F				
		EB	Left	-	-	-	-			-	-	-	-		
			Through												
			Right												
		WB	Left	-	-	8.7	A			-	-	54.2	D		
			Through	8.7	A					54.2	D				
			Right	-	-					-	-				
4	New Signal Route 3/Ramp to NB I-95 (triple lefts)	NB	Left	-	-	-	-	285.6	F	-	-	-	-	26.8	C
			Through												
			Right												
		SB	Left	-	-	-	-			-	-	-	-		
			Through												
			Right												
		EB	Left	41.1	D	24.6	C			55.5	E	19.9	B		
			Through	0.7	A					1.0	A				
			Right	-	-					-	-				
		WB	Left	-	-	812.7	F			-	-	38.2	D		
			Through	64.3	E					22.6	C				
			Right	1391.3	F					68.4	F				
5	Route 3/Gateway Boulevard	NB	Left	89.7	F	74.9	E	38.6	D	186.7	F	150.0	F	54.3	D
			Through	38.2	D					38.0	D				
			Right	42.0	D					97.6	F				
		SB	Left	48.7	D	50.3	D			48.7	D	48.9	D		
			Through	50.7	D					49.1	D				
			Right												
		EB	Left	47.4	D	33.6	C			47.4	D	54.6	D		
			Through	34.8	C					58.5	F				
			Right	26.7	C					39.3	D				
		WB	Left	46.6	D	36.5	D			69.7	E	26.3	C		
			Through	36.0	F					20.1	C				
			Right	3.1	A					0.0	A				

Notes: All results from HCS 2010. Intersections 1 ,2, 3, 4, 5, major movement is E-W.

Intersection		Approach	Movement	AM Peak Hour						PM Peak Hour					
				2040 Modified Build						2040 Modified Build					
				Movement		Approach		Intersection		Movement		Approach		Intersection	
				Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS
6	Route 17/McLane Drive	NB	Left	56.1	E	158.9	F	216.4	F	71.3	E	60.8	E	143.3	F
			Through	277.8	F					61.8	E				
			Right	1.4	A					0.1	A				
		SB	Left	54.2	D	158.9	F			68.5	E	213.8	F		
			Through	162.2	F					216.0	F				
			Right	17.9	B					14.4	B				
		EB	Left	33.1	C	33.1	C			47.1	D	47.1	D		
			Through												
			Right												
		WB	Left	33.9	C	33.9	C			49.5	D	49.5	D		
			Through												
			Right												
7	Route 17/Sanford Drive	NB	Left	84.2	F	95.9	F	62.0	E	88.7	F	267.6	F	111.7	F
			Through												
			Right	101.6	F					280.0	F				
		SB	Left	221.4	F	189.8	F			421.5	F	396.5	F		
			Through	145.8	F					70.0	E				
			Right	87.3	F					70.2	E				
		EB	Left	16.1	B	20.0	C			21.8	C	51.0	D		
			Through	19.4	B					47.4	D				
			Right	22.0	C					62.3	E				
		WB	Left	524.4	F	108.9	F			227.9	F	61.9	E		
			Through	12.8	B					13.4	B				
			Right	10.9	B					11.3	B				
9	Route 17/Short Street	NB	Left	35.7	D	35.2	D	80.2	F	43.3	D	42.4	D	219.5	F
			Through												
			Right	31.6	C					39.5	D				
		SB	Left	41.3	D	41.3	D			44.9	D	44.9	D		
			Through												
			Right												
		EB	Left	147.8	F	137.5	F			354.4	F	331.9	F		
			Through	137.5	F					337.9	F				
			Right	22.5	C					20.7	C				
		WB	Left	20.5	C	24.3	C			21.8	C	17.4	B		
			Through	24.2	C					17.5	B				
			Right	24.6	C					17.2	B				

Notes: All results from HCS 2010. Intersections 7, 9 major movement is E-W; Intersection 6 major movement is N-S.

Intersection		Approach	Movement	Storage (ft)	50th Percentile Queue Length (ft)			
					AM Peak Hour		PM Peak Hour	
					2020 Modified Build	2040 Modified Build	2020 Modified Build	2040 Modified Build
1	Route 3/Mall Drive/Central Park Boulevard	NB	Left	425	9.8	9.8	101.2	131.7
			Through	425	30.4	40.8	128.9	186.1
			Right	150	252.8	384.4	1017.7	1373.9
		SB	Left	250	10.4	10.5	122.0	166.7
			Through	2750	5.5	11.2	107.2	137.5
			Right	250	114.2	186.8	825.0	1179.0
		EB	Left	475	145.0	191.4	191.4	259.9
			Through	900	69.8	756.3	741.2	1078.0
			Right	900	0.8	0.9	105.7	139.9
		WB	Left	675	52.7	69.8	277.8	414.4
			Through	825	51.2	61.5	135.1	296.4
			Right	675	67.7	85.0	210.9	515.4
2	Route 3/Carl D. Silver Parkway	NB	Left	50	20.5	31.0	34.3	46.1
			Through					
			Right	50	19.8	31.1	30.1	41.7
		SB	Left	475	256.8	385.6	773.6	1199.7
			Through	1250	8.6	8.6	8.8	17.8
			Right	495	20.9	29.8	192.0	275.3
		EB	Left	250	80.4	101.9	160.7	207.6
			Through	800	615.6	1254.9	89.8	119.8
			Right	250	6.2	13.3	1.5	3.1
		WB	Left	400	20.7	30.6	41.8	55.9
			Through	3675	223.7	298.6	1117.3	1778.0
			Right	650	361.2	578.3	1292.0	1958.3
3	New Signal Route 3/Ramp from SB I-95	NB	Left	-	-	-	-	-
			Through					
			Right					
		SB	Left	-	-	-	-	-
			Through					
			Right	500	224.7	298.4	710.6	1860.1
		EB	Left	-	-	-	-	-
			Through					
			Right					
		WB	Left	-	-	-	-	-
			Through	1725	50.9	87.1	385.2	424.2
			Right	-	-	-	-	-
4	New Signal Route 3/Ramp to NB I-95 (triple lefts)	NB	Left	-	-	-	-	-
			Through					
			Right					
		SB	Left	-	-	-	-	-
			Through					
			Right					
		EB	Left	575	781.7	1093.4	426.8	538.2
			Through	1725	2.8	3.9	4.1	6.5
			Right	-	-	-	-	-
		WB	Left	-	-	-	-	-
			Through	825	261.3	419.2	225.9	375.8
			Right	825	2850.0	4142.6	512.0	1135.3
5	Route 3/Gateway Boulevard	NB	Left	400	217.3	327.9	374.2	557.7
			Through	4500	6.0	6.0	3.0	3.0
			Right	400	73.8	88.8	189.9	308.8
		SB	Left	650	7.4	7.4	7.4	7.4
			Through	650	17.9	25.3	7.0	7.0
			Right					
		EB	Left	350	27.6	27.6	20.5	27.6
			Through	3675	309.9	437.7	395.6	664.5
			Right	450	168.2	229.3	293.8	418.2
		WB	Left	275	37.6	48.3	92.7	129.8
			Through	375	67.4	215.5	58.0	129.5
			Right	375	0.8	0.8	0.0	0.0

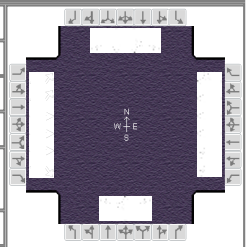
Notes: All results from HCS 2010. Intersections 1 ,2, 3, 4, 5, major movement is E-W.

Intersection		Approach	Movement	Storage (ft)	50th Percentile Queue Length (ft)			
					AM Peak Hour		PM Peak Hour	
					2020 Modified Build	2040 Modified Build	2020 Modified Build	2040 Modified Build
6	Route 17/McLane Drive	NB	Left	200	33.3	50.6	31.7	53.6
			Through	845	553.0	1758.1	39.0	440.0
			Right	845	2.5	4.0	0.6	0.9
		SB	Left	300	24.5	32.9	10.3	20.8
			Through	1000	558.2	1373.8	988.1	2194.8
			Right	1000	12.6	17.2	8.0	12.5
		EB	Left	35	24.7	31.2	21.0	29.7
			Through					
			Right					
		WB	Left	800	34.6	47.9	56.5	89.1
			Through					
			Right					
7	Route 17/Sanford Drive	NB	Left	425	68.0	113.5	45.8	78.1
			Through					
			Right	400	69.2	125.9	395.9	805.2
		SB	Left	850	82.4	187.3	358.0	542.3
			Through	475	74.3	152.6	22.9	33.8
			Right	360	19.0	35.5	10.8	10.4
		EB	Left	580	4.9	8.8	6.8	5.9
			Through	845	300.7	412.6	596.1	1013.0
			Right	845	210.6	431.7	620.4	1125.9
		WB	Left	275	266.2	615.7	582.4	600.1
			Through	2750	130.8	180.2	219.3	206.4
			Right	400	74.0	103.5	116.5	105.7
9	Route 17/Short Street	NB	Left	1000	53.9	71.5	54.3	75.1
			Through					
			Right	100	4.6	9.7	16.3	22.5
		SB	Left	35	8.7	14.6	13.0	13.0
			Through					
			Right					
		EB	Left	2750	483.3	992.2	1265.4	2200.8
			Through	2750	390.9	789.6	1131.4	1990.6
			Right	275	24.3	29.0	36.7	51.2
		WB	Left	150	6.2	6.2	3.0	6.1
			Through	3000	214.1	334.3	178.8	258.4
			Right	3000	212.3	335.1	176.5	255.9

Notes: All results from HCS 2010. Intersections 7, 9 major movement is E-W; Intersection 6 major movement is N-S.

HCS 2010 Signalized Intersection Results Summary

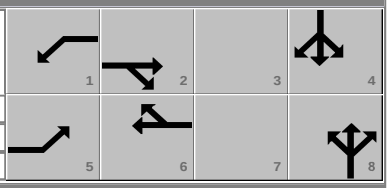
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Central Park Bl…	File Name	1 - Route 3 at Central Park - 2040 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	360	3740	70	130	1630	40	10	40	220	10	20	110

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	27.5	63.5	10.5	14.0	8.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	35.0	106.0	18.0	89.0		21.0		15.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (MAH), s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time (g_s), s	18.3		8.2			18.0		12.0
Green Extension Time (g_e), s	0.5	0.0	1.3	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	375	3896	68	135	1310	429	10	42	213	10	21	106
Adjusted Saturation Flow Rate (s), veh/h/ln	1740	1691	1594	1658	1810	1778	1810	1845	1563	1757	1696	1548
Queue Service Time (g_s), s	16.3	0.0	0.0	6.2	8.1	10.1	0.8	3.3	16.0	0.9	0.9	10.0
Cycle Queue Clearance Time (g_c), s	16.3	0.0	0.0	6.2	8.1	10.1	0.8	3.3	16.0	0.9	0.9	10.0
Green Ratio (g/C)	0.18	0.63	0.63	0.08	0.52	0.52	0.10	0.10	0.10	0.06	0.06	0.06
Capacity (c), veh/h	631	3203	1006	249	2850	906	181	184	156	110	212	97
Volume-to-Capacity Ratio (X)	0.595	1.216	0.067	0.545	0.460	0.474	0.058	0.226	1.359	0.095	0.098	1.098
Back of Queue (Q), ft/ln (50 th percentile)	191.4	756.3	0.9	69.8	61.5	85	9.8	40.8	384.4	10.5	11.2	186.8
Back of Queue (Q), veh/ln (50 th percentile)	7.6	29.8	0.0	2.7	2.4	3.3	0.4	1.6	15.0	0.4	0.4	7.2
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	64.8	0.0	0.0	69.4	5.4	6.9	65.2	66.3	72.0	70.7	70.7	75.0
Incremental Delay (d_2), s/veh	1.1	100.4	0.1	1.3	0.5	1.7	0.0	0.2	197.4	0.1	0.1	120.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	65.8	100.4	0.1	70.7	5.9	8.6	65.2	66.5	269.4	70.9	70.8	195.4
Level of Service (LOS)	E	F	A	E	A	A	E	E	F	E	E	F
Approach Delay, s/veh / LOS	95.8	F		11.2	B		229.4	F		167.1	F	
Intersection Delay, s/veh / LOS	78.7						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	2.9	C	1.3	A	0.9	A	0.6	A

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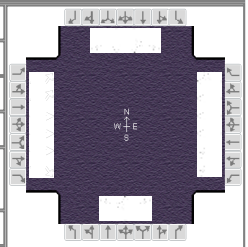
HCS 2010 Signalized Intersection Results Summary

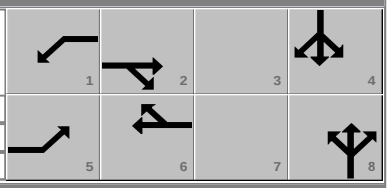
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Central Park Bl…	File Name	1 - Route 3 at Central Park - 2040 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	2310	140	680	3280	90	110	140	550	140	250	510

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	25.5	42.5	33.5	14.0	18.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



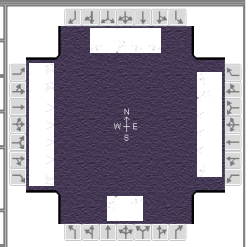
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		9.0		9.0
Phase Duration, s	33.0	83.0	41.0	91.0		21.0		25.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.0		3.0
Queue Clearance Time (g_s), s	23.4		36.0			18.0		22.0
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	458	2406	135	708	2637	873	115	146	532	146	260	494
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1757	1675	1594	1757	1863	1827	1810	1900	1610	1792	1900	1610
Queue Service Time (g_s), s	21.4	78.0	12.6	34.0	59.0	66.1	10.4	12.8	16.0	13.3	11.0	20.0
Cycle Queue Clearance Time (g_c), s	21.4	78.0	12.6	34.0	59.0	66.1	10.4	12.8	16.0	13.3	11.0	20.0
Green Ratio (*g/C*)	0.16	0.46	0.46	0.21	0.51	0.51	0.09	0.09	0.09	0.12	0.12	0.12
Capacity (*c*), veh/h	558	2306	731	723	2827	898	170	179	152	211	447	189
Volume-to-Capacity Ratio (*X*)	0.821	1.044	0.185	0.979	0.933	0.973	0.673	0.816	3.512	0.692	0.583	2.606
Back of Queue (*Q*), ft/ln (50 th percentile)	259.9	1078	139.9	414.4	296.4	515.4	131.7	186.1	1373.9	166.7	137.5	1179
Back of Queue (*Q*), veh/ln (50 th percentile)	10.4	42.1	5.6	16.6	11.7	20.6	5.3	7.4	55.0	6.6	5.5	47.2
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	69.2	72.0	44.3	61.3	12.0	14.6	74.5	75.6	77.0	72.0	71.0	75.0
Incremental Delay (d_2), s/veh	8.9	31.4	0.6	18.5	3.8	15.5	8.2	23.0	1147.0	7.9	1.3	738.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	78.1	103.4	44.9	79.8	15.8	30.1	82.7	98.6	1224.0	79.9	72.3	813.0
Level of Service (LOS)	E	F	D	E	B	C	F	F	F	E	E	F
Approach Delay, s/veh / LOS	96.9	F		29.5	C		852.0	F		479.9	F	
Intersection Delay, s/veh / LOS	170.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.5	D	3.8	D
Bicycle LOS Score / LOS	2.1	B	2.2	B	1.8	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

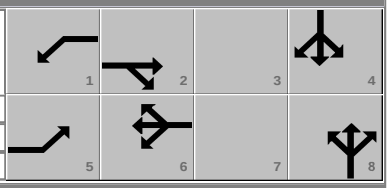
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Carl D Silver P…	File Name	2 - Route 3 at Carl D Silver - 2040 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	200	4120	20	30	1550	560	20	10	30	630	10	40

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	24.5	50.5	9.5	10.0	29.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	1.3	3.0		11.0		9.0
Phase Duration, s	32.0	90.0	17.0	75.0		17.0		36.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (MAH), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	10.8		2.0			5.0		31.2
Green Extension Time (g_e), s	0.3	0.0	3.6	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.48			0.05		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	208	4292	20	31	1615	583		31	29	656	10	35
Adjusted Saturation Flow Rate (s), veh/h/ln	1757	1708	1533	1774	1827	1579		1839	1464	1774	1900	1610
Queue Service Time (g_s), s	8.8	85.0	1.3	0.0	25.5	52.7		2.6	3.0	29.2	0.7	2.9
Cycle Queue Clearance Time (g_c), s	8.8	85.0	1.3	0.0	25.5	52.7		2.6	3.0	29.2	0.7	2.9
Green Ratio (g/C)	0.16	0.53	0.53	0.38	0.44	0.44		0.08	0.08	0.20	0.20	0.20
Capacity (c), veh/h	571	3630	815	178	3197	691		138	110	699	374	317
Volume-to-Capacity Ratio (X)	0.365	1.182	0.024	0.176	0.505	0.845		0.227	0.266	0.939	0.028	0.112
Back of Queue (Q), ft/ln (50 th percentile)	101.9	1254.9	13.3	30.6	298.6	578.3		31	31.1	385.6	8.6	29.8
Back of Queue (Q), veh/ln (50 th percentile)	4.1	49.8	0.5	1.2	11.6	22.8		1.2	1.2	15.2	0.3	1.2
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	63.7	23.3	24.7	68.5	33.3	40.1		71.2	69.8	63.3	51.9	52.8
Incremental Delay (d_2), s/veh	0.1	85.2	0.1	0.2	0.6	12.1		0.3	0.5	20.3	0.0	0.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	63.8	108.5	24.7	68.6	33.8	52.2		71.5	70.3	83.7	51.9	52.8
Level of Service (LOS)	E	F	C	E	C	D		E	E	F	D	D
Approach Delay, s/veh / LOS	106.1	F		39.1	D		70.9	E		81.6	F	
Intersection Delay, s/veh / LOS	83.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	2.4	B	1.4	A	0.6	A	1.6	A

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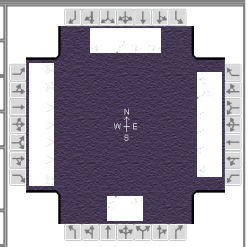
HCS 2010 Signalized Intersection Results Summary

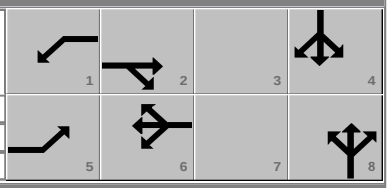
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Carl D Silver P…	File Name	2 - Route 3 at Carl D Silver - 2040 Modified Build…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	380	2590	20	50	3920	970	30	10	40	1240	20	280

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.5	43.5	9.5	10.0	36.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	1.3	3.0		11.0		9.0
Phase Duration, s	42.0	93.0	17.0	68.0		17.0		43.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (MAH), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	19.8		2.0			6.0		40.5
Green Extension Time (g_e), s	0.7	0.0	7.2	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.97			0.26		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	396	2698	20	52	4083	1010		42	39	1292	21	260
Adjusted Saturation Flow Rate (s), veh/h/ln	1757	1691	1610	1723	1881	1610		1761	1579	1810	1900	1610
Queue Service Time (g_s), s	17.8	27.7	0.3	0.0	63.0	63.0		3.9	4.0	38.5	1.5	25.4
Cycle Queue Clearance Time (g_c), s	17.8	27.7	0.3	0.0	63.0	63.0		3.9	4.0	38.5	1.5	25.4
Green Ratio (g/C)	0.21	0.52	0.52	0.31	0.37	0.37		0.07	0.07	0.23	0.23	0.23
Capacity (c), veh/h	744	3502	833	189	2789	597		124	111	820	430	365
Volume-to-Capacity Ratio (X)	0.532	0.770	0.024	0.275	1.464	1.693		0.335	0.346	1.576	0.048	0.714
Back of Queue (Q), ft/ln (50 th percentile)	207.6	119.8	3.1	55.9	1778	1958.3		46.1	41.7	1199.7	17.8	275.3
Back of Queue (Q), veh/ln (50 th percentile)	8.3	4.7	0.1	2.2	70.6	78.3		1.8	1.6	48.0	0.7	11.0
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	65.2	7.8	5.6	63.3	53.5	53.5		76.9	75.3	65.8	51.4	60.7
Incremental Delay (d_2), s/veh	0.4	1.7	0.1	0.3	211.0	319.2		0.6	0.7	265.1	0.0	5.6
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	65.6	9.5	5.7	63.6	264.5	372.7		77.5	75.9	330.8	51.4	66.3
Level of Service (LOS)	E	A	A	E	F	F		E	E	F	D	E
Approach Delay, s/veh / LOS	16.6	B		283.7	F		76.7	E		283.3	F	
Intersection Delay, s/veh / LOS	198.1						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	3.0	C	3.8	D	3.9	D
Bicycle LOS Score / LOS	1.8	A	2.6	B	0.6	A	3.1	C

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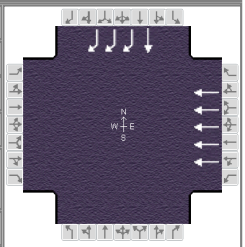
HCS 2010 Signalized Intersection Results Summary

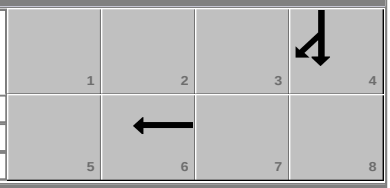
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	WB Rte 3 @ I-95 SB Off…	File Name	3 - Route 3 at I-95 SB Off-Ramp - 2040 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					1300						0	835

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	37.9	0.0	0.0	0.0	0.0
Yellow	0.0	4.0	0.0	0.0	0.0	0.0
Red	0.0	1.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				117.1				42.9
Change Period, ($Y+R_c$), s				5.0				5.0
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								34.9
Green Extension Time (g_e), s				0.0				3.0
Phase Call Probability								1.00
Max Out Probability								0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					6						4	14
Adjusted Flow Rate (*v*), veh/h					1413						0	908
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1725						1900	1425
Queue Service Time (g_s), s					9.4						0.0	32.9
Cycle Queue Clearance Time (g_c), s					9.4						0.0	32.9
Green Ratio (*g/C*)					0.70						0.24	0.24
Capacity (*c*), veh/h					6042						450	1014
Volume-to-Capacity Ratio (*X*)					0.234						0.000	0.895
Back of Queue (*Q*), ft/ln (50 th percentile)					87.1						0	298.4
Back of Queue (*Q*), veh/ln (50 th percentile)					3.5						0.0	11.9
Queue Storage Ratio (*RQ*) (50 th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					8.6						0.0	59.1
Incremental Delay (d_2), s/veh					0.1						0.0	1.2
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					8.7						0.0	60.3
Level of Service (LOS)					A							E
Approach Delay, s/veh / LOS	0.0			8.7		A	0.0			60.3		E
Intersection Delay, s/veh / LOS	28.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.3	B	3.5	D
Bicycle LOS Score / LOS			1.0	A			2.0	A

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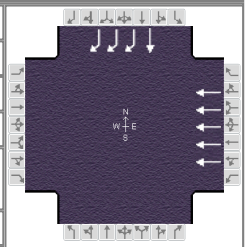
HCS 2010 Signalized Intersection Results Summary

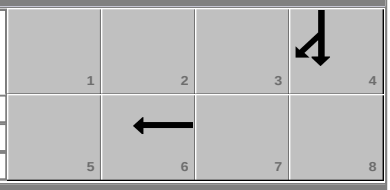
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	WB Rte 3 @ I-95 SB Off…	File Name	3 - Route 3 at I-95 SB Off-Ramp - 2040 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h					1955						0	3070

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	100.0	0.0	0.0	0.0	0.0
Yellow	0.0	4.5	0.0	0.0	0.0	0.0
Red	0.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				6				4
Case Number				8.0				11.0
Phase Duration, s				62.5				107.5
Change Period, ($Y+R_c$), s				7.5				7.5
Max Allow Headway (*MAH*), s				0.0				3.4
Queue Clearance Time (g_s), s								102.0
Green Extension Time (g_e), s				0.0				0.0
Phase Call Probability								1.00
Max Out Probability								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					6						4	14
Adjusted Flow Rate (*v*), veh/h					2125						0	3337
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1691						1900	1357
Queue Service Time (g_s), s					38.6						0.0	100.0
Cycle Queue Clearance Time (g_c), s					38.6						0.0	100.0
Green Ratio (*g/C*)					0.32						0.59	0.59
Capacity (*c*), veh/h					2736						1118	2395
Volume-to-Capacity Ratio (*X*)					0.777						0.000	1.393
Back of Queue (*Q*), ft/ln (50 th percentile)					424.2						0	1860.1
Back of Queue (*Q*), veh/ln (50 th percentile)					16.7						0.0	71.5
Queue Storage Ratio (*RQ*) (50 th percentile)					0.00						0.00	0.00
Uniform Delay (d_1), s/veh					52.0						0.0	35.0
Incremental Delay (d_2), s/veh					2.2						0.0	179.6
Initial Queue Delay (d_3), s/veh					0.0						0.0	0.0
Control Delay (*d*), s/veh					54.2						0.0	214.6
Level of Service (LOS)					D							F
Approach Delay, s/veh / LOS	0.0			54.2		D	0.0			214.6		F
Intersection Delay, s/veh / LOS	152.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	2.3	B	3.5	D
Bicycle LOS Score / LOS			1.2	A			6.0	F

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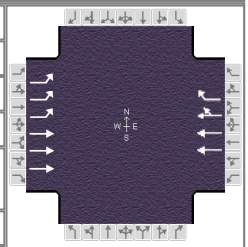
HCS 2010 Signalized Intersection Results Summary

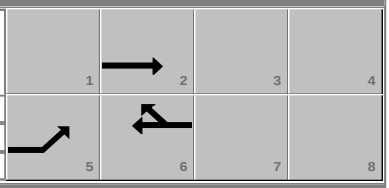
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @t I-95 NB On-Ra…	File Name	4 - Route 3 at I-95 NB On-Ramp - 2040 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	2990	2060			1090	1410						

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	104.5	40.5	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



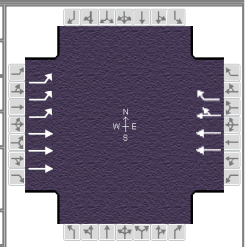
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		7.3				
Phase Duration, s	112.0	160.0		48.0				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	104.0							
Green Extension Time (g_e), s	0.5	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	1.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	3250	2239			1185	1533						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1810	1533						
Queue Service Time (g_s), s	102.0	6.2			33.4	40.5						
Cycle Queue Clearance Time (g_c), s	102.0	6.2			33.4	40.5						
Green Ratio (*g/C*)	0.65	0.95			0.25	0.25						
Capacity (*c*), veh/h	3278	4698			1375	388						
Volume-to-Capacity Ratio (*X*)	0.992	0.477			0.862	3.945						
Back of Queue (*Q*), ft/ln (50 th percentile)	1093.4	3.9			419.2	4142.6						
Back of Queue (*Q*), veh/ln (50 th percentile)	42.1	0.2			16.1	159.3						
Queue Storage Ratio (*RQ*) (50 th percentile)	2.73	0.00			0.00	0.00						
Uniform Delay (d_1), s/veh	27.3	0.3			57.1	59.7						
Incremental Delay (d_2), s/veh	13.7	0.3			7.3	1331.5						
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	41.1	0.7			64.3	1391.3						
Level of Service (LOS)	D	A			E	F						
Approach Delay, s/veh / LOS	24.6	C		812.7	F		0.0			0.0		
Intersection Delay, s/veh / LOS	285.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.9	C	3.3	C	3.5	D

HCS 2010 Signalized Intersection Results Summary

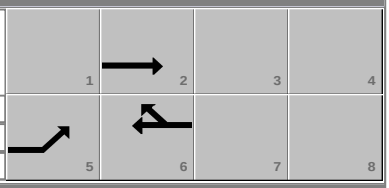
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 10, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.92
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ I-95 NB On-Ra…	File Name	4 - Route 3 at I-95 NB On-Ramp - 2040 Modified…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1390	2610			1605	830						

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	56.1	98.9	0.0	0.0	0.0	0.0
Yellow	4.5	4.5	0.0	0.0	0.0	0.0
Red	3.0	3.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	2.0	4.0		7.3				
Phase Duration, s	63.6	170.0		106.4				
Change Period, ($Y+R_c$), s	7.5	7.5		7.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (g_s), s	51.1							
Green Extension Time (g_e), s	5.0	0.0		0.0				
Phase Call Probability	1.00							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	1511	2837			1745	902						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1673	1643			1810	1533						
Queue Service Time (g_s), s	49.1	10.2			33.6	98.9						
Cycle Queue Clearance Time (g_c), s	49.1	10.2			33.6	98.9						
Green Ratio (*g/C*)	0.33	0.96			0.58	0.58						
Capacity (*c*), veh/h	1655	4712			3159	893						
Volume-to-Capacity Ratio (*X*)	0.913	0.602			0.552	1.011						
Back of Queue (*Q*), ft/ln (50 th percentile)	538.2	6.5			375.8	1135.3						
Back of Queue (*Q*), veh/ln (50 th percentile)	20.7	0.3			14.5	43.7						
Queue Storage Ratio (*RQ*) (50 th percentile)	1.35	0.00			0.00	0.00						
Uniform Delay (d_1), s/veh	54.6	0.4			21.9	35.5						
Incremental Delay (d_2), s/veh	0.9	0.6			0.7	32.8						
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	55.5	1.0			22.6	68.4						
Level of Service (LOS)	E	A			C	F						
Approach Delay, s/veh / LOS	19.9	B		38.2	D		0.0			0.0		
Intersection Delay, s/veh / LOS	26.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.5	A	2.8	C	3.3	C	3.5	D
Bicycle LOS Score / LOS	2.9	C	1.9	A				

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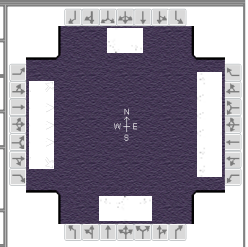
HCS 2010 Signalized Intersection Results Summary

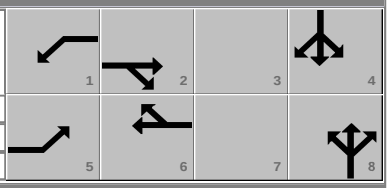
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Gateway Blvd/…	File Name	5 - Route 3 at Gateway - 2040 Modified Build AM.…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	1930	430	140	2160	10	310	10	140	10	5	30

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.3
Queue Clearance Time (g_s), s	4.4		6.5			22.4		4.4
Green Extension Time (g_e), s	0.0	0.0	2.4	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.91			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	2010	414	146	2250	9	323	10	134	10	36	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1646	
Queue Service Time (g_s), s	2.4	41.3	22.9	4.5	51.5	0.1	20.4	0.5	8.9	0.7	2.4	
Cycle Queue Clearance Time (g_c), s	2.4	41.3	22.9	4.5	51.5	0.1	20.4	0.5	8.9	0.7	2.4	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	108	
Volume-to-Capacity Ratio (*X*)	0.228	0.877	0.591	0.424	1.039	0.013	0.978	0.030	0.476	0.078	0.337	
Back of Queue (*Q*), ft/ln (50 th percentile)	27.6	437.7	229.3	48.3	215.5	0.8	327.9	6	88.8	7.4	25.3	
Back of Queue (*Q*), veh/ln (50 th percentile)	1.1	17.1	8.8	1.9	8.1	0.0	13.0	0.2	3.4	0.3	1.0	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	47.2	29.6	23.1	46.3	5.5	3.0	46.3	38.1	41.6	48.7	50.1	
Incremental Delay (d_2), s/veh	0.2	5.1	3.6	0.3	30.5	0.0	43.4	0.0	0.5	0.1	0.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.4	34.8	26.7	46.6	36.0	3.1	89.7	38.2	42.0	48.7	50.7	
Level of Service (LOS)	D	C	C	D	F	A	F	D	D	D	D	
Approach Delay, s/veh / LOS	33.6	C		36.5	D		74.9	E		50.3	D	
Intersection Delay, s/veh / LOS	38.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	1.8	A	1.8	A	1.3	A	0.6	A

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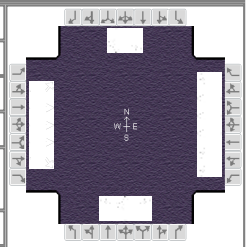
HCS 2010 Signalized Intersection Results Summary

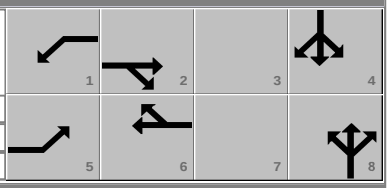
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Plank Road (Route 3)	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 3 @ Gateway Blvd/…	File Name	5 - Route 3 at Gateway - 2040 Modified Build PM.…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	2270	600	290	2030	0	400	5	280	10	5	5

Signal Information			
Cycle, s	114.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	31.5	10.0	19.5	7.5	0.0
Yellow	4.0	3.5	4.0	4.5	4.5	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		9.0		10.0
Phase Duration, s	17.0	55.0	17.0	55.0		27.0		15.0
Change Period, ($Y+R_c$), s	7.0	6.5	7.0	7.0		7.5		7.5
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		2.9		3.0
Queue Clearance Time (g_s), s	4.4		11.9			23.0		2.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	2365	591	302	2115	0	417	5	280	10	10	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1675	1533	1706	1597	1610	1792	1900	1533	1691	1743	
Queue Service Time (g_s), s	2.4	52.0	38.8	9.9	41.3	0.0	21.0	0.3	20.8	0.7	0.6	
Cycle Queue Clearance Time (g_c), s	2.4	52.0	38.8	9.9	41.3	0.0	21.0	0.3	20.8	0.7	0.6	
Green Ratio (*g/C*)	0.10	0.46	0.46	0.10	0.45	0.45	0.18	0.18	0.18	0.08	0.08	
Capacity (*c*), veh/h	183	2292	699	344	2165	727	330	350	282	134	115	
Volume-to-Capacity Ratio (*X*)	0.228	1.032	0.844	0.878	0.977	0.000	1.263	0.015	0.992	0.078	0.091	
Back of Queue (*Q*), ft/ln (50 th percentile)	27.6	664.5	418.2	129.8	129.5	0	557.7	3	308.8	7.4	7	
Back of Queue (*Q*), veh/ln (50 th percentile)	1.1	26.0	16.1	5.1	4.9	0.0	22.1	0.1	11.9	0.3	0.3	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	47.2	31.0	27.4	48.6	5.5	0.0	46.5	38.0	46.4	48.7	49.0	
Incremental Delay (d_2), s/veh	0.2	27.5	11.9	21.0	14.6	0.0	140.2	0.0	51.2	0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	47.4	58.5	39.3	69.7	20.1	0.0	186.7	38.0	97.6	48.7	49.1	
Level of Service (LOS)	D	F	D	E	C		F	D	F	D	D	
Approach Delay, s/veh / LOS	54.6	D		26.3	C		150.0	F		48.9	D	
Intersection Delay, s/veh / LOS	54.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.3	B	3.5	D	3.4	C
Bicycle LOS Score / LOS	2.1	B	1.8	A	1.6	A	0.5	A

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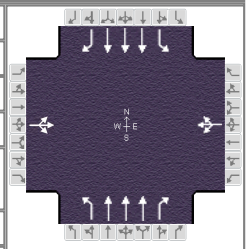
HCS 2010 Signalized Intersection Results Summary

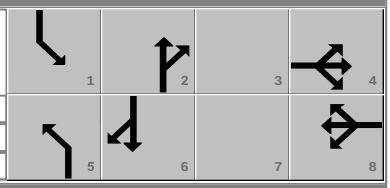
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Frdericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ McLane Dr	File Name	6 - Route 17 at McLane - 2040 Modified Build AM….		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	10	10	50	5	20	60	3670	90	40	2960	40

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	60.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	68.0	17.0	68.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		5.0		7.0	6.4		4.9	
Green Extension Time (g_e), s		0.2		0.2	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.10		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		52			78		63	3823	91	42	3083	40
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1480			1441		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			1.9		4.4	63.0	0.3	2.9	63.0	1.8
Cycle Queue Clearance Time (g_c), s		3.0			5.0		4.4	63.0	0.3	2.9	63.0	1.8
Green Ratio (*g/C*)		0.32			0.32		0.09	0.48	0.48	0.10	0.48	0.48
Capacity (*c*), veh/h		483			473		161	2412	750	174	2412	750
Volume-to-Capacity Ratio (*X*)		0.108			0.165		0.389	1.585	0.121	0.239	1.278	0.053
Back of Queue (*Q*), ft/ln (50 th percentile)		31.2			47.9		50.6	1758.1	4	32.9	1373.8	17.2
Back of Queue (*Q*), veh/ln (50 th percentile)		1.2			1.9		2.0	68.1	0.2	1.3	53.2	0.7
Queue Storage Ratio (*RQ*) (50 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		33.0			33.8		55.5	12.5	1.0	53.9	33.5	17.7
Incremental Delay (d_2), s/veh		0.0			0.1		0.6	265.3	0.3	0.3	128.7	0.1
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		33.1			33.9		56.1	277.8	1.4	54.2	162.2	17.9
Level of Service (LOS)		C			C		E	F	A	D	F	B
Approach Delay, s/veh / LOS	33.1	C		33.9	C		268.0	F		158.9	F	
Intersection Delay, s/veh / LOS	216.4						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.6	A	0.6	A	2.7	B	2.2	B

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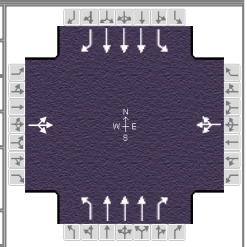
HCS 2010 Signalized Intersection Results Summary

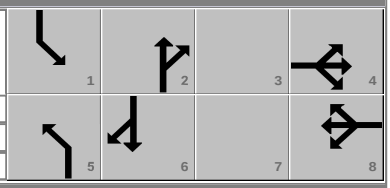
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ McLane Dr	File Name	6 - Route 17 at McLane - 2040 Modified Build PM…		
Project Description	I-95 Interchange Modification Report				



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	5	10	60	10	30	50	3110	60	20	3890	30

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.5	90.5	38.5	0.0	0.0	0.0
Yellow	3.5	4.5	3.5	0.0	0.0	0.0
Red	3.0	3.0	3.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		8.0		8.0	2.0	3.0	2.0	3.0
Phase Duration, s		45.0		45.0	17.0	98.0	17.0	98.0
Change Period, ($Y+R_c$), s		6.5		6.5	6.5	7.5	6.5	7.5
Max Allow Headway (*MAH*), s		3.2		3.2	2.8	0.0	2.8	0.0
Queue Clearance Time (g_s), s		4.8		11.0	6.6		3.8	
Green Extension Time (g_e), s		0.3		0.3	0.0	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.00	0.12		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		36			104		52	3240	59	21	4052	29
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1463			1466		1740	1659	1548	1740	1659	1548
Queue Service Time (g_s), s		0.0			6.2		4.6	93.0	0.0	1.8	93.0	1.3
Cycle Queue Clearance Time (g_c), s		2.8			9.0		4.6	93.0	0.0	1.8	93.0	1.3
Green Ratio (*g/C*)		0.26			0.26		0.08	0.58	0.58	0.08	0.58	0.58
Capacity (*c*), veh/h		387			389		130	2893	900	141	2893	900
Volume-to-Capacity Ratio (*X*)		0.094			0.268		0.399	1.120	0.066	0.147	1.401	0.032
Back of Queue (*Q*), ft/ln (50 th percentile)		29.7			89.1		53.6	440	0.9	20.8	2194.8	12.5
Back of Queue (*Q*), veh/ln (50 th percentile)		1.2			3.5		2.1	17.1	0.0	0.8	85.1	0.5
Queue Storage Ratio (*RQ*) (50 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		47.0			49.4		70.6	2.5	0.0	68.3	33.5	14.3
Incremental Delay (d_2), s/veh		0.0			0.1		0.7	59.3	0.1	0.2	182.5	0.1
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		47.1			49.5		71.3	61.8	0.1	68.5	216.0	14.4
Level of Service (LOS)		D			D		E	F	A	E	F	B
Approach Delay, s/veh / LOS	47.1	D		49.5	D		60.8	E		213.8	F	
Intersection Delay, s/veh / LOS	143.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.4	C	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.5	A	0.7	A	2.3	B	2.7	B

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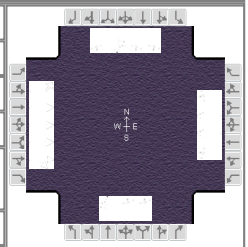
HCS 2010 Signalized Intersection Results Summary

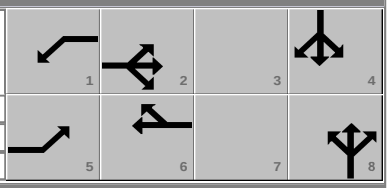
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Sanford Dr/St…	File Name	7 - Route 17 at Sanford - 2040 Modified Build AM.…		
Project Description	I-95 Interchange Modification Report				



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	2950	30	280	910	310	90	10	230	230	100	30

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.0	65.5	5.0	9.0	5.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.3	4.0	2.0	3.0		11.0		9.0
Phase Duration, s	12.5	85.5	16.5	89.5		16.0		12.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (*MAH*), s	2.8	0.0	2.8	0.0		3.1		2.9
Queue Clearance Time (g_s), s	2.0		13.0			12.1		9.4
Green Extension Time (g_e), s	2.4	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.99		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	21	2329	773	292	948	307		104	215	240	104	29
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1740	1827	1815	1740	1739	1548		1748	1370	1740	1827	1548
Queue Service Time (g_s), s	0.0	38.4	38.6	11.0	18.0	11.4		7.7	10.1	7.0	7.4	2.4
Cycle Queue Clearance Time (g_c), s	0.0	38.4	38.6	11.0	18.0	11.4		7.7	10.1	7.0	7.4	2.4
Green Ratio (*g/C*)	0.53	0.60	0.60	0.08	0.63	0.63		0.08	0.08	0.06	0.06	0.06
Capacity (*c*), veh/h	398	3288	1089	147	2194	1000		148	232	187	105	60
Volume-to-Capacity Ratio (*X*)	0.052	0.708	0.710	1.981	0.432	0.307		0.704	0.925	1.279	0.988	0.490
Back of Queue (*Q*), ft/ln (50 th percentile)	8.8	412.6	431.7	615.7	180.2	103.5		113.5	125.9	187.3	152.6	35.5
Back of Queue (*Q*), veh/ln (50 th percentile)	0.3	16.0	16.7	23.9	7.0	4.0		4.4	4.9	7.3	5.9	1.4
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	15.8	18.1	18.1	59.5	12.2	10.2		59.8	59.1	61.5	61.3	61.3
Incremental Delay (d_2), s/veh	0.2	1.3	3.9	464.9	0.6	0.8		24.5	42.5	159.9	84.6	26.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	16.1	19.4	22.0	524.4	12.8	10.9		84.2	101.6	221.4	145.8	87.3
Level of Service (LOS)	B	B	C	F	B	B		F	F	F	F	F
Approach Delay, s/veh / LOS	20.0	C		108.9	F		95.9	F		189.8	F	
Intersection Delay, s/veh / LOS	62.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.6	B	3.6	D	3.1	C
Bicycle LOS Score / LOS	1.8	A	1.8	A	1.0	A	1.1	A

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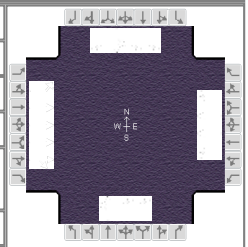
HCS 2010 Signalized Intersection Results Summary

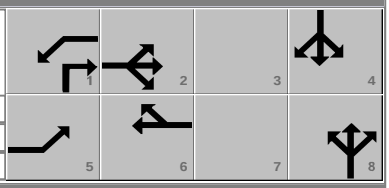
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Sanford Dr/St…	File Name	7 - Route 17 at Sanford - 2040 Modified Build PM.…		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	3660	70	340	890	270	50	10	950	510	30	10

Signal Information			
Cycle, s	160.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	23.0	74.5	5.0	9.0	12.0	0.0
Yellow	4.5	4.5	4.5	4.0	4.0	0.0
Red	3.0	3.0	3.0	3.0	3.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.3	4.0	2.0	3.0		11.0		9.0
Phase Duration, s	12.5	94.5	30.5	112.5		16.0		19.0
Change Period, ($Y+R_c$), s	7.5	7.5	7.5	7.5		7.0		7.0
Max Allow Headway (MAH), s	2.8	0.0	2.8	0.0		3.1		2.8
Queue Clearance Time (g_s), s	2.0		27.0			13.0		16.0
Green Extension Time (g_e), s	2.7	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.99		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	10	2911	970	354	927	273		63	903	531	31	9
Adjusted Saturation Flow Rate (s), veh/h/ln	1740	1827	1804	1740	1739	1548		1754	1370	1740	1827	1548
Queue Service Time (g_s), s	0.0	82.7	85.0	25.0	20.0	11.3		5.6	11.0	14.0	2.5	0.9
Cycle Queue Clearance Time (g_c), s	0.0	82.7	85.0	25.0	20.0	11.3		5.6	11.0	14.0	2.5	0.9
Green Ratio (g/C)	0.48	0.54	0.54	0.16	0.66	0.66		0.07	0.23	0.09	0.09	0.09
Capacity (c), veh/h	366	2980	981	272	2283	1035		121	617	304	166	116
Volume-to-Capacity Ratio (X)	0.028	0.977	0.989	1.303	0.406	0.264		0.518	1.465	1.745	0.189	0.081
Back of Queue (Q), ft/ln (50 th percentile)	5.9	1013	1125.9	600.1	206.4	105.7		78.1	805.2	542.3	33.8	10.4
Back of Queue (Q), veh/ln (50 th percentile)	0.2	39.3	43.6	23.3	8.0	4.1		3.0	31.2	21.0	1.3	0.4
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	21.7	35.5	36.0	67.5	12.9	10.7		73.7	62.0	73.0	67.5	68.9
Incremental Delay (d_2), s/veh	0.1	11.9	26.2	160.4	0.5	0.6		15.0	218.0	348.5	2.5	1.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	21.8	47.4	62.3	227.9	13.4	11.3		88.7	280.0	421.5	70.0	70.2
Level of Service (LOS)	C	D	E	F	B	B		F	F	F	E	E
Approach Delay, s/veh / LOS	51.0	D		61.9	E		267.6	F		396.5	F	
Intersection Delay, s/veh / LOS	111.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.6	B	3.6	D	3.1	C
Bicycle LOS Score / LOS	2.1	B	1.8	A	2.1	B	1.4	A

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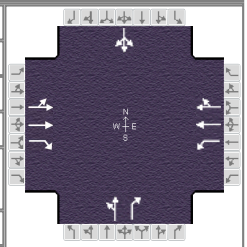
HCS 2010 Signalized Intersection Results Summary

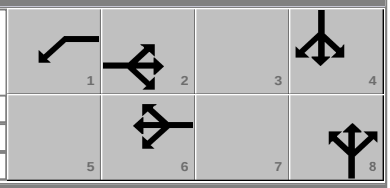
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	AM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Short St	File Name	9 - Route 17 at Short - 2040 Modified Build AM.xus		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	1400	70	20	1350	5	130	0	20	5	0	20

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	32.5	19.0	10.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		40.0	17.0	57.0		26.0		17.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.6			8.6		3.4
Green Extension Time (g_e), s		0.0	0.0	0.0		0.2		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	765	704	68	21	706	705		135	20		26	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1811	1679	1579	1810	1863	1860		1810	1563		1646	
Queue Service Time (g_s), s	11.9	35.0	2.9	0.6	29.3	29.3		6.6	1.0		1.4	
Cycle Queue Clearance Time (g_c), s	32.5	35.0	2.9	0.6	29.3	29.3		6.6	1.0		1.4	
Green Ratio (*g/C*)	0.35	0.35	0.35	0.48	0.52	0.52		0.21	0.21		0.12	
Capacity (*c*), veh/h	625	588	553	280	969	921		380	328		198	
Volume-to-Capacity Ratio (*X*)	1.224	1.198	0.123	0.074	0.729	0.766		0.356	0.060		0.132	
Back of Queue (*Q*), ft/ln (50 th percentile)	992.2	789.6	29	6.2	334.3	335.1		71.5	9.7		14.6	
Back of Queue (*Q*), veh/ln (50 th percentile)	34.7	30.8	1.1	0.2	13.2	13.4		2.9	0.4		0.6	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	33.3	32.5	22.1	20.4	19.4	18.6		35.5	31.6		41.2	
Incremental Delay (d_2), s/veh	114.5	105.0	0.5	0.0	4.8	6.1		0.2	0.0		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	147.8	137.5	22.5	20.5	24.2	24.6		35.7	31.6		41.3	
Level of Service (LOS)	F	F	C	C	C	C		D	C		D	
Approach Delay, s/veh / LOS	137.5	F		24.3	C		35.2	D		41.3	D	
Intersection Delay, s/veh / LOS	80.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.7	A	0.7	A	0.5	A

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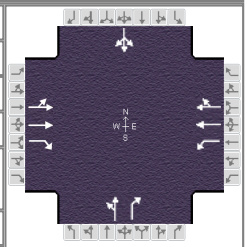
HCS 2010 Signalized Intersection Results Summary

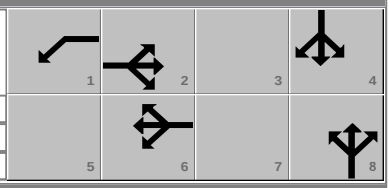
General Information				Intersection Information	
Agency	WRA			Duration, h	0.25
Analyst	JPH	Analysis Date	Jul 7, 2017	Area Type	Other
Jurisdiction	Fredericksburg	Time Period	PM Peak Hour	PHF	0.96
Urban Street	Warrenton Road (Route…	Analysis Year	2040 Modified Build	Analysis Period	1> 7:00
Intersection	Rte 17 @ Short St	File Name	9 - Route 17 at Short - 2040 Modified Build PM.xus		
Project Description	I-95 Interchange Modification Report				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	2370	120	20	1210	5	110	5	40	5	5	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.0	43.5	16.0	11.0	0.0	0.0
Yellow	4.0	4.5	4.0	4.0	0.0	0.0
Red	3.0	3.0	3.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		7.3	1.0	4.0		11.0		12.0
Phase Duration, s		51.0	18.0	69.0		23.0		18.0
Change Period, ($Y+R_c$), s		7.5	7.0	7.5		7.0		7.0
Max Allow Headway (*MAH*), s		0.0	2.8	0.0		3.1		3.3
Queue Clearance Time (g_s), s			2.6			8.6		3.2
Green Extension Time (g_e), s		0.0	0.0	0.0		0.2		0.0
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.00			0.01		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	1298	1181	117	21	633	632		120	39		21	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1845	1695	1548	1757	1863	1860		1813	1610		1723	
Queue Service Time (g_s), s	16.0	46.0	5.2	0.6	23.7	23.7		6.6	2.3		1.2	
Cycle Queue Clearance Time (g_c), s	43.5	46.0	5.2	0.6	23.7	23.7		6.6	2.3		1.2	
Green Ratio (*g/C*)	0.42	0.42	0.42	0.54	0.58	0.58		0.16	0.16		0.12	
Capacity (*c*), veh/h	763	709	647	265	1084	1040		297	263		204	
Volume-to-Capacity Ratio (*X*)	1.702	1.666	0.180	0.079	0.584	0.608		0.404	0.146		0.102	
Back of Queue (*Q*), ft/ln (50 th percentile)	2200.8	1990.6	51.2	6.1	258.4	255.9		75.1	22.5		13	
Back of Queue (*Q*), veh/ln (50 th percentile)	88.0	78.4	2.0	0.2	10.2	10.2		3.0	0.9		0.5	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	32.8	32.0	20.1	21.8	15.2	14.6		43.0	39.4		44.9	
Incremental Delay (d_2), s/veh	321.6	305.9	0.6	0.0	2.3	2.6		0.3	0.1		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (*d*), s/veh	354.4	337.9	20.7	21.8	17.5	17.2		43.3	39.5		44.9	
Level of Service (LOS)	F	F	C	C	B	B		D	D		D	
Approach Delay, s/veh / LOS	331.9	F		17.4	B		42.4	D		44.9	D	
Intersection Delay, s/veh / LOS	219.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.6	B	1.5	A	0.7	A	0.5	A

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Modified Build Alternative

2020 HCS Mainline / Ramp Junction Analysis

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 1*
Agency or Company	*WRA*	From/To	*South of Route 3*
Date Performed	*7/17/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*2630*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1197*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*17.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 1*
Agency or Company	*WRA*	From/To	*South of Route 3*
Date Performed	*7/17/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4970*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2062*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*61.4*	mph	S	mph
D = v_p / S	*33.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segments 2 & 3*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/17/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*980*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*432*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*6.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segments 2 & 3*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/17/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*2200*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*903*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*12.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 4*
Agency or Company	*WRA*	From/To	*North of Route 17*
Date Performed	*7/17/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3090*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1363*	pc/h/ln	Design LOS	
S	*69.7*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*19.6*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 4*
Agency or Company	*WRA*	From/To	*North of Route 17*
Date Performed	*7/17/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*6340*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2604*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*47.1*	mph	S	mph
D = v_p / S	*55.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*Southbound CD Lanes*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*2460*	veh/h	Peak-Hour Factor, PHF		*0.96*
AADT		veh/day	%Trucks and Buses, P_T		*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R		*0*
Peak-Hr Direction Prop, D			General Terrain:		*Grade*
DDHV = AADT x K x D		veh/h	Grade 2.72%	Length	*0.85mi*
			Up/Down %		*2.72*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*3.0*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*931*	pc/h/ln	Design LOS		
S	*65.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*14.3*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*Southbound CD Lanes*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2020 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*5300*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Grade*
DDHV = AADT x K x D		veh/h	Grade 2.72% Length	*0.85mi*
			Up/Down %	*2.72*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*3.0*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1940*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.9*	mph	S	mph
D = v_p / S	*31.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 17 WB
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	960
Freeway Volume, V_F	2110
Ramp Volume, V_R	490
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow
Ram
☑ Y
☐ N
L_{down}
V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2110	0.96	Rolling	18	0	0.787	1.00	
Ramp	490	0.88	Rolling	18	0	0.787	1.00	
UpStream								
DownStream	120	0.92	Rolling	18	0	0.787	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.658 using Equatior

V_{12} = 2078 pc/h

V_3 or V_{av34} 713 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	2791	Exhibit 13-8	
$V_{FO} = V_F - V_R$	2084	Exhibit 13-8	
V_R	707	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	2078	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	(pc/mi/ln)	D_R =	13.5 (pc/mi/ln)
LOS =	(Exhibit 13-2)	LOS =	B (Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	(Exibit 13-11)	D_s =	0.297 (Exhibit 13-12)
S_R=	mph (Exhibit 13-11)	S_R=	58.2 mph (Exhibit 13-12)
S_0=	mph (Exhibit 13-11)	S_0=	71.3 mph (Exhibit 13-12)
S =	mph (Exhibit 13-13)	S =	61.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 17 WB
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	960
Freeway Volume, V_F	4140
Ramp Volume, V_R	550
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow
Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	4140	0.97	Rolling	13	0	0.837	1.00	
Ramp	550	0.98	Rolling	13	0	0.837	1.00	
UpStream								
DownStream	150	0.88	Rolling	13	0	0.837	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.602 using Equatior

V_{12} = 3336 pc/h

V_3 or V_{av34} 1764 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	5100	Exhibit 13-8	
$V_{FO} = V_F - V_R$	4429	Exhibit 13-8	
V_R	671	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	3336	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	(pc/mi/ln)	D_R =	24.3 (pc/mi/ln)
LOS =	(Exhibit 13-2)	LOS =	C (Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	(Exibit 13-11)	D_s =	0.293 (Exhibit 13-12)
S_R=	mph (Exhibit 13-11)	S_R=	58.3 mph (Exhibit 13-12)
S_0=	mph (Exhibit 13-11)	S_0=	68.3 mph (Exhibit 13-12)
S =	mph (Exhibit 13-13)	S =	61.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 3 WB
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	2460
Ramp Volume, V_R	730
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2460	0.96	Level	18	0	0.917	1.00	
Ramp	730	0.95	Level	18	0	0.917	1.00	
UpStream								
DownStream	150	0.90	Level	18	0	0.917	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.450 using Equatior

V_{12} = 1718 pc/h

V_3 or V_{av34} 1075 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	2793	Exhibit 13-8	
$V_{FO} = V_F - V_R$	1955	Exhibit 13-8	
V_R	838	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	1718	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086 V_{12} - 0.009$ L

6.4 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = A (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.308 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 57.9 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 71.0 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 62.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 3 WB
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	5300
Ramp Volume, V_R	2700
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	5300	0.97	Level	13	0	0.939	1.00	
Ramp	2700	0.95	Level	13	0	0.939	1.00	
UpStream								
DownStream	290	0.95	Level	13	0	0.939	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.450 using Equatior

V_{12} = 4283 pc/h

V_3 or V_{av34} 1536 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	5819	Exhibit 13-8	
$V_{FO} = V_F - V_R$	2792	Exhibit 13-8	
V_R	3027	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	4283	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L$

28.5 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = D (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.505 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 53.4 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 69.2 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 56.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Rest Area
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	2460
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow
Ram
☑ Y
☐ N
L_{down}
V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2460	0.95	Grade	18	0	0.917	1.00	
Ramp	110	0.96	Grade	18	0	0.917	1.00	
UpStream								
DownStream	110	0.96	Level	18	0	0.917	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.684 using Equatior

V_{12} = 1970 pc/h

V_3 or V_{av34} 853 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	2823	Exhibit 13-8	
$V_{FO} = V_F - V_R$	2698	Exhibit 13-8	
V_R	125	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	1970	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

16.7 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = B (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.244 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 59.4 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 71.3 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 62.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Rest Area
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	5300
Ramp Volume, V_R	190
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	5300	0.97	Grade	13	0	0.939	1.00	
Ramp	190	0.97	Grade	13	0	0.939	1.00	
UpStream								
DownStream	190	0.97	Level	13	0	0.939	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.605 using Equatior

V_{12} = 3603 pc/h

V_3 or V_{av34} 2216 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	5819	Exhibit 13-8	
$V_{FO} = V_F - V_R$	5610	Exhibit 13-8	
V_R	209	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	3603	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L$

30.7 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = D (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.252 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 59.2 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 66.6 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 61.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 17 EB Ramp to I-95 SB CD
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1050 ft

V_u = 350 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	750
Deceleration Lane Length L_D	
Freeway Volume, V_F	1390
Ramp Volume, V_R	1070
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	1390	0.96	Level	18	0	0.917	1.00	
Ramp	1070	0.90	Level	18	0	0.917	1.00	
UpStream	350	0.95	Level	18	0	0.917	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 876 pc/h

V_3 or V_{av34} 702 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 901 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2874	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2197	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 7.9 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = A (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.131 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 62.0 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 64.4 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 62.5 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 17 EB Ramp to I-95 SB CD
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 900 ft

V_u = 350 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	750
Deceleration Lane Length L_D	
Freeway Volume, V_F	3740
Ramp Volume, V_R	2040
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	3740	0.97	Level	13	0	0.939	1.00	
Ramp	2040	0.95	Level	13	0	0.939	1.00	
UpStream	350	0.95	Level	13	0	0.939	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 2279 pc/h

V_3 or V_{av34} 1827 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2346 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6393	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4633	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 26.5 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = C (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.497 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 53.6 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 60.5 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 55.3 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 3 EB Ramp to I-95 SB CD
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1000 ft

V_u = 580 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	1300
Ramp Volume, V_R	350
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Down Ram

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	1300	0.93	Rolling	18	0	0.787	1.00	
Ramp	350	0.80	Rolling	18	0	0.787	1.00	
UpStream	580	0.91	Rolling	18	0	0.787	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1775 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2331	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2331	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	17.8 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	B (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.271 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	58.8 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	N/A mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	58.8 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 3 EB Ramp to I-95 SB CD
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1000 ft

V_u = 820 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2070
Ramp Volume, V_R	700
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2070	0.97	Rolling	13	0	0.837	1.00	
Ramp	700	0.93	Rolling	13	0	0.837	1.00	
UpStream	820	0.95	Rolling	13	0	0.837	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2550 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3449	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3449	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	26.3 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	C (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.354 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	56.9 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	N/A mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	56.9 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound
Agency or Company	WRA	Junction	I-95 SB CD Ramp to I-95 SB
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	980
Ramp Volume, V_R	1650
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	980	0.95	Level	18	0	0.917	1.00	
Ramp	1650	0.90	Level	18	0	0.917	1.00	
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 624 pc/h

V_3 or V_{av34} 500 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 642 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3122	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2640	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-
13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	4.5 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	A (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	-0.053 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	71.5 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	70.0 mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	71.3 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound
Agency or Company	WRA	Junction	I-95 SB CD Ramp to I-95 SB
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	2200
Ramp Volume, V_R	2770
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2200	0.96	Level	13	0	0.939	1.00	
Ramp	2770	0.96	Level	13	0	0.939	1.00	
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 1355 pc/h

V_3 or V_{av34} 1086 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1394 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5514	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4634	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-
13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	19.5 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	B (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.293 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	58.3 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	63.6 mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	59.0 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Rest Area Ramp to I-95 SB CD
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 750 ft

V_u = 110 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1400
Deceleration Lane Length L_D	
Freeway Volume, V_F	2350
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2350	0.95	Level	18	0	0.917	1.00	
Ramp	110	0.96	Level	18	0	0.917	1.00	
UpStream	110	0.96	Level	18	0	0.917	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1438.29 (Equation 13-6 or 13-7)

P_{FM} = 0.573 using Equation (Exhibit 13-6)

V_{12} = 1546 pc/h

V_3 or V_{av34} 1150 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1546 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2821	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1671	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 9.7 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = A (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.202 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 60.4 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 62.7 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 61.3 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Rest Area Ramp to I-95 SB CD
Date Performed	7/20/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 750 ft

V_u = 190 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1400
Deceleration Lane Length L_D	
Freeway Volume, V_F	5110
Ramp Volume, V_R	190
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	5110	0.95	Level	13	0	0.939	1.00	
Ramp	190	0.97	Level	13	0	0.939	1.00	
UpStream	190	0.97	Level	13	0	0.939	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2105.33 (Equation 13-6 or 13-7)

P_{FM} = 0.531 using Equation (Exhibit 13-6)

V_{12} = 3043 pc/h

V_3 or V_{av34} 2686 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 3273 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5938	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3482	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 23.8 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = C (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.308 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 57.9 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 57.5 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 57.8 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/20/2017
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 17
Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	600ft
Freeway free-flow speed, FFS	65 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1270	0.96	18	0	2.5	2.0	0.787	1.00	1680
V_{RF}	120	0.92	18	0	2.5	2.0	0.787	1.00	166
V_{FR}	350	0.85	18	0	2.5	2.0	0.787	1.00	523
V_{RR}	0	0.94	18	0	2.5	2.0	0.787	1.00	0
V_{NW}	1680							V =	2369
V_W	689								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	689 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	797 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	797 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	1866 veh/h	Weaving intensity factor, W	0.283
Weaving segment capacity, c_w	6224 veh/h	Weaving segment speed, S	56.2 mph
Weaving segment v/c ratio	0.300	Average weaving speed, S_W	54.0 mph
Weaving segment density, D	10.5 pc/mi/ln	Average non-weaving speed, S_{NW}	57.2 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	5486 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/20/2017
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 17
Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	600ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3110	0.97	13	0	2.5	2.0	0.837	1.00	3831
V_{RF}	150	0.88	13	0	2.5	2.0	0.837	1.00	204
V_{FR}	480	0.98	13	0	2.5	2.0	0.837	1.00	585
V_{RR}	0	0.90	13	0	2.5	2.0	0.837	1.00	0
V_{NW}	3831							V =	4620
V_W	789								
VR	0.171								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	789 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	897 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	344 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1241 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	3867 veh/h	Weaving intensity factor, W	0.401
Weaving segment capacity, c_w	7103 veh/h	Weaving segment speed, S	58.0 mph
Weaving segment v/c ratio	0.544	Average weaving speed, S_W	54.3 mph
Weaving segment density, D	19.9 pc/mi/ln	Average non-weaving speed, S_{NW}	58.8 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	4240 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/20/2017
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 3
Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	850ft
Freeway free-flow speed, FFS	65 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1150	0.96	18	0	2.5	2.0	0.787	1.00	1521
V_{RF}	150	0.88	18	0	2.5	2.0	0.787	1.00	216
V_{FR}	580	0.91	18	0	2.5	2.0	0.787	1.00	809
V_{RR}	0	0.90	18	0	2.5	2.0	0.787	1.00	0
V_{NW}	1521							V =	2546
V_W	1025								
VR	0.403								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1025 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1107 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	196 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1303 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	2006 veh/h	Weaving intensity factor, W	0.317
Weaving segment capacity, c_w	4493 veh/h	Weaving segment speed, S	53.3 mph
Weaving segment v/c ratio	0.446	Average weaving speed, S_W	53.0 mph
Weaving segment density, D	15.9 pc/mi/ln	Average non-weaving speed, S_{NW}	53.5 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	6710 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/20/2017
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 3
Analysis Year	2020 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	850ft
Freeway free-flow speed, FFS	65 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1780	0.97	13	0	2.5	2.0	0.837	1.00	2193
V_{RF}	290	0.96	13	0	2.5	2.0	0.837	1.00	361
V_{FR}	820	0.95	13	0	2.5	2.0	0.837	1.00	1031
V_{RR}	0	0.90	13	0	2.5	2.0	0.837	1.00	0
V_{NW}	2193							V =	3585
V_W	1392								
VR	0.388								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1392 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1474 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	335 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1809 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	3001 veh/h	Weaving intensity factor, W	0.410
Weaving segment capacity, c_w	4805 veh/h	Weaving segment speed, S	49.7 mph
Weaving segment v/c ratio	0.624	Average weaving speed, S_W	50.5 mph
Weaving segment density, D	24.0 pc/mi/ln	Average non-weaving speed, S_{NW}	49.2 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	6550 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Modified Build Alternative

2040 HCS Mainline / Ramp Junction Analysis

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segmennt 1*
Agency or Company	*WRA*	From/To	*South of Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3750*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1707*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*67.0*	mph	S	mph
D = v_p / S	*25.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 1*
Agency or Company	*WRA*	From/To	*South of Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*5410*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*13*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2245*	pc/h/ln
S	*57.3*	mph
D = v_p / S	*39.2*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segments 2 & 3*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*1500*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*661*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segments 2 & 3*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*1590*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*653*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*9.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 4*
Agency or Company	*WRA*	From/To	*North of Route17*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*4250*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*18*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.787*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1874*	pc/h/ln	Design LOS	
S	*64.7*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*29.0*	pc/mi/ln	S	mph
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*I-95 SB Segment 4*
Agency or Company	*WRA*	From/To	*North of Route 17*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*6950*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.837*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2854*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*38.3*	mph	S	mph
D = v_p / S	*74.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*Southbound CD Lanes*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*3280*	veh/h	Peak-Hour Factor, PHF	*0.97*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.847*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.5*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.5*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1330*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*20.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JPH*	Highway/Direction of Travel	*Southbound CD Lanes*
Agency or Company	*WRA*	From/To	*Route 17 to Route 3*
Date Performed	*7/11/2017*	Jurisdiction	*Fredericksburg*
Analysis Time Period	*PM Peak*	Analysis Year	*2040 Modified Build*

Project Description *I-95 Interchange Modification Report*

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

Flow Inputs

Volume, V	*7070*	veh/h	Peak-Hour Factor, PHF	*0.97*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Grade*
DDHV = AADT x K x D		veh/h	Grade 2.72% Length	*0.85mi*
			Up/Down %	*2.72*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*3.0*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2575*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*45.4*	mph	S	mph
D = v_p / S	*56.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 17 WB
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	960
Freeway Volume, V_F	2750
Ramp Volume, V_R	700
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow
Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2750	0.96	Rolling	18	0	0.787	1.00	
Ramp	700	0.88	Rolling	18	0	0.787	1.00	
UpStream								
DownStream	150	0.92	Rolling	18	0	0.787	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.623 using Equatior

V_{12} = 2646 pc/h

V_3 or V_{av34} 992 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	3638	Exhibit 13-8	
$V_{FO} = V_F - V_R$	2628	Exhibit 13-8	
V_R	1010	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	2646	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	(pc/mi/ln)	D_R =	18.4 (pc/mi/ln)
LOS =	(Exhibit 13-2)	LOS =	B (Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	(Exibit 13-11)	D_s =	0.324 (Exhibit 13-12)
S_R=	mph (Exhibit 13-11)	S_R=	57.6 mph (Exhibit 13-12)
S_0=	mph (Exhibit 13-11)	S_0=	71.3 mph (Exhibit 13-12)
S =	mph (Exhibit 13-13)	S =	60.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 17 WB
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	960
Freeway Volume, V_F	5360
Ramp Volume, V_R	790
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow
Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	5360	0.97	Rolling	13	0	0.837	1.00	
Ramp	790	0.98	Rolling	13	0	0.837	1.00	
UpStream								
DownStream	200	0.88	Rolling	13	0	0.837	1.00	

Estimation of v_{12} — Merge Areas

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.551 using Equatior

V_{12} = 4069 pc/h

V_3 or V_{av34} 2534 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks

	Actual	Capacity	
V_F	6603	Exhibit 13-8	
$V_{FO} = V_F - V_R$	5640	Exhibit 13-8	
V_R	963	Exhibit 13-10	

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	4069	Exhibit 13-8	440

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L$

D_R =	(pc/mi/ln)	D_R =	30.6 (pc/mi/ln)
LOS =	(Exhibit 13-2)	LOS =	D (Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	(Exibit 13-11)	D_s =	0.320 (Exhibit 13-12)
S_R=	mph (Exhibit 13-11)	S_R=	57.6 mph (Exhibit 13-12)
S_0=	mph (Exhibit 13-11)	S_0=	65.3 mph (Exhibit 13-12)
S =	mph (Exhibit 13-13)	S =	60.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 3 WB
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	3280
Ramp Volume, V_R	940
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Dow Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	3280	0.96	Level	18	0	0.917	1.00	
Ramp	940	0.95	Level	18	0	0.917	1.00	
UpStream								
DownStream	180	0.90	Level	18	0	0.917	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.450 using Equatior

V_{12} = 2269 pc/h

V_3 or V_{av34} 1455 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	3724	Exhibit 13-8	
$V_{FO} = V_F - V_R$	2645	Exhibit 13-8	
V_R	1079	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	2269	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L$

11.2 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = B (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.135 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 61.9 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 69.5 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 64.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Route 3 WB
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	7070
Ramp Volume, V_R	3460
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Dow
Ram
☑ Y
☐ N
L_{down}
V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	7070	0.97	Level	13	0	0.939	1.00	
Ramp	3460	0.95	Level	13	0	0.939	1.00	
UpStream								
DownStream	340	0.95	Level	13	0	0.939	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.450 using Equatior

V_{12} = 5626 pc/h

V_3 or V_{av34} 2136 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	7762	Exhibit 13-8	
$V_{FO} = V_F - V_R$	3883	Exhibit 13-8	
V_R	3879	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	5626	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

40.0 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = F (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.387 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 56.1 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 66.9 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 58.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Rest Area
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	3280
Ramp Volume, V_R	150
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	50.0

Dow
Ram

☑ Y

☐ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	3280	0.95	Grade	18	0	0.917	1.00	
Ramp	150	0.96	Grade	18	0	0.917	1.00	
UpStream								
DownStream	150	0.96	Level	18	0	0.917	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

(pc/mi/ln)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.658 using Equatior

V_{12} = 2535 pc/h

V_3 or V_{av34} 1228 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-1 19)

Capacity Checks

	Actual	Capacity	
V_F	3763	Exhibit 13-8	
$V_{FO} = V_F - V_R$	3593	Exhibit 13-8	
V_R	170	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	2535	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L$

21.6 (pc/mi/ln)

D_R =	D_R =
LOS = (Exhibit 13-2)	LOS = C (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = (Exibit 13-11)	D_s = 0.248 (Exhibit 13-12)
S_R= mph (Exhibit 13-11)	S_R= 59.3 mph (Exhibit 13-12)
S_0= mph (Exhibit 13-11)	S_0= 70.4 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 62.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	I-95 SB CD Ramp to Rest Area
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	500
Freeway Volume, V_F	7070
Ramp Volume, V_R	270
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Dow
Ram
☑ Y
☐ N
L_{down}
V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	7070	0.97	Grade	13	0	0.939	1.00	
Ramp	270	0.97	Grade	13	0	0.939	1.00	
UpStream								
DownStream	270	0.97	Level	13	0	0.939	1.00	

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = 0.552 using Equatior

V_{12} = 4420 pc/h

V_3 or V_{av34} 3342 pc/h (Equation

Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 5062 pc/h (Equation or 13-19)

Capacity Checks

	Actual	Capacity	
V_F	7762	Exhibit 13-8	
$V_{FO} = V_F - V_R$	7466	Exhibit 13-8	
V_R	296	Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}	4420	Exhibit 13-8	440

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	(pc/mi/ln)	D_R =	43.3 (pc/mi/ln)
LOS =	(Exhibit 13-2)	LOS =	F (Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	(Exibit 13-11)	D_s =	0.065 (Exhibit 13-12)
S_R=	mph (Exhibit 13-11)	S_R=	63.5 mph (Exhibit 13-12)
S_0=	mph (Exhibit 13-11)	S_0=	64.7 mph (Exhibit 13-12)
S =	mph (Exhibit 13-13)	S =	63.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 17 EB Ramp to I-95 SB CD
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1050 ft

V_u = 440 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	750
Deceleration Lane Length L_D	
Freeway Volume, V_F	1760
Ramp Volume, V_R	1520
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	1760	0.96	Level	18	0	0.917	1.00	
Ramp	1520	0.90	Level	18	0	0.917	1.00	
UpStream	440	0.95	Level	18	0	0.917	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 1109 pc/h

V_3 or V_{av34} 889 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1141 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3839	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2982	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 13.8 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = B (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.105 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 62.6 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 63.7 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 62.8 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 17 EB Ramp to I-95 SB CD
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 900 ft

V_u = 440 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	750
Deceleration Lane Length L_D	
Freeway Volume, V_F	4170
Ramp Volume, V_R	2900
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ram

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	4170	0.97	Level	13	0	0.939	1.00	
Ramp	2900	0.95	Level	13	0	0.939	1.00	
UpStream	440	0.95	Level	13	0	0.939	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 2541 pc/h

V_3 or V_{av34} 2037 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2616 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7829	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5867	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 35.6 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = F (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 1.406 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 32.7 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 59.7 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 36.8 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 3 EB Ramp to I-95 SB CD
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1000 ft

V_u = 720 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	1800
Ramp Volume, V_R	450
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ram

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	1800	0.93	Rolling	18	0	0.787	1.00	
Ramp	450	0.80	Rolling	18	0	0.787	1.00	
UpStream	720	0.91	Rolling	18	0	0.787	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2458 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3172	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3172	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	24.2 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	C (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.297 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	58.2 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	N/A mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	58.2 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Route 3 EB Ramp to I-95 SB CD
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1000 ft

V_u = 1020 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2930
Ramp Volume, V_R	890
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	2930	0.97	Rolling	13	0	0.837	1.00	
Ramp	890	0.93	Rolling	13	0	0.837	1.00	
UpStream	1020	0.95	Rolling	13	0	0.837	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3610 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4754	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4754	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	36.4 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	F (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.657 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	49.9 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	N/A mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	49.9 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound
Agency or Company	WRA	Junction	I-95 SB CD Ramp to I-95 SB
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	1500
Ramp Volume, V_R	2250
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	1500	0.95	Level	18	0	0.917	1.00	
Ramp	2250	0.90	Level	18	0	0.917	1.00	
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 955 pc/h

V_3 or V_{av34} 766 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 983 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4446	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3708	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L$

D_R =	12.5 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	B (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.051 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	68.6 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	69.1 mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	68.7 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound
Agency or Company	WRA	Junction	I-95 SB CD Ramp to I-95 SB
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	2
Acceleration Lane Length, L_A	1100
Deceleration Lane Length L_D	
Freeway Volume, V_F	1590
Ramp Volume, V_R	3820
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	1590	0.96	Level	13	0	0.939	1.00	
Ramp	3820	0.96	Level	13	0	0.939	1.00	
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

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

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

V_{12} = 979 pc/h

V_3 or V_{av34} 785 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1008 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6002	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5366	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-
13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 4.252 + 0.0086\, V_{12} - 0.009$ L

D_R =	24.7 (pc/mi/ln)	D_R =	(pc/mi/ln)
LOS =	C (Exhibit 13-2)	LOS =	(Exhibit 13-2)
Speed Determination		***Speed Determination***	
M_S =	0.727 (Exibit 13-11)	D_s =	(Exhibit 13-12)
S_R=	48.3 mph (Exhibit 13-11)	S_R=	mph (Exhibit 13-12)
S_0=	64.5 mph (Exhibit 13-11)	S_0=	mph (Exhibit 13-12)
S =	49.6 mph (Exhibit 13-13)	S =	mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Rest Area Ramp to I-95 SB CD
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	AM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 750 ft

V_u = 150 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1400
Deceleration Lane Length L_D	
Freeway Volume, V_F	3130
Ramp Volume, V_R	150
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	3130	0.95	Level	18	0	0.917	1.00	
Ramp	150	0.96	Level	18	0	0.917	1.00	
UpStream	150	0.96	Level	18	0	0.917	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2424.25 (Equation 13-6 or 13-7)

P_{FM} = 0.511 using Equation (Exhibit 13-6)

V_{12} = 1835 pc/h

V_3 or V_{av34} 1756 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2052 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3761	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2222	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 14.0 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = B (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.175 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 61.0 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 61.3 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 61.1 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	JPH	Freeway/Dir of Travel	I-95 Southbound CD Lanes
Agency or Company	WRA	Junction	Rest Area Ramp to I-95 SB CD
Date Performed	7/17/2017	Jurisdiction	Fredericksburg
Analysis Time Period	PM Peak Hour	Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 750 ft

V_u = 270 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1400
Deceleration Lane Length L_D	
Freeway Volume, V_F	6800
Ramp Volume, V_R	270
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	65.0

Down Ramp

☐ Y

☑ N

L_{down}

V_D =

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V
Freeway	6800	0.95	Level	13	0	0.939	1.00	
Ramp	270	0.97	Level	13	0	0.939	1.00	
UpStream	270	0.97	Level	13	0	0.939	1.00	
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 3314.07 (Equation 13-6 or 13-7)

P_{FM} = 0.455 using Equation (Exhibit 13-6)

V_{12} = 3468 pc/h

V_3 or V_{av34} 4155 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 4923 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7919	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5219	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or

P_{FD} = using Equation (Exh

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 o

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-1 13-19)

Capacity Checks

	Actual	Capacity	
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Diverge Influence A

	Actual	Max Desirable	
V_{12}		Exhibit 13-8	

Level of Service Determination (if

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$	$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L$
D_R = 37.3 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = F (Exhibit 13-2)	LOS = (Exhibit 13-2)
Speed Determination	***Speed Determination***
M_S = 0.860 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R= 45.2 mph (Exhibit 13-11)	S_R= mph (Exhibit 13-12)
S_0= 56.1 mph (Exhibit 13-11)	S_0= mph (Exhibit 13-12)
S = 48.4 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/17/2017
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 17
Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	600ft
Freeway free-flow speed, FFS	65 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2310	0.96	18	0	2.5	2.0	0.787	1.00	3056
V_{RF}	150	0.92	18	0	2.5	2.0	0.787	1.00	207
V_{FR}	440	0.85	18	0	2.5	2.0	0.787	1.00	657
V_{RR}	0	0.94	18	0	2.5	2.0	0.787	1.00	0
V_{NW}	3056							V =	3920
V_W	864								
VR	0.220								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	864 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	972 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	184 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1156 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	3087 veh/h	Weaving intensity factor, W	0.379
Weaving segment capacity, c_w	6403 veh/h	Weaving segment speed, S	53.4 mph
Weaving segment v/c ratio	0.482	Average weaving speed, S_W	51.3 mph
Weaving segment density, D	18.3 pc/mi/ln	Average non-weaving speed, S_{NW}	54.1 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	4746 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/17/2017
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 17
Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	600ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4760	0.97	13	0	2.5	2.0	0.837	1.00	5864
V_{RF}	200	0.88	13	0	2.5	2.0	0.837	1.00	272
V_{FR}	600	0.98	13	0	2.5	2.0	0.837	1.00	732
V_{RR}	0	0.90	13	0	2.5	2.0	0.837	1.00	0
V_{NW}	5864							V =	6868
V_W	1004								
VR	0.146								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1004 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1112 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	763 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1875 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	5747 veh/h	Weaving intensity factor, W	0.555
Weaving segment capacity, c_w	7163 veh/h	Weaving segment speed, S	53.9 mph
Weaving segment v/c ratio	0.802	Average weaving speed, S_W	50.4 mph
Weaving segment density, D	31.9 pc/mi/ln	Average non-weaving speed, S_{NW}	54.5 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	3993 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/17/2017
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 3
Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	850ft
Freeway free-flow speed, FFS	65 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1620	0.96	18	0	2.5	2.0	0.787	1.00	2143
V_{RF}	180	0.88	18	0	2.5	2.0	0.787	1.00	260
V_{FR}	720	0.91	18	0	2.5	2.0	0.787	1.00	1005
V_{RR}	0	0.90	18	0	2.5	2.0	0.787	1.00	0
V_{NW}	2143							V =	3408
V_W	1265								
VR	0.371								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1265 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1347 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	324 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1671 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	2684 veh/h	Weaving intensity factor, W	0.385
Weaving segment capacity, c_w	4554 veh/h	Weaving segment speed, S	50.7 mph
Weaving segment v/c ratio	0.589	Average weaving speed, S_W	51.1 mph
Weaving segment density, D	22.4 pc/mi/ln	Average non-weaving speed, S_{NW}	50.4 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	6360 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JPH
Agency/Company	WRA
Date Performed	7/17/2017
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	I-95 Southbound CD Lanes
Weaving Segment Location	I-95 SB CD Weave at Route 3
Analysis Year	2040 Modified Build

Project Description I-95 Interchange Modification Report

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	850ft
Freeway free-flow speed, FFS	65 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Rolling

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2590	0.97	13	0	2.5	2.0	0.837	1.00	3191
V_{RF}	340	0.96	13	0	2.5	2.0	0.837	1.00	423
V_{FR}	1020	0.95	13	0	2.5	2.0	0.837	1.00	1283
V_{RR}	0	0.90	13	0	2.5	2.0	0.837	1.00	0
V_{NW}	3191							V =	4897
V_W	1706								
VR	0.348								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1706 lc/h
Interchange density, ID	0.0 int/mi	Weaving lane changes, LC_W	1788 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	540 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2328 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

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

Weaving segment flow rate, v	4098 veh/h	Weaving intensity factor, W	0.500
Weaving segment capacity, c_w	4890 veh/h	Weaving segment speed, S	46.0 mph
Weaving segment v/c ratio	0.838	Average weaving speed, S_W	48.3 mph
Weaving segment density, D	35.5 pc/mi/ln	Average non-weaving speed, S_{NW}	44.9 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6109 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Modified Build Alternative

2020 CORSIM Analysis

I-95 NB Mainline

	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	RAMP	FREEWAY
Actual Volumes	4,100	4,100	3,810	3,810	3,500	3,500	2,090	4,890	6,020	6,020
Simulated Volumes	4,100	4,094	3,807	3,805	3,497	3,498	2,082	4,717	5,671	5,675
		765	Rt 3 OffRamp	847	Off-Ramp	800			1,000	
Actual Ramp Volumes			290		310		1,410	2800	1130	
Simulated Ramp Volumes			287		310		1,413	2638	950	
Ramp Distance (ft)			394		182		333	501	772	
Ramp Space Mean Speed (mph)			40.1		38.9		31.7	50.7	46.8	
Ramp Density (veh/ln/mi)			7.2		7.9		22.3	26.0	20.3	
Distance (ft)	449	6,259	1,048	847	12,510	1,320	1,258	4,993	1,526	2,339
Space Mean Speed (mph)	67.1	66.8	66.4	65.7	66.1	56.4	63.3	61.8	56.8	62.5
Link Density (veh/ln/mi)	21.3	19.6	16.3	14.5	17.6	17.2	11.0	17.7	27.3	30.3

2 1 16 13 14 33 28 34 37 51 52

I-95 NB Mainline

	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	RAMP	FREEWAY
Actual Volumes	4,100	4,100	3,810	3,810	3,500	3,500	2,090	4,890	6,020	6,020
Simulated Volumes	4,100	4,094	3,807	3,805	3,497	3,498	2,082	4,717	5,671	5,675
Distance (ft)	449	6,259	1,048	847	12,510	1,320	1,258	4,993	1,526	2,339
Lane 3 Space Mean Speed (mph)	67.2	67.1	66.9	66.7	66.4	67.6	67.7	67.7	66.8	65.8
Lane 3 Density (veh/ln/mi)	19.6	18.3	17.6	16.3	15.9	10.4	11.0	16.1	22.8	28.2
Lane 2 Space Mean Speed (mph)	67.1	67.3	66.3	67.2	66.9	64.6	66.4	65.3	61.7	62.9
Lane 2 Density (veh/ln/mi)	22.0	20.8	18.9	17.6	18.2	13.8	13.5	23.5	30.9	31.4
Lane 1 Space Mean Speed (mph)	67.1	66.4	65.6	65.9	65.0	50.3	52.6	57.6	48.8	59.0
Lane 1 Density (veh/ln/mi)	22.4	21.5	11.5	18.6	18.9	31.7	8.4	32.2	43.1	31.3
Lane 9 Space Mean Speed (mph)		58.9		57.6		50.0		53.9	47.6	
Lane 9 Density (veh/ln/mi)		0.6		5.5		6.1		3.7	3.0	
Lane 10 Space Mean Speed (mph)								49.1		
Lane 10 Density (veh/ln/mi)								0.7		

2 1 16 13 14 33 28 34 37 51 52

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

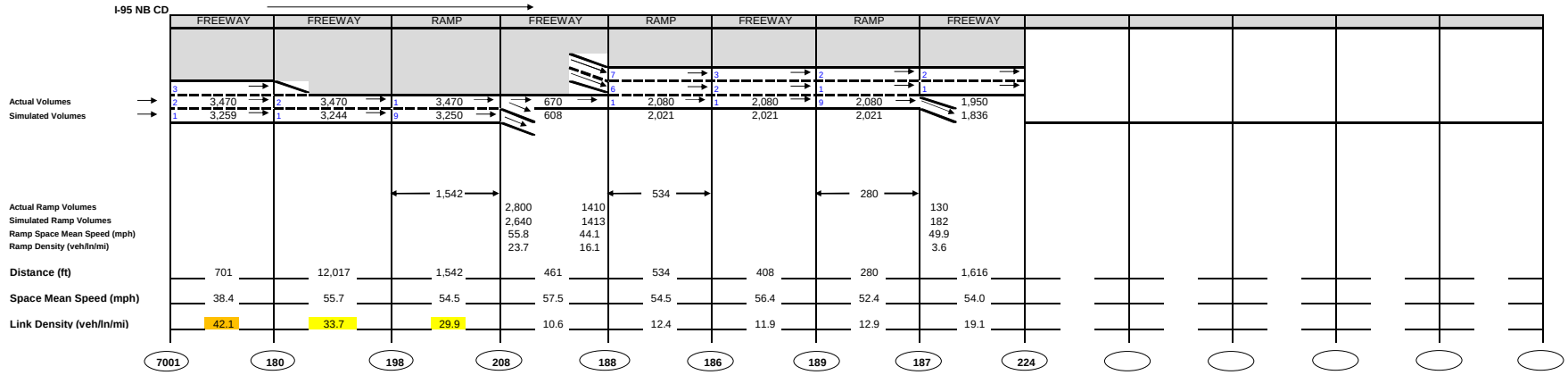
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

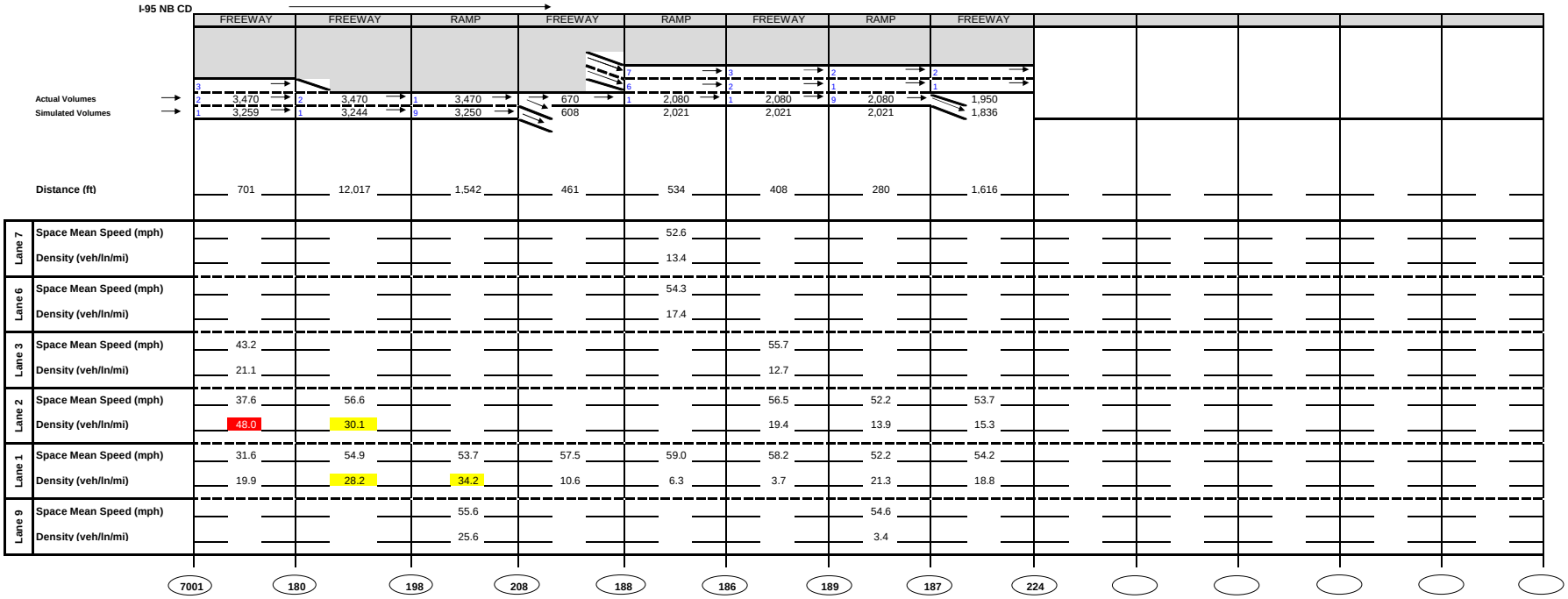
This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound Mainline

2020 Modified Build - AM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound CD Lanes

2020 Modified Build - AM Peak

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	8 → 7 980 → 6	3 → 2 980 → 1	3 → 2 980 → 1	1 → 9 980 → 10
Simulated Volumes	995	995	998	999
Actual Ramp Volumes				
Simulated Ramp Volumes				
Ramp Space Mean Speed (mph)				
Ramp Density (veh/ln/mi)				
Distance (ft)	801	731	18,317	2,587
Space Mean Speed (mph)	68.6	68.7	68.6	68.4
Link Density (veh/ln/mi)	3.6	4.6	4.8	4.9

92 120 280 93 100

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	8 → 7 980 → 6	3 → 2 980 → 1	3 → 2 980 → 1	1 → 9 980 → 10
Simulated Volumes	995	995	998	999
Distance (ft)	801	731	18,317	2,587
Lane 8 Space Mean Speed (mph)	69.0			
Lane 8 Density (veh/ln/mi)	4.4			
Lane 7 Space Mean Speed (mph)	69.6			
Lane 7 Density (veh/ln/mi)	5.1			
Lane 6 Space Mean Speed (mph)	67.3			
Lane 6 Density (veh/ln/mi)	5.0			
Lane 4 Space Mean Speed (mph)				
Lane 4 Density (veh/ln/mi)				
Lane 3 Space Mean Speed (mph)		69.0	68.7	
Lane 3 Density (veh/ln/mi)		4.4	4.2	
Lane 2 Space Mean Speed (mph)		69.4	69.5	
Lane 2 Density (veh/ln/mi)		5.0	5.2	
Lane 1 Space Mean Speed (mph)		67.6	67.7	68.7
Lane 1 Density (veh/ln/mi)		4.7	5.1	4.2
Lane 9 Space Mean Speed (mph)				69.4
Lane 9 Density (veh/ln/mi)				5.3
Lane 10 Space Mean Speed (mph)				67.2
Lane 10 Density (veh/ln/mi)				5.2

92 120 280 93 100

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

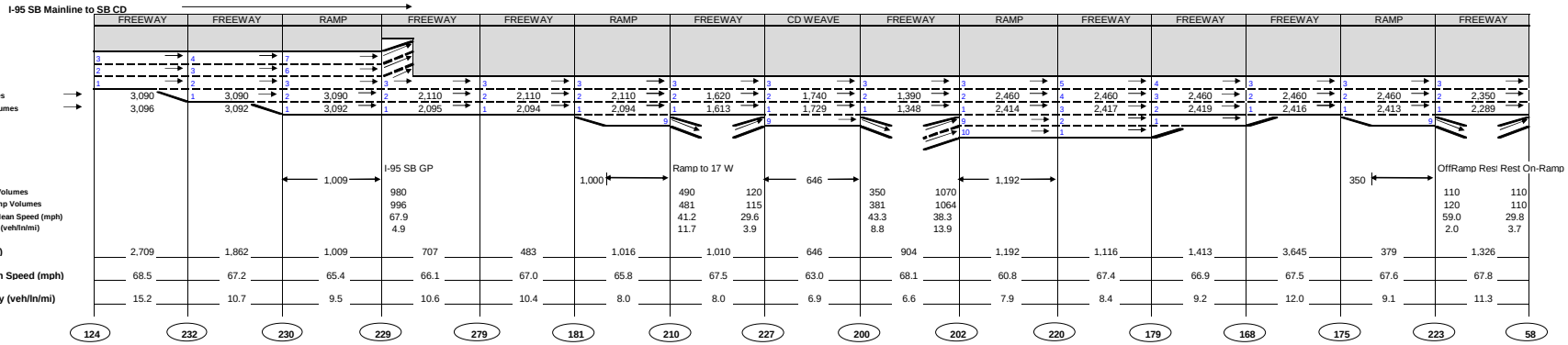
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

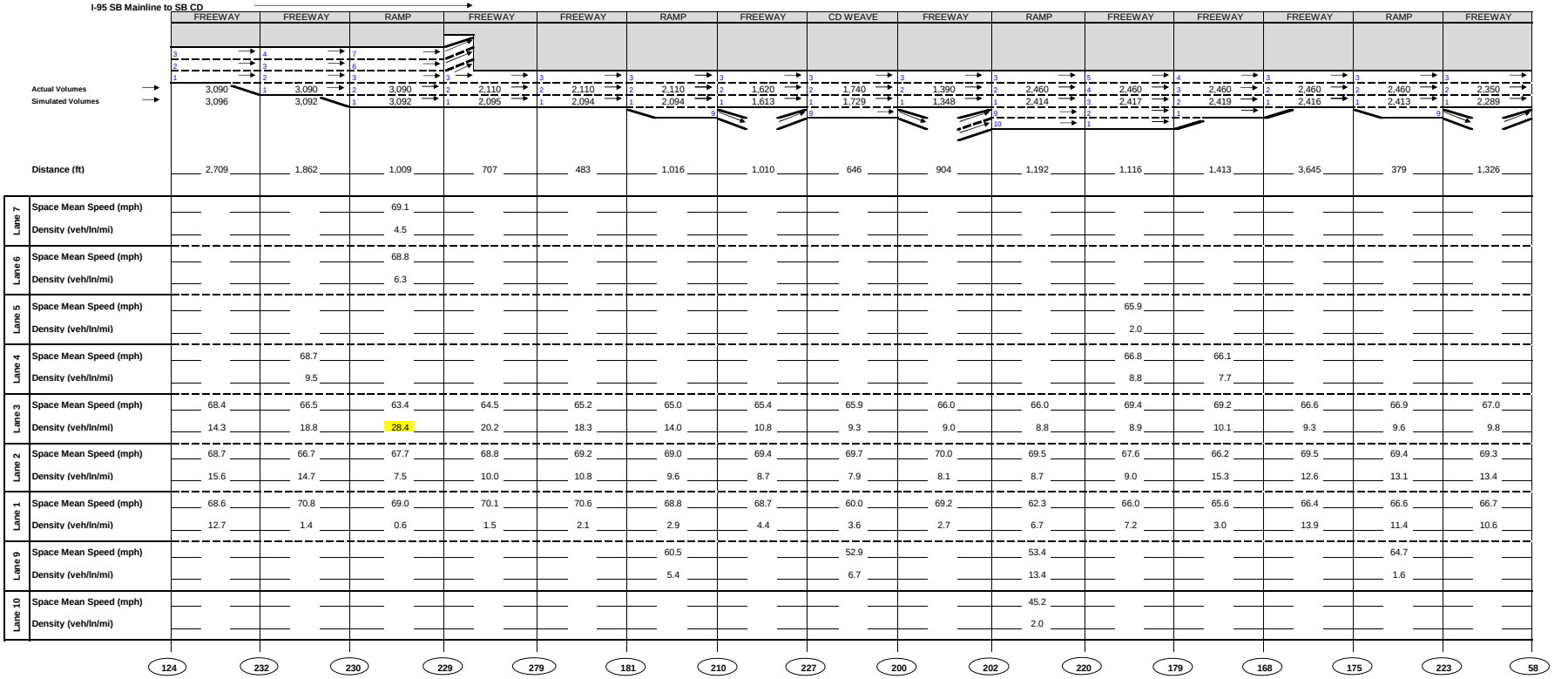
This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Southbound Mainline

2020 Modified Build - AM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

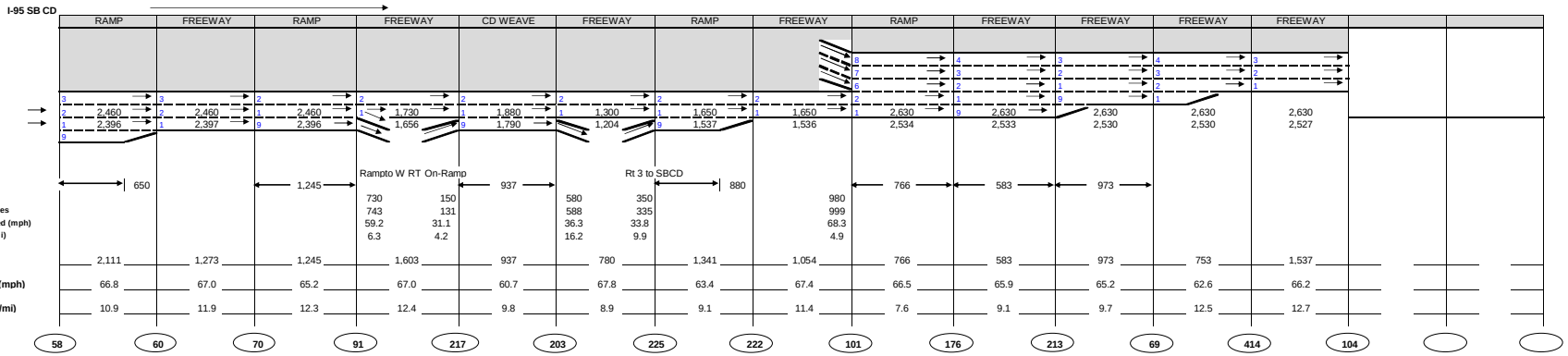
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

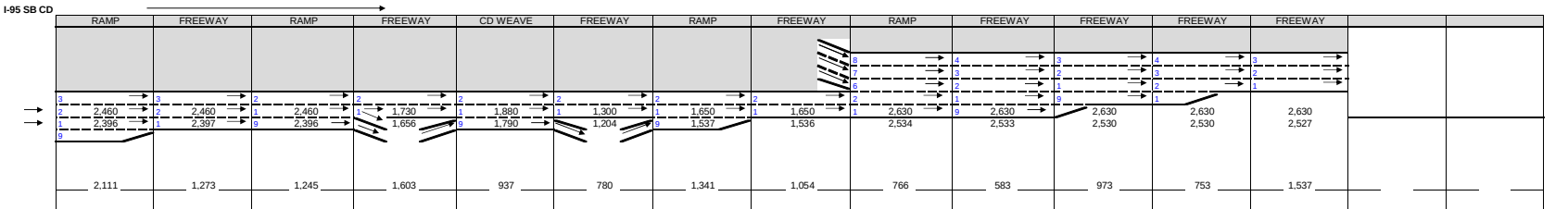
This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 SB Mainline to SB CD

2020 Modified Build - AM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Southbound CD

2020 Modified Build - AM Peak

I-95 NB Mainline

	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	RAMP	FREEWAY
Actual Volumes	3,890	3,890	3,630	3,630	3,090	3,090	1,950	3,150	3,880	3,880
Simulated Volumes	3,887	3,891	3,641	3,641	3,093	3,097	2,101	3,220	3,865	3,873
		765	Rt 3 OffRamp	847	Off-Ramp	800			1,000	
Actual Ramp Volumes			260		540		1,140	1200	730	
Simulated Ramp Volumes			254		545		992	1135	648	
Ramp Space Mean Speed (mph)			40.6		37.3		33.6	52.0	47.4	
Ramp Density (veh/ln/mi)			6.3		14.6		14.8	10.9	13.7	
Distance (ft)	449	6,259	1,048	847	12,510	1,320	1,258	4,993	1,526	2,339
Space Mean Speed (mph)	67.2	67.1	66.6	65.2	66.7	61.0	64.5	65.0	63.3	65.7
Link Density (veh/ln/mi)	20.2	18.6	15.5	14.0	15.4	14.1	10.9	11.6	16.7	19.6
Node	2	1	16	13	14	33	28	34	37	51

I-95 NB Mainline

	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	FREEWAY	RAMP	RAMP	FREEWAY
Actual Volumes	3,890	3,890	3,630	3,630	3,090	3,090	1,950	3,150	3,880	3,880
Simulated Volumes	3,887	3,891	3,641	3,641	3,093	3,097	2,101	3,220	3,865	3,873
Distance (ft)	449	6,259	1,048	847	12,510	1,320	1,258	4,993	1,526	2,339
Lane 3 Space Mean Speed (mph)	67.3	67.3	67.3	67.2	66.9	67.9	67.9	68.2	68.2	68.0
Lane 3 Density (veh/ln/mi)	18.5	17.4	15.8	14.3	14.0	9.8	10.2	11.9	14.3	16.2
Lane 2 Space Mean Speed (mph)	67.2	67.6	66.5	67.7	67.5	66.5	67.2	67.3	66.3	66.7
Lane 2 Density (veh/ln/mi)	20.8	19.7	17.4	15.8	16.1	12.7	13.0	16.5	19.5	20.6
Lane 1 Space Mean Speed (mph)	67.2	66.7	65.5	66.2	65.8	56.4	57.1	61.8	59.0	63.0
Lane 1 Density (veh/ln/mi)	21.2	20.4	13.1	16.1	16.3	23.7	9.4	19.6	26.0	22.1
Lane 9 Space Mean Speed (mph)		59.6		56.3		54.5		56.4	50.8	
Lane 9 Density (veh/ln/mi)		0.5		9.7		4.5		1.4	1.3	
Lane 10 Space Mean Speed (mph)								50.6		
Lane 10 Density (veh/ln/mi)								0.2		
Node	2	1	16	13	14	33	28	34	37	51

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)
45 and above
35 to 45
26 to 35
0 to 26

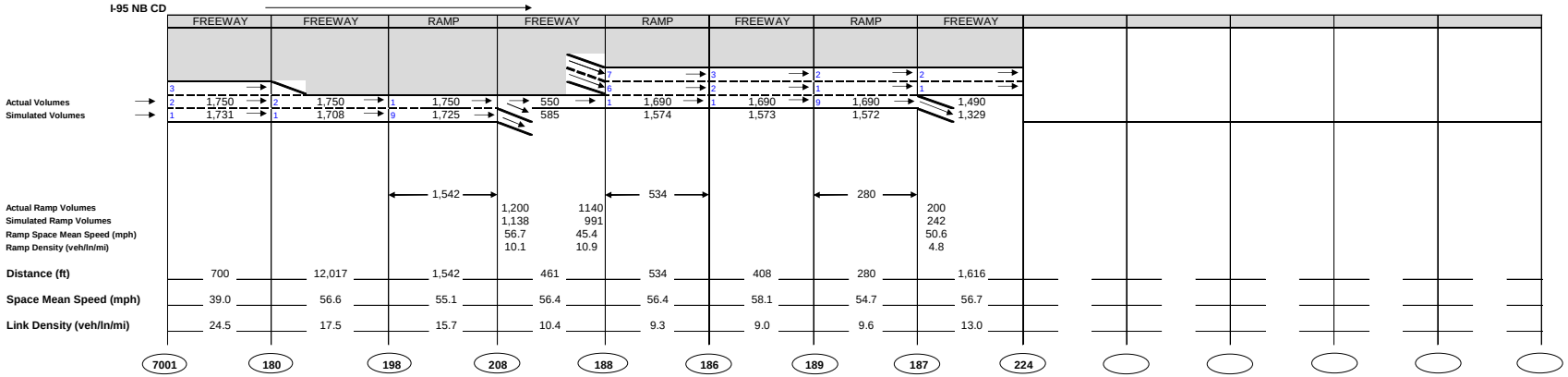
Weave/Ramp Density (veh/ln/mi)
45 and above
35 to 45
28 to 35
0 to 28

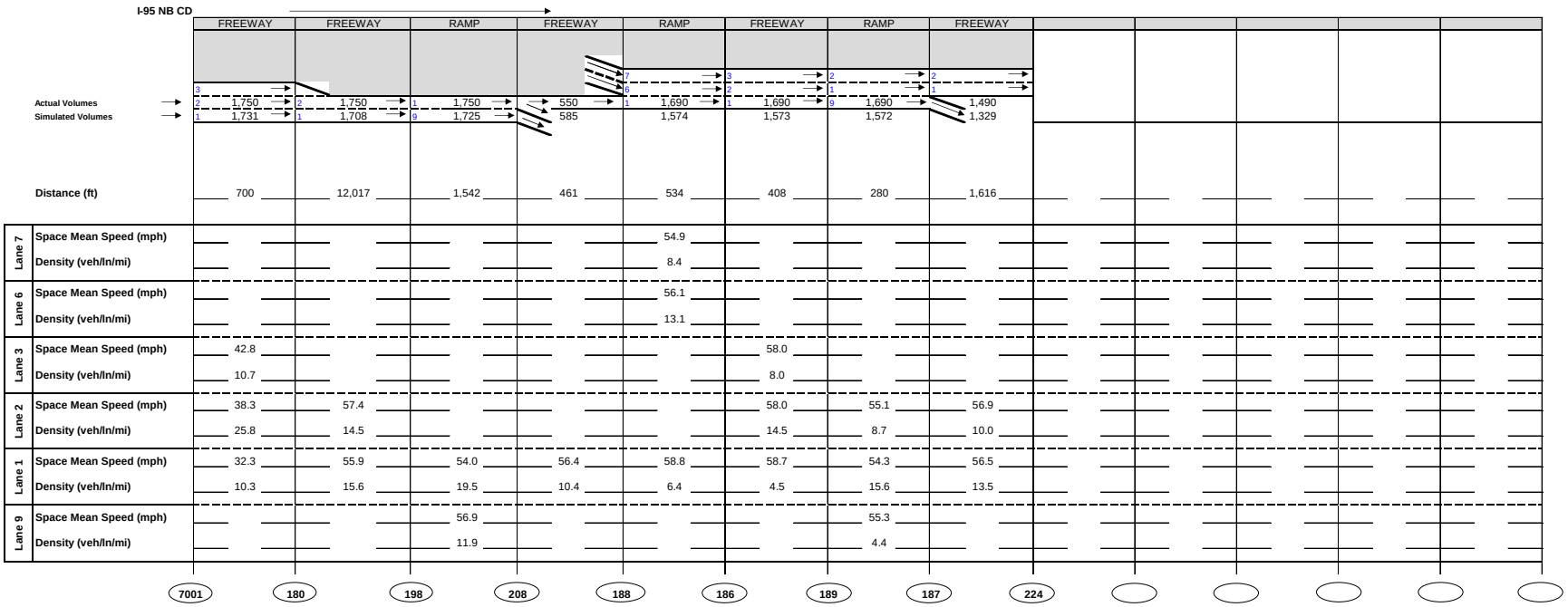
CD Road Weave Density (veh/ln/mi)
45 and above
36 to 45
32 to 36
0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound Mainline
2020 Modified Build - PM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound CD Lanes
2020 Modified Build - PM Peak

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	8 → 9 → 9 → 1 →			
	7 → 2,200 → 2 → 2,200 → 2 → 2,200 → 8 → 2,200 →			
Simulated Volumes	6 → 2,238 → 1 → 2,238 → 1 → 2,237 → 10 → 2,236 →			
Actual Ramp Volumes				
Simulated Ramp Volumes				
Ramp Space Mean Speed (mph)				
Ramp Density (veh/ln/mi)				
Distance (ft)	801	731	18,317	2,587
Space Mean Speed (mph)	65.9	66.7	67.5	67.5
Link Density (veh/ln/mi)	8.5	10.7	11.1	11.1

92 120 280 93 100

I-95 SB Mainline

		FREEWAY	FREEWAY	FREEWAY	FREEWAY
	Actual Volumes	8 → 9 → 9 → 1 →			
		7 → 2,200 → 2 → 2,200 → 2 → 2,200 → 8 → 2,200 →			
	Simulated Volumes	6 → 2,238 → 1 → 2,238 → 1 → 2,237 → 10 → 2,236 →			
	Distance (ft)	801	731	18,317	2,587
Lane 8	Space Mean Speed (mph)	68.0			
	Density (veh/ln/mi)	14.6			
Lane 7	Space Mean Speed (mph)	66.5			
	Density (veh/ln/mi)	10.5			
Lane 6	Space Mean Speed (mph)	61.7			
	Density (veh/ln/mi)	8.8			
Lane 4	Space Mean Speed (mph)				
	Density (veh/ln/mi)				
Lane 3	Space Mean Speed (mph)		67.8	66.7	
	Density (veh/ln/mi)		13.9	11.5	
Lane 2	Space Mean Speed (mph)		67.6	68.3	
	Density (veh/ln/mi)		10.6	11.9	
Lane 1	Space Mean Speed (mph)		63.4	67.4	66.6
	Density (veh/ln/mi)		8.1	9.7	10.4
Lane 9	Space Mean Speed (mph)				68.0
	Density (veh/ln/mi)				11.9
Lane 10	Space Mean Speed (mph)				67.8
	Density (veh/ln/mi)				10.8

92 120 280 93 100

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Southbound Mainline
2020 Modified Build - PM Peak

I-95 SB Mainline to SB CD

	FREEWAY	FREEWAY	RAMP	FREEWAY	FREEWAY	RAMP	FREEWAY	CD WEAVE	FREEWAY	RAMP	FREEWAY	FREEWAY	FREEWAY	RAMP	FREEWAY
Actual Volumes	6,340	6,340	6,340	4,140	4,140	4,140	3,590	3,740	3,260	5,300	5,300	5,300	5,300	5,300	5,110
Simulated Volumes	6,327	6,325	6,324	4,087	4,086	4,086	3,560	3,706	3,188	5,148	5,151	5,151	5,144	5,139	4,941
			1,009	I-95 SB GP		1,000	Ramp to 17 W	646		1,192				350	OffRamp Rest Rest On-Ramp
Actual Ramp Volumes				2,200			550 150		480 2040						190 190
Simulated Ramp Volumes				2,238			526 147		518 1960						200 190
Ramp Space Mean Speed (mph)				61.0			39.7 29.4		39.2 37.9						55.9 29.9
Ramp Density (veh/ln/mi)				12.2			13.2 5.0		13.2 25.9						3.6 6.4
Distance (ft)	2,709	1,862	1,009	707	483	1,016	1,010	646	904	1,192	1,116	1,413	3,645	379	1,326
Space Mean Speed (mph)	66.0	42.3	42.5	54.8	60.2	59.8	62.2	60.4	65.1	59.9	64.9	58.2	63.8	65.3	65.6
Link Density (veh/ln/mi)	32.3	35.2	29.8	24.9	22.6	17.2	19.1	15.3	16.5	17.2	18.6	22.6	27.9	20.1	25.1
	124	232	230	229	279	181	210	227	200	202	220	179	168	175	223 58

I-95 SB Mainline to SB CD

	FREEWAY	FREEWAY	RAMP	FREEWAY	FREEWAY	RAMP	FREEWAY	CD WEAVE	FREEWAY	RAMP	FREEWAY	FREEWAY	FREEWAY	RAMP	FREEWAY
Actual Volumes	6,340	6,340	6,340	4,140	4,140	4,140	3,590	3,740	3,260	5,300	5,300	5,300	5,300	5,300	5,110
Simulated Volumes	6,327	6,325	6,324	4,087	4,086	4,086	3,560	3,706	3,188	5,148	5,151	5,151	5,144	5,139	4,941
Distance (ft)	2,709	1,862	1,009	707	483	1,016	1,010	646	904	1,192	1,116	1,413	3,645	379	1,326
Lane 7 Space Mean Speed (mph)			62.2												
Lane 7 Density (veh/ln/mi)			17.6												
Lane 6 Space Mean Speed (mph)			45.0												
Lane 6 Density (veh/ln/mi)			23.3												
Lane 5 Space Mean Speed (mph)											65.0				
Lane 5 Density (veh/ln/mi)											3.1				
Lane 4 Space Mean Speed (mph)		53.0									65.6	65.6			
Lane 4 Density (veh/ln/mi)		33.9									15.3	13.4			
Lane 3 Space Mean Speed (mph)	66.2	36.0	30.9	47.2	54.1	54.9	58.6	61.6	63.3	64.5	66.1	64.6	65.8	66.4	66.3
Lane 3 Density (veh/ln/mi)	31.6	55.5	69.0	27.8	21.4	18.5	15.3	13.7	13.6	13.7	20.0	21.3	21.3	22.6	23.2
Lane 2 Space Mean Speed (mph)	66.0	36.1	50.3	57.0	61.2	59.5	62.1	62.8	65.3	66.0	64.6	53.5	64.5	65.8	65.8
Lane 2 Density (veh/ln/mi)	31.5	44.0	26.3	27.6	25.7	23.8	20.4	18.8	18.1	18.5	24.1	41.9	27.6	26.9	26.9
Lane 1 Space Mean Speed (mph)	66.1	57.9	57.2	62.7	65.3	65.9	65.0	62.8	66.4	64.4	63.0	55.3	61.8	64.3	64.7
Lane 1 Density (veh/ln/mi)	24.4	9.9	12.8	19.2	20.7	19.7	21.5	19.1	17.3	21.4	16.8	11.9	31.9	26.4	25.2
Lane 9 Space Mean Speed (mph)						56.0		49.3		52.7				62.1	
Lane 9 Density (veh/ln/mi)						6.3		9.7		26.7				2.8	
Lane 10 Space Mean Speed (mph)										46.0					
Lane 10 Density (veh/ln/mi)										5.7					
	124	232	230	229	279	181	210	227	200	202	220	179	168	175	223 58

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

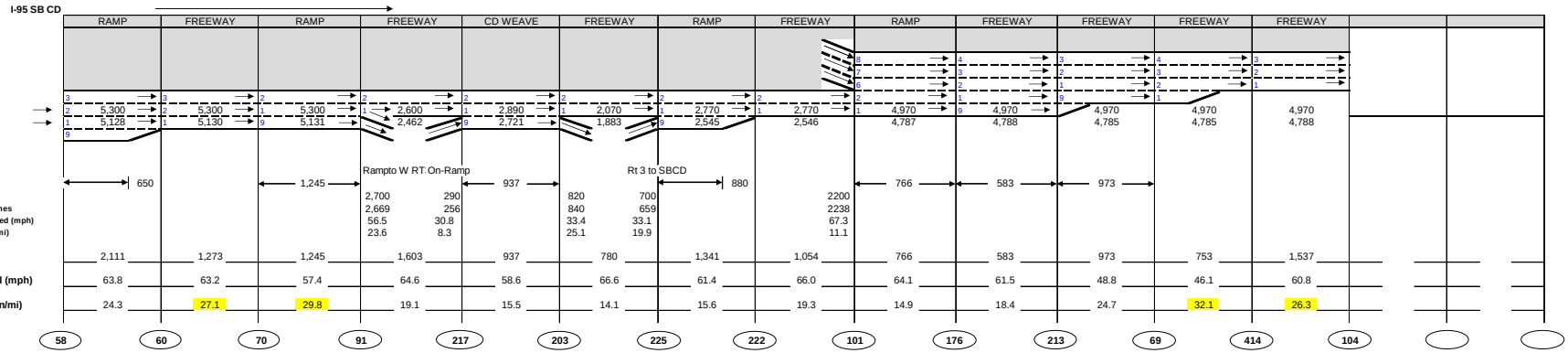
Auxiliary Lane Length

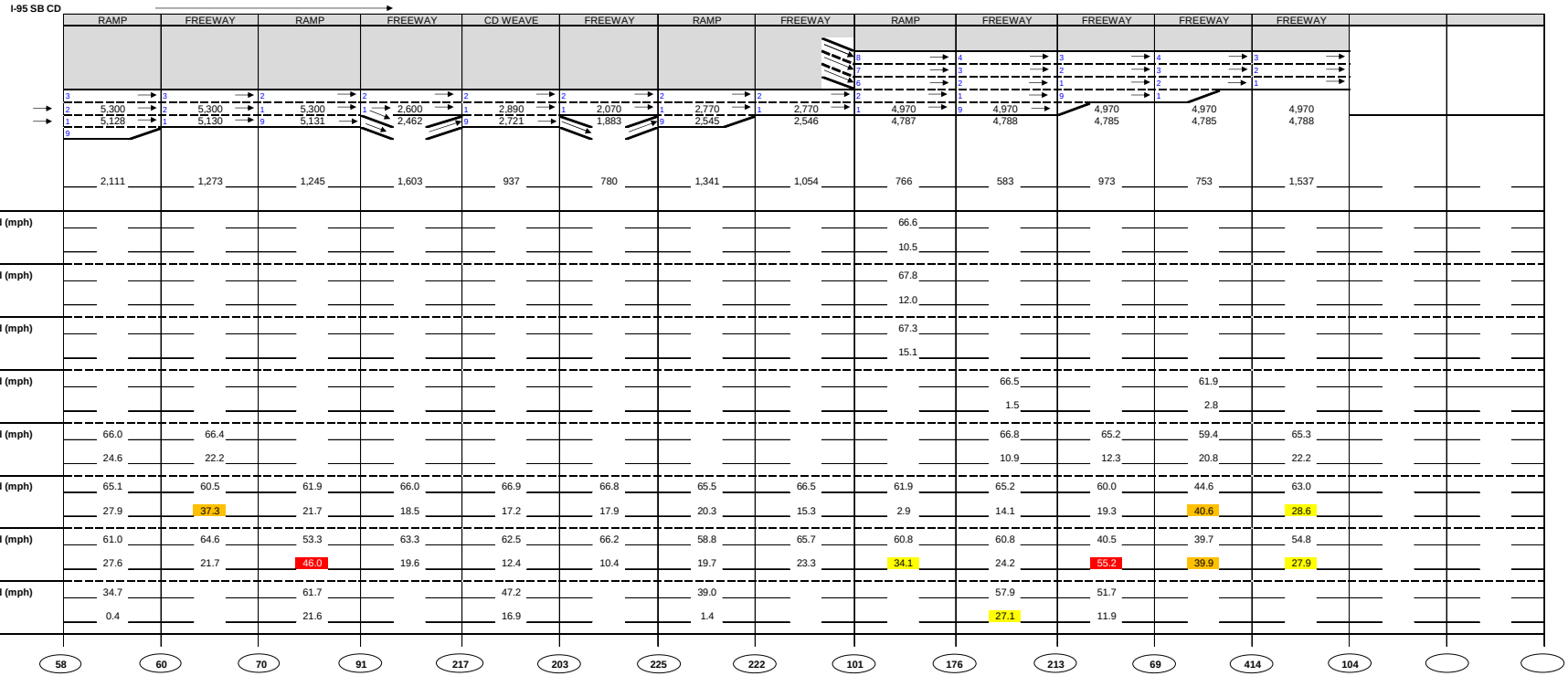
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Mainline to SB CD
2020 Modified Build - PM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

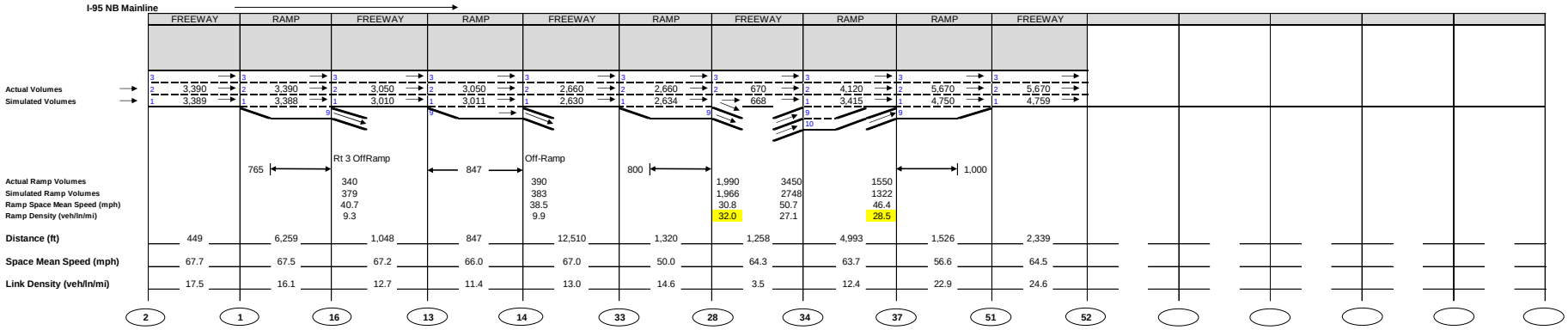
VDOT Virginia Department of Transportation

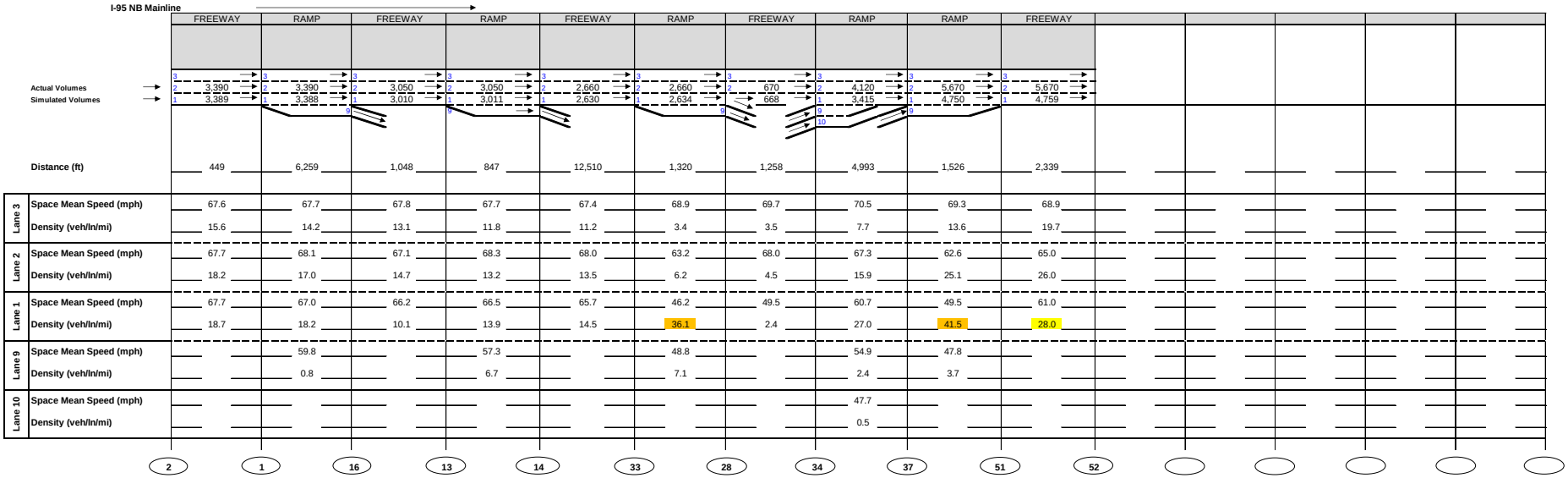
I-95 Southbound CD

2020 Modified Build - PM Peak

Modified Build Alternative

2040 CORSIM Analysis





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

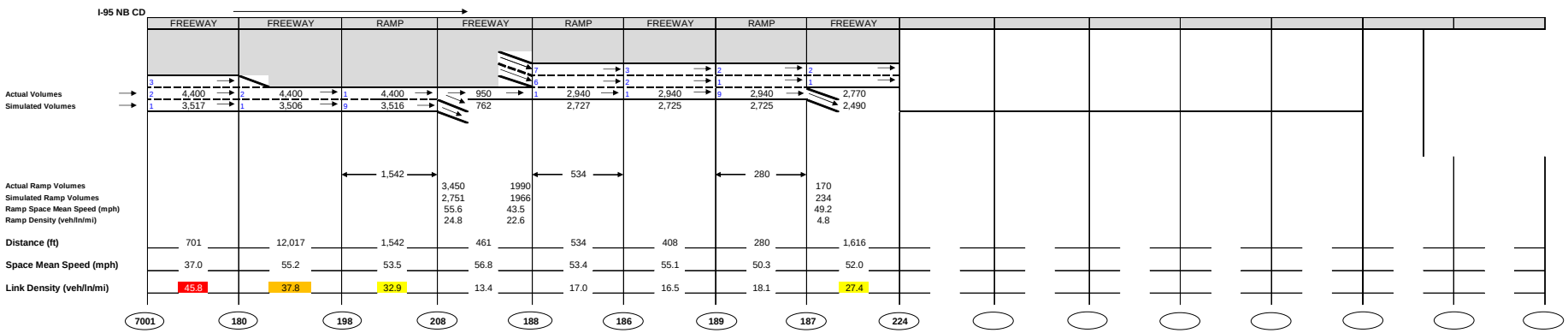
Auxiliary Lane Length

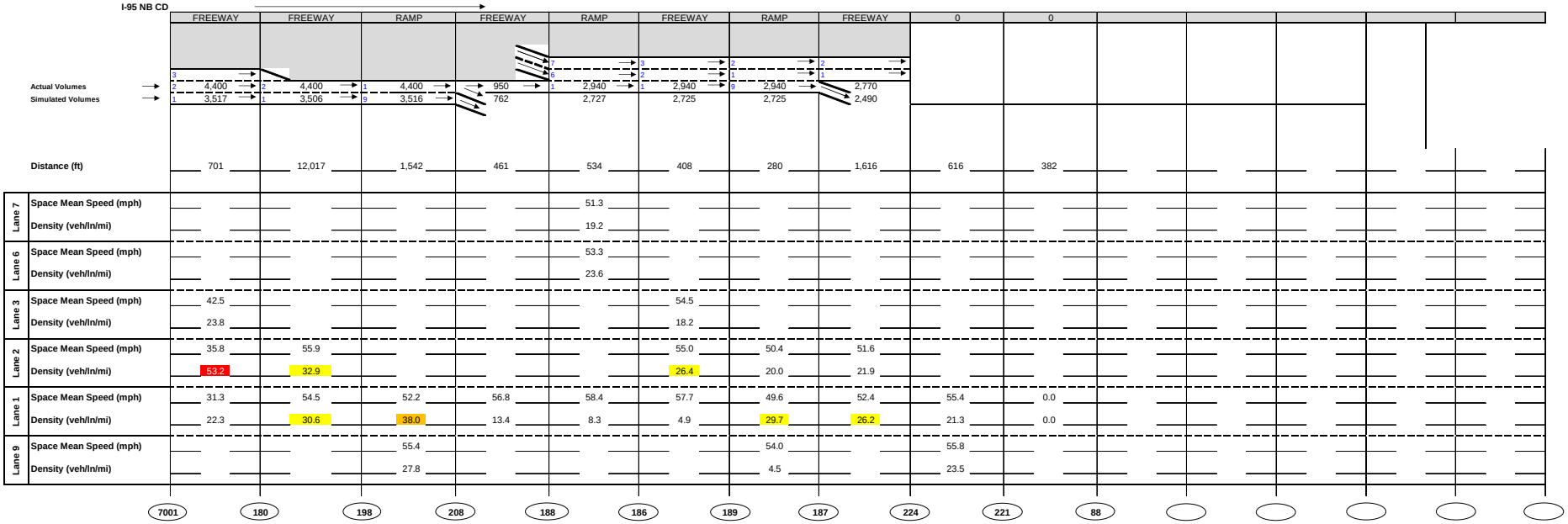
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound Mainline
2040 Modified Build - AM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound CD Lanes
2040 Modified Build - AM Peak

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	1,500	1,500	1,500	1,500
Simulated Volumes	1,520	1,520	1,520	1,517
Actual Ramp Volumes				
Simulated Ramp Volumes				
Ramp Space Mean Speed (mph)				
Ramp Density (veh/ln/mi)				
Distance (ft)	801	731	18,317	2,587
Space Mean Speed (mph)	67.9	68.1	68.2	68.0
Link Density (veh/ln/mi)	5.6	7.1	7.4	7.4

92 120 280 93 100

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	1,500	1,500	1,500	1,500
Simulated Volumes	1,520	1,520	1,520	1,517
Distance (ft)	801	731	18,317	2,587
Lane 8 Space Mean Speed (mph)	68.8			
Lane 8 Density (veh/ln/mi)	7.0			
Lane 7 Space Mean Speed (mph)	68.8			
Lane 7 Density (veh/ln/mi)	8.0			
Lane 6 Space Mean Speed (mph)	66.1			
Lane 6 Density (veh/ln/mi)	7.3			
Lane 4 Space Mean Speed (mph)				
Lane 4 Density (veh/ln/mi)				
Lane 3 Space Mean Speed (mph)		68.8	68.5	
Lane 3 Density (veh/ln/mi)		7.0	6.7	
Lane 2 Space Mean Speed (mph)		68.8	68.8	
Lane 2 Density (veh/ln/mi)		7.9	8.0	
Lane 1 Space Mean Speed (mph)		66.7	67.4	68.4
Lane 1 Density (veh/ln/mi)		6.9	7.6	6.6
Lane 9 Space Mean Speed (mph)				68.6
Lane 9 Density (veh/ln/mi)				7.9
Lane 10 Space Mean Speed (mph)				67.1
Lane 10 Density (veh/ln/mi)				7.8

92 120 280 93 100

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 SB Mainline

2040 Modified Build - AM Peak

I-95 SB Mainline to SB CD

	FREEWAY	FREEWAY	RAMP	FREEWAY	FREEWAY	RAMP	FREEWAY	CD WEAVE	FREEWAY	RAMP	FREEWAY	FREEWAY	FREEWAY	RAMP	FREEWAY
Actual Volumes	4,250	4,250	4,250	2,750	2,750	2,750	2,050	2,200	1,760	3,280	3,280	3,280	3,280	3,280	3,130
Simulated Volumes	4,244	4,242	4,244	2,728	2,727	2,728	2,043	2,183	1,701	3,221	3,219	3,221	3,224	3,225	3,066
			1,009	I-95 SB GP		1,000	Ramp to 17 W	646		1,192				350	OffRamp Rest Rest On-Ramp
Actual Ramp Volumes				1,500			700 / 150		440 / 1520						150 / 150
Simulated Ramp Volumes				1,519			687 / 140		481 / 1528						160 / 150
Ramp Space Mean Speed (mph)				66.6			40.5 / 29.5		41.3 / 37.8						57.3 / 30.1
Ramp Density (veh/ln/mi)				7.6			17.0 / 4.8		11.6 / 20.3						2.8 / 5.0
Distance (ft)	2,709	1,862	1,009	707	483	1,016	1,010	646	904	1,192	1,116	1,413	3,645	379	1,326
Space Mean Speed (mph)	67.6	65.9	62.1	63.6	65.4	64.1	66.3	62.1	67.5	59.7	66.5	65.2	66.4	66.8	67.1
Link Density (veh/ln/mi)	21.2	15.0	13.7	14.3	13.9	10.7	10.3	8.8	8.4	10.8	11.3	12.6	16.4	12.3	15.3
	124	232	230	229	279	181	210	227	200	202	220	179	168	175	223 / 58

I-95 SB Mainline to SB CD

	FREEWAY	FREEWAY	RAMP	FREEWAY	FREEWAY	RAMP	FREEWAY	CD WEAVE	FREEWAY	RAMP	FREEWAY	FREEWAY	FREEWAY	RAMP	FREEWAY
Actual Volumes	4,250	4,250	4,250	2,750	2,750	2,750	2,050	2,200	1,760	3,280	3,280	3,280	3,280	3,280	3,130
Simulated Volumes	4,244	4,242	4,244	2,728	2,727	2,728	2,043	2,183	1,701	3,221	3,219	3,221	3,224	3,225	3,066
Distance (ft)	2,709	1,862	1,009	707	483	1,016	1,010	646	904	1,192	1,116	1,413	3,645	379	1,326
Lane 7 Space Mean Speed (mph)			68.8												
Lane 7 Density (veh/ln/mi)			7.2												
Lane 6 Space Mean Speed (mph)			67.0												
Lane 6 Density (veh/ln/mi)			10.6												
Lane 5 Space Mean Speed (mph)											65.5				
Lane 5 Density (veh/ln/mi)											2.2				
Lane 4 Space Mean Speed (mph)		67.7									66.5	66.0			
Lane 4 Density (veh/ln/mi)		14.7									10.4	9.0			
Lane 3 Space Mean Speed (mph)	67.7	64.3	58.3	61.1	63.0	62.9	64.0	65.0	65.3	65.5	68.4	68.1	66.6	66.9	66.9
Lane 3 Density (veh/ln/mi)	20.0	25.2	37.1	24.0	21.2	15.9	12.1	10.3	10.1	9.9	12.0	13.3	12.0	12.8	13.2
Lane 2 Space Mean Speed (mph)	67.6	65.4	65.1	66.5	67.4	66.9	67.7	68.2	68.7	68.3	66.5	63.6	68.1	68.3	68.2
Lane 2 Density (veh/ln/mi)	21.5	19.3	12.0	15.4	15.7	13.2	11.6	10.3	10.3	11.2	13.5	22.2	17.3	17.6	17.8
Lane 1 Space Mean Speed (mph)	67.5	70.4	66.5	68.1	69.3	67.8	67.9	62.2	69.3	62.6	64.5	62.7	64.8	65.6	65.8
Lane 1 Density (veh/ln/mi)	17.6	2.7	1.5	3.5	4.8	5.7	7.2	5.9	4.8	10.5	10.3	4.9	19.3	15.7	14.7
Lane 9 Space Mean Speed (mph)						58.9		51.2		52.7				63.2	
Lane 9 Density (veh/ln/mi)						7.8		8.7		18.8				2.2	
Lane 10 Space Mean Speed (mph)										45.1					
Lane 10 Density (veh/ln/mi)										3.7					
	124	232	230	229	279	181	210	227	200	202	220	179	168	175	223 / 58

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

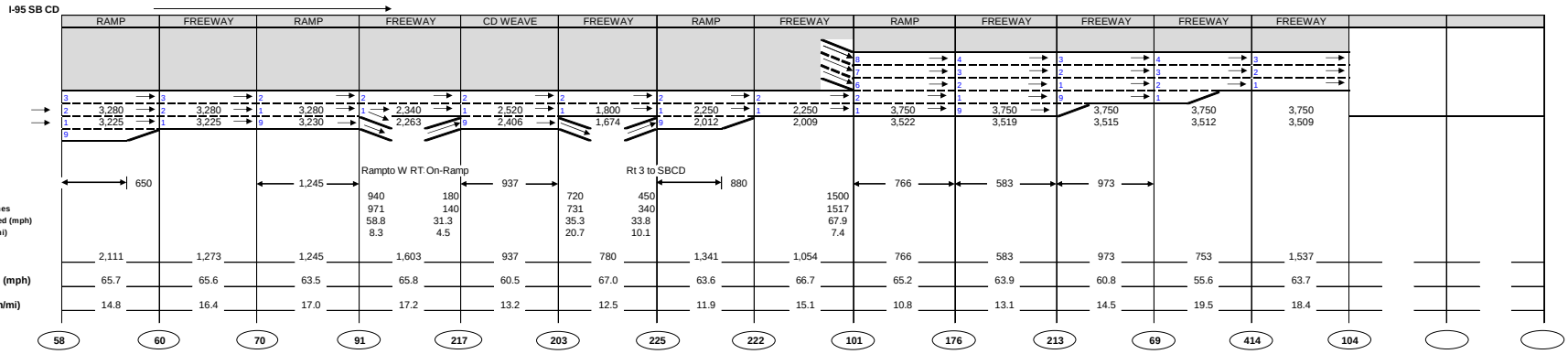
Auxiliary Lane Length

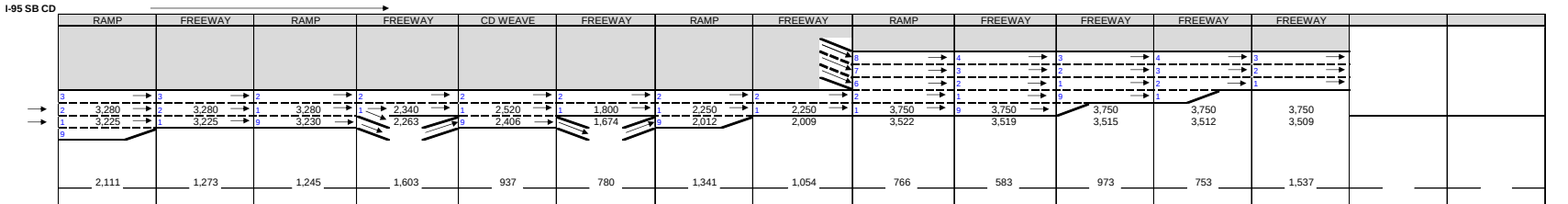
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 SB Mainline to SB CD
2040 Modified Build - AM Peak





		58	60	70	91	217	203	225	222	101	176	213	69	414	104
	Distance (ft)	2,111	1,273	1,245	1,603	937	780	1,341	1,054	766	583	973	753	1,537	
Lane 8	Space Mean Speed (mph)									68.4					
	Density (veh/ln/mi)									6.7					
Lane 7	Space Mean Speed (mph)									68.5					
	Density (veh/ln/mi)									8.0					
Lane 6	Space Mean Speed (mph)									67.3					
	Density (veh/ln/mi)									10.8					
Lane 4	Space Mean Speed (mph)										68.2		66.6		
	Density (veh/ln/mi)										1.0		1.4		
Lane 3	Space Mean Speed (mph)	66.8	66.8								68.4	68.1	65.0	68.1	
	Density (veh/ln/mi)	14.1	13.5								7.0	7.2	11.1	11.9	
Lane 2	Space Mean Speed (mph)	67.6	64.5	65.5	67.2	67.2	67.3	66.4	67.1	63.3	66.7	66.0	55.9	66.4	
	Density (veh/ln/mi)	18.4	25.0	15.3	14.6	14.2	14.7	16.0	11.5	1.8	9.3	12.2	23.4	19.4	
Lane 1	Space Mean Speed (mph)	63.1	66.9	62.2	64.8	64.1	66.6	61.7	66.4	62.7	63.5	57.3	51.1	59.3	
	Density (veh/ln/mi)	16.3	10.6	27.4	19.8	11.8	10.3	14.9	18.7	26.7	18.9	34.0	27.2	23.9	
Lane 9	Space Mean Speed (mph)	34.5		64.3		50.5		39.5			61.1	61.0			
	Density (veh/ln/mi)	0.2		8.1		13.7		0.8			19.0	4.5			

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

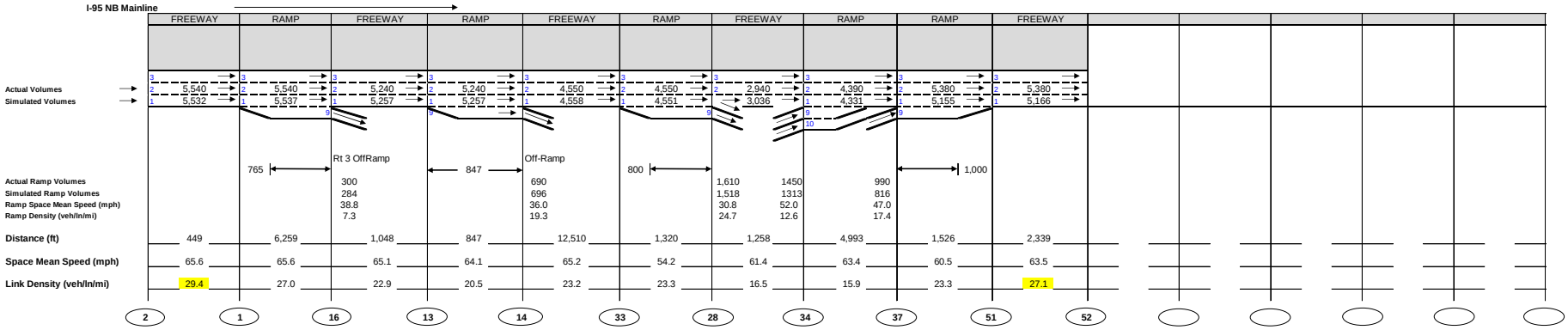
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

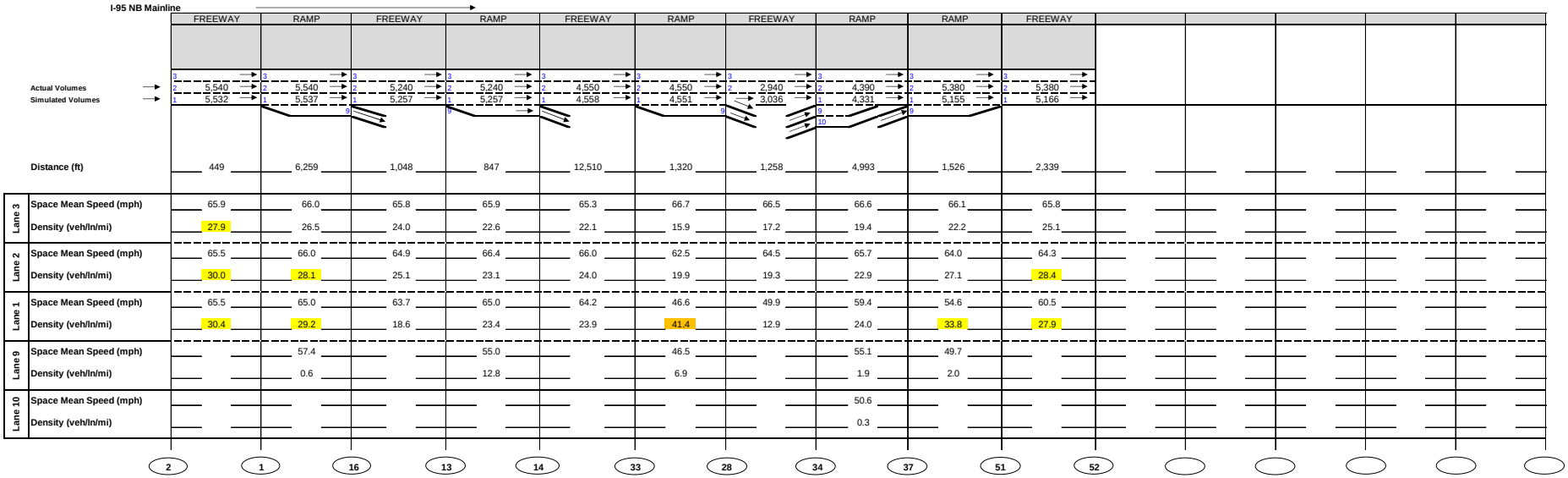
This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Southbound CD

2040 Modified Build - AM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)
45 and above
35 to 45
26 to 35
0 to 26

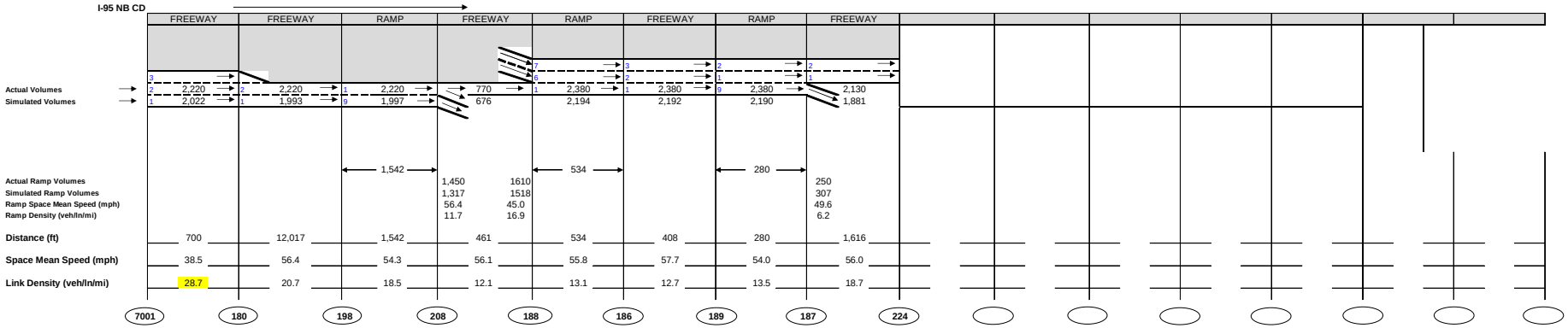
Weave/Ramp Density (veh/ln/mi)
45 and above
35 to 45
28 to 35
0 to 28

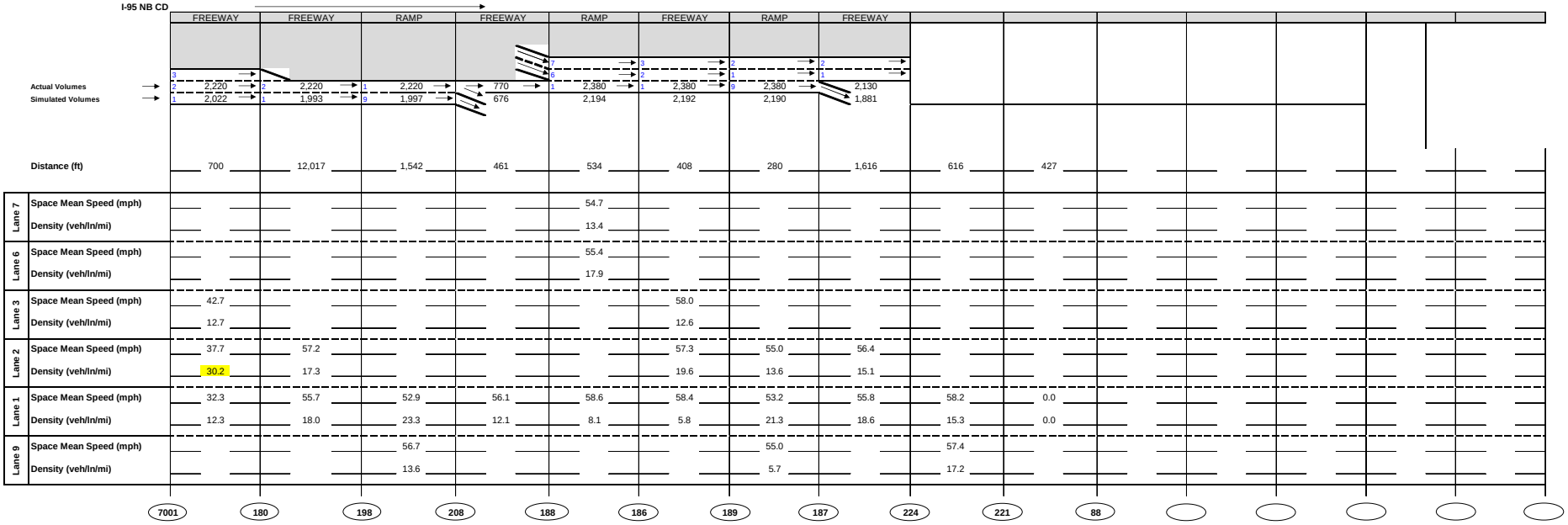
CD Road Weave Density (veh/ln/mi)
45 and above
36 to 45
32 to 36
0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound Mainline
2040 Modified Build - PM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Northbound C-D Lanes
2040 Modified Build - PM Peak

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	8 / 7 1,590	3 / 2 1,590	3 / 2 1,590	1 / 9 1,590
Simulated Volumes	8 1,517	1 1,517	1 1,511	10 1,508
Actual Ramp Volumes				
Simulated Ramp Volumes				
Ramp Space Mean Speed (mph)				
Ramp Density (veh/ln/mi)				
Distance (ft)	801	731	18,317	2,587
Space Mean Speed (mph)	66.1	67.0	68.1	68.3
Link Density (veh/ln/mi)	5.8	7.2	7.5	7.4
	92	120	280	93
	100			

I-95 SB Mainline

	FREEWAY	FREEWAY	FREEWAY	FREEWAY
Actual Volumes	8 / 7 1,590	3 / 2 1,590	3 / 2 1,590	1 / 9 1,590
Simulated Volumes	8 1,517	1 1,517	1 1,511	10 1,508
Distance (ft)	801	731	18,317	2,587
Lane 8 Space Mean Speed (mph)	68.1			
Lane 8 Density (veh/ln/mi)	10.1			
Lane 7 Space Mean Speed (mph)	67.3			
Lane 7 Density (veh/ln/mi)	6.3			
Lane 6 Space Mean Speed (mph)	61.8			
Lane 6 Density (veh/ln/mi)	6.4			
Lane 4 Space Mean Speed (mph)				
Lane 4 Density (veh/ln/mi)				
Lane 3 Space Mean Speed (mph)		68.0	66.9	
Lane 3 Density (veh/ln/mi)		9.6	7.7	
Lane 2 Space Mean Speed (mph)		68.4	69.4	
Lane 2 Density (veh/ln/mi)		6.5	8.0	
Lane 1 Space Mean Speed (mph)		63.6	67.9	66.8
Lane 1 Density (veh/ln/mi)		5.9	6.4	6.9
Lane 9 Space Mean Speed (mph)				69.1
Lane 9 Density (veh/ln/mi)				8.2
Lane 10 Space Mean Speed (mph)				68.7
Lane 10 Density (veh/ln/mi)				7.1
	92	120	280	93
	100			

NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

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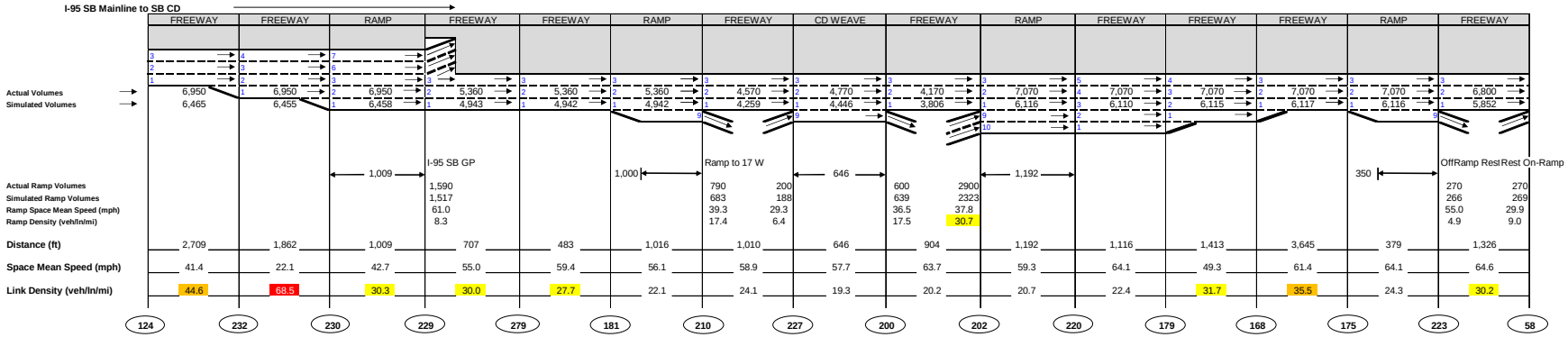
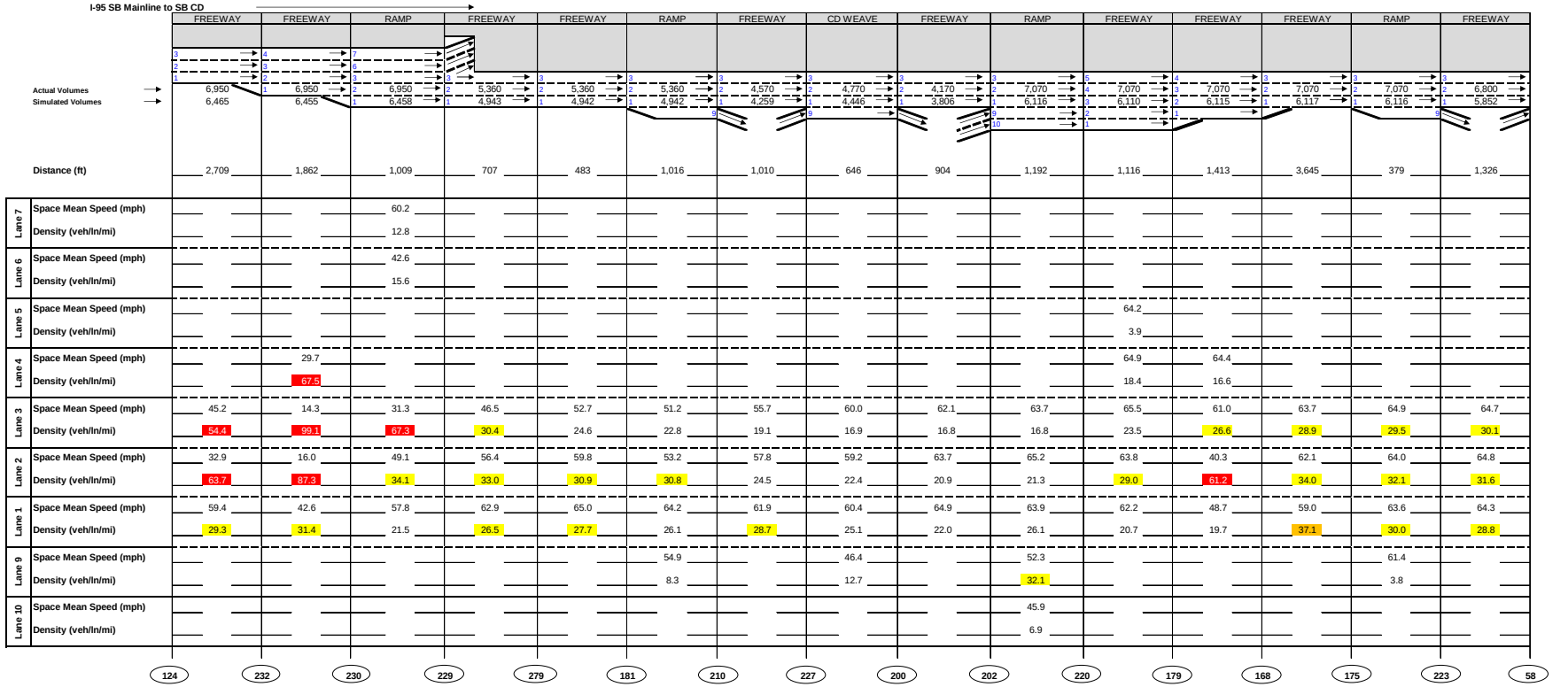
VDOT Virginia Department of Transportation

I-95 Southbound Mainline
2040 Modified Build - PM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

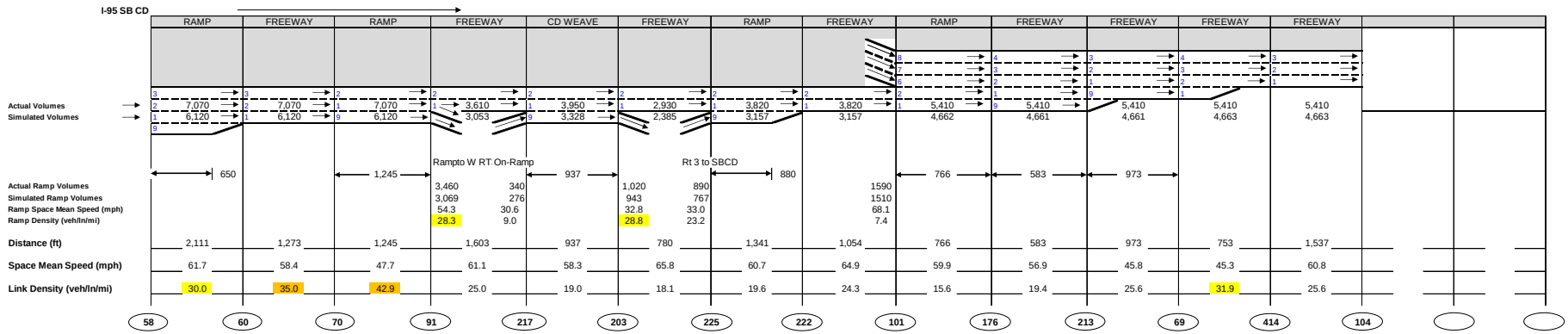
Auxiliary Lane Length

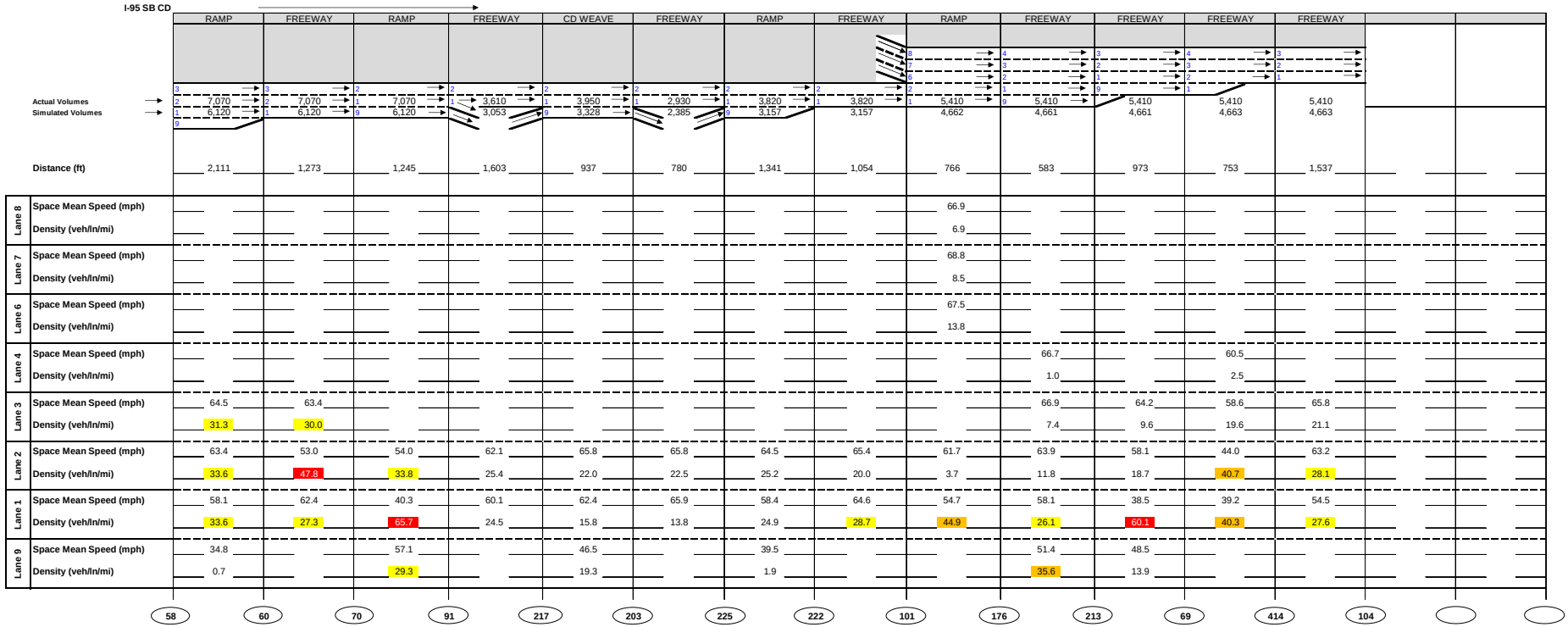
Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Southbound Mainline to SB CD
2040 Modified Build - PM Peak





NOTE: numbers in chart are provided for illustrative purposes only

LEGEND

100 Node Number

Auxiliary Lane Length

Freeway Density (veh/ln/mi)	Weave/Ramp Density (veh/ln/mi)	CD Road Weave Density (veh/ln/mi)
45 and above	45 and above	45 and above
35 to 45	35 to 45	36 to 45
26 to 35	28 to 35	32 to 36
0 to 26	0 to 28	0 to 32

This output was created using a beta version of the VDOT Traffic Analysis Tool Guidebook CORSIM Freeway Output Template Processing Tool (Beta Version 1.2).

VDOT Virginia Department of Transportation

I-95 Southbound CD

2040 Modified Build - PM Peak

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